Economic Analysis for the TSCA Lead Renovation, Repair, and Painting Program Final Rule for Target Housing and Child-Occupied Facilities

Economic and Policy Analysis Branch
Economics, Exposure and Technology Division
Office of Pollution Prevention and Toxics
U.S. Environmental Protection Agency

December 4, 2007

– Deliberative Working Draft –
Do Not Cite, Quote, or Release March 2008

Acknowledgment

EPA acknowledges the analytical and draft preparation support of Abt Associates Inc. of Cambridge, Massachusetts, provided under Contract No. 68-W2-077, in the preparation of this report.

Executive Summary

Introduction

EPA published a proposed rule for the Lead, Renovation, Repair, and Painting program on January 10, 2006 (71 FR 1588) covering target housing, and a supplemental proposal on June 5, 2007 (72 FR 31022) that extended the regulated universe to include child-occupied facilities (COFs). This report presents an economic analysis of alternative regulatory options for the final rule for the Lead, Renovation, Repair, and Painting Program.

Under the rule, firms that perform renovation, repair or painting activities for compensation in buildings covered by the regulation will need to obtain EPA certification, train at least one of their employees as a renovator, train additional staff or laborers as workers, and ensure that lead-safe work practices are used for projects disturbing lead-based paint.

The rulemaking is being promulgated under the authority of §402(c) of TSCA. Title IV of TSCA was established by the Residential Lead-Based Paint Hazard Reduction Act of 1992, also known as Title X of the Housing and Community Development Act of 1992, Public Law 102-550.

Target housing is defined in section 401 of the Toxic Substances Control Act (TSCA) as any housing constructed before 1978, except housing for the elderly or persons with disabilities (unless any child under age 6 resides or is expected to reside in such housing) or any 0-bedroom dwelling.

A COF is defined under the rule as a building, or portion of a building, constructed prior to 1978, visited regularly by the same child, under 6 years of age, on at least two different days within any week (Sunday through Saturday period), provided that each day's visit lasts at least 3 hours and the combined weekly visits last at least 6 hours, and the combined annual visits last at least 60 hours. COFs may include, but are not limited to, day care centers, preschools and kindergarten classrooms. COFs may be located in target housing or in public or commercial buildings.

Number of Facilities Subject to the Rule

Table ES-1summarizes the number of facilities subject to the rule by type and age of construction. The rule would apply to 37.8 million facilities, of which 37.7 million are target housing and 100,000 are public or commercial building COFs. (Note that this count addresses all pre-1978 buildings, and includes both buildings with lead-based paint and those without lead-based paint.)

Table ES-1: Number of Facilities Subject to the Rule by Type and Age of Construction		
Type	**All Pre-1960**	**All Pre-1978**
Target Housing (Rental, COF, or owner-occupied where a child <6 or a ~~woman who is or maybe~~ pregnant woman resides)	20,321,000	37,655,000
Public or Commercial Building COFs – Daycare Centers	29,000	52,000
Public or Commercial Building COFs – Schools	25,000	45,000
Total	20,375,000	37,752,000
Note: Counts include buildings with and without lead-based paint.		

Rule Options Analyzed

This report analyzes ~~six~~seven regulatory options. ~~There are five~~Six final rule options (Options A through ~~E) that~~F) were analyzed; they differ from each other in the scope of the housing units and COFs covered by the rule. Specifically, the options differ in terms of:

- When the buildings were built (i.e. pre-1960 or pre-1978);
- Whether all owner-occupied housing units are covered or only owner-occupied units where a pregnant woman or child under the age of six resides;[1] and
- Whether the coverage is the same in all years or phased in over the first two years.

Options A though ~~E~~ F are compared to Option P, the option that was previously analyzed in the economic analyses of the 2006 proposed rule and the 2007 supplemental proposal. Option P is included for comparison purposes ~~with the proposal~~, and is reanalyzed here using the cost and benefit models and assumptions developed for this report. The regulated universe under Option P is the same as under Option B. Option P, however, does not ~~account for the cost of using vertical containment when needed during certain exterior jobs to ensure that dust and debris from the renovation does not migrate to adjacent properties. Nor does Option P~~ include a prohibition on the use of any paint removal techniques. By contrast, in renovations for which lead-safe work practices are required under the rule, Options A through ~~E~~F prohibit or restrict open-flame burning or torching of LBP; operating a heat gun on LBP at 1100° F or higher; and using machines that remove LBP through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are used with HEPA exhaust control~~;~~. Option F (the Final Rule) covers the same housing units and ~~operating a heat gun on LBP at 1100° F or higher.~~COFs as Option E, but has a broader definition of the minor maintenance exception and provides for 5-year certification and training periods as opposed to 3-year periods.[2]

The ~~six~~seven options are described in Table ES-2. For each option, the table describes the scope; the application of the minor maintenance exception; ~~documentation requirements for trained renovators~~certification and training periods; the additional training required for previously trained

---

[1] The coverage of rental units does not depend on whether a pregnant woman or child is in residence.

[2] The minor maintenance exception is defined as 6 ft^2 or less per room for interiors or 20 ft^2 or less for exteriors, excluding renovations involving prohibited activities, demolition or window replacement. This different definition in Option F impacts the number of renovation events required to use lead-safe work practices. However, the difference between the number of events under Options E and F could not be estimated because sufficient data were not available.

individuals; how exterior containment requirements are described in the rule; ~~and~~ whether any paint removal practices are prohibited for renovations requiring lead-safe work practices under the rule~~.~~ ; and whether digital photographs are required as part of trainee registration.

Table ES-2: -Options Included in Economic Analysis

Option		Scope: First Year	Scope: Second Year	Minor Maintenance Exception**	Digital Trainee Photos	Previously Trained Individuals	Exterior Containment	Prohibited Practices[‡]
Proposed Rule Option	Option P	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*	<2 ft² per component for interiors, <20 ft² for exteriors.	No	Certification given to those with previous relevant training.	Cover the ground a sufficient distance to collect falling paint debris.[†]	None
Final Rule Options	Option A	All pre-1960 target housing and COFs.*	All target housing and COFs.	<2 ft² per room for interiors, <20 ft² for exteriors.	Yes	Certification given to those with previous training only if they complete a refresher course.	Cover the ground a sufficient distance to collect falling paint debris, with a minimum of 10 feet required. Ground covering would be supplemented with vertical containment where necessary.	Open-flame burning or torching of LBP; using machines that remove LBP through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are used with HEPA exhaust control; and operating a heat gun on LBP at 1100° F or higher.
	Option B	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*					
	Option C	All pre-1960 target housing and COFs.*						
	Option D	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 where a child under the age of six resides.*						
	Option E *Preferred Option for Final Rule*	All rental target housing and COFs, and owner-occupied target housing *where a child under the age of six or a woman who is or may be pregnant resides.*						

* Plus all target housing units built before 1978 where a child with an increased blood-lead level resides, where an increased blood-lead level is defined as greater than or equal to 10 µg/dL or a State or local government level of concern, if lower.
** Not analyzed due to limitations with the data on the incidence of renovation, repair, and painting events.
† The use of vertical containment was implicit in the proposed rule, but was not included in the economic analysis of the proposal.
‡ Practices are prohibited or restricted for renovations requiring lead-safe work practices under the rule.

Option	Scope	Minor	Certification &	Previously	Exterior	Prohibited	Digital

		First Year	Second Year	Maintenance Exception**	Training Periods	Trained Individuals	Containment	Practices	Trainee Photos
Proposed Rule	P	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*	<2 ft^2 per component.	Firm certification and renovator training periods are 3 years each	Certification given to those with previous relevant training.	Cover the ground a sufficient distance to collect falling paint debris. †	None	No
Final Rule Options	A	All pre-1960 target housing and COFs.*	All target housing and COFs.	<2 ft^2 per room for interiors, <20 ft^2 for exteriors.		Certification given to those with previous training only if they complete a refresher course.	Cover the ground a sufficient distance to collect falling paint debris, with a minimum of 10 feet required.	Yes ‡	Yes
	B	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*						
	C	All pre-1960 target housing and COFs.*							
	D	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 where a child under the age of six resides.*							
	E	All rental target housing and COFs, and owner-occupied target housing *where a child under the age of 6 or a pregnant woman resides.*							
	F **Final Rule**	All rental target housing and COFs, and owner-occupied target housing *where a child under the age of 6 or a pregnant woman resides.*		<6 ft^2 per room for interiors, <20 ft^2 for exteriors.	Firm certification and renovator training periods are 5 years each				

* Plus all target housing units built before 1978 where a child with an increased blood-lead level resides.

** Not analyzed due to limitations with the data on the incidence of renovation, repair, and painting events. The minor maintenance exception is only available for renovations that do not use prohibited or restricted practices, and that do not involve window replacement or demolition of painted surfaces areas.

† The use of vertical containment was implicit in the proposed rule, but was not included in the economic analysis of the proposal.

‡ Practices prohibited or restricted for renovations requiring lead-safe work practices under the rule or qualifying for the minor maintenance exception: Open-flame burning or torching of LBP; using machines that remove LBP through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are used with HEPA exhaust control; and operating a heat gun on LBP at 1100° F or higher.

Costs

For purposes of this analysis, four cost categories are estimated for the rule: (1) training costs, (2) work practice costs, ~~and~~ (3) certification costs (which include the firm's paperwork burden and government administrative and enforcement costs); and (4) pre-renovation education costs. The general approach of the analysis is to first estimate the number of affected activities or entities, then estimate the incremental regulatory cost per-activity or entity affected. Finally, the incremental costs and the number of affected activities and entities are combined to estimate the total costs.[3]

These costs are driven, in part, by the number of renovation, repair, and painting events, and the number of events using lead-safe work practices. The number of events under each option is summarized in Table ES-3. The number of events covered by the rule varies across options, but under any option the number of events covered is substantial. Under ~~Option~~ both Options E~~, approximately 10.9 million~~ and F, an estimated 11.4 million events per year would be conducted in compliance with the rule. While both Options E and F include pre-1978 structures in both Year 1 and Year 2, Option F has a different definition of the minor maintenance exemption than Option E, which affects the number of renovation events required to use lead-safe work practices. However, the difference between the number of events under Options E and F could not be estimated because sufficient data were not available.

Because not all buildings built before 1978 have lead-based paint, the number of renovation events that need to use lead safe work practices is a subset of the total number of events covered by the rule. ~~The number of events with lead safe work practices decreases from the first year to the second year because the accuracy of lead paint~~Currently available test kits ~~(in terms of~~ for detecting whether lead-based paint is present~~) is expected to have improved by the second year. The current tests~~ have a high false positive rate (estimated to average 63 percent), resulting in the frequent use of lead safe work practices when they are not necessary, i.e., when lead-based paint is not present. ~~The improved tests are expected to have~~ EPA expects that improved test kits (with a false positive rate of 10 percent) will be commercially available by September 2010, but this analysis does not assume that the improved test kits will be in use until the second year that all of the rule's requirements are in effect. Thus, the number of events with lead safe work practices is estimated to decrease from the first year to the second year because of the adoption of the improved test kits. As a result of the improved test kits, the number of events with lead-safe work practices under Option ~~E~~ F drops from 8.4 million in the first year to 4.4 million in the second year.

In addition to the number of covered renovation events in compliance with the rule, other major factors in determining the costs of the rule are the number of firms certified, the number of renovators trained, ~~and~~ the number of workers trained, and the frequency with which firms need to be re-certified and personnel re-trained. The rule requires that each certified firm (including COFs and property managers and lessors who perform their own renovation work in a building subject to the rule, as well as renovation contractors who work in a building subject to the rule) employ at least one renovator who has taken an EPA-accredited training course and provide on-the-job training for all other staff or laborers who will be performing renovation activities. As shown in Table ES-4, under Option ~~E~~F there will be approximately 212,000 firms certified and 236,000 renovators trained in the first year. The numbers seeking

[3] The costs, benefits, and small entity impacts are all calculated assuming a 75~~%~~ percent compliance rate with the rule's requirements, based on existing literature about regulatory compliance rates in the construction industry.

certification and training in subsequent years will drop by two thirds80 percent, because certification and training are valid for threefive years. The number of workers receiving on-the-job training is estimated to be 338,000 in the first year under Option E.[4]

[4] The number of firms and individuals certified and trained, respectively, are assumed to decline by 0.41 percent annually to account for the decline in the size of the regulated housing stock over time, and thus the demand for lead-safe renovation services.

F[5]

As shown in Table ES-3, Option ~~E~~F is estimated to result in a total cost of nearly $~~800~~758 million in the first year, before improved test kits become available. The cost is estimated to drop to approximately $~~400~~407 million per year after the improved test kits become available. The 50-year annualized costs provide a measure of the steady-state cost. Annualized costs of the rule are estimated to be approximately $~~400~~404 million per year using a 3~~%~~ percent discount rate and $~~500~~441 million per year using a 7~~%~~ percent discount rate. Annualized costs for the other scope options range from approximately $~~300~~273 million to approximately $~~700~~727 million per year using either a 3~~%~~ percent or a 7~~%~~ percent discount rate.

Table ES-3: Number of Events With Lead-Safe Work Practices and Total Rule Costs

Scope	Number of Events (Millions)				Total Rule Costs (Millions 2005$)			
	Year 1		Year 2				50-Year Annualized	
Option	Total Events	LSWP Events	Total Events	LSWP Events	Year 1	Year 2	3% Discount Rate	7% Discount Rate
-P	6.1	4.9	11.3	4.4	$358	$~~412~~424	$343	$367
-A	10.0	8.1	18.6	7.4	$696	$~~791~~815	$681	$727
-B	6.1	4.9	11.3	4.4	$427	$~~479~~493	$409	$437
-C	10.0	8.1	10.0	5.7	$696	$~~451~~465	$455	$491
-D	6.1	4.9	6.1	3.4	$427	$~~271~~279	$273	$295
-E	11.~~3~~4	8.4	11.~~3~~4	4.4	$758	$~~414~~ 427	$423	$460
~~Analysis assumes a 75% compliance rate with the rule.~~ ~~LSWP = Lead-Safe Work Practices.~~ ~~Preferred option is Option E.~~ ~~*Source: See Chapter 4.*~~								
F	11.4	8.4	11.4	4.4	$758	$407	$404	$441
Analysis assumes a 75% compliance rate with the rule. LSWP = Lead-Safe Work Practices. The Final Rule option is Option F. *Source: See Chapter 4.*								

[5] The number of firms and individuals certified and trained, respectively, are assumed to decline by 0.41 percent annually to account for the decline in the size of the regulated housing stock over time, and thus the demand for lead-safe renovation services.

Table ES-4: Number of Establishments Certified and Renovators and Workers Trained (thousands)

	~~**Option P**~~	~~**Option A**~~	~~**Option B**~~	~~**Option C**~~	~~**Option D**~~	~~**Option E**~~	
	Option P	**Option A**	**Option B**	**Option C**	**Option D**	**Option E**	**Option F**
Year 1							
~~Number of Establishments Seeking Certification~~	~~114,000~~	~~173,000~~	~~114,000~~	~~173,000~~	~~114,000~~	~~**212,00**~~	
~~Number of Renovators Seeking Training~~	~~127,000~~	~~195,000~~	~~127,000~~	~~195,000~~	~~127,000~~	~~**236,00**~~	
~~Number of Workers Seeking Training~~	~~182,000~~	~~283,000~~	~~182,000~~	~~283,000~~	~~182,000~~	~~**338,00**~~	
Number of Establishments Seeking Certification	114	173	114	173	114	212	212
Number of Renovators Seeking Training	127	195	127	195	127	236	236
Number of Workers Seeking Training	182	283	182	283	182	338	338
Year 2							
~~Number of Establishments Seeking Certification~~	~~130,000~~	~~202,000~~	~~130,000~~	~~58,000~~	~~38,000~~	~~**70,000**~~	
~~Number of Renovators Seeking Training~~	~~145,000~~	~~227,000~~	~~145,000~~	~~65,000~~	~~42,000~~	~~**78,000**~~	
~~Number of Workers Seeking Training~~	~~334,000~~	~~525,000~~	~~334,000~~	~~282,000~~	~~181,000~~	~~**337,000**~~	
Number of Establishments Seeking Certification	130	202	130	58	38	70	42
Number of Renovators Seeking Training	145	227	145	65	42	78	47
Number of Workers Seeking Training	334	525	334	282	181	337	337
Year 3							
~~Number of Establishments Seeking Certification~~	~~69,000~~	~~107,000~~	~~69,000~~	~~57,000~~	~~38,000~~	~~**70,000**~~	
~~Number of Renovators Seeking Training~~	~~77,000~~	~~120,000~~	~~77,000~~	~~64,000~~	~~42,000~~	~~**78,000**~~	
~~Number of Workers Seeking Training~~	~~333,000~~	~~523,000~~	~~333,000~~	~~281,000~~	~~180,000~~	~~**335,000**~~	
Number of Establishments Seeking Certification	69	107	69	57	38	70	42
Number of Renovators Seeking Training	77	120	77	64	42	78	47
d FNumber of Workers Seeking Training	330	523	333	281	180	335	335

Note: Components may not add up to totals due to rounding. The number of firms and individuals certified and trained, respectively, are assumed to decline by 0.41 percent annually to account for the decline in the size of the regulated housing stock over time, and thus the demand for lead-safe renovation services.
Source: See Chapter 4

Benefits

Renovation, repair, and painting activities in buildings with lead-based paint can generate lead dust and debris that create lead hazards. The use of lead-safe work practices can minimize exposure to lead-based paint hazards created during renovation, repair, and painting activities. The rule's benefits are a result of the reduction in adverse health effects due to decreased exposure to lead dust.

The number of individuals protected as a result of the rule is shown in Table ES-5. Option ~~E~~F protects ~~nearly~~an estimated 1.~~9~~4 million children in the first year. Option E protects a similar number, while the other options protect approximately 1.~~5~~2 million children in the first year. ~~Option~~Options E ~~covers~~and F cover an additional ~~316~~238,000 children in the first year because ~~it covers~~they cover children under the age of six in pre-1978 buildings, not just those in pre-1960 buildings. In the second year, the scope of Options P, A, and B, expands to include pre-1978 buildings. Thus, beginning in the second year, these options protect approximately 1.~~9~~4 million children under the age of six per year, the same as ~~Option~~Options E and F.[6] The scope of Options C and D does not increase in the second year, so the number of people protected under these options does not increase. The rule will also reduce exposures of children over the age of six and adults. As shown in Table ES-5, ~~Option~~Options E ~~protects 7.2~~and F protect 5.4 million individuals age six and older per year, while the number protected by the other options ranges from ~~6~~5 million to ~~14~~11 million per year.

Table ES-5: Annual Number of People Protected due to the Regulations				
	Number of People Protected (thousands)*			
Option	Children Under 6		~~Individual~~Individuals Age 6 and Older	
	First Year	Second Year	First Year	Second Year
Option P	1,~~549~~161	1,~~857~~393	~~6,100~~4,575	~~7,108~~5,331
Option A	1,~~549~~161	1,~~857~~393	~~12,022~~9,016	~~14,178~~10,633
Option B	1,~~549~~161	1,~~857~~393	~~6,100~~4,575	~~7,108~~5,331
Option C	1,~~549~~161	1,~~542~~157	~~12,022~~9,016	~~11,973~~8,980
Option D	1,~~549~~161	1,~~542~~157	~~6,100~~4,575	~~6,075~~4,556
Option E	1,~~865~~398	1,~~857~~393	~~7,239~~5,430	~~7,210~~5,407
~~* Assumes a 75% compliance rate.~~ ~~The preferred option is Option E.~~ ~~*Source: See Chapter 5.*~~				
Option F	1,398	1,393	5,430	5,407

* Assumes a 75% compliance rate.
The Final Rule option is Option F
Source: See Chapter 5.

The benefits of the rule result from the prevention of adverse health effects attributable to lead exposure. ~~These health~~ Neurotoxic effects ~~include impaired cognitive function~~ in children and ~~several illnesses in children and adults. Quantified benefits are estimated based on the avoided~~

[6] From the second year forward, all options affect a progressively smaller number of buildings due to demolitions of pre-1978 units.

incidence of IQ loss in children under the age of six from reduced lead exposure. The analysis was limited to the avoided incidence of IQ loss because there are not sufficient data at this time to develop dose-response functions for other health cardiovascular effects in children. It does not include IQ losses in children that result from prenatal exposures adults are among those best substantiated as occurring at blood-lead concentrations as low as 5 to 10 ugldL (or IQ losses from exposure to lead in breast milk, even though it is well known that lead freely crosses the placenta to the fetus during pregnancy and moves from the mother's body into her breast milk during lactation.

There is evidence that adult exposure to lead is linked to various adverse health possibly lower); and these categories of effects suchare currently clearly of greatest public health concern. Other newly demonstrated immune and renal system effects among general population groups are also emerging as low-level lead-exposure effects of potential public health concern. Both epidemiologic and toxicologic studies have shown that environmentally relevant levels of lead affect many different organ systems.

The overall weight of the available evidence provides clear substantiation of neurocognitive decrements being associated in young children with blood-lead concentrations in the range of 5-10 µg/dL, and possibly somewhat lower. Some newly available analyses appear to show lead effects on the intellectual attainment of preschool and school age children at population mean concurrent blood-lead levels ranging down to as low as 2 to 8 µg/dL.

Epidemiologic studies have consistently demonstrated associations between lead exposure and enhanced risk of deleterious cardiovascular outcomes, including increased blood pressure and incidence of hypertension, coronary heart disease, stroke, and premature. A meta-analysis of numerous studies estimates that a doubling of blood-lead level (e.g., from 5 to 10 µg/dL) is associated with ~1.0 mm Hg increase in systolic blood pressure and ~0.6 mm Hg increase in diastolic pressure. Studies have also found that cumulative past lead exposure (e.g., bone lead) may be as important, if not more, than present lead exposure in assessing cardiovascular effects. The evidence for an association of lead with cardiovascular morbidity and mortality. is limited but supportive. Experimental toxicology studies have confirmed lead effects on cardiovascular functions. However, there is sufficient uncertainty about the level of exposure and likelihood of effects that adults will experience that this analysis did not attempt to estimate the number of cases that would be avoided due to the regulation.

The selection of blood lead models is a critical element because it provides the link between the exposure media concentrations and the measures of IQ change. This analysis uses the Leggett model since it is capable of modeling the impacts of very short-term lead exposures (even acute, one-time exposures), typical of renovation activities.

Several methods were used to examine the uncertainty associated with the Leggett model. One method of examining model uncertainty is through the use of different red blood cell (RBC) saturation concentrations. Thus, in a separate analysis, blood lead concentrations were estimated separately using two different saturation concentrations for several different exposure scenarios, and the change in IQ was then estimated.

Model uncertainty can also be evaluated by comparing blood lead estimates from several models with similar inputs and durations of exposure. Previous comparisons have shown that, under chronic exposure conditions, the blood lead estimates obtained with the Leggett model are approximately 2 to 3 times those obtained with the IEUBK model. Estimates of the background blood lead averaged over 0 to 6 years were obtained with the Leggett and IEUBK models, and were consistent with previous comparisons. Only limited conclusions can be drawn from this comparison, however, because the IEUBK model is not appropriate for use in modeling short-term acute exposures typical of renovation projects.

Based on these analyses, it is possible that the Leggett model may have an upward bias ranging from 5-25% of actual levels (based on the RBC saturation results) to 2-3 times actual levels. In order to allow the benefits analysis to consider a lower bound in its quantified analyses, two renovation examples were re-analyzed using the original blood lead levels and blood lead levels that were divided by a factor of three. IQ calculations were then generated from these blood-lead levels. Based on these analyses, adjustment factors were generated, which were then used to calculate the lower bounds of the benefits estimates.

In addition, as EPA notes later in Chapter 5, the benefits analysis generated certain results that seem to indicate that more stringent control options yield smaller improvements in reducing the risks of adverse health and ecological effects than do less stringent control options. For example, the analysis estimates that using only containment of dust and debris generated during a RRP activity yields higher benefits than using all of the rule's work practices (containment, cleaning, and cleaning verification). This is the opposite of what one might expect and of what is observed in the Dust Study, since it implies that the combination of rule-style containment with rule-style cleaning and verification would result in more exposure than when such containment is combined with conventional cleaning. This is inconsistent with the Dust Study which shows that more careful cleaning decreases exposure. Therefore, this result is likely an artifact of sparse underlying data and modeling assumptions.

Because EPA has not determined why the benefits analysis contains anomalous results, EPA has limited confidence in the estimated benefits. EPA does not view the results as being sufficiently robust to represent the difference in magnitude of the benefits across regulatory alternatives. The estimated benefits for the control options relative to the assumed baseline are also affected by both the limited number of experiments in the Dust Study and the fact that the housing and the COF used in the Dust Study do not represent a statistically valid sample of housing at the national level. EPA also has limited confidence in the quantification of the baseline because of the limited data available to the Agency on the range of practices currently used by contractors.

The estimated benefits of the rule are summarized in Table ES-6. -The quantified IQ benefits to children from Option E are expected to be approximately $2,300F are estimated to be between $681 million and $1,670 million per year when annualized using a 3% percent discount rate, or between $725 million and $2,5001,778 million per year when using a 7% percent discount rate. The estimated benefits for the other final rule scope options range from approximately $1,800$485 million to $2,3001,670 million using a 3% percent discount rate and from $2,000516 million to $2,5001,778 million using a 7% percent discount rate. The quantified benefits for Option P are approximately $1,700estimated to be between $309 million and $821 million per year under either discount rate. As noted above (see also Chapter 5 for discussion of anomalous results), EPA has limited confidence in the estimated benefits.

In reviewing the benefits, it is important to remember that these estimates only partially account for the benefits of the rule; some important groups of benefits are excluded from monetization. Among the categories of benefits excluded from this analysis are:

- IQ loss in children resulting from prenatal and breast milk exposure;
- Other children's health and developmental effects for which the science is less certain and for which there are not adequate data to develop dose- response curves, and thus benefit estimates. These outcomes include attention deficits, reduced ability to inhibit inappropriate responding; impulsivity, distractibility, criminal Investigating associations between lead exposure and behavior, reactivity to the environment, mood, and social behavior, and auditory function.conduct of children has been an emerging area of research. Early studies indicated linkages between lower-level lead toxicity and behavioral problems (e.g., aggression, attentional problems, and hyperactivity) in children. Recent research suggest that IQ loss is most strongly associated with concurrent blood lead levels and that this relationship is stronger in older children;
- Benefits that may accrue to adults, including avoided cases of increased blood pressure and hypertension, coronary heart disease (CHD), stroke, and death; and
- Adverse effects on plants and animals.

In addition, the incremental difference between willingness-to-pay to avoid children's IQ loss due to exposure to lead dust, and the income loss resulting from the IQ loss is not included in the valuation of benefits. (The calculated benefits estimates are based on lost income instead of willingness-to-pay values.)

Table ES-6: Children's IQ Benefits – Annualized Benefits (millions 2005$) $)*

Option	3% Discount Rate	7% Discount Rate
Option P	$1,650$309 - $776	$1,748$326 - $821
Option A	$2,322$673 - $1,657	$2,455$710 - $1,752
Option B	$2,322$673 - $1,657	$2,455$710 - $1,752
Option C	$485 - $1,834334	$516 - $1,952420
Option D	$485 - $1,834334	$516 - $1,952420
Option E	**$2,342**$681 - $1,670	**$2,493**$725 - $1,778
The preferred option is Option E.		

Net Benefits

Net benefits are the difference between benefits and costs. Table ES-7 displays the annualized net benefit calculations for the rule. Option E has the largest net benefits of the options. This result holds regardless of whether the annualization is done with a 3 percent or a 7 percent discount rate. Using annualized values, Options B and E are very similar in terms of costs, benefits, and net benefits. Option E, however, has somewhat larger net benefits and protects slightly more children than Option B as a result of the broader scope of Option E in the first year.

Table ES-7: Comparison of Options – Annualized Net Benefits Option F	$681 - $1,670	$725 - $1,778
* Assumes a 75% compliance rate. The Final Rule option is Option F *Source: See Chapters 5 and 6.*		

Net Benefits

Net benefits are the difference between benefits and costs. Table ES-7 displays the annualized net benefit calculations for the rule. Option F has the largest net benefits of the options. This result holds regardless of whether the annualization is done with a 3 percent or a 7 percent discount rate. The next largest net benefits, measured using annualized values, accrue to Options B and E. While Options B and E have nearly the same net benefits, Option E has somewhat larger benefits and protects slightly more children than Option B as a result of the broader scope of Option E in the first year.

Table ES-7: Comparison of Options – Annualized Net Benefits*

Option	Annualized Cost (millions 2005$)	Children's IQ Benefits – Annualized (millions 2005$)	Net Benefits – Children's IQ Only (millions 2005$)
Annualized using 3 Percent Discount Rate			
Option P	$343	~~$1,650~~ $309 - $776	~~$1,307~~ $34 - $433
Option A	$681	~~$2,322~~ $673 - $1,657	~~$1,641~~ -$8 - $976
Option B	$409	~~$2,322~~ $673 - $1,657	$264 - $1,~~913~~ 247
Option C	$455	$485 - $1,~~834~~ 334	~~$1,379~~ $30 - $879
Option D	$273	$485 - $1,~~834~~ 334	$211 - $1,~~561~~ 061
Option E	$423	~~**$2,342**~~ $681 - $1,670	$258 - $1,~~**920**~~ 248
Option F	$404	$681 - $1,670	$277 - $1,266
Annualized using 7 Percent Discount Rate			
Option P	$367	~~$1,748~~ $326 - $821	~~$1,381~~ $41 - $454
Option A	$727	~~$2,455~~ $710 - $1,752	-$17 - $1,~~728~~ 025
Option B	$437	~~$2,455~~ $710 - $1,752	$2~~,018~~ 72 - $1,315
Option C	$491	$516 - $1,~~952~~ 420	~~$1,461~~ $24 - $929
Option D	$295	$516 - $1,~~952~~ 420	$220 - $1,~~657~~ 125
Option E	$460	~~**$2,493**~~ $725 - $1,778	$2~~**,033**~~ 65 - $1,318
~~The preferred option is Option E.~~			
Option F	$441	$725 - $1,778	$284 - $1,337

* Assumes a 75% compliance rate.
The Final Rule option is Option F
Source: See Chapters 5 and 6.

One of the major differences between the option previously analyzed (Option P) and Options A through ~~E~~F is that the final rule options prohibit certain paint preparation and removal practices.[7] Table ES-8 ~~presents the net benefits under Option E~~examines the impact of prohibiting ~~these~~certain paint removal practices, using Option E as an example. The first row ~~indicates~~presents the costs, benefits, and net benefits that would occur under Option E if the use of these paint removal practices was allowed to continue. The net benefits of such a rule ~~would~~are estimated to be ~~approximately $1,200~~between negative $106 million and positive $363 million per year. The second row presents the incremental costs, benefits, and net benefits associated with the restrictions on paint removal practices. As shown in the table, the costs of the restrictions are modest (because there are readily available substitute practices such as using a heat gun under 1100 °F, and machine sanding, grinding, or abrasive blasting using HEPA exhaust controls), while the benefits are substantial. As a result, the net benefits are ~~approximately $700~~estimated to be between $369 million and $888 million per year. The third row presents the total costs, benefits, and net benefits of Option E, including the prohibition on these practices. The net benefits of Option E including the paint removal restrictions are ~~approximately $1,900~~estimated to be between $258 and $1,248 million per year.

Table ES-8: Annualized Net Benefits – Option E Prohibited Paint Removal Practices (3 percent discount rate, million 2005$)

	Annualized Cost (millions 2005$)	Children's IQ Benefits – Annualized (millions 2005$)	Net Benefits – Children's IQ Only (millions 2005$)
Modified Option E, excluding any prohibition on paint removal practices	$419	~~$1,660~~$312 - $782	~~$1,241~~ -$106 - $363
Incremental impact of prohibiting certain paint removal practices *	$4	$~~682~~369 - $888	$~~678~~365 - $885
Total after prohibiting certain paint removal practices *	$423	~~$2,342~~$681 - $1,670	$258 - $1,~~920~~248

* Prohibits or restricts the following paint removal practices in renovations requiring lead-safe work practices under the rule: open-flame burning or torching of LBP; using machines that remove LBP through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are used with HEPA exhaust control; and operating a heat gun on LBP at 1100° F or higher.

Table ES-9 uses Option E to compare the net benefits for other possible combinations of the work practices required by the rule (containment, cleaning, and cleaning verification). As shown in Table ES-9, the ~~table, Option E (rule containment, rule cleaning, and cleaning verification) has estimated benefits of $2,342 million per year, the largest benefits among these alternatives. The estimated~~ net benefits for banning prohibited practices and requiring ~~rule~~ containment, but not requiring ~~rule~~ cleaning or cleaning verification~~,~~ are ~~slightly~~ higher than the net benefits from the preferred version of Option E. ~~This is because the savings~~While the decline in costs ~~are greater than~~is expected, the ~~lost~~increase in benefits is unexpected. The other two alternative versions (those that rely on cleaning as opposed to containment), have much smaller benefits and thus smaller net benefits than Option E.

[7] In renovations requiring lead-safe work practices under the rule, Options A though ~~E~~ F prohibit or restrict open-flame burning or torching of LBP; operating a heat gun on LBP at 1100° F or higher; and using machines that remove LBP through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are used with HEPA exhaust control~~; and operating a heat gun on LBP at 1100° F or higher~~.

As discussed more fully in Chapter 5, this unexpected increase in benefits is likely to have resulted from multiple factors. The benefits analysis is based on three main components: the Dust Study, blood lead-IQ modeling, and benefits estimation. Each makes some contribution to these unexpected results. The Dust Study provided directly relevant data from which distributions of dust lead loadings were developed, but had relatively small sample sizes for this purpose, leading to significant uncertainty associated with these distributions. Also, the ~~preferred version~~Dust Study was a field study, not a laboratory study, so it was not possible to control all the variables one would wish to control in the study. For example, different control options for a given renovation task were conducted in different houses which had different lead levels in the paint, and different renovators performed different experiments. These are factors that can lead to situations in which a stricter control option in one house can generate higher dust lead levels than a less strict control option in another house.

Moving to the next component of ~~Option E.~~ analysis, distributions from the Dust Study were used as inputs to the blood lead-IQ modeling. In this modeling, the comparison between two control options often can compare two different sets of non-activity-related inputs (e.g., routine cleaning efficiency, background indoor dust loadings) and these input differences could contribute to unexpected results. Although a large number of iterations were run in a Monte Carlo analysis to seek stability in the results, differences in the random number inputs to the modeling sometimes yielded unexpected results.

The benefits analysis, which estimates incremental IQ losses associated with the regulatory control options and assigns dollar values to them, uses mean IQ changes from the blood lead-IQ modeling. The mean represents the expected value of the estimated IQ change distributions, so is the desired statistic for this purpose. However, means are more influenced by the tails of the distribution and issues of stability than are other measurements, such as the median. Therefore, the use of the mean IQ change as a metric could be contributing to the unexpected results.

Table ES-9: Annualized Net Benefits – Option E Work Practice Variations (3 percent discount rate, million 2005$)

Option	Annualized Cost (millions 2005$)	Children's IQ Benefits – Annualized (millions 2005$)	Net Benefits – Children's IQ Only (millions 2005$)
Option E – Rule Containment, Rule Cleaning, Cleaning Verification	$423	~~$2,342~~$681 - $1,670	$258 - $1,~~920~~248
Option E1 – Rule Containment Only	$364	$860 - $2,~~318~~086	$496 - $1,~~954~~722
Option E2 – Rule Cleaning and Cleaning Verification Only	$372	$1~~,337~~54 - $380	~~$965~~ $219 - $8
Option E3 – Rule Cleaning Only	$349	~~$1,128~~$356 - $867	$~~779~~7 - $517

Option E and the variations described above prohibit or restrict the following practices for renovations requiring lead-safe work practices under the rule: open-flame burning or torching of LBP; using machines that remove LBP through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are used with HEPA exhaust control; and operating a heat gun on LBP at 1100° F or higher.

Small Entity Impacts

The Regulatory Flexibility Act (RFA) of 1980, amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996, requires regulators to assess the effects of regulations on small entities including businesses, nonprofit organizations, and governments. The vast majority of entities in the industries affected by this rule are small. The renovation, repair, and painting program will affect approximately 188,600 small entities.

Two factors are evaluated in analyzing the rule's ~~requirements~~ impacts on small entities, the number of firms that would experience the impact, and the size of the impact. Average annual compliance costs as a percentage of average annual revenues ~~are~~ is used to assess the potential average impact of the rule on small businesses and small governments. This ratio is a good measure of entities' ability to afford the costs attributable to a regulatory requirement, because comparing compliance costs to revenues provides a reasonable indication of the magnitude of the regulatory burden relative to a commonly available measure of economic activity. Where regulatory costs represent a small fraction of a typical entity's revenues, the financial impacts of the regulation on such entities may be considered as not significant. For non-profit organizations, impacts are measured by comparing rule costs to the organization's annual expenditures. When expenditure data were not available, however, revenue information was used as a proxy for expenditures. It is appropriate to calculate the impact ratios using annualized costs, because these costs are more representative of the continuing costs entities face to comply with the rule.

The average annualized cost to a typical small entity is estimated to range from about $500 to about $2,600 per year, depending on the number of renovation, repair, and painting events undertaken by a small entity in the industry sector involved. As shown in Table ES-10, the cost impact of the combined proposals on small entities ranges from about 0.004~~%~~ percent to 1.8~~%~~ percent of revenues, depending on the industry sector.

Table ES-11 presents the total number of small governments, non-profit organizations, and small for-profit businesses, and the average cost-to-revenue ratios. Of the 188,600 small entities that would be affected by the ~~combined~~ renovation, repair, and painting activities program, there are an estimated 165,400 small businesses with average impacts of 0.7~~%~~ percent, 16,700 small non-profits with average impacts of 0.1~~%~~ percent, and 6,500 small governments with average impacts of 0.004~~%~~ percent.

Table ES-10: Number of Small Entities with Regulated RRP Events in a Typical Year			
Description	**Type**	**Number of Small Entities**	**Cost-Impact Ratio**
Residential remodelers	Business	41,400	0.6%
Siding contractors	Business	3,000	0.8%
Finish carpentry contractors	Business	29,400	0.9%
Other building equipment contractors	Business	1,400	0.7%
Other building finishing contractors	Business	1,900	0.8%
Tile and terrazzo contractors	Business	4,200	0.9%
Plumbing and HVAC contractors	Business	14,100	0.7%
Glass and glazing contractors	Business	1,200	0.6%
Painting and wall covering contractors	Business	16,300	1.2%
Electrical contractors	Business	10,000	0.9%
Drywall and insulation contractors	Business	6,900	0.8%
Residential Property Managers	Business	5,800	1.8%
Lessors of Residential Real Estate	Business	16,000	0.6%
Public School Districts	Government	6,500	0.004%
Private Schools	Non-Profit	6,200	0.06%
Daycare Centers	Non-Profit	10,500	0.2%
Non-Residential Landlords	Business	11,100	0.4%
Non-Residential Contractors (working in public or commercial building COFs)	Business	2,900	0.3%
Total		**188,600**	
Source: See Chapter 8.			

Table ES-11: Aggregate Small Entity Impacts		
	Total Number of Small Entities Affected	**Average Impacts, All Small Entities**
Small Governments	6,500	0.004%
Non-Profit Organizations	16,700	0.1%
Small For-Profit Businesses	165,400	0.7%
Total	**188,600**	
Source: See Chapter 8.		

1. Introduction

This report presents an economic analysis of alternative regulatory options affecting renovation, repair and painting (RRP) work in target housing and child occupied facilities (COFs) that contain lead-based paint. The LRRP rule for target housing was proposed in 2006, with a supplement covering COFs in 2007. The economic analysis presented in this report supports the development of the LRRP regulations to be promulgated under §402(c.) of the Toxic Substances Control Act (TSCA). Section IV of TSCA was established by the Residential Lead-Based Paint Hazard Reduction Act of 1992, also known as Title X of the Housing and Community Development Act of 1992, Public Law 102-550.

These regulations will require entities that perform renovation, repair and painting work for compensation in buildings covered by the rule to become certified by EPA, ensure that their employees are trained as either renovators or workers, and use lead-safe work practices when disturbing more than the exempt amount of lead-based paint.

Past use of lead-based paint has resulted in contamination that continues to pose human health hazards. While intact lead-based paint is not likely to contribute to such hazards, the deterioration of a structure over time or acute environmental stresses, such as are commonly present during renovation activities, has been found to create lead hazards. Since many buildings constructed before 1978 have lead-based paint, it is likely that renovation activities in pre-1978 buildings will contribute to lead hazards unless appropriate containment and clean-up practices are employed.

1.1 Purpose of the Proposed Rule

The training and work practice standards required and fostered by the LRRP rule will yield health benefits to the children living in target housing and/or attending COFs, to the adults working or living in them, and to the neighboring communities. The rule will reduce lead exposure by reducing the amount of lead contamination generated by renovation activities, and thus reduce the health and ecological risks in their vicinity. EPA anticipates that the rule will further develop a market[1] for lead safe renovation services that has been established by past lead awareness rules, such as the §406(b) rule, which requires compensated renovators to distribute lead awareness pamphlets to owners and occupants of most pre-1978 residential housing before beginning renovations.

The LRRP rule requires certification of entities that perform renovation, repair and/or painting in buildings covered by the regulations. This includes construction contractors (including sole practitioners) as well as landlords and other building owners (such as school districts) that may perform RRP activities using their own staff. It does not, however, cover RRP work performed by homeowners on their own homes. The certified entity must ensure that all persons performing RRP activities on behalf of the entity in buildings covered by the rule are either renovators who have received formal training in EPA-approved work practices from an EPA-accredited course or workers who have received on-the-job training in these approved work practices. In addition, the rule requires the use of these approved work practices to ensure that proper cleanup has occurred. Supporting these work practices, training and certification

[1] These markets are expected to consist of suppliers who offer lead safe renovation services (LSRS) and consumers who are willing to pay the incremental costs associated with using LSRS over non-LSRS.

requirements, EPA will be undertaking an enhanced outreach program to educate the general public about the dangers of lead exposure and ways to limit exposure resulting from RRP activities.

1.2 Goal of the Economic Analysis

The purpose of this report is to present policy options that are under consideration and to analyze their respective costs and benefits. The report also meets the requirements for economic analysis of Executive Order 12866 – *Regulatory Planning and Review*; the Regulatory Flexibility Act (RFA) and Small Business Regulatory Enforcement Fairness Act (SBRFA); Executive Order 12898 – *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*; Executive Order 13045 – *Protection of Children from Environmental Health Risks and Safety Risks*; the Unfunded Mandates Reform Act, Executive Order 12875 – *Enhancing the Intergovernmental Partnership*; and the Paperwork Reduction Act (PRA).

This economic analysis considers sixseven regulatory options. Options A through E F differ in terms of the universe of the structures they affect in each year (rule scope and phasing in of coverage). They also differ in terms of the definition of the minor maintenance exception and the required frequency for re-certification and re-training. Option P is the previously analyzed option from the proposed rule, with costs and benefits estimated using the cost and benefit models and assumptions developed in this report. The regulated universe under Option P is the same as under Option B. Option P, however, does not include any costs for using vertical containment during certain exterior jobs, nor does it prohibit the use of any paint removal techniques for renovations that require lead-safe work practices under the rule.

summarizes the options considered in this analysis; they are described in more detail below.

Options P, A, and B are limited to pre-1960 structures during Phase 1 of the regulation and their scope is expanded to structures built between 1960 and 1978 in Phase 2. Options C and D are limited to pre-1960 structures in Phase 1 and Phase 2. Finally, Option E includes Options E and F include pre-1978 structures in Phase 1 and Phase 2. Options A and C include all public or commercial building COFs and target housing units within the vintage categories specified above. Options P, B, D, E and EF include all rental units, all target housing COFs, and all owner-occupied target housing units where a child under the age of 6 resides within the vintage categories specified above—owner-occupied target housing units that are not COFs and where no child under the age of 6 resides are excluded. Option F (the Final Rule) covers the same housing units and COFs as Option E, but has a broader definition of minor maintenance exception and provides for 5-year certification and training periods as opposed to a 3-year period. [1] All Optionsoptions consider compensation for renovation to include pay for renovation work or rental payments, but not payments for childcare.

[1] The minor maintenance exception is defined as 6 ft^2 or less per room for interiors or 20 ft^2 or less for exteriors, excluding renovations involving prohibited activities, demolition or window replacement. This different definition in Option F impacts the number of renovation events required to use lead-safe work practices. However, the difference between the number of events under options E and F could not be estimated because sufficient data were not available.

Table 1-_1: -Options Included in Economic Analysis

<table>
<tr><th rowspan="2">Option</th><th colspan="2">Scope</th><th rowspan="2">Minor Maintenance Exception**</th><th rowspan="2">Digital Trainee Photos</th><th rowspan="2">Previously Trained Individuals</th><th rowspan="2">Exterior Containment</th><th rowspan="2">Prohibited Practices‡</th></tr>
<tr><th>First Year</th><th>Second Year</th></tr>
<tr><td>Option P – Proposed Rule Option</td><td>All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 where a child under the age of six resides.*</td><td>All rental target housing and COFs and owner-occupied target housing where a child under the age of six resides.</td><td><2 ft^2 per component for interiors, <20 ft^2 for exteriors.</td><td>No</td><td>Certification given to those with previous relevant training.</td><td>Cover the ground a sufficient distance to collect falling paint debris.†</td><td>None</td></tr>
<tr><td>Option A</td><td>All pre-1960 target housing and COFs.*</td><td>All target housing and COFs.</td><td rowspan="5"><2 ft^2 per room for interiors, <20 ft^2 for exteriors.</td><td rowspan="5">Yes</td><td rowspan="5">Certification given to those with previous training only if they complete a refresher course.</td><td rowspan="5">Cover the ground a sufficient distance to collect falling paint debris, with a minimum of 10 feet required. Ground covering would be supplemented with vertical containment where necessary.</td><td rowspan="5">Open-flame burning or torching of LBP; using machines that remove LBP through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are used with HEPA exhaust control; and operating a heat gun on LBP at 1100° F or higher.</td></tr>
<tr><td>Option B</td><td>All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 where a child under the age of six resides.*</td><td>All rental target housing and COFs and owner-occupied target housing where a child under the age of six resides.</td></tr>
<tr><td>Option C</td><td colspan="2">All pre-1960 target housing and COFs.*</td></tr>
<tr><td>Option D</td><td colspan="2">All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 where a child under the age of six resides.*</td></tr>
<tr><td>Option E – Preferred Option for Final Rule</td><td colspan="2">All rental target housing and COFs, and owner-occupied target housing where a child under the age of six or a woman who is or may be pregnant resides.</td></tr>
</table>

* Plus all target housing units built before 1978 where a child with an increased blood-lead level resides, where an increased blood-lead level is defined as greater than or equal to 10 µg/dL or a State or local government level of concern, if lower. ** Not analyzed due to limitations with the data on the incidence of renovation, repair, and painting events. † The use of vertical containment was implicit in the proposed rule, but was not included in the economic analysis of the proposal. ‡ Practices are prohibited or restricted for renovations requiring lead-safe work practices under the rule.

	Option	Scope		Minor Maintenance Exception**	Certification & Training Periods	Previously Trained Individuals	Exterior Containment	Prohibited Practices	Digital Trainee Photos
		First Year	Second Year						
Proposed Rule	P	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*	<2 ft^2 per component	Firm certification and renovator training periods are 3 years each	Certification given to those with previous relevant training.	Cover the ground a sufficient distance to collect falling paint debris. †	None	No
Final Rule Options	A	All pre-1960 target housing and COFs.*	All target housing and COFs.	<2 ft^2 per room for interiors, <20 ft^2 for exteriors.		Certification given to those with previous training only if they complete a refresher course.	Cover the ground a sufficient distance to collect falling paint debris, with a minimum of 10 feet required.	Yes ‡	Yes
	B	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*						
	C	All pre-1960 target housing and COFs.*							
	D	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 where a child under the age of six resides.*							
	E	All rental target housing and COFs, and owner-occupied target housing *where a child under the age of 6 or a pregnant woman resides.*							
	F **Final Rule**	All rental target housing and COFs, and owner-occupied target housing *where a child under the age of 6 or a pregnant woman resides.*		<6 ft^2 per room for interiors, <20 ft^2 for exteriors.	Firm certification and renovator training periods are 5 years each				

* Plus all target housing units built before 1978 where a child with an increased blood-lead level resides.
** Not analyzed due to limitations with the data on the incidence of renovation, repair, and painting events. The minor maintenance exception is only available for renovations that do not use prohibited or restricted practices, and that do not involve window replacement or demolition of painted surfaces areas.
† The use of vertical containment was implicit in the proposed rule, but was not included in the economic analysis of the proposal.
‡ Practices prohibited or restricted for renovations requiring lead-safe work practices under the rule or qualifying for the minor maintenance exception: Open-flame burning or torching of LBP; using machines that remove LBP through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are used with HEPA exhaust control; and operating a heat gun on LBP at 1100° F or higher.

1.3 Organization of this Report

Chapter 2 profiles the RRP industry, as well as non-profit and governmental suppliers of childcare including family daycare providers. It examines the supply of and demand for renovation, remodeling and painting services. Using data from a variety of sources, including the U.S. Economic Census, the chapter discusses the size of the RRP industry and characteristics of its firms, as well as the organizational structure and competitiveness of the industry. The demand for RRP services is characterized and the factors that affect demand are discussed. Other affected industries (e.g. training providers, property owners and managers) are also profiled in this chapter.

Chapter 3 characterizes the lead contamination problem to be addressed under the proposed rule. It discusses how incomplete information and external costs have resulted in inefficient levels of lead contamination resulting from renovation activity, and introduces regulation as a reasonable solution for these market failures. The chapter also reviews state and local regulations that affect RRP activities (both those affecting residences and those affecting COFs) and demonstrates that these are not sufficient to address the problem.

Chapter 4 describes in detail the methods used to calculate costs of the various regulatory options considered. It describes the data sources used and is organized around the four general categories of costs for complying with the proposed rule: training costs, work practice compliance costs, cleaning verification costs, and administrative costs. The last section of the chapter estimates the costs of each option over a 50-year period and presents annualized costs at both 3 percent and 7 percent.

Chapter 5 describes in detail the benefit estimation in terms of value of IQ benefits in children. It also discusses potential benefits to adults and provides estimates of the number of adults who will experience reduced lead exposures due to the LRRP rule. ~~Four~~Five appendixes are presented that include technical discussions of how the benefits were estimated and a brief discussion of the lead-related adverse health effects, both included and not included in the benefit analysis, as well as ecological effects.

Chapter 6 provides a summary of the costs and benefits, and the corresponding net benefits. This chapter also provides a summary of the number of individuals who will benefit from reduced lead exposures.

Chapter 7 presents the results of several sensitivity analyses conducted to measure the effect of particular components of the model. These analyses address uncertainties in both the cost and the benefit analyses.

Finally, Chapter 8 presents findings of distributional analyses relevant to specific rule-making requirements, including small business impacts, environmental justice, protection of children and unfunded mandates.

2. Lead, Renovation, Repair, and Painting Industry Profile

On January 10, 2006, EPA published a proposed rule (71 FR 1588) for the Lead, Renovation, Repair, and Painting program in target housing (2006 proposed LRRP TH rule). A supplemental proposal (72 FR 31022) extended the regulated universe to include child-occupied facilities (COFs). Under the rule, firms that renovate, repair or paint structures subject to the regulations for compensation will need to obtain EPA certification, train at least one of their employees as a renovator and, if necessary, additional staff members as workers, and ensure that lead-safe work practices are used whenever a project disturbs more than the exempt amount of lead-based paint. These requirements also apply to building owners or managers who use their own staff to conduct RRP activities in target housing.

Target housing is defined in section 401 of the Toxic Substances Control Act (TSCA) as any housing constructed before 1978, except housing for the elderly or persons with disabilities (unless any child under age 6 resides or is expected to reside in such housing) or any 0-bedroom dwelling.

A COF is defined under the rule as:

> Child-occupied facility means a building, or portion of a building, constructed prior to 1978, visited regularly by the same child, under 6 years of age, on at least two different days within any week (Sunday through Saturday period), provided that each day's visit lasts at least 3 hours and the combined weekly visits last at least 6 hours, and the combined annual visits last at least 60 hours. Child-occupied facilities may include, but are not limited to, day care centers, preschools and kindergarten classrooms. Child-occupied facilities may be located in target housing or in public or commercial buildings. With respect to common areas in public or commercial buildings that contain child-occupied facilities, the child-occupied facility encompasses only those common areas that are routinely used by children under age 6, such as restrooms and cafeterias. Common areas that children under age 6 only pass through, such as hallways, stairways, and garages are not included. In addition, for public or commercial buildings that contain child-occupied facilities, the child-occupied facility encompasses only the exterior sides of the building that are immediately adjacent to the child-occupied facility or the common areas routinely used by children under age 6.

The term renovation encompasses a wide variety of construction activities. Renovation would be defined as:

> Renovation means the modification of any existing structure, or portion thereof, that results in the disturbance of painted surfaces, unless that activity is performed as part of an abatement as defined by this part (40 CFR § 745.223). The term renovation includes (but is not limited to): the removal, modification or repair of painted surfaces or painted components (e.g., modification of painted doors, surface restoration, window repair, surface preparation activity (such as sanding, scraping, or other such activities that may generate paint dust)); the removal of building components (e.g., walls, ceilings, plumbing, windows); weatherization projects (e.g., cutting holes in painted surfaces to install blown-in insulation or to gain access to attics, planing thresholds to install weather-stripping), and interim controls that disturb painted surfaces. A renovation performed for the purpose of converting a building, or part of a building, into target housing or a child-occupied facility is a renovation under this subpart.

Thus, renovation includes repair and painting work. Renovation activities are conducted without the intent of removing lead, but may disturb it in the process. Lead abatement activities, on the other hand, are conducted with the intent to remove lead-based paint or otherwise permanently eliminate a lead-based paint hazard. Depending on the reason they are undertaken, many activities, such as replacing windows, can be either renovation or abatement. Because the rule will address renovation, rather than abatement activity, this profile characterizes the renovation industry as opposed to the abatement services industry.

The industry profile is categorized into ten sections. Section 2.1 presents summary information on the operators of COFs. Section 2.2 discusses the numbers and characteristics of daycare centers, family daycare and informal daycare. Section 2.2 also plots and describes past trends and future expectations for the growth of these entities. Section 2.3 is divided into two parts, first discussing the scale and finances of public schools before then discussing private schools, paying particular attention to those schools with either pre-kindergarten or kindergarten programs. Section 2.4 presents similar information for non-residential property owners and managers likely to be affected by the rule. Section 2.5 discusses the supply of contractor-provided renovation services. Section 2.6 focuses on the demand-side of renovation by identifying the quantity of renovation activities performed. Section 2.7 discusses the overall market organization for the renovation industry. Section 2.8 describes the residential property owner and manager industry Section 2.9 discusses training providers. Section 2.10 summarizes the numbers of structures potentially affected by the rule, as well as the numbers of children regularly present in these buildings.

2.1 Overview of Child-Occupied Facilities

For the purposes of analysis, COFs are divided into the following categories[1]:

- **Kindergartens and Pre-Kindergartens in Schools:** Located in public and private schools.
- **Daycare centers:** Organized (licensed) facilities located in public or commercial buildings.
- **Family daycare:** Organized (licensed) daycare facilities located in the provider's home.
- **Informal daycare:** Informal (i.e. not licensed) day care providers, including relatives and non-relatives. Some of these providers may be paid for their services.

There is a great deal of diversity and complexity in the childcare industry. The formal childcare sector consists primarily of two types of facilities – center-based care and family daycare. Daycare centers are typically located in commercial or educational buildings, including schools and university campuses. They include private for-profit and non-profit facilities that can operate as independent centers or as part of chains. For-profit facilities can be found in office buildings, factories, other workplace settings, or in stand-alone facilities. Non-profit facilities may be found in YMCAs or other community centers, churches, college and university campuses, as well as in office or stand-alone buildings. Government education and human services agencies also provide daycare through programs such as Head Start, as well as through kindergarten and pre-kindergarten programs at local schools.

Unlike center-based care, family daycare is typically offered in the home of the caregiver. Family daycare facilities tend to serve smaller groups of children and have a smaller child-to-caregiver ratio (KeepKidsHealthy 2001). In addition to formal care provided by daycare centers, schools, and family daycare, children may also be cared for informally by relatives, family friends, or other acquaintances.

[1] The analysis is limited to kindergartens, pre-schools, daycare centers, family daycare, and informal daycare. Due to a lack of data, it does not include other facilities that may qualify as COFs under the rule.

Informal care may be paid or unpaid, and usually takes place at the home of either the child or the provider.

Table 2-1 summarizes the types and numbers of facilities and childcare providers in this universe, grouping them by the age of their construction. It shows that the rule would apply to 1,656,000 child-occupied facilities, of which 1,559,000 are in target housing.

Table 2-1: Total Number of Childcare Facilities in the United States, Number of Child-Occupied Facilities Potentially Affected by the Rule

Type	Total Childcare Facilities in the United States[a]	Number by Date of Construction[b,c,]	
		All Pre-1978	All Pre-1960
(1) Schools with pre-kindergartens and/or kindergartens	79,000	46,000	25,000
(2) Pre-schools and daycare centers located outside of schools	88,000	51,000	28,000
(3) Childcare in target housing	2,398,000	1,559,000	823,000
Total	**2,565,000**	**1,656,000**	**876,000**

a. The Total Childcare Facilities in the United States count includes facilities constructed both before and after 1978. Facilities constructed after 1978 are not regulated under the rule.
b. Not all facilities in the table have lead-based paint.
c. The number of facilities by date of construction is inclusive (pre-1960 is a subset of pre-1978).

Sources: Center for the Childcare Workforce and Human Services Policy Center 2002; U.S. Bureau of Labor Statistics 2006; U.S. Department of Education 2004; U.S. Department of Energy 2003; Wilder Research Center 2001, Wilder Research Center 2005.

2.2 Daycare Centers and Family Daycare

Establishments involved in the provision of day care of infants or children are classified under NAICS 624410 – Child Day Care Services. This industry covers child day care centers (including those located in the provider's home), pre-school centers, nursery schools and pre-kindergarten centers (except as part of elementary schools). In 2002, Census reported that this industry included over 55,000 firms that employed nearly 752,000 people (U.S. Census Bureau 2005d). Furthermore, Census reports 618,947 non-employers in the industry (U.S. Census Bureau 2005k).

While Census covers both family and center-based childcare under NAICS 624410, there is reason to believe that Census undercounts the number of employer firms in this industry. This is likely to occur for two reasons. First, it is likely that the number of firms reported by Census primarily includes centers, since care provided solely by one person (as occurs at many family daycare establishments) would be classified under non-employer statistics. Second, Census classifies a business into NAICS 624410 if its primary line of business is the provision of child day care services; it is likely that many facilities have alternate primary lines of business (YMCAs and churches, for example). The number of non-employers, on the other hand, is likely to include care providers such as nannies or babysitters that do not constitute formal care, but that cannot be disentangled from the total count.

In light of the limitations of the Census data, an alternative data source is used for this analysis. In 2005, the National Association for Regulatory Administration (NARA) in conjunction with the National Childcare Information Center (NCCIC) conducted a study on the number and licensed capacity of daycare centers and family daycare establishments in the 50 U.S. states. Based on these data, there are approximately 115,000 licensed daycare centers in the United States. Because licensing requirements differ from state to state, this count includes 105,444 facilities licensed as daycare centers, as well as about 10,000 facilities such as Head Start, religious daycare, and other similar establishments, which are required to obtain a license in some states, but must only be registered or certified in others.

According to the Department of Housing and Urban Development's (HUD) *First National Health Survey of Childcare Centers*, about 22 percent of licensed daycare centers are located in elementary schools. Since throughout this analysis, schools are analyzed separately from daycare centers, the number of daycare centers was reduced by 22 percent, bringing the total number of centers to 89,260. According to NCES data on public and private schools, however, an additional 1,421 schools without kindergartens have a pre-kindergarten program (See Section 2.3.1). These 1,421 centers are also excluded from the total center counts to avoid double-counting, bringing the number of centers to 87,840.

In addition to the 115,000 centers, NARA reported a total of 166,514 licensed small family childcare homes and 47,452 large family childcare homes.[2] With the addition of about 16,000 family daycare homes that are reported as certified, not licensed, NARA reports a total of 229,875 family daycare facilities.

Because some states either completely exempt family daycare with fewer than a certain number of students from licensing requirements, or offer voluntary registration, the family daycare numbers reported by NARA are likely to underestimate the total family daycare universe. As such, to estimate the number of family daycares, this analysis relied on a 2002 report by the Center for the Childcare Workforce, which provides data on family childcare providers caring for unrelated children in their own homes. Based on these data, it is estimated that there are a total of 591,071 family daycare facilities in the United States. Table 2-2 summarizes the size of the formal (center and family daycare) childcare universe.

Table 2-2: Number of Daycare Centers and Family Daycare Facilities in the United States

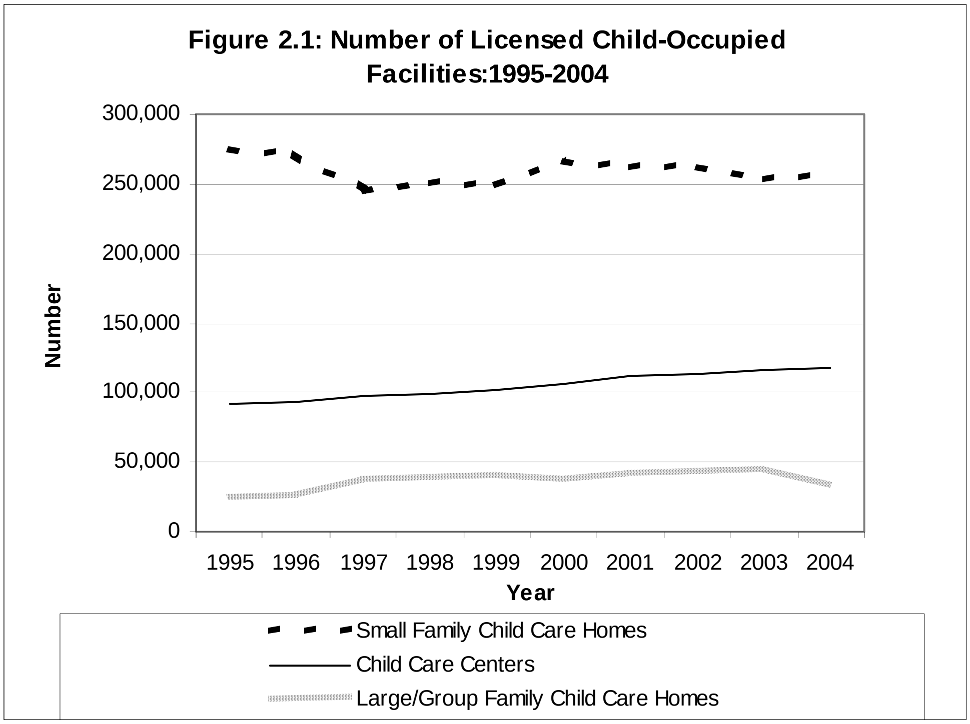
	Daycare Centers (excluding schools)	Total Family Daycare
Number of facilities	87,840	591,071
Sources: NARA 2006; Center for Childcare Workforce 2002		

2.2.1 Daycare Center and Family Daycare Outlook

Figure 2.1 plots changes in the numbers of licensed child-occupied facilities between 1995 and 2004 using information compiled from the Childcare Licensing Studies published annually by the Children's

[2] Here large and small refer to the number of children enrolled. It is not the same as the large and small definitions used by SBA.

Foundation and the National Association for Regulatory Administration (NARA).[3] These data give larger counts than the data above because they include facilities in Puerto Rico, Guam and the Virgin Islands.[4] But the trends displayed in this data are likely to be present in the smaller data set. The number of licensed Childcare Centers has grown gradually over time, from 92,000 in 1995 to 120,000 facilities in 2004. The number of Large/Group Family Childcare Homes grew in a similar manner, before tapering off in 2004. Over the time period specified, the number of Small Family Childcare Homes declined from 276,000 to 256,000, while exhibiting much more variation from year to year than the other two categories. Here, as noted earlier, large and small refer to the number of children enrolled, not the SBA definition of a large or small entity.



Sources: National Childcare Information Center 2005

The market for lead-safe renovation activities in COFs is dependent on the number of care providing facilities. Figure 2.1 indicates that while there have been some fluctuations in the underlying components of the overall market, when considered over the entire time frame the number of licensed COFs has been relatively stable.

While there wasn't significant growth in childcare over the 1995-2004 timeframe, a study forecasts growth in the demand for childcare labor. Fueling the future demand for childcare services is the

---

[3] When the Children's Foundation closed in 2005, NARA assumed sole responsibility for collecting licensing information through the annual study. However, because the methodology was altered with the new leadership, data from the 2005 Childcare Licensing Study were not included into Figure 2.1.

[4] While the rule would apply to Puerto Rico, Guam and the Virgin Islands, they are not included in this analysis for reasons of consistency since some of the major data sources used elsewhere in the analysis were limited to the 50 states and the District of Columbia. Holding all other things equal, by not including COFs in Puerto Rico, Guam, and the Virgin Islands, the analysis underestimates the costs and benefits of the rule.

expected increase in the amount of children below 5 between 2004 and 2014. Adding to this growing demand will be an increased female labor force participation rate, forcing families to find alternate care options for their children. Furthermore, many states will be implementing their own care programs for 3- and 4- year old children in the coming years. The government also plans to increase subsidies for low-income families attending day care programs (Bureau of Labor Statistics 2005). While trends point to increased demand for childcare labor, it is difficult to assess whether this will be accompanied by an increase in the number of facilities, and to what extent these new facilities will be located in pre-1978 buildings.

2.2.2 Informal Daycare

Informal daycare is provided by unlicensed providers, including relatives, friends, and others. Calculations determining the number of informal daycare providers are based on figures and percentages found in a report on the number of paid relatives and non-relatives providing childcare entitled "Estimating the Size Components of the U.S. Childcare Workforce and Caregiving Population: Key Findings from the Childcare Workforce Estimate" (Center for Childcare Work Force 2002).[5] According to the Center for Childcare Workforce Study, over three million relatives and 420 thousand non-relatives provide informal childcare, either with or without pay. As explained in detail in Section 4.2 of Chapter 4, these numbers were adjusted to account for the fact that some of these caregivers provide care in the child's own home, or for fewer than 6 hours per week. Subtracting these non-COF caregivers from the totals reported by CCWS brings the number of informal caregiver facilities to 1.8 million. As presented in Table 2-3, 460,000 of these caregivers are paid relatives, while the remainder is unpaid relatives and non-relatives.

As discussed in Chapter 4, this analysis estimates that 29 percent of informal caregivers providing care in their own home have a child under the age of 6, and 39 percent of these caregivers live in rental units. In addition to showing the total number of informal childcare providers, Table 2-3 also shows the number of paid and un-paid caregivers living with children under the age of 6, or in rental housing.

Table 2-3: Adjusted Number of Informal Childcare Providers

		Providers in Rental Units		**Providers in Owner-Occupied Units**	
	Total Informal Childcare Providers	**With Child <6 years of age**	**Without Child <6 years of age**	**With Child <6 years of age**	**Without Child <6 years of age**
Paid Relative	459,942	51,644	127,988	80,589	199,721
Unpaid Relative/ Non-relative	1,346,941	151,240	374,812	236,006	584,883
Total	**1,806,883**	**202,884**	**502,800**	**316,595**	**784,605**

Adjusted to exclude caregivers providing care in the child's own home, or for fewer than 6 hours per week. Includes childcare provided in post-1978 housing.
Source: See Section 4.2 of Chapter 4

[5] For a more in-depth discussion of the methodology refer to Section 2 of Chapter 4 of this analysis.

Target Housing COFs

Family daycare and informal daycare take place in target housing. Renovation events in some target housing COFs would be regulated regardless of their status as a COF; for example, if they are owner-occupied units where a child under the age of six or a woman who is or mat be pregnant woman resides or if they are rental units. Table 2-4 illustrates the estimated number of COFs in target housing by renter/owner occupancy status, child/pregnant woman-occupancy status, and type of child care. All target housing COFs (informal and family daycare) were adjusted to account for the fact that 65 percent of the residential housing stock was built before 1978. For a detailed explanation of the adjustment factors used to calculate these numbers, please see Section 4.2 of Chapter 4.

Table 2-4: Estimated Number of Target Housing COFs

		Rental Units		Owner Occupied Units		
Compensation	**Provider Type**	**child <6 or pregnant women**	**no child <6, no pregnant women**	**child <6 or pregnant women**	**no child <6, no pregnant women**	**Total**
Paid	Family Care*:	n.a.	n.a.	**65,000**	*319,000*	**384,000**
	Relatives	35,000	82,000	**54,000**	*128,000*	**299,000**
	Non-Relatives	*	*	*	*	*
	Paid Subtotal	**35,000**	**82,000**	**119,000**	*448,000*	**684,000**
Unpaid	Family Care:	n.a.	n.a.	n.a.	*n.a.*	n.a.
	Relatives	95,000	229,000	150,000	*357,000*	832,000
	Non-Relatives	6,000	12,000	9,000	*19,000*	46,000
	Unpaid Subtotal	**101,000**	**241,000**	**157,000**	***376,000***	**875,000**
All Target Housing COFs		**136,000**	**323,000**	**276,000**	***824,000***	**1,559,000**

Notes: * Estimates for Family Care includes some informal care from paid non-relatives.
All target housing COFs (informal and family daycare) were adjusted to account for the fact that 65 percent of the residential housing stock was built before 1978. Not all the facilities in the table have lead-based paint.

There are an estimated 1.6 million COFs in target housing. The shaded cells in Table 2-4 indicate target housing units that would be regulated without COF status, because they are in rental housing or in owner-occupied housing where a child under the age of 6 resides. The italicized entries with the white background in Table 2-4 represent the target housing units only regulated because they are COFs. Table 2-4 indicates that the adding of COFs to the scope of otherwise regulated target housing adds 824,000 housing units to the regulated universe.

2.3 Public and Private Schools

This section describes the number and size of public and private schools with kindergartens and pre-kindergartens.

2.3.1 Number of Schools

According to the National Center for Education Statistics, during the 2004-2005 academic year, there were 93,295 public schools with students in the United States. In total, these schools served 48.8 million students (NCES 2006a). The rule will apply only to those portions of schools that meet the COF definition. Thus, the rule is expected to primarily impact schools that have kindergarten or pre-kindergarten programs. According to the NCES's Public Elementary and Secondary School Universe Survey, which collects data on all operational public schools in the United States, in 2004-2005, 52,129 of the 93,295 U.S. public schools (roughly 56 percent) provided either pre-kindergarten or kindergarten services.[6] Of these 52,129 schools, 20,885 offered both pre-kindergarten and kindergarten and 29,884 schools provided kindergarten services only. Only 1,400 schools offered pre-kindergarten, but not kindergarten services; this group of schools includes standalone preschools operated by local school boards, as well as daycare centers located in public middle schools, high schools, and ungraded schools (See Table 2-5). Note that these figures are not limited to schools with pre-1978 buildings.

Table 2-5: Number of Public Schools, by Type	
Type of Public School	**Number of Schools**
Total number of public elementary and secondary schools	93,295
Number of schools with pre-kindergartens and kindergartens	20,885
Number of schools with pre-kindergartens but no kindergartens	1,400
Number of schools with kindergartens, but no pre-kindergartens	29,844
Total number of schools with pre-kindergartens	***22,285***
Total number of schools with kindergartens	***50,729***
Total number of schools with pre-kindergartens or kindergartens	**52,129**
Source: NCES 2006a,b	

As shown in Table 2-6, in 2004-2005 a total of 990,421 pre-kindergartners and 3,543,554 kindergartners were enrolled in pre-kindergartens and kindergartens offered at public schools, respectively. Given the number of programs described above, this means that there are roughly 44 pre-kindergarten students per school and 70 kindergarten students per school.

Table 2-6: Enrollment in Public Pre-kindergarten and Kindergarten Program Statistics			
	Number of Schools offering program	**Number of Students Served**	**Average Students Served per School**
Pre-kindergartens in public schools	22,285	990,421	44
Kindergartens in public schools	50,729	3,543,554	70
Source: NCES 2006a,b			

Number of Public School Districts

Public schools in the United States are operated by local education agencies (LEAs), organizations "responsible for providing free public elementary/secondary instruction or education support services." The National Center for Education Statistics collects data on LEAs through its Common Core of Data (CCD) fiscal and non-fiscal surveys. NCES designed the Common Core of Data system to "accommodate the many and varied organizational structures used in the provision of public elementary and secondary education." As such the CCD contains records that represent "administrative and operating units that are unlike typical public schools and school districts – for example, regional administrative service centers without students."

[6] A school was considered as having a pre-kindergarten if a) pre-kindergarten enrollment was greater than zero students, or b) the school reported that the lowest grade offered was pre-kindergarten, but enrollment data were not provided. Similarly, a school was considered as having a kindergarten if a) kindergarten enrollment was greater than zero, or b) the school reported that the lowest grade offered was pre-kindergarten or kindergarten, but did not report kindergarten enrollment.

According to the CCD Local Education Agency Universe Survey, in 2004-2005, 17,647 LEAs operated in the 50 contiguous states and the District of Columbia. Of these 17,647 agencies, 14,473 operated at least one school that offered pre-kindergarten or kindergarten services and may thus be affected by the rule.

Of the 14,473 local education agencies responsible for schools with pre-kindergarten and kindergarten programs, just under 13,200 are typical public school districts (usually county or town agencies responsible for providing education services in that location). An additional 949 agencies are charter school organizations. The remaining 333 agencies represent regional, state, and federal institutions, as well as supervisory union administrative centers.[7] Table 2-7 presents a detailed breakdown of the number of education agencies by agency type, as well as counts of schools with pre-kindergartens and/or kindergartens operated by each agency.

Table 2-7: Number of Local Education Agencies Operating Schools with Kindergartens or Pre-Kindergartens, by Agency Type

Type of Local Education Agency	Number of Agencies	Number of Schools with Pre-K or Kindergarten Programs	Average Number of Pre-K or K Schools
Local School District	13,191	50,386	3.8
Supervisory Union Administrative Office	85	159	1.9
Regional Education Services Agency	167	308	1.8
State Institution	54	75	1.4
Federal Institution	27	188	7.0
Other Agency (Primarily Charter Schools)	949	1,013	1.1
Total	14,473	52,129	3.6

Source: NCES 2006b,c

The NCES collects data on the revenues and expenditures of local education agencies through its CCD School District Finance Survey. Table 2-8 presents the total revenues, average revenues, and percent revenues derived from federal, state, and local funds for education agencies operating schools with pre-kindergarten and/or or kindergarten programs. All figures are based only on agencies with available data; for each agency type, the table indicates the percent of LEAs represented in the totals. Note that financial data were not available for any federal institutions, nor for most state institutions.

[7] Supervisory union administrative centers operate schools only in Massachusetts, Vermont, and Virginia.

Table 2-8: Total Revenues, Average Revenues and Percent of Revenues by Source for Local Education Agencies Operating with Pre-Kindergarten and/or Kindergarten Programs						
		Revenues		Percent of Revenues by Revenue Source		
	% LEAs with Data	Total Revenues, (Millions of $)	Average LEA Revenues ($)	Federal	State	Local
Local School District	99%	$440,444	$33,560,173	8%	47%	45%
Supervisory Union Administrative Office	91%	$1,269	$16,481,935	8%	41%	52%
Regional Education Services Agency	95%	$7,612	$48,180,367	24%	35%	41%
State Institution	7%	$8	$2,115,250	12%	54%	34%
Federal Institution	0%	n.a.	n.a	n.a	n.a	n.a
Other Agency (Primarily charter schools)	81%	$2,074	$2,683,282	11%	68%	21%
All LEAs	***98%***	***$451,408***	***$31,933,217***	***9%***	***46%***	***45%***
Source: NCES 2006b,c,d						

Table 2-9 presents the total and average expenditures of local education agencies. Total expenditures are composed of total current expenditures for elementary/secondary education, as well as other expenditures. Elementary/secondary education current expenditures include expenditures for instruction (e.g. teacher salaries), support services (including, but not limited to, administrative, maintenance, and operations costs), and other expenses, such as transportation and food services. Other expenditures include spending not related to elementary/secondary education, such as expenditures for community service, or adult education, capital outlay expenditures, payments to other government and educational entities, and debt interest payments. In Table 2-9 current expenditures are split out by type, while the remainder (capital and non-educational) are combined and labeled as "all other" expenditures.

Table 2-9: Total Expenses, Average Expenses, and Percent of Expenditures by Expenditure Type for Local Education Agencies							
		Expenses		Percent of Expenditures by Expenditure Type			
	% LEAs with Data	Total Expenses (in Millions of $)	Average Expenses	Instruc.	Support Service	Other Current	All Other
Local School District	99%	$451,464	$34,399,846	52%	28%	3%	17%
Supervisory Union Administrative Office	91%	$1,203	$15,628,805	57%	32%	3%	8%
Regional Education Services Agency	95%	$7,154	$45,278,905	28%	33%	1%	38%
State Institution	7%	$7	$1,759,000	49%	39%	0%	11%
Federal Institution	0%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other Agency (Primarily charter schools)	81%	$2,023	$2,616,922	47%	41%	3%	9%
All LEAs	98%	$461,851	$32,671,971	51%	29%	3%	17%
Sources: NCES 2006b,c,d							

For most LEAs, the majority of expenditures (51 percent on average, across all LEAs) are spent on instruction. In aggregate, the category containing maintenance costs (i.e. support service) makes up around one-third of all expenditures. Lastly, the 'all other' expenditures category makes up a significant percentage of the expenditures for regional education services agencies.

Under the Regulatory Flexibility Act, public school districts are considered large if they serve a population of more than 50,000. Table 2-10 presents the number of LEAs that operate schools that have pre-kindergartens and/or kindergartens, by agency type and the size of the population served.

Table 2-10: Local Education Agencies that operate schools with Kindergartens and/or Pre-Kindergartens, by Agency Type and Size of Population Served

Type of Local Education Agency	Total Number of LEAs with Pre-K or K Programs	Number of LEAs Serving < 50,000[a]	Small LEAs as % of all LEAs with Pre-K or K Programs
Local School District	13,191	12,130	92%
Supervisory Union Administrative Office	85	84	99%
Regional Education Services Agency	167	167	100%
State Institution	54	0[b]	0%
Federal Institution	27	0[b]	0%
Other Agency (Primarily charter schools)	949	949	100%
All LEAs	14,473	13,330	92%

a. Local districts, supervisory union offices, regional education agencies and charter school districts for which no population data were available were assumed to serve a population of fewer than 50,000.
b. Assumes that all state and federal agencies are large.
Source: NCES 2006b,c,e,g

Private schools

In 2003-2004, the National Center for Education Statistics conducted a survey of private schools in the United States. NCES's *Characteristics of Private Schools in the United States: Results From the 2003-2004 Private School Universe Survey* (2006) presents a summary of survey results, including numbers of schools currently in operation, the number of students enrolled, and teachers employed. Table 2-11[8] presents summary statistics on national private schools, including a total count of all private schools, enrollment and teachers, as presented in NCES's report.

Table 2-11: Enrollment and Teacher Statistics for Private Schools

Entity	Number of Schools	Total Enrollment	Total Teachers	Average Enrollment	Average Teachers
Private Schools	34,681	5,212,992	441,384	150.3	12.7

Sources: NCES 2006e

[8] All other tables in this subsection draw from this dataset as well.

According to the NCES data, in 2003-2004 there were 34,681 private schools in the U.S., enrolling a total of just over 5.2 million students, with a total teaching staff of over 441,000. On average, there were 150 students enrolled in a private school and 13 teachers per school. These figure must be interpreted with caution however, since they encompass elementary schools, secondary schools, etc. which, by definition, include different numbers of classes.

While the NCES report provides some data on the number of private schools by grade level, it does not provide data on grades offered by each individual school in the survey. In order to identify schools with kindergartens only, pre-kindergartens and kindergartens, and pre-kindergartens only, this analysis relied on the Excel database underlying NCES's 2003-2004 report. This database, which contains records for 29,907 of the estimated 34,461 private schools in the United States, specifies the highest and lowest grade offered at each school, as well as the number of students enrolled in each grade. The database, however, does not include sampling weights used to adjust some of the survey results to generate final numbers presented in NCES's report. In order to most accurately estimate the number of schools offering each combination of kindergarten or pre-kindergarten programs, as well as the number of children enrolled in these programs, this analysis:

- used the underlying database to identify schools with pre-kindergartens only, kindergartens only, and both kindergartens and pre-kindergartens, then
- inflated these counts to account for the 4,500 schools that were not included in the database. The numbers of schools offering each combination of programs was inflated using the ratio of the number of schools presented in the published report to the number of schools included in the database. Similarly, the number of children in each school setting, estimated based on the underlying data, was adjusted using the ratio of the number of kindergartners presented in the published report to the number of kindergartners reported in the database.[9]

Table 2-12 breaks down the totals from the previous table to provide a count of the number of private schools with pre-kindergartens and/or kindergartens.

Table 2-12: Number of Private Schools, by Type	
Type of Private School	**Number of schools**
Total number of private elementary and secondary schools	34,681
Number of schools with pre-kindergartens and kindergartens	19,305
Number of schools with pre-kindergartens and no kindergartens	21
Number of schools with kindergartens but no pre-kindergartens	7,205
Total number of schools with pre-kindergartens	19,326
Total number of schools with kindergartens	26,510
Total number of schools with pre-kindergartens or kindergartens	26,531
Source: NCES 2006e	

[9] In its report, NCES tracks schools where kindergarten is the highest grade offered separately from regular elementary, middle and high schools. As such, when inflating counts obtained from underlying data, the analysis calculated two sets of ratios for the numbers of schools and numbers of children enrolled – one for regular, and another for kindergarten-terminal schools.

Of the 34,681 private schools counted in the 2003-2004 survey, 26,531 provided either pre-kindergarten or kindergarten services.[10] Furthermore, of these 26,531 private schools, 19,305 provided both pre-kindergarten and kindergarten services. Only 21 private schools provided pre-kindergarten but not kindergarten services[11]; while 7,205 private schools offered kindergarten but not pre-kindergarten services. Note that these figures are not limited to schools in pre-1978 buildings.

Table 2-13 presents a count of the number of pre-kindergarten and kindergarten students served in private schools, as well as the average number of students served per school.

Table 2-13: Total Number and Average Kindergarten and Pre-Kindergarten Students Served Per School

	Number of Schools offering Program	Number of Students Served	Average Students Served per School
Pre-kindergartens in private schools	19,326	863,542	45
Kindergartens in private schools	26,510	555,531	21
Source: NCES 2006e			

According to Table 2-13, there are 26,510 private schools with kindergartens, enrolling a total of 555,531 kindergarteners. Also, there are 19,326 private schools with pre-kindergartens, enrolling 863,542 pre-kindergarten students. The average number of private pre-kindergarten students per school (45) is more than double the average number of kindergarten students (21). Whereas, the public school figures displayed nearly the opposite ratio with, on average, 44 pre-kindergarten students and 70 kindergarten students per school.

Non-profit organizations, including private schools, are defined as small under the Regulatory Flexibility Act if they are independently owned and operated and not dominant in their field. While determining whether a school meets this definition is difficult, it is useful to present some statistics describing the size distribution of private schools. Table 2-14 shows the distribution of private schools by the number of students they serve. This represents the total number of students served, and not just the number of kindergarten and pre-kindergarten students.

---

10 A private school was identified as having a pre-kindergarten or kindergarten in the same fashion as a public school was in Section 2.2.1.

11 Beginning in 1995, the definition of school employed by the Private School Survey was expanded to include schools whose highest grade was kindergarten. Therefore, these statistics are likely to include some pre-kindergartens that are more likely also classified as preschools in other sources (NCES 2006e). Later sections explain how the calculations avoid double-counting. However, because this is a small figure, it is almost negligible.

Table 2-14: Schools with Kindergarten or Pre-Kindergarten programs, by Number of Students in the School										
	Number of Students Served									
	<100		100-499[a]		500-999		1000-1499		>1500	
	Total	%	Total	%	Total	%	Total	%	Total	%
Number of Private School	10,862	41%	13,951	53%	1,519	6%	161	1%	38	0%

Note: schools that did not report the total number of students were considered as having less than 100 student
a. Includes all schools with missing total student data. These schools are assumed to have student enrollment equal to the average school with over 100 students, or 285.
Source: NCES 2006e

The distribution of private schools in the U.S. is heavily skewed toward smaller schools, with 94% of private schools serving less than 500 students and 99% of private schools serving less than 1000 students. However, these data do not indicate whether the schools are affiliated with or part of a larger organization.

2.4 Nonresidential Commercial Property Owners and Managers

Nonresidential commercial property owners and managers will be affected by the rule if they rent space to daycare facilities or other COFs in buildings constructed prior to 1978. The number and size of firms in this industry is described below.

2.4.1 Industry Definitions and Characteristics

Firms involved in the leasing of nonresidential buildings (except Miniwarehouses) are classified under NAICS 531120 – Lessors of nonresidential buildings (except Miniwarehouses). In 2002, this industry included 28,426 firms that employed 154,725 people (U.S. Census Bureau 2005b).

Firms involved in the management of non-residential properties are classified under NAICS 531312 – Nonresidential property managers. In 2002, this industry included 10,506 firms that employed 125,616 people (U.S. Census Bureau 2005b).[12] Table 2-15 includes only firms with employees. The U.S. Census Bureau does not differentiate between self-employed contractors that lease or manage commercial real estate as opposed to residential buildings. This analysis assumes that non-employers primarily lease residential buildings, rather than commercial property. As such, non-employer establishments are not included in this profile, or in the remainder of the analysis.

[12] Firms involved in the leasing and/or management of residential buildings are already covered under the residential lead RRP rule.

Table 2-15: Summary Statistics for NAICS 531120 and NAICS 531312				
NAICS Code and Description	Firms	Annual Revenues (000)	Annual Payroll (000)	Employees
531120 - Lessors of nonresidential buildings (except miniwarehouses)	28,426	$51,778,431	$5,384,512	154,725
531312 - Nonresidential property managers	10,506	$12,297,703	$5,521,674	125,616
Total	38,932	$64,076,134	$10,906,186	280,341
Sources: U.S. Census Bureau 2005j				

As discussed in Section 4.4 of Chapter 4, EPA's analysis indicates that a total of 17,705 daycare centers rent space in pre-1978 buildings. Because daycare centers are only one of many types of establishments renting non-residential space, and because the rule applies only to centers in buildings constructed prior to 1978, the analysis also assumes that each property manager or lessor firm owns only one regulated building. As such, the number of affected lessor/manager firms is equivalent to the number of daycare centers renting space, or 17,705 under Option EF.

2.4.2 Establishment Size and Industry Environment

The U.S. Small Business Administration indicates that to qualify for small business status, a firm in NAICS 531120 must have revenues of less than $6.5 million, while firms in NAICS 531312 must have revenues of less than $2 million (U.S. Small Business Administration 2006b). Average revenues in these NAICS codes are significantly below the small business designation threshold (Table 2-16).

Table 2-16: Summary Statistics for NAICS 531120 and NAICS 531312 (Per Firm)			
NAICS Code and Description	Average Annual Revenues ($)	Average Annual Payroll ($)	Paid Employees Per Firm
531120 - Lessors of nonresidential buildings (except miniwarehouses)	$1,821,517	$189,422	5.4
531312 - Nonresidential property managers	$1,170,541	$525,573	12.0
Sources: U.S. Census 2005j			

Census data are not specific enough to report revenues at either the $6.5 million dollar or $2 million dollar cutoff; Table 2-17 presents the percent of firms in NAICS 531120 and NAICS 531312 that have revenues below $5 million and $1 million respectively. Consequently, the figures in Table 2-17 are all underestimates of the true percentages of firms that qualify as small businesses.

Table 2-17: Small and Large Firms as Percent of Industry				
NAICS Code:	**Description**	**Percent of Firms by Revenue Bracket**	**Percent of Industry Revenues by Revenue Bracket**	**Percent of Industry Employees by Revenue Bracket**
531120	Lessors of nonresidential buildings (except mini-warehouses)			
	Firms with Revenues < $5 million	96%	32%	73%
	Firms with Revenues of $5 million+	4%	68%	27%
531312	Nonresidential property managers			
	Firms with Revenues < $1 million	81%	19%	26%
	Firms with Revenues of $1 million +	19%	81%	74%
Sources: U.S. Census 2005j				

Based on 2002 data, 96 percent of NAICS 531120 firms and 81 percent of NAICS 531312 firms have revenues below $5 million and $1 million, respectively. In the Lessors of Nonresidential Buildings industry, these firms contribute 32 percent of the industry revenues while employing 73 percent of the workforce. The revenue and employment distribution is more skewed in the Nonresidential Property Managers sector. Small firms in this industry contribute only 19 percent of the revenues, while employing only 26 percent of the workforce.

2.5 Contractors that Supply Renovation Services

Data from the U.S. Economic Census were used to identify the North American Industry Classification System (NAICS) industry groups that may provide renovation, repair and painting work (U.S. Census Bureau 2004a). An establishment is assigned to a NAICS group based on the activities from which it derives the greatest share of its revenues. These activities may or may not make up the majority of work (i.e. labor hours) performed by the establishment, which may also be involved in a variety of other related (or unrelated) lines of work. The analysis identified 12 NAICS codes that are likely to include the vast majority of construction-related establishments that will be affected by the rule. Affected industry groups include two building construction sectors (NAICS 236118 – Residential Remodelers; and NAICS 236220 – Commercial and Institutional Building Construction) and ten specialty trade contractor sectors.

The number of contracting establishments affected is also discussed in Chapter 4. This profile examines the financial and employment characteristics of construction establishments likely to provide renovation work in child-occupied facilities.

NAICS sectors likely to perform projects regulated under the LRRP rule, as well as examples of the work they perform, are presented in Table 2-18.

Table 2-18: Contractor Sectors likely to be affected by the rule	
2002 NAICS	**Examples of Work Performed**
236118 - Residential Remodelers	• Addition, alteration and renovation of single-family homes • Addition, alteration and renovation of multifamily buildings • Home improvement (e.g., adding on, remodeling, renovating)
236220 - Commercial Building Construction	• Addition, alteration, maintenance and repair of commercial and institutional buildings • Commercial and Institutional building general contractors
238150 - Glass and Glazing Contractors	• Mirror Installation • Window pane or sheet installation
238170 - Siding Contractors	• Vinyl Siding, soffit and fascia, installation • Wood Siding, Installation
238210 - Electrical Contractors	• Electrical wiring contractors • Lighting system installation • Electrical power control panel and outlet installation
238220 – Plumbing and HVAC Contractors	• Heating equipment installation • Plumbing fixture installation • Plumbing and heating contractors
238290 – Other Building Equipment Contractors	• Pipe, duct and boiler installation • Water pipe insulating • Deodorization (i.e., air filtration) system installation
238310 – Drywall and Insulation Contractors	• Panel or rigid board insulation installation • Mineral wool insulation installation • Plastering (i.e., ornamental, plain) contractors
238320 – Painting and Wall Covering Contractors	• House painting • Paint and Wallpaper Stripping • Paperhanging and removal contractors
238340 – Tile and Terrazzo Contractors	• Ceramic tile installation • Mantel, marble or stone, installation • Mosaic work
238350 – Finish Carpentry Contractors	• Door and window, prefabricated, installation • Millwork installation • Paneling installation
238390 - Other Building Finishing Contractors	• Window shade and blind installation • Building fixture and fitting (except mechanical equipment) installation • Drapery fixture (e.g., hardware, rods, tracks) installation
Source: U.S. Census Bureau 2004a	

Number of Establishments with Employees

The U.S. Economic Census tracks businesses with paid employees (employer establishments) and non-employer establishments (self-employed contractors) separately.[13] This discussion deals with employer establishments only; non-employers are addressed in the next section.

Table 2-19 presents both the number of establishments and the number of employees in each NAICS group of interest. The number of establishments "includes all establishments that were in business at any time during the year are included. Construction establishments that were inactive or idle for the entire year were not included" (U.S. Census Bureau 2006a). Table 2-19 also presents the average per-establishment employment numbers by NAICS code. The average employment numbers are small for all affected sectors. Overall, Other Building Equipment contractors have the largest number of employees per establishment (20.8 people), while Residential Remodelers have the smallest (3.9 people).

Table 2-19: Number of Employer Establishments and Employees by NAICS Code

NAICS	Industry	Establishments	Number of Employees	Average Size
236118	Residential Remodelers	82,750	320,208	3.9
236220	Commercial building construction	37,208	715,896	19.2
238150	Glass and glazing contractors	5,294	50,800	9.6
238170	Siding contractors	6,632	43,042	6.5
238210	Electrical contractors	62,586	771,184	12.3
238220	Plumbing and HVAC contractors	87,501	974,368	11.1
238290	Other building equipment contractors	6,087	126,559	20.8
238310	Drywall and insulation contractors	19,598	311,077	15.9
238320	Painting and wall covering contractors	38,943	234,562	6.0
238340	Tile and terrazzo contractors	8,950	60,001	6.7
238350	Finish Carpentry contractors	35,087	179,476	5.1
238390	Other building finishing contractors	3,729	50,617	13.6
	Total, All sectors	394,365	3,837,790	9.7

Source: U.S. Census Bureau 2005c

Table 2-20 presents the total number of employees and the number of construction workers in each identified industry. The number of employees "includes all full-time and part-time individuals on the payrolls of construction establishments during any part of the pay period which included the 12th of March, May, August, and November" (U.S. Census Bureau 2005m). The number of construction workers "includes all payroll workers (up through the working supervisory level) directly engaged in construction operations, such as painters, carpenters, plumbers, and electricians… journeymen, mechanics…truck drivers and helpers." Non-construction employees include "payroll employees in executive, purchasing, accounting, …and routine office functions" (U.S. Census Bureau 2005m).

[13] Data at the firm level are not yet available for these NAICS groups.

Because construction workers form the vast majority of the people who require training under the rule, their role in the composition of each sector's labor force provides an indication of the extent to which each sector will be affected by the regulations.

In total, about 3.8 million people work for the 394,365 establishments in the potentially affected industries. About 73 percent of these employees are construction workers. The affected sectors differ in terms of the composition of their labor force. For example, construction workers make up 84 percent of employees in the Drywall and Insulation contractor sector. In the Residential Remodelers sector, however, construction workers make up only 65 percent of the labor force (U.S. Census Bureau 2005c)

Table 2-20: Number of Employer Establishments, Total Employees and Employees involved in Construction

NAICS	Description	Total Number of Employees	Number of Construction Workers	Construction Workers as Percent of Total Employees
236118	Residential Remodelers	320,208	207,637	65%
236220	Commercial Building Construction	715,896	478,923	67%
238150	Glass and Glazing Contractors	50,800	34,086	67%
238170	Siding Contractors	43,042	30,284	70%
238210	Electrical Contractors	771,184	606,403	79%
238220	Plumbing and HVAC Contractors	974,368	712,452	73%
238290	Other Building Equipment Contractors	126,559	90,504	72%
238310	Drywall and Insulation Contractors	311,077	261,239	84%
238320	Painting and Wall Covering Contractors	234,562	184,328	79%
238340	Tile and Terrazzo Contractors	60,001	44,729	75%
238350	Finish Carpentry Contractors	179,476	129,888	72%
238390	Other Building Finishing Contractors	50,617	37,353	74%
Total		3,837,790	2,817,826	73%
Sources: U.S. Census Bureau 2005c				

Number of Non-Employer Establishments

As mentioned above, the U.S. Economic Census tracks non-employer establishments separately from establishments with employees. Data on the number of non-employer establishments were available from the U.S. Small Business Administration. A non-employer firm "is defined as one that has no paid employees, has annual business receipts of $1,000 or more ($1 or more in the construction industries), and is subject to federal income taxes" (U.S. Small Business Administration 2006a). Essentially, non-employers are self-employed contractors. Because little financial and operational data is available for non-employers, the vast majority of this profile focuses on establishments with employees. This subsection discusses the number of non-employers in the affected industry sectors and the receipts of these establishments.

The U.S. Small Business Administration does not currently provide data on the number or revenues of non-employer establishments in each of the 6-digit level NAICS industries addressed in this profile. Data on the number of such establishments is available for Plumbing and HVAC contractors (NAICS 238220) and Electrical contractors (NAICS 238210) only; for the remaining industries, data is provided at the more general 4-digit NAICS level. In total, there are nearly 1.2 million self-employed contractors.

To estimate the number of non-employer establishments in each of the 6-digit sectors, it was assumed that the distribution of non-employer establishments in each 4-digit NAICS code is the same as the distribution of establishments with payroll in the same 4-digit group. Similarly, to estimate the revenues of these establishments, it was assumed that the distribution of receipts in each 4-digit NAICS code is the same as the distribution of revenues of payroll establishments in the same 4-digit industry.

Table 2-21 presents the estimated number and revenues of non-employer establishments in each of the 12 sectors affected by the rule.

Table 2-21: Number and Annual Revenues of Non-Employer Establishments in Affected Sectors

NAICS	Description	Number of Non-Employer Establishments	Revenues of Non-Employer Establishments (000)
236118	Residential Remodelers	194,182	$6,187,917
236220	Commercial Building construction	74,255	$4,784,817
238150	Glass and Glazing contractors	12,723	$720,934
238170	Siding contractors	15,939	$485,112
238210	Electrical contractors	102,219	$3,834,347
238220	Plumbing and HVAC contractors	110,183	$5,920,986
238290	Other Building Equipment contractors	9,710	$356,461
238310	Drywall and Insulation contractors	103,398	$8,798,899
238320	Painting and Wall Covering contractors	205,462	$4,823,217
238340	Tile and Terrazzo contractors	47,220	$1,684,174
238350	Finish Carpentry contractors	185,118	$5,254,955
238390	Other Building Finishing contractors	19,674	$1,396,611

Sources: U.S. Census Bureau 2005h, U.S. Census Bureau 2004q, U.S. Census Bureau 2005i

2.5.1 Financial Profile

In this section, Census data is used to examine key financial indicators for the renovation industry. The indicators include net value of construction (value of construction less value of construction subcontracted out to others) and labor costs. Net value of construction work is used instead of the total value of construction work because it is a measure of the work actually performed by the establishment. Table 2-22 presents the average per establishment net value of construction work (NVCW) for each industry sector. The table also presents labor costs as a percent of the net value of construction for each of the affected NAICS codes.

Table 2-22: Financial Summary for Contractor Sectors Affected by the rule						
2002 NAICS code	**Industry Name**	**Annual Net Value of Construction Work (000)**	**Number of Establishments**	**Net Value of Construction Work per Establishment (000)**	**Total Payroll (000)**	**Payroll as % of Net Values of Construction Work**
236118	Residential Remodelers	$30,627,850	82,750	$370	$8,703,503	28
236220	Commercial Building construction	$108,229,283	37,208	$2,909	$29,210,092	27
238150	Glass and Glazing contractors	$6,016,766	5,294	$1,137	$1,764,314	29
238170	Siding contractors	$3,810,070	6,632	$574	$1,185,348	31
238210	Electrical contractors	$77,671,846	62,586	$1,241	$29,324,486	38
238220	Plumbing and HVAC contractors	$105,323,163	87,501	$1,204	$35,942,262	34
238290	Other Building Equipment contractors	$13,680,062	6,087	$2,247	$4,940,641	36
238310	Drywall and Insulation contractors	$27,046,301	19,598	$1,380	$9,766,997	36
238320	Painting and wall covering contractors	$15,316,726	38,943	$393	$6,005,447	39
238340	Tile and Terrazzo contractors	$5,639,641	8,950	$630	$1,834,890	33
238350	Finish Carpentry contractors	$15,640,544	35,087	$446	$4,711,739	30
238390	Other Building Finishing contractors	$4,560,138	3,729	$1,223	$1,719,039	38
	Total, all industries	**$407,922,749**	**394,365**	**$1,034**	**$135,108,758**	**33**
Source: U.S. Census Bureau 2005c						

Table 2-22 shows the wide range of values of construction work per establishment across all NAICS codes of interest. The average establishment in the Residential Remodeler industry (NAICS 236118) has the smallest net value of construction work ($370,000), followed by the Finish Carpentry contractors industry ($446,000). Meanwhile, the average establishment in the Commercial Building Construction industry (NAICS 236220) has the largest net value of construction value ($2,909,000), with the Other Building Equipment contractors industry netting the second largest value ($2,247,000). It should come as no surprise that the Commercial Building Construction industry's net value of construction is so much larger than the Residential Remodeler industry's net value of construction work given that commercial building construction projects tend to be substantially larger in scope and size than residential remodeling projects.

As demonstrated in Table 2-22 while labor constitutes about 33% of net value of construction for all the industry sectors, the composition varies across industry sectors. The Painting and Wall Covering contractor (NAICS 238220) industry is most dependent on labor, with an overall labor cost to net value of construction ratio of 39 percent. The Commercial Building Construction industry, with an overall labor cost to net value of construction work ratio of 27 percent, is the least dependent of the 12 sectors (U.S. Census Bureau 2005c). It is worth mentioning that labor (as measured by payroll) is a relatively small percentage (27% to 39%) of total net value, reflecting the fact that a large percent of revenues go to covering the cost of materials and profit.

Establishment Size by Revenue Bracket

The Small Business Administration (SBA) defines a small business in both the Residential Remodeler and Commercial Building Construction industries as one that has revenues of $31.0 million dollars a year or less. The small business definition for the ten specialty contractor industries is $13 million per year (U.S. Small Business Administration 2006b). The SBA size standards apply to firms rather than establishments; revenue data in the 2002 Economic Census, however, is currently only available at the establishment level. Since a firm may consist of one establishment, a few establishments or even a very large number of establishments, by using establishment rather than firm data, this analysis overestimates the number of small businesses in the affected industry.

The remainder of this section examines the number of establishments, number of employees, net value of construction work and value of business done[14] distributed by establishment revenue bracket. These data were available from the 2002 Economic Census at the NAICS code level only. Establishments were classified into two revenue categories based on the total value of business done – those with revenues less that $10 million and those with revenues greater than $10 million. Because the Census groups all establishments with revenues of $10 million or more into one revenue bracket, it is not possible to determine what percentage of Residential Remodeler nor Commercial Building Construction establishments have revenues of less than $31 million. Note, however, that nearly 100 percent of Residential Remodeler establishments have revenues of less than $10 million per year. The same cannot be said for Commercial Building Construction establishments, as 12 percent have revenues greater than $10 million per year. The percent of establishments, employees and net value of construction contributed by establishments in each revenue bracket is presented in Table 2-23.

[14] Value of business done is defined by the U.S. Census Bureau as including "the sum of value of construction work and other business receipts. Value of business done is the sum of receipts, billings, or sales from establishments of construction business activities plus receipts from other business activities" (U.S. Census Bureau 2004d).

Table 2-23: Small and Large Establishments as Percent of Industry					
NAICS	NAICS	Percent of Establishments	Percent of Employees	Percent of Net Value of Construction	Percent of Value of Business done
236118	**Residential Remodelers**				
236118	Revenues < $10 million	100%	95%	92%	91%
236118	Revenues > $10 million	0%	5%	8%	9%
236220	**Commercial Building Contractors**				
236220	Revenues < $10 million	88%	41%	30%	24%
236220	Revenues > $10 million	12%	59%	70%	76%
238150	**Glass and Glazing Contractors**				
238150	Revenues < $10 million	98%	82%	77%	77%
238150	Revenues > $10 million	2%	18%	23%	23%
238170	**Siding Contractors**				
238170	Revenues < $10 million	100%	90%	88%	87%
238170	Revenues > $10 million	0%	10%	12%	13%
238210	**Electrical Contractors**				
238210	Revenues < $10 million	98%	68%	61%	60%
238210	Revenues > $10 million	2%	32%	39%	40%
238220	**Plumbing and HVAC Contractors**				
238220	Revenues < $10 million	98%	70%	63%	61%
238220	Revenues > $10 million	2%	30%	37%	39%
238290	**Other Building Equipment Contractors**				
238290	Revenues < $10 million	95%	60%	55%	55%
238290	Revenues > $10 million	5%	40%	45%	45%
238310	**Drywall and Insulation Contractors**				
238310	Revenues < $10 million	97%	64%	60%	60%
238310	Revenues > $10 million	3%	36%	40%	40%
238320	**Painting and Wall Covering Contractors**				
238320	Revenues < $10 million	100%	92%	88%	88%
238320	Revenues > $10 million	0%	8%	12%	12%
238340	**Tile and Terazzo Contractors**				
238340	Revenues < $10 million	100%	91%	86%	86%
238340	Revenues > $10 million	0%	9%	14%	14%
238350	**Finish Carpentry Contractors**				
238350	Revenues < $10 million	100%	86%	84%	83%
238350	Revenues > $10 million	0%	14%	16%	17%
238390	**Other Building Finishing Contractors**				
238390	Revenues < $10 million	98%	81%	74%	74%
238390	Revenues > $10 million	2%	19%	26%	26%
	Total				
Total	Revenues < $10 million	98%	69%	58%	50%
Total	Revenues > $10 million	2%	31%	42%	50%

100 percent = establishments in this revenue category make up over 99.5 percent, but less than 100 percent of establishments in the industry.

Source: U.S. Census Bureau 2004c,d,e,f,g,h,i,j,k,l,m; U.S. Census Bureau 2005m

The distribution of the number of establishments for all twelve NAICS codes is greatly skewed toward smaller establishments. In five out of twelve industry sectors, over 99.5 percent of establishments have revenues below $10 million. For the remaining sectors, establishments with revenues greater than $10 million make up less than 5 percent of establishments in any sector (with the exception of the Commercial Building Construction industry where 12% of establishments earn more than $10 million in revenues[15]). Thus, about 98 percent of all establishments in the affected industries have revenues well below the SBA definition of small business.

Establishments with revenues of less than $10 million account for between 41 and 95 percent of total employment for each sector, and about 69 percent of employment overall. The distribution of the net value of construction work and the total value of business done is skewed toward smaller establishments in a manner similar to the distribution of employees. Establishments with revenues of less than $10 million account for between 30 and 92 percent of the net value of construction work and between 24 and 91 percent of the total value of business done in each sector. It is worth mentioning that if you remove the Commercial Building Construction industry, the lows in the previously cited categories jump to 55 percent. Overall (across all industry sectors) small businesses contribute about 58 percent of the net value of construction work and 50% of the total value of business (U.S. Census Bureau 2004c,d,e,f,g,h,i,j,k,l,m; U.S. Census Bureau 2005m).

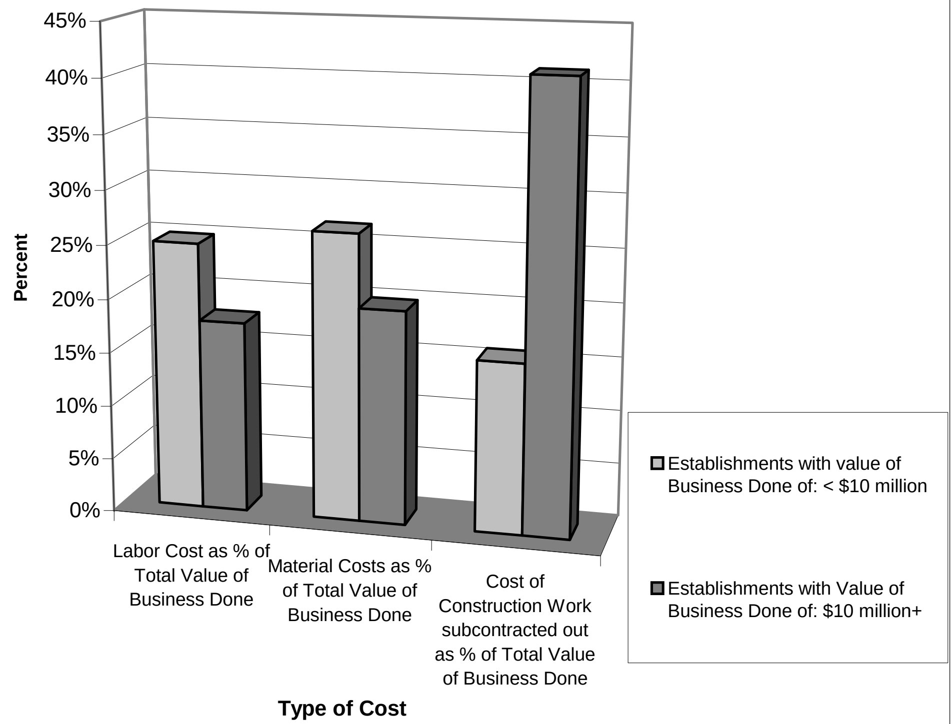
Labor and Material Costs as a Percentage of Total Value of Business Done

In order to better understand the potential impacts of the rule on the affected industries, and particularly on small businesses, it is important to observe whether establishment costs as a percentage of the total establishments' total revenues differ for small and large establishments. Figure 2.2 examines labor and material costs, as well as the cost of construction work subcontracted out as a percentage of the total value of business done for the twelve affected sectors. While the rule will increase the cost of material slightly, the major impact will be on labor costs, including the training of staff. Each of the sectors was broken down into two size categories by revenue bracket: less than $10 million and $10 million and more. The cost of labor, of materials, and of construction work subcontracted out was summed across the 12 industry sectors for large and for small establishments. These values were then compared to their total value of business.

Labor costs, material costs, and the cost of construction work subcontracted out as a percentage of total value of business done are presented in Figure 2.2. Regardless of size of establishments, material costs tend to be a slightly larger percentage of total revenues than do labor costs. Labor costs make up about 25 percent of revenues for small establishments and about 16 percent for large establishments. Based on Census data, large establishments subcontract out a much larger percentage of their work than do small businesses.

[15] Once again, this difference arises because of the larger size of a majority of Commercial building construction projects. Regardless, if only 12% earn revenues greater than $10 million, it can easily be assumed that a much smaller percentage of establishments in this industry earn revenues greater than the SBA cutoff of $31 million.

Figure 2.2
: Labor and Material Costs as % of Total Value of Business Done



Source: U.S. Census Bureau 2005a

2.6 The Demand for Renovation Services

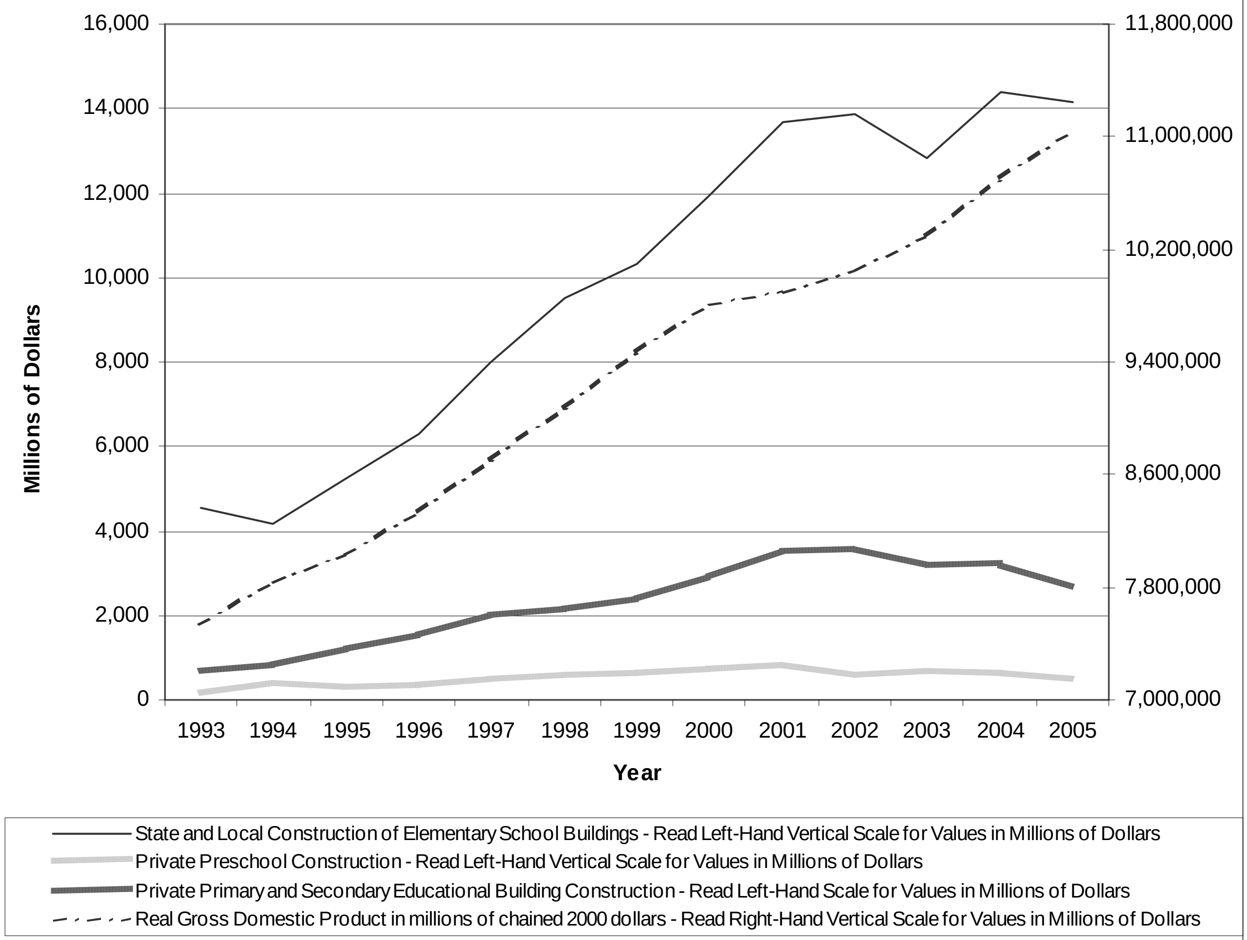
The demand for renovation is responsive to changes in the overall economic conditions. The same factors that stimulate economic growth, such as low unemployment, high consumer confidence and low interest rates, also stimulate the demand for renovation activities. For both residential and nonresidential building projects, the U.S. Census Bureau tracks information on the "value of construction put in place," a figure composed of some of the variables previously discussed in this chapter such as labor and material costs (while also including other variables such as the contractors profit, the cost of architectural and engineering work, etc). Although the definition of construction includes renovations, alterations, additions, and other improvements, it does not include "maintenance and repairs to existing structures or service facilities" (U.S. Census Bureau 2006d), two components of primary interest to this rule.

Using this Census data, Figure 2.3 illustrates the relationship between the value of construction put in place for private preschools (a term that includes childcare and day-care centers, nurseries, and preschools), state and local elementary school buildings, private primary and secondary educational buildings, and real GDP (U.S. Census Bureau 2006b,c).[16] Both real GDP and the value of state and local construction of elementary school buildings substantially increased over the previous 12 years.

[16] State and Local Construction of Elementary School Buildings is meant to give an indication of public kindergarten construction, while Private Primary and Secondary Educational Building Construction is meant to give an indication of private school kindergartens. Since the variables shown in figure 2.2 are more broadly defined than the variables of interest, they overestimate the value of construction put in place.

Meanwhile, the value of private preschool construction and private primary and secondary educational buildings construction have seen more moderate growth, peaking around 2001 and then gradually tapering off.

Figure 2.3: Annual Value of Construction Put in Place Compared to GDP



Source: U.S. Census Bureau 2006b,c; U.S. Department of Commerce 2006

Construction is a term that encompasses not only the creation of new buildings but renovations to older structures as well. While Census tracks this breakdown between renovation and new building construction for residential construction, it does not for non-residential construction. The U.S. Census Bureau, however, did compile statistics for the expenditures of non-residential improvements in 1986, 1989, and 1992. The U.S. Census defines improvements as “additions, alterations (renovations, remodeling, etc.) and major replacements.” While not being able to collect data on the number or extent of the individual projects, Census was able to make some estimations in the non-residential domain, concluding that “about 23 percent of all buildings had some improvement work, while about 71 percent had some expenditures for repair” (U.S. Census Bureau 1999). The collected data, however, were not specific enough to capture improvement expenditures on COFs. Thus, Table 2-24 presents improvement expenditures as the percentage of the total value of non-residential educational building construction put in place in each of the three years for which improvement expenditure data were available.

Table 2-24: Improvement Expenditures as a Percentage of the Value of Construction Put in Place for Non-Residential Educational Buildings			
Type of Construction	**1986**	**1989**	**1992**
Private Non-Residential Educational Buildings	40%	46%	19%
State and Local Non-Residential Educational Buildings	58%	35%	41%
Source: U.S. Census Bureau 1999, U.S. Census Bureau 2006b,c			

As shown in Table 2-24, expenditures on improvements as a percent of the total value of educational building construction put in place vary year to year. Expenditures on improvement made up between 35 and 58 percent of the total value of construction put in place in either private or state and local non-residential buildings in the three selected years, with the data moderately variable. These figures indicate that a substantial amount of non-residential educational building expenditures are for activities that might disturb lead-based paint. The high frequency of these improvement activities points to the importance of schools in this rule.

2.7 Renovation Industry Market Structure

The previous sections focused on the supply and demand for renovation services. This section discusses the overall market structure of the renovation industry.

Firms and consumers interact in markets for goods and services with the results of these interactions depending on the competitive characteristics of the market. Competitive markets are characterized as markets with a large number of buyers (e.g., consumers) and sellers (e.g., firms) and relatively homogeneous goods. In competitive markets, neither firms nor consumers can influence the price of the good by altering their supply or demand decisions. Oligopolistic, monopolistic and monopsonistic markets are markets where either firms or consumers have market power and exhibit strategic behavior to change the price of the good sold. The competitive nature of an industry can be estimated by examining the following market characteristics.

- Number of establishments;
- Specialization of establishments;
- Number of consumers;
- Barriers to entry;
- Availability of substitutes; and
- Homogeneity of the good/service.

The data in Section 2.5 indicate that there are a large number of firms in the construction industry. Using data for the twelve NAICS codes, there are approximately 394,365 establishments with employees in construction sectors potentially affected by the rule. Of these establishments, only 2.3 percent have annual revenues of $10 million or more. In addition, there are about 1.2 million self-employed contractors in these industries, all of which are, in all likelihood, considered small by SBA standards. Given the large number of small establishments, it is unlikely that any one firm exhibits substantial market share in the overall market for renovation services. It is possible in some geographic areas for a small number of firms or a single firm to establish a market niche, but overall the market for renovation services appears to be quite competitive on the supply side.

The relatively low barriers to entry in the renovation industry enhance the competition taking place within it. Much of the work covered by this rule does not require particularly unusual or high levels of skills. Renovation work has traditionally attracted recent immigrants because a lack of English is not important (Farzad 2005). While any training required as part of this rule will increase the skill level, the cost of the training is expected to be relatively low.

There are also a large number of consumers in the industry. As such, no single consumer of renovation services is expected to exhibit influence over the price of these services.

There are three sources of substitutes for renovation services. First, consumers can substitute from one contractor to another. Second, consumers can substitute away from professional renovation and into DIY work. This is less likely to occur for COFs than for residential RRP work. Operators of COFs must be certified and have their employees trained in order to do covered RRP in the facility. Third, consumers can reduce the scope of the project or forgo renovation altogether. However, that is unlikely as the cost of the rule is a relatively small share of the cost of a renovation. Again, this is less likely to occur for COFs than for residential RRP work. Many states require annual inspections in COFs that assess the amount of chipped or peeling lead-based paint and dictate that appropriate measures must be taken to alleviate the risk that it imposes.

Additional characteristics of the RRP market result in reduced demand elasticity. First, some differentiation in RRP services does exist. Contractors can provide services at a higher price if they can convince consumers that their services are better or distinctly different from their competitors. This is an important factor in anticipating the impact of the RRP requirements on contractors. The costs of safely renovating or repairing target housing and COFs are expected to be higher than traditional methods. If the consumer is indifferent between safe- or unsafe-lead work practices, then those companies that choose not to use lead-safe work practices may have a competitive advantage in the market due to lower costs. However, if the consumer recognizes that higher quality renovation jobs are those jobs completed with lead-safe work practices, then firms may be able to comply with the regulation and charge a higher price. Under such a scenario, the consumer's marginal benefit for an additional unit of safe renovation may be higher than for an additional unit of unsafe renovation. The consumer who has a preference for lead-safe work practices would choose to do lead-safe renovation as long as the incremental cost of the lead-safe renovation is less than the incremental benefit of such a renovation. Also, the market for RRP services is fragmented and there are substantial costs involved in getting prices. Getting bids from various contractors takes time and consumers need to compare prices across services that differ along many dimensions. These difficulties make it easier for firms to increase their prices to cover the costs for the new requirements.

The combination of a large number of firms, a large number of consumers, low barriers to entry, and available substitutes indicate that the renovation industry is likely to have a relatively high price elasticity of supply. The price elasticity of demand, however, may be small in absolute value.

2.8 Residential Property Owners & Managers

Property owners and managers also will be affected by the rule if they choose to perform their own RRP projects rather than hire an outside contractor or if their renovation and maintenance costs rise as a result of the regulations.

Property owners and managers may have in-house crews that perform RRP activities. If this is the case, then the property owners and managers will directly bear the costs of training and certifying their workers as well as the cost of safe work practices. Furthermore, because all firms that perform regulated RRP projects will experience an increase in costs due to training of supervisors and workers and the use of safe work practices, it is assumed that costs to property owners and managers who hire outside contractors will increase.

2.8.1 Industry Definitions and Characteristics

Establishments involved in the leasing of apartments and other residential units are classified under NAICS 531110 **-** Lessors of Residential Buildings and Dwellings. This industry, in turn, is divided into two sub-sectors, NAICS 5311101—Lessors of Apartment Buildings and NAICS 5311109—Lessors of Dwellings Other than Apartment Buildings. According to the 2002 U.S. Economic Census data, together these industries include a total of 61,787 establishments that employ 292,405 people (U.S. Census Bureau 2004b).

Establishments involved in the management of residential properties are classified under NAICS 531311—Residential Property Managers. In 2002, this industry included 26,233 establishments that employed 289,870 people (U.S. Census Bureau 2004b). Table 2-25 presents summary statistics for the businesses in NAICS 531311 as well as NAICS 531110 and its sub-sectors.

1. Table 2-25: Summary Statistics for NAICS 531110, NAICS 5311101 and NAICS 5311109

NAICS Code and Description	Establishments	Annual Revenues (000)	Annual Payroll (000)	Paid Employees
5311101 - Lessors of Apartment Buildings	51,502	$51,708,553	$5,831,398	257,624
5311109 - Lessors of Dwellings other than Apartment Buildings	10,285	$5,263,795	$748,821	34,781
531311 - Residential property managers	26,223	$19,988,344	$8,193,831	289,870
Total	**88,010**	**$76,960,692**	**$14,774,050**	**582,275**

Source: U.S. Census Bureau 2004b

2.8.2 Establishment Size and Industry Environment

The U.S. Small Business Administration indicates that to qualify for small business status, a firm in NAICS 531110 must have annual revenues of less than $6 million, while establishments in NAICS 531311 must have revenues of less than $1.5 million (U.S. Small Business Administration, 2004). Although data on the number of firms by revenue bracket were not available from the 2002 U.S. Economic Census when this analysis was performed, the average revenues of establishments in these NAICS codes are significantly below the small business designation threshold (Table 2-26).

Table 2-26: Summary Statistics for NAICS 531110, NAICS 5311101 and NAICS 5311109 (Per Establishment)			
NAICS Code and Description	**Average Annual Revenues ($)**	**Average Annual Payroll ($)**	**Paid Employees per Establishment**
5311101 - Lessors of Apartment Buildings	$1,004,011	$113,227	5.0
5311109 - Lessors of dwellings other than apartment buildings	$511,793	$72,807	3.4
531311 - Residential property managers	$762,245	$312,467	11.1
Source: U.S. Census Bureau 2004b			

In 1997, 98.7 percent of the then 51,572 establishments in the Lessors of Residential Buildings and Dwellings sector had annual revenues below $5 million and about 85 percent of the 19,000 establishments in NAICS 531311 had revenues less than $1 million (U.S. Census Bureau 2000a).[17] Because 2002 data on the number of establishments by revenue bracket is not yet available, 1997 data was used to estimate the percent of establishments in each industry that qualify for small business status. Table 2-27 presents the percent of NAICS 531311 and NAICS 531110 establishments that have revenues below $1 million and $5 million, respectively. The table also presents the percent of industry revenues and employment that can be attributed to these establishments.

Table 2-27: Small and Large Establishments as Percent of Industry				
NAICS Code	**Description**	**Percent of Establishments by Revenue Bracket**	**Percent of Industry Revenues by Revenue Bracket**	**Percent of Industry Employees by Revenue Bracket**
531311	**Residential Property Managers**			
	Establishments with Revenues < $1 million	85	35	40
	Establishments with Revenues of ≥$1 million	15	65	60
531110	**Lessors of Residential Buildings and Dwellings**			
	Establishments with Revenues < $5 million	99	82	86
	Establishments with Revenues of ≥$5 million	1	18	14
Source: U.S. Census Bureau 2000a				

Based on 1997 data over 85 percent of NAICS 531311 establishments, and about 99 percent of NAICS 53110 establishments have revenues below the small business threshold defined by SBA. In the Residential Property Manager industry, these establishments contribute only 35 percent of the revenues, and employ only 40 percent of the workforce. The revenue and employment distribution is less skewed in the Lessor of Residential Buildings and Dwellings sector. Small establishments in this industry contribute about 82 percent of the revenues and employ 86 percent of the workforce (U.S. Census Bureau 2000a).

2.8.3 Industry Outlook

The market for lead-safe renovation activities will depend in part on the state of the rental housing market—an increase in rents would provide resources to construct new housing and/or renovate existing housing. According to Harvard University's Joint Center for Housing Studies (JCHS), "rents fell in 9 of

[17] Includes establishments open year-round only.

the 27 metropolitan areas tracked by the federal government [in 2003]. Nationally, real contract and gross rents barely increased last year." The JCHS indicates that both the weak labor market and increased home ownership contributed to the softening of the rental market (JCHS 2004).

At the same time as rents fell, the nation-wide rental vacancy rate increased from 8.9 percent in 2002 to 9.8 percent in 2003. The vacancy rate was slightly above 10 percent during the first three quarters of 2004 (U.S. Census Bureau 2004e). None-the-less, the JCHS predicts a strengthening of the rental market over the next ten years due to the influx of immigrants and the aging of the "echo baby-boom generation." The strengthening of the market may also come from overall economic growth and a stemming of home ownership growth due to rising interest rates and/or house prices (JCHS 2004).

2.9 Training Providers

Impacts of the rule will be felt beyond the construction industry. Certified renovators will need accredited training. Both initial and refresher training courses will be required for certified renovators.

2.9.1 Definitions and Industry Characteristics

It is likely that lead-based paint training courses will be provided by establishments categorized as NAICS code 611519: Other Technical and Trade Schools. Census defines NAICS 61159 as "establishments primarily engaged in offering job or career vocational or technical courses (except cosmetology and barber training, aviation and flight training, and apprenticeship training). The curriculums offered by these schools are highly structured and specialized and lead to job-specific certification" and these establishments are believed to currently provide training for lead abatement professionals (U.S. Census Bureau 2004p).

According to the 2002 Economic Census, there are a total of 3,323 establishments in the U.S. certified as Other Technical and Trade Schools (see Table 2-28). On average, each establishment employees 15.3 people. A striking characteristic is that about 19% of these establishments are exempt from the Federal Income Tax (FIT). Exempt establishments include non-profit organizations and educational institutions such as colleges or universities.

Table 2-28: Number of Establishments in NAICS 611519

Industry	Number of Establishments	Total Number of Employees	Average Number of Employees
NAICS 611519 - Other Technical and Trade Schools	3,323	50,709	15.3

Source: U.S. Census Bureau 2004n

Table 2-29 summarizes available financial information for establishments categorized under NAICS 611519. These include total revenues for the sector, average annual revenues per establishment, annual payroll for the sector, and payroll as a percent of revenue. As Table 2-29 indicates, for Other Technical and Trade schools, annual payroll is equal to about 35 percent of establishment revenue.

Table 2-29: Summary Statistics for NAICS 611519					
Industry	**Number of Establishments**	**Annual Sector Revenue (000)**	**Average Revenue per Establishment (000)**	**Average Payroll per Establishment (000)**	**Labor Cost as percent of Revenue**
NAICS 611519 - Other Technical and Trade Schools	3,323	$4,118,995	$1,240	$429	35 %
Source: U.S. Census Bureau 2004n					

According to the U.S. Small Business Administration, in order to qualify as a small business, a firm categorized under NAICS 611519 must have annual revenues of $6.5 million or less (U.S. Small Business Administration 2006a).[18] The 2002 Economic Census provided data on the number of firms by revenue bracket. In 2002, 94 percent of the then 2,274 firms classified as Other Technical and Trade Schools that were in operation for the entire year had revenues under $5 million (U.S. Census Bureau 2005f). This figure indicates that a large percentage of firms had revenues under the $6.5 million threshold and thus qualified for small business status.

2.9.2 Number and Type of Training Establishments

As mentioned in Section 2.9.1, there are over 3,000 establishments in the Other Technical and Trade school industry. It is likely that only a small portion of these establishments are involved in lead based paint-related training. To help characterize the lead training segment of the training provider industry, a random sample of firms that offer one or more of the courses required for EPA lead abatement certification were identified as part of the economic analysis of the 2006 proposed LRRP TH rule (EPA 2006). The goal was both to collect tuition data for currently offered lead abatement training courses and to learn what types of institutions (private establishments, non-profits, unions, etc.) offer these classes.

The sample consisted of 83 establishments selected from the Lead Listing[19] directory of 194 training providers.[20] Data were collected from company web sites (when available) and/or over the phone. Information was obtained from 68 training providers; a total of 15 training providers could not be reached. Seven of the 68 contacted providers no longer offered lead abatement training courses.

There were five types of training providers in the sample: private for-profit establishments, non-profit establishments, educational institutions, trade unions and public/government training institutions. Trade unions provide tuition-free training to their members. Public/government providers train state employees and workers who qualify for financial assistance through government programs. They do not offer training to the general public.

---

[18] Effective July 31st, 2006.

[19] The Lead Listing (www.leadlisting.org) website was run for the U.S. Department of Housing and Urban Development's Office of Healthy Homes and Lead Hazard Control that contained a directory of lead service providers. It is no longer in operation (as of late 2004).

[20] The sample included all the establishments on the list that are certified to offer a Project Designer course (42 total), as well as a random sample of 41 establishments that were not certified to offer this class. The data were weighted by the inversed probability of selection into the sample (P=1 for providers that offer a Project Designer course and P=.270 for providers that do not offer this class). It was assumed that there was no non-response bias.

Table 2-30 summarizes the number of private establishments, educational institutions, non-profits, unions and public government providers that appeared in the sample. The table also presents the estimated national number of providers that fall into each of these categories. More than a third of lead hazard reduction training providers are private, for-profit establishments. The next largest group of providers is labor unions, followed by educational institutions (colleges and universities). None of the unions, however, are certified to offer the Project Designer course. About 13 percent of certified providers either do not offer training at this time, or have permanently stopped offering lead courses.

More than half of the privately owned, for-profit establishments in the sample (19 out of 35) offer environmental consulting services in addition to training. Thirteen of the 35 privately-owned providers specialize in training and do not offer other services. All of these 13 firms offer both lead and asbestos training courses, as well as, in most cases, OSHA safety, HAZ-MAT and/or mold classes. Although there was not enough information to determine the services provided by the remaining three companies, these findings indicate that lead-based paint training providers generally participate in several lines of business.

Table 2-30: Estimated Number of Training Providers

Type of Provider	Number in Sample	National Estimates	
		Total	Percent
Private Providers	35	74	38
Educational Institutions	11	27	14
Non-Profit	4	19	10
Union	9	42	22
Pub/Gov Providers	2	6	3
No Longer Offer Training	7	26	13
Total Companies	68	194	

a. Adjusted for non-response assuming no non-response bias and weighted based on the probability of selection into the sample

Source: U.S. Environmental Protection Agency 2006

2.10 Summary Characteristics: Numbers of Buildings and Children Affected

This section provides summary information that form the basis for the analyses presented in the subsequent chapters of this report. In particular, this includes tables that provide counts on the number of:

- Target housing and public or commercial building COFs; and
- Children under the age of 6

Each tally is then subdivided into categories based on the age of the building and the type of structure. After each table, there is a discussion of how the numbers presented in that table were calculated.

2.10.1 Number of Facilities

Table 2-31 provides counts of the number of buildings by type and vintage of building. There are 37.8 million structures covered by the rule, including 37.7 million target housing units and 0.1 million COFs in public or commercial buildings.

Table 2-31: Number of Structures, by Type and Age of Construction		
Type	All Pre-1960	All Pre-1978
Target Housing	41,040,000	77,888,000
Target Housing (Rental, COF, or where a child <6 or pregnant woman resides)	20,321,000	37,655,000
Target Housing COF	823,000	1,559,000
Public or Commercial Building COFs	54,000	97,000
Daycare Centers*	29,000	52,000
Schools*	25,000	45,000
Kindergarten Only	12,000	21,000
Kindergarten and Pre-Kindergarten	13,000	23,000
Note: Counts include buildings with and without lead-based paint. * There are 800 Pre-1978 schools that have pre-kindergartens but no kindergarten. In SBFRA and other industry-level analyses these buildings are accounted for as schools. For total cost and benefits estimation analysis, and in this table, they are accounted for as daycare centers.		

Target Housing

This section provides a brief discussion of the estimates of the number of the target housing units presented in Table 2-31; a detailed explanation of these estimates can be found in Section 4.2 of Chapter 4.

Section 4.2 of Chapter 4 provides a detailed explanation of the estimated number of target housing units that do not contain COFs. The COFs in target housing include family daycare providers and the homes of family, friends, and neighbors who regularly care for someone else's children. These estimates include care provided for pay and not for pay, and rely primarily on estimates of the size of the childcare workforce as published by the Center for Childcare Workforce, 2002. This report includes data on the number of: (1) family childcare providers caring for unrelated children, (2) paid relatives and non-relatives providing childcare, and (3) unpaid relatives and non-relatives providing childcare. Based on data provided by the Center for Childcare Workforce, a total of just under 2.4 million caregivers provide care outside of the child's home for more than six hours per week. As described in detail in Section 4.2, these data are used to estimate the number of COFs in target housing. These numbers are further reduced to estimate the number of pre-1960 and pre-1978 housing units based on American Housing Survey data.

Childcare Centers

In 2006, the National Association for Regulatory Administration (NARA) released a report entitled "The 2005 Childcare Licensing Study" providing counts of all the licensed childcare centers and family childcare homes in the United States. The NARA report indicated that there were approximately 115,000 licensed childcare centers, 66,700 of which are estimated to be built before 1978 according to CBECs data (DOE 2003). According to HUD's *First National Health Survey of Childcare Centers* (2003), approximately 24 percent of licensed centers are located in elementary schools. These 15,753 centers are assumed to be included in the estimated 40,190 elementary schools with pre-schools and kindergartens. Thus, there are a total of 50,947 Pre-1978 daycare centers located outside of elementary schools. According to NCES data on public and private schools, however, an additional 824 Pre-1978 schools without kindergartens have a pre-kindergarten program, which brings the total number of buildings accounted for as daycare centers in the total cost and benefits analyses to 52,000.

Schools

- **Public Schools**

The National Center for Education Statistics (NCES) reported that during the 2004-2005 academic year, there were more than 93,000 public schools in the United States. Of these 93,295 public schools, 52,129 had either a pre-kindergarten (PK) or kindergarten (K) program. The Common Core of Data Public Elementary/Secondary School Universe Survey data was used to calculate the number of private schools with PK or K programs. Using this data, a school was considered as having a pre-kindergarten if a) pre-kindergarten enrollment was greater than zero students, or b) the school reported that the lowest grade offered was pre-kindergarten, but enrollment data were not provided. Similarly, a school was considered as having a kindergarten if a) kindergarten enrollment was greater than zero, or b) the school reported that the lowest grade offered was pre-kindergarten or kindergarten, but did not report kindergarten enrollment. Again, the educational building age distribution found in CBECS and HUD was applied to the total counts, resulting in the estimated 17,000 pre-1960, and 30,000 pre-1978 public schools.

- **Private Schools**

This analysis used NCES's Results from the 2003-2004 Private School Universe Survey report and the underlying dataset to estimate the number of private schools with kindergartens and/or pre-kindergartens. A school was considered as having a pre-kindergarten if a) pre-kindergarten enrollment was greater than zero students, or b) the school reported that the lowest grade offered was pre-kindergarten, but enrollment data were not provided. Similarly, a school was considered as having a kindergarten if a) kindergarten enrollment was greater than zero, or b) the school reported that the lowest grade offered was pre-kindergarten or kindergarten, but did not report kindergarten enrollment. The previously cited CBECS and HUD educational building age distribution was then applied to the private school universe to calculate the number of private schools by age of construction. This adjustment yielded 9,000 pre-1960, and 15,000 pre-1978 private schools.

For the purpose of the total cost analysis, private and public schools were categorized according to whether they offered kindergarten only, kindergarten and pre-kindergarten, and pre-kindergarten only. Table 2-31 uses information drawn from Table 2-5 and Table 2-12 to obtain the total number of schools with each combination of programs. Table 2-5 and Table 2-12 indicate that there are 29,844 public schools and 7,205 private schools with kindergarten programs only, for a total of 37,049 such schools. Table 2-5 and Table 2-12 also indicate that there are 20,885 public schools and 19,305 private schools with both pre-kindergarten and kindergarten programs. Finally, there are a total of 1,400 public and 21 private schools with pre-kindergarten, but no kindergarten, which are accounted for as daycare centers for the purposes of the benefit-cost analysis. Table 2-31 presents the total number of schools with kindergartens, kindergartens and pre-kindergartens, and pre-kindergartens only by age of construction. Information about the age distribution of buildings was taken from CBECS and HUD and applied to the data to give estimates of the number of schools by the age of the building.

2.10.2 Number of Children Affected

Table 2-32 provides counts of the number of children under age 6, by the type and the age of the building.[21]

Table 2-32: Number of Children under age 6, by Type and Age of Building				
Type	All Pre-1960		All Pre-1978	
	Number of Children Occupants or Regular Visitors [a]	Annual Number of Children Affected by the Rule [b]	Number of Children Occupants or Regular Visitors [a]	Annual Number of Children Affected by the Rule [b]
Daycare Centers	847,120	78,870	1,535,404	109,070
Schools	1,097,147	102,149	1,988,578	141,262
Target Housing Non-Occupants Attending Daycare	1,820,767	266,774	3,447,825	315,848
Target Housing Occupants	7,088,650	1,100,855	13,086,085	1,298,784
	847,120	78,870	1,535,404	109,070

a. Counts include children in buildings with and without lead-based paint.
b. Estimated annual number of children under the age of six occupying or regularly visiting structures where LBP is present and RRP is performed by certified renovators under the rule.

Sources: Mulligan et al 2005, NCES 2006a, NCES 2006b, NCES 2006f.

Daycare Centers:

Data from Table 2 of Mulligan et al. (2005) were used to determine the number of children under 6 in childcare centers. Center-based arrangements include day care centers, Head Start programs, preschools, pre-kindergartens, and other early childhood programs. Table 4 of the report indicated that 6,695,000 children were in center-based care.

To avoid double counting with other categories, center-based children reported to be in pre-kindergarten and kindergarten (PKKG) and target housing (TH) settings were removed from the daycare center count. These adjustments were:

- Subtract from Center population the proportion of children in PKKG (27%) (These children are moved to the PKKG group).
- Subtract from Center population the proportion of children in private or TH settings (5%) (These children are moved to the TH group).

The vintage distribution percentages found in the CBECS data were used to calculate the number of children in pre-1978 buildings; the HUD (2003) data on Child Care Centers were used to estimate the number of pre-1960 buildings.

[21] Mulligan et al (2005) present data on the number of children in various types of daycare settings by age, while the National Center for Education Statistics reports numbers of children in kindergarten and pre-kindergarten programs. All of these children are assumed to be under the age of 6.

- **Kindergartens:**

Population data for kindergartners includes children in public and private schools, which may or may not have a preschool. Different assumptions are made about the number of rooms/cost associated with kindergarten facilities that contain a preschool—i.e., these facilities and the associated children are put into the pre-kindergarten/kindergarten category. The distribution of kindergarteners between public/private schools with and without a preschool was derived from the raw datasets used to estimate the total (published) number of kindergartens. The distribution was then applied to the published number of kindergartners to estimate the proportion of kindergartners in public or private schools without a preschool.

The CBECS building age distribution information was applied to the data, in order to calculate the number of children in pre-1978 buildings; the HUD (2003) data on Child Care Centers were used to estimate the number of pre-1960 buildings.

Schools (Pre-Kindergartens):

The number of children in schools with both kindergarten and pre-kindergarten were derived from the sum of:

- Center based children reported in a pre-kindergarten/kindergarten setting (27%).
- Kindergarten children in public/private schools with a preschool (49%).

The CBECS educational building age distribution was applied to the data to estimate the number of children in pre-1978 buildings; the HUD (2003) data on Child Care Centers were used to estimate the number of pre-1960 buildings.

Target Housing (Non-Occupants Attending Daycare):

Data from Table 2 of Mulligan et al (2001) were used to determine the number of children under 6 in Target Housing COFs. Population data for TH includes children in the care of relatives and non-relatives as well as the proportion (5%) of children in centers identified as being in private settings (i.e., family care).[22] Other adjustments were made to exclude paid care by a non-relative (e.g., a nanny) in the child's home. Relative and non-relative care were further classified into paid and non-paid care. The following adjustments were made for each category:

1. Paid Non-relative care not in the child's home (aka family care):
    a. 81 percent of non-relative care occurs in location outside of the child's home.
    b. 5 percent of center based care occurs in a private setting--assumed to be non-relative care outside child's home.
    c. 90 percent of non-relative care is paid.

[22] This analysis assumes that all daycare centers are located in public or commercial buildings (i.e. not in residential buildings). Due to differences in licensing requirements and survey questionnaire design, some sources used in this analysis categorize children cared for in residential settings as being in center-based care. Whenever possible, these daycare facilities and the children they serve were included in the family daycare, rather than in daycare center counts.

2. Unpaid Non-Relative Care (not in the child's home):
    a. 81 percent of non-relative care occurs in location outside of the child's home.
    b. 5 percent of center based care occurs in a private setting--assumed to be non-relative care outside child's home.
    c. 10 percent of non-relative care is unpaid paid.

3. Paid relative care:
    d. 28 percent of relative care is paid.

4. Unpaid relative care:
    e. The difference between all relative care and paid relative care.

Target Housing (Occupants):

The number of child-occupants in target housing was estimated using 2003 American Housing survey data. The description of these data and the is described in Section 4.2 of Chapter 4.

References

Bureau of Labor Statistics. 2005. "Child Day Care Services." Available at: http://www.bls.gov/oco/cg/cgs032.htm#outlook. (Accessed: 12/12/2006)

Center for the Childcare Workforce and Human Services Policy Center. 2002. "Estimating the Size Components of the U.S. Childcare Workforce and Caregiving Population: Key Findings from the Childcare Workforce Estimate (Preliminary Report)." May 2002.

Farzad, Roben. "A Housing Boom Brings Jobs and Sometimes, Abuse." *The New York Times* 07 July. 2005.

KeepKidsHealthy.com. 2001. "Daycare Issues." Available at: http://www.keepkidshealthy.com/welcome/daycare.html. (Accessed 1/30/2007).

Joint Center for Housing Studies (JCHS) at Harvard University. 2004. *The State of the Nation's Housing*. Available at: http://www.jchs.harvard.edu/publications/markets/son2004.pdf. (January 21, 2004).

Mulligan, G.M., Brimhall, D., and West, J. (2005). Childcare and Early Education Arrangements of Infants, Toddlers, and Preschoolers: 2001 (NCES 2006-039). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

National Administration for Regulatory Administration. 2006. "Number of Licensed Childcare Facilities in 2005." *2005 Childcare Licensing Study*. Available at: http://www.nara.affiniscape.com/associations/4734/files/Number of Licensed Programs 2005.pdf(Downloaded 12/12/2006)

National Center for Education Statistics (NCES). 2006a. "Overview of Public Elementary and Secondary Students, Staff, Schools, School Districts, Revenues, and Expenditures: School Year 2004-2005 and Fiscal Year 2004." Available at: http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2007309. (Downloaded 12/22/2006).

National Center for Education Statistics (NCES). 2006b. Common Core of Data Public Elementary/Secondary School Universe Survey Data, 2004-2005." Available at: http:///nces.ed.gov/gov/ccd/pubschuniv.asp. (Accessed 12/22/2006).

National Center for Education Statistics (NCES). 2006c. Common Core of Data Local Education Agency (School District) Universe Survey Data. Available at: http://nces/ed/gov/ccd/pubschuniv.asp. (Accessed 12/22/2006).

National Center for Education Statistics (NCES). 2006d. Common Core of Data Local Education Agency (School District) Finance Survey (F-33) Data. Available at: http://nces.ed.gov/ccd/f33agency.asp. (Accessed 12/22/2006).

National Center for Education Statistics (NCES). 2006e. "Characteristics of Private Schools in the United States: Results From the 2003-2004 Private School Universe Survey." (Accessed 12/15/2006).

National Center for Education Statistics (NCES). 2006f. 2003-2004 Private School Universe Survey Data. Received from Stephen Broughman (NCES) December 15, 2006.

National Center for Education Statistics (NCES). 2006g. Crosswalk Between 2004-2005 Local Education Agency Universe Survey Data and Year 2000 U.S. Census Population Data. Table created at: http://www.nces.ed.gov/ccd/bat/index.asp (Accessed 12/15/2006).

National Childcare Information Center. 2005. "Number of Licensed Facilities: 1991-2004." http://www.nara-licensing.org

U.S. Bureau of Labor Statistics. 2006. "Current Population Survey: Basic Monthly Survey." January 2006.

U.S. Census Bureau. 1999. "Expenditures for Nonresidential Improvements and Repair Statistics." Available at: http://www.census.gov/const/www/nrsupndx.html (Accessed 12/8/2006).

U.S. Census Bureau. 2000a. *Establishment and Firm Size (Including Legal Form and Organization). 1997 Economic Census: Subject Series for Real Estate and Rental and Leasing. Subject Series.* EC97F53S-SZ.

U.S. Census Bureau. 2004a. North American Industry Classification System – Revisions for 2002. Available at: http://www.census.gov/epcd/naics02/ (Accessed 12/4/2006).

U.S. Census Bureau. 2004b. "Sector 53: Industry Series: Summary Statistics for the US: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/EconSectorServlet?caller=dataset&sv_name=*&_SectorId=53&ds_name=EC0200A1&_lang=en&_ts=141736463723 (Downloaded 8/3/2005).

U.S. Census Bureau. 2004c. 2002 Economic Census: Industry Series: Commercial and Institutional Building Construction ECO2-231-236220 (RV). Available at: http://www.census.gov/prod/ec02/ec0223i236220.pdf (Accessed 11/18/2006).

U.S. Census Bureau. 2004d. 2002 Economic Census: Industry Series: Drywall and Insulation Contractors ECO2-231-238310. Available at: http://www.census.gov/prod/ec02/ec0223i238310.pdf (Accessed 11/18/2006).

U.S. Census Bureau. 2004e. 2002 Economic Census: Industry Series: Electrical Contractors ECO2-231-238210. Available at: http://www.census.gov/prod/ec02/ec0223i238210.pdf (Accessed 11/18/2006).

U.S. Census Bureau. 2004f. 2002 Economic Census: Industry Series: Finish Carpentry ECO2-231-238350. Available at: http://www.census.gov/prod/ec02/ec0223i238350.pdf (Accessed 11/18/2006).

U.S. Census Bureau. 2004g. 2002 Economic Census: Industry Series: Glass and Glazing Contractors ECO2-231-238150. Available at: http://www.census.gov/prod/ec02/ec0223i238150.pdf (Accessed 11/18/2006).

U.S. Census Bureau. 2004h. 2002 Economic Census: Industry Series: Other Building Equipment Contractors ECO2-231-238290. Available at: http://www.census.gov/prod/ec02/ec0223i238290.pdf (Accessed 11/18/2006).

U.S. Census Bureau. 2004i. 2002 Economic Census: Industry Series: Other Building Finishing Contractors ECO2-231-238390. Available at: http://www.census.gov/prod/ec02/ec0223i238390.pdf (Accessed 11/18/2006).

U.S. Census Bureau. 2004j. 2002 Economic Census: Industry Series: Painting and Wall Covering Contractors ECO-231-238320. Available at: http://www.census.gov/prod/ec02/ec0223i238320.pdf (Accessed 11/18/2006).

U.S. Census Bureau. 2004k. 2002 Economic Census: Industry Series: Plumbing, Heating, and Air-Conditioning Contractors ECO2-231-238220. Available at: http://www.census.gov/prod/ec02/ec0223i238220.pdf (Accessed 11/18/2006).

U.S. Census Bureau. 2004l. 2002 Economic Census: Industry Series: Siding Contractors ECO2-231-238170. Available at: http://www.census.gov/prod/ec02/ec0223i238170.pdf (Accessed 11/18/2006).

U.S. Census Bureau. 2004m. 2002 Economic Census: Industry Series: Tile and Terrazzo Contractors ECO2-231-238340. Available at: http://www.census.gov/prod/ec02/ec0223i238340.pdf (Accessed 11/18/2006).

U.S. Census Bureau. 2004n. "Educational Services: Industry Series: Summary Statistics for the United States: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-ds_name=EC0261I1&-_lang=en (Downloaded 11/13/2006).

U.S. Census Bureau. 2004p. "Other Technical and Trade Schools - Definition." Census Data Information. *American Fact Finder*. Available at: http://factfinder.census.gov/servlet/MetadataBrowserServlet?typ (Accessed 12/4/2006).

U.S. Census Bureau. 2004q. "Nonemployer Statistics." Available at: http://www.census.gov/epcd/nonemployer/download/04_data/nonemp04us.txt (Accessed 12/4/2006).

U.S. Census Bureau. 2005a. "Sector 23: Construction: Industry Series: Selected Statistics for Establishments by Value of Business Done: 2002." *American Fact Finder*. Available at: http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-ds_name=EC0223I06&-_lang=en (Downloaded 11/13/2006).

U.S. Census Bureau. 2005b. "Sector 53: Real Estate and Rental and Leasing: Subject Series – Estab and Firm Size: Employment Size of Establishments for the United States: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-ds_name=EC0253SSSZ2&-_lang=en (Downloaded 11/13/2006).

U.S. Census Bureau. 2005c. "Section 23: Construction: Industry Series: Detailed Statistics for Establishments: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-ds_name=EC0223I04A&-_lang=en (Downloaded 11/13/2006).

U.S. Census Bureau. 2005d. "Sector 62: Health Care and Social Assistance: Subject Series – Estab and Firm Size: Employment Size of Establishments for the United States: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-ds_name=EC0262SSSZ2&-_lang=en (Downloaded 11/14/2006).

U.S. Census Bureau. 2005f. "Educational Services: Subject Series – Estab and Firm Size: Receipts/Revenue Size of Firms for the United States: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-ds_name=EC0261SSSZ4&-_lang=en (Downloaded 11/13/2006).

U.S. Census Bureau. 2005h. 2002 Economic Census: Construction by Subsector. Available at: http://www.census.gov/econ/census02/data/us/US000_23.HTM (Accessed 12/1/2006).

U.S. Census Bureau. 2005i. 2002 Economic Census: Construction: By Industry. Available at: http://www.census.gov/econ/census02/data/us/US000_23.HTM (Accessed 8/3/2005).

U.S. Census Bureau. 2005j. "Sector 53: Real Estate and Rental and Leasing: Subject Series - Estab & Firm Size: Revenue Size of Firms for the United States: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0200A1&-_skip=100&-ds_name=EC0253SSSZ4&-_lang=en. (Downloaded 12/19/2006).

U.S. Census Bureau. 2005k. "Nonemployer Statistics – Heatlh Care and Social Assistance – United States." http://www.census.gov/epcd/nonemployer/2002/us/US000_62.HTM. (Downloaded 3/24/2007).

U.S. Census Bureau. 2005m. 2002 Economic Census: Industry Series: Residential Remodelers ECO2-23I-236118 (RV). Available at: http://www.census.gov/prod/ec02/ec0223i236118.pdf (Accessed 11/18/2006).

U.S. Census Bureau. 2006a. "Number of Establishments: General Definition." Census Data Information. *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/MetadataBrowserServlet? (Accessed 12/1/2006).

U.S. Census Bureau 2006b. "Annual Value of State and Local Construction Put in Place." Available at: http://www.census.gov/const/C30/state.xls (Downloaded 12/8/2006).

U.S. Census Bureau 2006c. "Annual Value of Private Construction Put in Place." Available at: http://www.census.gov/const/C30/private.xls (Downloaded 12/8/2006).

U.S. Census Bureau. 2006d. "Definitions of Construction." Available at: http://www.census.gov/const/C30/definitions.pdf (Accessed 2/15/2006.)

U.S. Department of Commerce. 2006. *Table 1.1.6. Real Gross Domestic Product, Chained Dollars.* Last revised: November 29, 2006.

U.S. Department of Education, Institute of Education Sciences. 2004. "Full-day and Half-day Kindergarten in the United States: Findings from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99" June 2004.

U.S. Department of Education, National Center for Education Statistics. Kindergarten Teachers: Public and Private School Teachers of the Kindergarten Class of 1998–99, NCES 2004–060, by Elvira Germino-Hausken, Jill Walston, and Amy H. Rathbun. Project Officer: Elvira Germino-Hausken. Washington, DC: 2004.

U.S. Department of Energy. 2003. Commercial Buildings Energy Consumption Survey (CBECS).

U.S. Department of Housing and Urban Development (HUD). 2003. First National Environmental Health Survey of Childcare Centers.

U.S. Environmental Protection Agency. 1996. "Lead; Requirements for Lead-Based Paint Activities in Target Housing and Child-Occupied Facilities; Final Rule." *Federal Register. http://www.epa.gov/docs/fedrgstr/EPA-TOX/1996/August/Day-29/pr-24181DIR/pr-24181.pdf (Accessed 12/8/2006).*

U.S. Environmental Protection Agency. 2006. "Economic Analysis for the Renovation, Repair and Painting Program Proposed Rule", February 2006.

U.S. Small Business Administration. 2006a. "Firm Size Data." Available at: http://www.sba.gov/advo/research/data.html. (Accessed 11/30/2006).

U.S. Small Business Administration. 2006b. "Small Business Size Standards matched to North American Industry Classification System." Available at: http://www.sba.gov/services/contractingopportunities/sizestandardstopics/tableofsize/SERV_TABLE_HTML.html (Downloaded 11/24/2006).

Wilder Research Center. 2001. "Staff recruitment and retention in early childhood care and education and school-age care." April 2001.

Wilder Research Center. 2005. "Family, Friend and Neighbor Caregivers: Results of the 2004 Minnesota statewide household childcare survey." December 2005.

3. Problem Definition and Regulatory Options

This chapter begins by characterizing the lead contamination problem to be addressed under the LRRP regulations. The various sources of exposure, along with related adverse health effects, are presented in Section 3.1. This is followed by a discussion of how the market failures of incomplete information and external costs have resulted in inefficient levels of lead containment and control in renovation activities. Section 3.2 summarizes existing federal, state and local regulations and argues that additional federal regulation is a reasonable solution for these market failures. Alternative regulatory options are presented in Section 3.3.

3.1 Lead Contamination Problem

Despite recent reductions in air, water, and food contamination, important sources of lead exposure remain, due largely to the widespread presence of lead-based paint. Exposure to lead results in increased blood lead levels associated with various adverse health effects, including reductions in IQ and other negative cognitive effects, particularly in children. In addition, exposure to lead can result in a variety of adverse health effects in adults.

3.1.1 Exposure Sources

As described in Chapter 5 and Appendix 5A, lead may cause adverse health effects in any individual, exposed at any stage of life (*in utero* through adulthood) (U.S. EPA 2005c). However, young children are particularly susceptible to lead hazards because their central nervous systems are rapidly developing, and because their behavior is likely to result in greater exposure than older individuals experience. The benefit analysis presented in Chapter 5 includes the benefits of protecting the child occupants of renovated target housing[1] and public or commercial building child-occupied facilities (COFs)[2] from the resulting lead hazards.

Currently the most significant high-dose source of lead exposure in children under school age is lead-based paint. Through the 1940's, paint manufacturers used lead as a primary ingredient in many oil-based interior and exterior house paints. During the 1950's and 1960's, the usage gradually decreased as new paints were developed, and in 1978 the Consumer Product Safety Commission (CPSC) ruled that paint used for residences, toys, furniture, and public areas must not contain more than 0.06% lead by weight. Nevertheless, about 50 percent of housing units and public and commercial buildings constructed before 1980 still contain lead-based paint (U.S. HUD 2000). Children's exposure to lead from lead-based paint is likely to be high when the paint is in a deteriorated state or is found on accessible, chewable, impact, or

[1] "Target housing" is defined in TSCA Section 401 as any housing constructed before 1978, except housing for the elderly or persons with disabilities (unless any child under age 6 resides or is expected to reside in such housing) or any 0-bedroom dwelling.

[2] A COF is defined as a building or portion of a building, constructed prior to 1978, visited regularly by the same child, under 6 years of age, on at least two different days within any week (Sunday through Saturday period), provided that each day's visit lasts at least 3 hours and the combined weekly visits last at least 6 hours, and the combined annual visits last at least 60 hours.

friction surfaces, making the lead paint available to children who ingest paint chips. This "pica" behavior appears to be rare, but is the likely cause of many of the highest blood lead levels observed in children. Renovation activities can create lead-based paint hazards for children by making paint chips more accessible for ingestion. These hazards can occur both within and outside the building unit being renovated.

In addition to being a source of direct exposure, lead-based paint can be the source of lead contamination in soil and dust. Children are exposed to lead from soil or dust in their homes as a result of typical hand-to-mouth activities. Lead-contaminated dust and soil are the major pathway through which most young children are exposed to lead from lead-based paint hazards. Renovation activities increase the level of lead dust in the facility and in the soil, thereby increasing the risk of lead ingestion in young children.

While occupational exposure is the primary exposure pathway to lead for adults, other common exposure pathways for teenagers and adults include gardening, housework, drinking water and certain hobbies such as creating objects from stained-glass and making pottery. Individuals (children, teenagers and adults) are also exposed to a variety of other lead sources, some of which are localized in nature. Airborne lead is present in emissions from lead smelters, battery manufacturing plants, and solid waste incinerators. The phase-out of leaded gasoline has substantially reduced airborne lead. Drinking water may become contaminated with lead after it leaves the treatment plant. Although lead levels in drinking water generally do not have a statistically significant effect on blood-lead concentrations as a result of the 1986 Safe Drinking Water Act, water is still considered an important localized exposure source where lead solder and/or brass plumbing fixtures are present because of the high absorption rate of lead in water. Lead exposure through food ingestion has declined greatly due to the phase-out of lead-soldered food cans and public education. With these improvements in exposure from air, water, and food, lead-based paint remains as the largest widespread source of lead exposure.

3.1.2 Health Effects of Lead Exposure

Most studies of the health effects of lead use body-lead burden as a biomarker for lead exposure. Although blood lead level reflects a mixture of recent and past exposure, it has the advantage of being easily and inexpensively measured. Other measures of body-lead burden include lead in bones, teeth, and hair. Each of these options, however, has disadvantages as measures of lead in the body, including poor sensitivity and external surface contamination problems.

Increased blood lead levels are associated with an assortment of deleterious health effects. See Appendix 5A for a discussion of the adverse health effects resulting from lead exposure.

EPA exposure data (EPA 1997) indicate that renovation activities potentially increase both short-term and long-term lead exposure levels. Lead concentrations are greatest in the area where the renovation work is performed, but lead does settle into other areas of the building and potentially the surrounding area, causing longer-term exposure. The study found that, with the exception of carpet removal and drilling into plaster, all renovation activities examined deposited significant amounts of lead onto the floors in the area where the work was being performed, ranging from 480 micrograms per square foot for sawing to 15,500 micrograms per square foot for paint removal. This lead may be ingested or inhaled by occupants if proper containment and clean-up practices are not used. The study found that sweeping and shop-vacuum clean-up, considered to be standard practice in the industry, reduced the total amount of lead available to occupants. However, as the distance from the activity increased, the cleanup left more of the lead behind so that lead hazards remained following cleanup. These findings demonstrate that these practices do not adequately reduce risks from lead dust generated by renovation activities. Lead dust settled in carpeted areas or in soil is the most difficult to remove with simple broom and vacuum clean-up and thereby creates the longest lasting exposure pathway for facility occupants.

3.2 Justification for Federal Regulations of Lead Exposure during Renovation

Executive Order 12866 calls for three findings to justify the need for a federal regulation. First, there should be a market failure that can be corrected or other social purpose that can be met through regulation. Second, there should be an explanation of why the regulation should be carried out at the federal level. Finally, there should be a discussion of why current regulatory initiatives are not sufficient to correct the market failure.

3.2.1 Market Failure

From an economic perspective, a necessary condition for regulations is the existence of an inefficiency in the allocation of resources. This inefficiency is commonly labeled a market failure since the market is the mechanism assumed to make efficient resource allocations possible. A market failure can come from one or more of several sources. These include poorly defined property rights (such as negative externalities, common property resources, and public goods); imperfect markets for trading property rights (because of a lack of perfect information or of contingent markets; monopoly power; distortionary taxes and subsidies and other inappropriate government regulations); and the divergence of private and social discount rates.

The occurrence of any of these conditions justifies further inquiry into the need for government regulation to reduce inefficiencies in the allocation of society's resources. This section considers whether any of these conditions are linked to excess exposures from lead contamination resulting from renovation in target housing and public or commercial building COFs. If so, understanding the nature of the inefficiencies involved facilitates the design of more effective regulations. The specific regulatory approach considered here involves the promulgation of certification, training and accreditation requirements for firms that perform renovations that disturb lead-based paint in target housing units and public or commercial building COFs, as well as the establishment of containment, clean-up and cleaning verification practices to be used during regulated renovation projects.

Economic efficiency suggests that "lead-safe" renovation will occur as long as the property owners' willingness-to-pay for reduced lead risks exceeds the cost of reducing these risks. If the property owners are aware of the risks and of the availability and costs of reducing these risks, then arguably they will be able to accurately trade off risk and cost without the aid of government regulation. However, there are two arguments for why individual property owners may not trade off risk and cost efficiently.

Incomplete/Incorrect Information
The strongest case for the existence of a market failure can be built on the lack of reliable information. Correct information is an important prerequisite to the demand for containment and clean-up practices that reduce lead exposure during renovation projects. In deciding whether lead-safe work practices or

well-trained contractors are worth the extra cost, the property owner has to know whether there is lead in the work area, what risks are implied by having renovation done in areas with lead-based paint, the significance of these risks, what can be accomplished in reducing those risks through specific containment and clean-up practices, and how much these practices cost.

Misinformation can lead to inefficient outcomes. Without knowing there is a lead problem, or how renovation might create lead hazards, the owner will have too low a demand for proper work practices and may be unwilling to pay additional costs for contractors who voluntarily abide by these containment and clean-up standards. Furthermore, a great deal of uncertainty can exist if the consumer is unsure about the quality of lead-safe renovation services being purchased and their likely benefits. If consumers do not have any guarantee that the contractor is qualified to identify and control lead-based paint hazards, his/her demand for these services is likely to be lower than in the presence of such a guarantee. On the supply side, contractors may be unaware of the risks they are creating and/or the methods they can use to reduce risks of lead exposure.

External Costs and Public-Good Characteristics of Lead-Safe Renovation

Another major cause of market failure stems from the external cost of poorly performed renovation projects in target housing units or public and commercial building COFs with lead-based paint. An efficient outcome is achieved when the marginal willingness-to-pay for a service is equivalent to the marginal cost of providing that service. Because the use of lead-safe work practices is likely to benefit not only the consumer of the renovation (the operator of the daycare facility, or the homeowner, for example) but his/her children, other children who are enrolled (if it is a daycare), neighbors and/or tenants, lead-safe renovation services are, in part, a public good. As such, even with perfect information, the maximum amount that the individual consumer of the renovation would be willing to pay for lead-safe work is likely to be lower than the total amount that that particular consumer plus the other beneficiaries (including children, neighbors, etc.) would be willing-to-pay for the service. Children, for example, cannot testify to their willingness-to-pay for risk reduction and thus rely on their parents' or the property owners' willingness-to-pay. Similarly, neighboring properties may also experience an increased exposure to lead and may be willing-to-pay to reduce or eliminate this exposure but may not be consulted by the property owner making the decision.

An example of an external cost market failure could be found in an owner's decision about which contractor to hire to perform renovation in his/her housing unit or COF. Contractors that provide lead-safe renovation services are likely to charge more for their work than establishments that do not use lead-safe practices. Lead-safe work practices may also increase the duration of the project because contractors need to take additional steps to prevent the spread of lead dust. Since the property owner or COF operator pays for the renovation, but not necessarily for the consequences of the children's lead exposure, s/he is faced with powerful short-term incentives (lower cost and a faster turn-around) to hire a contractor that does not use lead-safe work practices. Because the children and their parents, and not the property owner or COF operator pay for the consequences of lead exposure, this scenario could result in a socially inefficient outcome of too little lead-safe renovation services provided.

A similar external cost problem also leads to inefficiencies on the supply side of this market. Renovators that use lead-safe work practices incur higher costs than other contractors who are faced with the incentives to keep their costs as low as possible. Similar to property owners and COF operators, contractors may not incur the costs of consumer lead exposure resulting from unsafe renovation work. Because the legal/liability system is not perfect, the owner's and contractor's financial responsibilities in terms of costs related to tenant/customer lead exposure are not clear and consistently enforced. This, in turn, may result in an inefficient outcome of either too much or too little lead-safe renovation services, depending on the risk-averseness of the owner or contractor and his/her understanding of the risks and responsibilities involved. Given the other factors confronting landlords and contractors, there is likely to be too little lead-safe services.

Impacts of the Regulation on Demand for Lead-Safe Renovation Services

The market for RRP services is further complicated by the ability of property owners to substitute their own labor for purchased services. The general market failure relationships discussed above are illustrated in Exhibit 3-1 as three markets for close substitutes. A consumer's demand for renovation services is a function of the price of these services, the characteristics of the services (e.g., quality, lead safety etc.), and the characteristics of consumers. Assume that all renovation services are identical except that some are performed using lead-safe containment and clean-up practices and some are not. Assume for illustration purposes that there is only one consumer and one supplier in the market. Of the services that are performed not using these lead-safe practices, some are done by the supplier, while others are do-it-yourself projects performed by the consumer. Figure (a) represents the market for lead-safe renovation projects, Figure (b) represents the professional market for "standard or non-lead-safe practice" renovation, and Figure (c) represents the do-it-yourself market for "standard practice" renovation. In each market, S_0 represents the supply of renovation services and D_0 represents the demand for renovation services in the baseline with incomplete information. Note that, moving from left to right, each supply curve is lower than the prior one, corresponding to the lower cost in terms of materials and time combined. The area under the demand curve in each market represents the consumer's willingness-to-pay for renovation services.

Exhibit 3-1: Impact of Regulation on Markets for Renovation/Remodeling Services

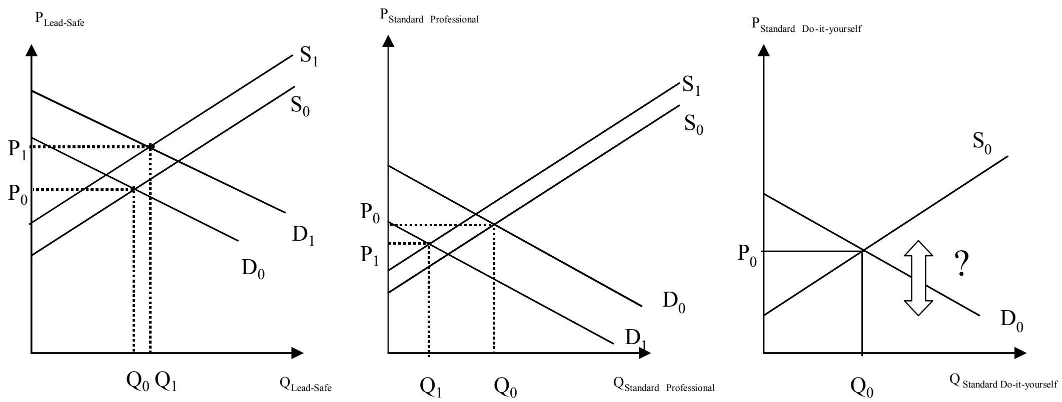


Figure (a) Market with Lead-Safe Work Practices

Figure (b) Professional Market with "Standard" Work Practices

Figure (c) Do-it-Yourself Market with "Standard" Work Practices

The regulatory options alter the nature of these three markets by providing information to the consumer and contractor about the risk associated with lead-based paint renovation activities and by requiring lead-safe containment and clean-up practices for professional projects. EPA's §406(b) regulations already require that compensated renovators distribute a lead awareness pamphlet to owners and occupants of most pre-1978 target housing before beginning renovations. The LRRP rule builds on §406(b) by providing additional information to the consumer that will help to establish a more structured market for lead-safe renovation services. As discussed earlier in this section, prior to the rule, consumers of renovation services had no guarantee that a contractor who claimed to provide lead-safe renovation services would actually perform the project in a lead-safe manner. The implementation of work practice standards and training/certification requirements is likely to increase consumer confidence in the quality of the work provided by certified contractors, increasing their willingness-to-pay for these services.

EPA's targeted outreach program is also likely to increase demand for lead-safe renovation services by raising consumer awareness about the dangers of unsafe work. Although contractors that currently provide well-trained staff and perform lead-safe work practices are expected to find it in their vested interest to provide the kinds of information cited above, this possibility has not closed the information gaps for the public. One impediment may be public uncertainty about the reliability of information that contractors themselves provide. Their information may be considered unreliable because they are not fully competent to assess the lead contamination and what needs to be done, because the businesses are subject to moral hazard (which occurs, for example, when a firm tells a property owner that there is a lead problem that warrants certain practices at an additional cost), or both. Since many property owners may lack easy access to independent sources of information to motivate their decisions, doing nothing may be the likely response. When provided with reliable information, however, consumers are more likely to avoid the dangers posed by unsafe renovation and hire a qualified contractor to perform the work in a lead-safe manner.

The increased demand discussed above is shown by an upward shift of the demand curve in Figure (a) from D_0 to D_1 and an associated increase in price. Simultaneously, the demand for "standard practice" renovation services decreases with an associated decrease in price. Given scarce resources for enforcement, it is expected that some "standard practice" professional work will continue, even in properties where there is the potential for lead exposure. The effect of the regulation on the do-it-yourself market is ambiguous. Some property owners that might have hired a professional to perform "standard practice" renovation work in the baseline may decide to perform this work themselves rather than pay the additional costs for lead-safe work practices. This would shift the supply curve back up. On the other hand, with increased information, property owners and COF operators that would have performed do-it-yourself "standard" practice" renovation in the baseline may decide to either forgo renovation altogether or hire a lead-safe professional, thus reducing do-it-yourself demand.

Impacts of the Regulation on the Supply of Lead-Safe Renovation Services
The regulation will increase both the costs of supplying lead-safe services and standard services. In Figures (a) and (b), S_1 represents the supply of services with the regulations. A contractor that already uses lead-safe practices will also incur the costs of training, certification and cleaning verification. A contractor that continues to provide standard (not lead-safe) renovation services will have higher costs of operation due to potential enforcement actions, and potentially higher liability. The relative size of the shifts in the two submarkets will affect the final changes in quantity and price of both lead-safe and standard renovation services.

The net impact on the quantity of renovation projects performed is also ambiguous. If all property owners and COF operators are willing to pay the full amount for lead-safe work practices, then the total quantity performed across all three markets will remain constant but the average price will rise. However, if some property owners and COF operators are not willing to pay for the risk reduction they may chose to forgo renovation services altogether, resulting in a net decline in renovation services provided after regulation.[3]

Conclusions
As demonstrated in this review, due to the lack of perfect information and the existence of externalities, the quantity of lead-safe RRP services currently provided is likely to be inefficiently low. The results of the market failures discussed in this review are significant in both qualitative and quantitative terms. Childhood lead exposure continues to be a major public health problem among young children in the United States. During 1999 through 2002, approximately 310,000 children aged 1 to 5 years, had blood-lead levels greater than 10 μg/dL, despite the removal of lead from gasoline and the banning of lead-based paint in 1978 (CDC 2005). Most children with blood-lead levels in excess of CDC's current level of concern have been exposed to lead in non-intact paint, interior settled dust, and dust and soil in and around deteriorating older housing or other buildings where they spend time. According to the Center for Disease Control (CDC), "renovation and remodeling activities that disturb lead-based paint can create

[3] The amount by which price and quantity change in each of these markets is a function of both the amount by which the supply and/or demand functions shift and the relative elasticities of the two functions. See Appendix 3A for a discussion of how these factors affect the price of renovation services and the quantity provided by the market. Appendix 3B presents price elasticity estimates for construction and RRP.

substantial amounts of lead dust in the home; such dust can then be inhaled or ingested by children" (CDC 1997). An insufficient number of lead-based paint interventions have occurred to remove the dangers posed by uncontrolled renovation activities; renovation activity thus continues to pose a significant risk of lead exposure.

3.2.2 Justification for Regulation at the Federal Level

In the Residential Lead-Based Paint Hazard Reduction Act of 1992 (Title X), the United States Congress stated that the elimination of lead-based paint hazards was a national goal. Congress found that the Federal Government must take a leadership role in building the required infrastructure, including an informed public, State and local delivery systems, certified inspectors, contractors, and laboratories, and trained workers (§1002(8)). The LRRP rule for target housing proposed on January 10, 2006, under the authority of §402(c), aimed to help the Federal Government achieve these objectives by establishing training, certification and accreditation requirements plus containment and clean-up standards for renovation work done in target housing. With identical objectives, the supplemental proposal on June 5, 2007 added child-occupied facilities (COFs) to the universe defined under the earlier proposal. It proposed to apply the same training, certification, accreditation, work practice, and recordkeeping requirements to firms and individuals who perform renovations for compensation in COFs.

As written by Congress, various sections of Title X address different parts of the imperfect information problem. By setting hazard standards, §403 helps consumers identify situations that subject them to risk. Without this information, consumers are more likely to not value an intervention properly. They may either underestimate or overestimate its value. Hazard standards provide necessary, although not sufficient, information for making an informed choice. In addition, the consumer needs information on the cost and effectiveness of the various lead hazard control options available (e.g. removal of lead-based paint or lead contaminated soil, encapsulation of lead-based paint, dust clean-up). This information need is addressed by the LRRP rule, which assures that trained and certified personnel are qualified to identify and control lead-based paint hazards in target housing units and public or commercial building COFs, including hazards resulting from renovation activities. In addition, §1018 and §406 provide information about lead-based paint hazards to the population in general and in particular at the time of property transactions and prior to compensated renovations. Finally, the LRRP rule reduces transaction costs by assuring property owners and operators of COFs that the information provided to them about their particular situation will be accurate and complete. The LRRP rule addresses a special case – renovation activities in target housing units and COFs that may disturb lead-based paint and thus expose the workers, occupants and potentially their neighbors to lead.

Lead hazards are found in target housing units and public or commercial building COFs in all parts of the nation, and renovation activities that disturb lead-based paint will likely create lead hazards. Federal regulations can promote cost savings by encouraging coordination among jurisdictions with resulting economies of scale. For example, training and certification costs are reduced where states share the same requirements and provide for certification reciprocity. Federal regulations also promote partnerships in developing the most cost-effective ways to address lead-paint hazards. Establishing training, certification and accreditation requirements, as well as containment and clean-up standards, at the federal level does not preempt states from addressing needs peculiar to their situation. States are granted the power to administer and implement the federal guidelines and are encouraged to do so. It is the Agency's belief that states and localities are in a better position to determine how the hazard standards are used and how to adapt their implementation to local circumstances. In addition, states have the option of imposing requirements that are more stringent than the federal procedures.

3.2.3 Regulatory Background

This section outlines the extensive history of lead-based paint regulations at the federal, state and local levels and shows that current regulations are not sufficient to correct the market failure outlined in Section 3.2.1. While these regulations cover a wide-range of lead-related issues, no single regulation, nor combination of regulations, adequately closes the information gap for lead exposure from renovation projects.

The Federal Lead-based Paint Program.

Title X and the Federal goal

Primarily in response to the persistent health threat posed by lead-based paint, in 1992 Congress enacted Title X. Congress found that low-level lead poisoning was widespread among American children, affecting, at that time, as many as 3 million children under age 6; that the ingestion of household dust containing lead from deteriorating or abraded lead-based paint was the most common cause of lead poisoning in children; and that the health and development of children living in as many as 3.8 million American homes was endangered by chipping or peeling lead paint, or excessive amounts of lead-contaminated dust in their homes. Congress determined that the prior Federal response to this crisis was insufficient and established, in Title X, a national goal of eliminating lead-based paint hazards as expeditiously as possible. Congress decided that the Federal government would take a leadership role in building the infrastructure necessary to achieve this goal.

The stated purposes of Title X are:

- To develop a national strategy to build the infrastructure necessary to eliminate lead-based paint hazards in all housing as expeditiously as possible.
- To reorient the national approach to the presence of lead-based paint in housing to implement, on a priority basis, a broad program to evaluate and reduce lead-based paint hazards in the Nation's housing stock.
- To encourage effective action to prevent childhood lead poisoning by establishing a workable framework for lead-based paint hazard evaluation and reduction and by ending the current confusion over reasonable standards of care.
- To ensure that the existence of lead-based paint hazards is taken into account in the development of Government housing policies and in the sale, rental, and renovation of homes and apartments.
- To mobilize national resources expeditiously, through a partnership among all levels of government and the private sector, to develop the most promising, cost-effective methods for evaluating and reducing lead-based paint hazards.
- To reduce the threat of childhood lead poisoning in housing owned, assisted, or transferred by the Federal Government.

- To educate the public concerning the hazards and sources of lead-based paint poisoning and steps to reduce and eliminate such hazards (Residential Lead-Based Paint Hazard Reduction Act of 1992).

To accomplish this ambitious goal, a number of agencies were assigned specific responsibilities under Title X, including HUD, CDC, OSHA, the National Institute for Occupational Safety and Health (NIOSH), and EPA.

The elimination of lead-based paint hazards in the nation's housing remains an important goal for the Federal government. In 1997, President Clinton created the President's Task Force on Environmental Health Risks and Safety Risks to Children in response to increased awareness that children face disproportionate risks from environmental health and safety hazards. Co-chaired by the Secretary of HHS and the Administrator of the EPA, the Task Force consisted of representatives from 16 Federal departments and agencies. The Task Force set a Federal goal of eliminating childhood lead poisoning by the year 2010. This rule is an important component of the Federal strategy for achieving this goal. In October 2001, President Bush extended the work of the Task Force for an additional 18 months beyond its original charter (President's Task Force on Environmental Health Risks and Safety Risks to Children 2000). Reducing lead poisoning in children was the Task Force's top priority.

Childhood lead exposure continues to be a major public health problem among young children in the United States. Most children with blood lead levels in excess of CDC's current level of concern have been exposed to lead in non-intact paint, interior settled dust, and dust and soil in and around deteriorating older housing (CDC 2004). The nature and extent of the problems associated with lead-based paint in housing units have been thoroughly investigated. Approximately 40% of all U.S. housing units (about 38 million homes) have some lead-based paint.[4] Use of lead safe work practices during renovation can advance the goal of primary prevention of lead poisoning (CDC 2004).

EPA's lead-based paint program

Under Title X, EPA is directed to take actions that can be divided into 4 key categories:

- Establishing a training and certification program for persons engaged in lead-based paint activities, accrediting training providers, establishing work practice standards for the safe, reliable, and effective identification and elimination of lead-based paint hazards, and developing a program to address exposure to lead-based paint hazards from renovation and remodeling activities.
- Ensuring that, for most housing constructed before 1978, lead-based paint information flows from sellers to purchasers, from landlords to tenants, and from renovators to owners and occupants.
- Establishing standards for identifying dangerous levels of lead in paint, dust and soil.
- Providing information on lead hazards to the public, including steps that people can take to protect themselves and their families from lead-based paint hazards. Each of these categories is discussed in more detail in the following sections.

[4] The prevalence of lead-based paint in target housing where childcare is provided is assumed to be the same as the prevalence of lead-based paint in target housing as a whole.

a. Training and certification, accreditation, and work practice standards. Title X added a new title to TSCA entitled ''Title IV Lead Exposure Reduction.'' Most of EPA's responsibilities for addressing lead-based paint hazards can be found in this title, with section 402 being one source of the rulemaking authority to carry out these responsibilities. TSCA section 402(a) directs EPA to promulgate regulations covering lead-based paint activities to ensure persons performing these activities are properly trained, that training programs are accredited, and that contractors performing these activities are certified. These regulations must contain standards for performing lead-based paint activities, taking into account reliability, effectiveness, and safety.

On August 29, 1996, EPA promulgated final regulations under TSCA section 402(a) governing lead-based paint inspections, lead hazard screens, risk assessments, and abatements in target housing (U.S. EPA 1996). TSCA section 401 defines ''target housing'' as any housing constructed prior to 1978, except housing for the elderly or persons with disabilities (unless any child who is less than 6 years of age resides or is expected to reside in such housing for the elderly or persons with disabilities) or any 0-bedroom dwelling. These regulations also apply to ''child-occupied facilities,'' which are defined at 40 CFR 745.223 as buildings constructed before 1978, or portions of such buildings, where children under age 6 are regularly present. TSCA section 402 defines lead-based paint activities in target housing as inspections, risk assessments and abatements. The 1996 regulations cover lead-based paint abatement activities in target housing and child-occupied facilities, along with limited screening activities called lead hazard screens. The regulations also established an accreditation program for training providers and a certification program for individuals and firms performing these activities. Training providers who wish to provide lead-based paint training for the purposes of the Federal lead-based paint program must be accredited by EPA. Implementing regulations at 40 CFR 745.225 describe in detail the requirements for each course of study, how training programs must be operated, and the process for obtaining accreditation. Training programs must have a training manager with experience or education in a construction or environmental field, and a principal instructor with experience or education in a related field and education or experience in teaching adults. Training programs must also have adequate facilities and equipment for delivering the training. To become accredited, an application for accreditation must be submitted to EPA on behalf of the training program. The application must either include the course materials and syllabus, or a statement that EPA model materials or materials approved by an authorized State or Tribe will be used. The application must also include a description of the facilities and equipment that will be used, a copy of the test blueprint for each course, a description of the activities and procedures that will be used during the hands-on skills portion of each course, a copy of the quality control plan, and the correct amount of fees. If EPA finds that the program meets the regulatory requirements, it will accredit the training program for 4 years. To maintain accreditation, the training program must submit an application and the correct amount of fees every 4 years.

Individuals and firms that perform inspections, lead hazard screens, risk assessments, or abatements in target housing or child-occupied facilities must be certified. Certification requirements and the process for becoming certified are described in 40 CFR 745.226. A firm that wishes to become certified must submit an application, along with the correct amount of fees, attesting that it will use only certified individuals to perform lead-based paint activities and that it will follow the work practice standards in 40 CFR 745.227. An individual who wishes to become certified must take an accredited training course in at least one of the certified disciplines: Inspector, risk assessor, project designer, abatement worker, and abatement supervisor. The risk assessor, project designer, and abatement supervisor disciplines have additional requirements for education or experience in a construction or environmental field. The inspector, risk assessor, and abatement supervisor disciplines also require the applicant to pass a certification examination administered by a third party.

The regulations at 40 CFR part 745, subpart L, also contain work practice standards for performing inspections, lead hazard screens, risk assessments and abatements in target housing and child-occupied facilities. The regulations contain specific requirements for conducting paint sampling during an inspection and specify information that must be gathered and samples that must be taken as part of a lead hazard screen or risk assessment. The requirements for abatements are also set forth in the regulations. When conducting abatements, an occupant protection plan must be prepared by a certified supervisor or project designer; certain work practices such as open-flame burning, machine sanding or abrasive blasting without high-efficiency exhaust control, dry scraping, and heat guns at high settings are prohibited; and a visual inspection and dust clearance sampling must be performed after the abatement is finished to ensure that the area is ready for re-occupancy. Any samples collected during any of these regulated lead-based paint activities must be analyzed by a laboratory recognized by EPA as being capable of analyzing paint chips, dust, and soil for lead. Requirements for inspection, lead hazard screen, risk assessment or abatement reports are also described in this section

Recognizing the importance of States and Territories in achieving the goal of eliminating lead-based paint hazards in housing, Congress specifically directed EPA to establish a model State program and a process for authorizing States to operate such programs in lieu of the Federal program. Concurrently with the subpart L rulemaking in 1996, EPA codified, at 40 CFR part 745, subpart Q, a model training and certification program and a process for enabling States, Territories, and Tribes to apply for authorization to administer their own lead-based paint activity programs. Providing Indian Tribes with this opportunity is consistent with EPA’s Policy for the Administration of Environmental Programs on Indian Reservations (U.S. EPA 1984). EPA also provides grants under TSCA section 404 to States, Territories, and Tribes to assist them in developing and administering these programs, as well as programs implementing TSCA section 406(b). On June 9, 1999, the subpart L regulations were amended to include a fee schedule for training programs seeking EPA accreditation and for individuals and firms seeking EPA certification (U.S. EPA 1999). These fees were established as directed by TSCA section 402(a)(3), which requires EPA to recover the cost of administering and enforcing the lead-based paint activities requirements in unauthorized States. The most recent amendment to the subpart L regulations occurred on April 8, 2004, when notification requirements were added to help EPA monitor compliance with the training and certification provisions and the abatement work practice standards (U.S. EPA 2004a).

As of December 2005, 44 programs comprised of 39 States, 3 Tribes, Puerto Rico, and the District of Columbia were authorized to administer lead-based paint activity programs. In the remaining jurisdictions, where EPA is responsible for administering the subpart L regulations, there were approximately 55 accredited training course providers, 1,300 certified firms, 500 certified inspectors, 1,400 certified risk assessors, 60 certified project designers, 1,000 certified abatement supervisors, and 2,800 certified abatement workers. EPA believes that, in most areas of the country, there is an adequate supply of accredited courses and certified firms and individuals available to meet the demand for lead based paint services. This is a significant part of the national infrastructure necessary to achieve the goal of eliminating lead-based paint hazards in housing.

In addition, Congress directed EPA, in TSCA section 405, to establish protocols, criteria, and minimum performance standards for analysis of lead in paint, dust, and soil. TSCA section 405 further directed EPA, in consultation with HHS, to develop a program to certify qualified laboratories. The National Lead Laboratory Accreditation Program (NLLAP) provides the public with a list of laboratories that have met EPA requirements and demonstrated the capability to accurately analyze paint chip, dust, or soil samples for lead. All laboratories recognized by NLLAP must pass on-site audits conducted by one of the two accrediting organizations currently participating in NLLAP, the American Industrial Hygiene Association (AIHA), and the American Association for Laboratory Accreditation. Recognized laboratories must also perform successfully on a continuing basis in the Environmental Lead Proficiency Analytical Testing (ELPAT) Program established by NIOSH, AIHA, and EPA.

More recently, in January of 2006, under the authority of TSCA Section 402(c)(3), EPA proposed a rule creating requirements to reduce exposure to lead hazards produced by renovation, repair, and painting activities in target housing. The proposed rule contained requirements for training renovators and dust sampling technicians; certifying renovators, dust sampling technicians, and renovation firms; accrediting providers of renovation and dust sampling training; for renovation work practices; and for recordkeeping. In 2007, a supplemental proposal added child-occupied facilities (COFs) to the universe defined under the initial proposal. This report analyzes the regulatory options considered for the final LRRP rule and compares them to the proposed options analyzed in 2006/2007

b. Lead-based paint information for purchasers, renters, owners, and occupants of target housing. Another of EPA's responsibilities under Title X is to require that purchasers and tenants of target housing, as well as and occupants of target housing and parents of children in COFs undergoing renovation are provided information on lead-based paint and lead-based paint hazards. As directed by TSCA section 406(a), CPSC, HUD, and EPA, in consultation with CDC, jointly developed a lead hazard information pamphlet entitled ''Protect Your Family From Lead in Your Home'' (''PYF'') (U.S. EPA et al 2003). The availability of this pamphlet was announced on August 1, 1995 (U.S. EPA 1995). This pamphlet was designed to be distributed as part of the disclosure requirements of section 1018 of Title X and TSCA section 406(b), to provide home purchasers, renters, owners, and occupants with the information necessary to allow them to make informed choices when selecting housing to buy or rent, or deciding on home renovation projects. The pamphlet contains information on the health effects of lead, how exposure can occur, and steps that can be taken to reduce or eliminate the risk of exposure during various activities in the home.

Pursuant to the authority provided in section 1018 of Title X, on March 6, 1996, HUD and EPA jointly promulgated regulations requiring persons who are selling or leasing target housing to provide the PYF pamphlet and information on known lead-based paint and lead-based paint hazards in the housing to purchasers and renters (HUD and U.S. EPA 1996). These joint regulations, codified at 24 CFR part 35, subpart A, and 40 CFR part 745, subpart F, describe in detail the information that must be provided before the contract or lease is signed and require that sellers, landlords, and agents document compliance with the disclosure requirements in the contract to sell or lease the property. Title X does not provide for these requirements to be administered by States or Tribes in lieu of the Federal regulations. Therefore, HUD and EPA are responsible for administering and enforcing these disclosure obligations.

TSCA section 406(b) directs EPA to promulgate regulations requiring persons who perform home renovations for compensation to provide a lead hazard information pamphlet to owners and occupants of target housing being renovated. These regulations, promulgated on June 1, 1998, are codified at 40 CFR part 745, subpart E (U.S. EPA 1998). The term ''renovation'' is defined, at 40 CFR 745.83, as the modification of any existing structure, or portion of a structure, that results in the disturbance of painted surfaces. Lead-based paint abatement projects are specifically excluded, as are small projects that disturb 2 square feet (ft2) or less of painted surfaces, emergency projects, and renovations affecting components that have been found to be free of lead-based paint, as that term is defined in the regulations, by a certified inspector or risk assessor. Like the regulations regarding disclosure during sales or leases, these regulations require the renovation firm to document compliance with the requirement to provide the owner and the occupant with the PYF pamphlet. One important difference from the disclosure requirements in section 1018 of Title X is that TSCA section 404 allows States to apply for, and receive authorization to administer, the TSCA section 406(b) requirements. Two States are currently authorized to operate this program.

c. Standards for lead in paint, dust, and soil. Another responsibility assigned to EPA by Title X is the development of standards for identifying dangerous levels of lead in paint, dust and soil. These standards, promulgated pursuant to TSCA section 403 on January 5, 2001 and codified at 40 CFR part 745, subpart D, provide various Federal agencies, including HUD, and State, local and Tribal governments with uniform benchmarks on which to base decisions on remedial actions to safeguard children and the public from lead-based paint hazards (U.S. EPA 2001b). These standards also allow certified inspectors and risk assessors to easily determine whether a particular situation presents a lead-based paint hazard and whether to recommend remedial actions such as lead-based paint abatement, cleaning of dust, or removal of soil. The standards define lead-based paint hazards in target housing and child-occupied facilities as paint-lead, dust-lead, and soil-lead hazards. A paint-lead hazard is defined as any damaged or deteriorated lead-based paint, any chewable lead-based painted surface with evidence of teeth marks, or any lead-based paint on a friction surface if lead dust levels underneath the friction surface exceed the dust-lead hazard standards. A dust-lead hazard is surface dust that contains a mass-per-area concentration of lead equal to or exceeding 40 micrograms per square foot (µg/ft2) on floors or 250 µg/ft2 on interior windowsills based on wipe samples. A soil-lead hazard is bare soil that contains total lead equal to or exceeding 400 parts per million (µg/ g) in a play area or average of 1,200 parts per million of bare soil in the rest of the yard based on soil samples.

d. Public outreach and education. Among other things, TSCA section 405(d) directs EPA, along with the Agency for Toxic Substances and Disease Registry (ATSDR) and HUD, to sponsor public education and outreach activities to increase public awareness of the health effects of lead, the potential for exposures, the importance of screening children for elevated blood lead levels, and measures that can be taken to reduce or eliminate lead-based paint hazards. Accordingly, EPA has worked to provide the public with information and increase public awareness of such matters. To date, these activities have included web site management, development of public outreach strategies, development of partnership agreements, distribution of materials, participation in national conferences and exhibits, and developing hazard information documents (and other media, such as videos), as necessary to implement Title X. EPA has collaborated closely with other Federal agencies and its State, Tribal, and local government partners in developing outreach campaigns targeted for the Women, Infants and Children (WIC) program, Little League Baseball, and Spanish-speaking populations. Recently, EPA worked with the National Head Start

Association to develop a lead poisoning prevention campaign entitled ''Give Your Child a Chance of a Lifetime.'' The campaign consisted of a number of lead awareness documents, including a brochure for parents, fact sheets for Head Start staff, and a curriculum for Head Start teachers. Lead awareness outreach materials were provided to Head Start Centers in New York, Chicago, Philadelphia, Houston, and Los Angeles. The material was also distributed at the National Head Start Association Training Conferences. EPA has also been involved in developing model tool kits of various educational tools to provide to partners, such as slogans and graphic materials for public buses, trains, and mass transit stations.

EPA has used its authority under TSCA section 10 to award grants to Tribes to support Tribal educational outreach and to conduct baseline assessments of Tribal children's existing and potential exposure to lead. In fiscal year 2005, EPA began a new targeted grant program aimed at reducing the incidence of childhood lead poisoning in vulnerable populations (U.S. EPA 2004b). These grants are providing funding for proven or innovative programs in areas with high rates of childhood lead poisoning, and in areas where rates are unknown but other conditions suggest high rates may exist.

TSCA section 405(e) further directs EPA to establish, in connection with HUD, CDC, other Federal agencies, and State and local governments, a clearinghouse for information on lead-based paint and a hotline for the public to use for questions and requests for information on lead-based paint. This clearinghouse, the National Lead Information Center, handles approximately 50,000 calls per year, and disseminates up to 500,000 documents per year to the public.

Lead-based paint programs at other Federal agencies

In addition to EPA, other Federal agencies have important roles in achieving the goals of reducing or eliminating lead-based paint hazards in housing, as well as the national goal of eliminating childhood lead poisoning by 2010. Other agencies specifically assigned tasks in Title X include HUD, CDC, and OSHA.

The Federal agencies have long realized that they must work together to develop and implement Federal strategies for addressing lead-based paint hazards in order to be efficient and effective. In 1989, HUD and EPA formed an inter-agency task force to work through issues associated with lead-based paint abatement. The Federal Interagency Lead Based Paint Task Force has remained active throughout the years and continues to meet on a quarterly basis. Participating agencies include the Department of Defense, the Veterans Administration, the National Institute of Standards and Technology (NIST), the U.S. Public Health Service, the National Aeronautics and Space Administration (NASA), the United States Department of Agriculture (USDA), the Government Accountability Office (GAO), the National Institute for Environmental Health Sciences (NIEHS), ATSDR, CDC, CPSC, NIOSH, OSHA, HUD, and EPA. This Task Force serves as an important forum for coordinating the strategic plans of the Federal agencies who have responsibilities under Title X or who have responsibilities for maintaining and disposing of property that may contain lead-based paint.

Title X assigned certain responsibilities to HUD. One of HUD's functions is the administration of the Lead-Based Paint Hazard Control Grant Program established by the Act. This program provides grants of $1 million to $3 million to State and local governments for control of lead-based paint hazards in privately owned, low-income owner-occupied and rental housing that is not receiving federal assistance.

These grants are also designed to stimulate the development of a trained and certified hazard evaluation and control industry. Evaluation and hazard control work funded by the program must be conducted by either contractors who are certified by EPA or an EPA-approved State or Tribal program, or by contractors trained in lead-safe work practices, in the case of interim controls. Through these requirements, HUD hopes to create infrastructure that will last beyond the life of the grant. In awarding grants, HUD promotes the use of cost-effective approaches to hazard control that can be replicated across the nation. Since 1993, approximately $971 million has been awarded to over 200 local and State jurisdictions across the country. The work approved to date will lead to the control of lead-based paint hazards in more than 70,000 homes where young children reside or are expected to reside. Other HUD lead grant programs include the Lead Hazard Reduction Demonstration program, the Lead Elimination Action Program (LEAP), the Lead Outreach program and the Lead Technical Studies program.

HUD was also given regulatory authority over some aspects of lead based paint hazard control. As noted previously, on March 6, 1996, HUD and EPA jointly promulgated regulations requiring the disclosure of lead-based paint information during sale or lease transactions involving target housing. The HUD disclosure regulations are codified at 24 CFR part 35, subpart A. Subparts B through R of 24 CFR part 35 are known as the ''Lead Safe Housing Rule,'' initially promulgated on September 15, 1999, and updated in June 2004 (HUD 2004b). This rule was designed to protect young children from lead-based paint hazards in target housing that is being sold by the Federal government or receives financial assistance from the government. The requirements generally depend upon the level of assistance being provided, and may include such things as inspections, risk assessments, abatement, paint stabilization, or interim controls, which are temporary measures to reduce potential exposure to lead-based paint hazards. The emphasis is on reducing lead-based paint hazards, so, after paint is disturbed, a visual assessment for surface dust, debris, and residue and dust clearance testing is required to ensure that no dust lead hazards were created or left in the work area or, for rehabilitation projects of moderate or substantial scope, in the entire housing unit. More information on the Lead Safe Housing Rule is available on the HUD website at http:/ /www.hud.gov/offices/lead/leadsaferule/index.cfm or by calling (202) 755–1785, extension 104.

Section 1017 of Title X required HUD to issue ''guidelines for the conduct of federally supported work involving risk assessments, inspections, interim controls, and abatement of lead-based paint hazards.'' In response to this directive, HUD completed the Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing (Guidelines), in June 1995 (HUD 1995). The Guidelines provide detailed, comprehensive, technical information on how to identify lead-based paint hazards in housing and how to control such hazards safely and efficiently.

Other core activities of HUD's lead-based paint program include providing technical assistance to housing authorities, nonprofit housing providers, local and State agencies, other Federal agencies, housing developers, inspectors, real estate professionals, contractors and financiers, and public health authorities; evaluating the hazard reduction methods used in the grant program to measure their effectiveness, cost and safety; and maintaining a community outreach program in coordination with the other Federal agencies involved in lead-based paint hazard reduction.

CDC also provides significant funding for the prevention of childhood lead poisoning. CDC provides funding to support State, city and county programs in the areas of primary prevention, case management and screening, surveillance, strategic partnerships, and program evaluation. Since 2002, CDC has recommended that a blood lead level of 10 micrograms per deciliter (µg/dL) be used as a threshold for individual intervention (CDC 2002). Additional CDC recommendations address the type and intensity of individual intervention strategies that should be undertaken, depending upon the child's blood lead level. These strategies range from nutritional and educational interventions, along with more frequent testing, for a child with a blood lead level of 10–14 µg/dL, to medical and environmental interventions for children with blood lead levels above 45 µg/dL (CDC 2002). CDC has established a national surveillance system for children with elevated blood lead levels. In addition, CDC works with HUD and EPA to coordinate outreach and education campaigns.

OSHA is another agency with regulatory authority under Title X. As directed by the Act, OSHA promulgated an interim final standard on May 4, 1993, which regulates lead exposures in the construction industry (OSHA 1993). This standard, codified at 29 CFR 1926.62, limits worker exposures to 50 micrograms of lead per cubic meter of air averaged over an 8–hour workday. Employers must use a combination of engineering controls and work practices to reduce employee exposure as much as possible, using appropriate respiratory protection where necessary to achieve the exposure limit. Employees must receive training on the health effects of lead and how to limit exposure through proper work practices and personal protective equipment. Exposure monitoring and medical monitoring, including blood lead testing, are also required. This standard remains in effect and OSHA retains the authority to protect workers from occupational exposure to lead.

Many Federal agencies have been working to reduce or eliminate lead-based paint hazards in housing and to end childhood lead poisoning. EPA, HUD, and other Federal agencies have been working for many years on the problem of lead-based paint hazards that can be created during renovation and remodeling activities in housing and child-occupied facilities. This rulemaking is an important component of the Federal strategy for eliminating childhood lead poisoning.

State Programs

States regulate the presence and handling of lead-based paint in target-housing units and public or commercial building COFs where children under the age of six are present incompletely, and in a variety of manners. First, this section of Chapter 3 discusses the licensing regulations regarding lead-based paint in target housing units and then discusses regulations concerning LRRP activities in childcare facilities.

Target Housing Regulations

Table 3-1 provides an overview of state involvement in LRRP activities in target housing units.

Table 3-1: State RRP Regulations		
State	**Type of RRP Regulations and Applicability**	**Comments**
CA	*Cannot create lead hazard* Applies to: All Pre-1978 Housing	Title 17 and SB 460 prohibit creation of lead hazard during RRP activity. Definition of lead hazard includes "disturbing lead-based paint without containment." If lead hazard is discovered and reported, it will have to be abated/mitigated using trained personnel and following abatement work practices. Title 17 does not establish training or additional work practice requirements. Under CalOSHA regulations (Section 1532.1), workers performing lead-related construction (which includes renovation of residential or public building) who are exposed to more than 50µg/m^3 average over 8-hour period must be trained and certified as abatement workers or supervisors.
ME	*Cannot allow lead to enter environment* Applies to: Pre-1978 housing	Title 38, Chapter 12-B requires RRP contractors to take precautions to prevent release of lead to the environment, "including cleanup, removal and appropriate disposal of all visible lead-based paint debris generated by the project." Lists certain practices that are likely to result in release of lead to the environment. If lead dust or lead debris resulting from project creates a threat to public health, commissioner may order an immediate end to the project and may force responsible party to mitigate the risk. There are no training requirements for renovation contractors.
IN	*Work Practices Prohibited* Applies to: Pre-1960 target housing	326 IAC 23-5-2: Prohibits the use of certain methods of lead-based paint removal during RRP activities that disturb over 20 sq. ft. on the exterior of a building, or 2 sq. ft. in any room on the interior. Prohibited practices include open flame burning, abrasive blasting and machine sanding. Also, in case of exterior renovations, prohibits leaving any visible dust/debris on soil/surroundings for over 48 hours. There are no training requirements for renovation contractors.
OR	*Work Practices Prohibited* Applies to: Pre-1978 housing	OAR 333-069: Anyone removing or stabilizing (remodeling/painting) lead-based paint must apply to the Department of Human Services for a permit. The permit application requires firm/contractor to agree not to use prohibited work practices (including hydro/other power blasting without containment), to post warning sign, and to notify occupant of potential risks. There are no training requirements for renovation contractors.
MA	*Work Practice Standards* Applies to: All pre-1978 residences	454 CMR 22.11: Requires that in pre-78 housing where no inspection/risk assessment showing absence of LBP has been conducted, all workers must have undergone OSHA Lead in Construction Standard training. Sets forth work practice standards including posting of signs, shutdown and coverage of HVAC systems, and prohibition of certain lead-based paint removal techniques.

Table 3-1: State RRP Regulations

State	Type of RRP Regulations and Applicability	Comments
RI	*Work practice standards and training requirements* Applies to: Increased blood lead cases	R23-24.6-PB: Owners of certain high-risk properties and owners of properties receiving HUD or other funding, who are disturbing more than 15 sq. ft. of paint in any unit, or 3 sq. ft. feet in any common area, must use a certified Lead Hazard Reduction Contractor or Lead Renovator/Remodeler unless an inspection/risk assessment conducted by a certified professional has shown that there is no LBP present.
	Work practice standards Applies to: All exterior renovations	Air Pollution Control Regulation No. 24: Contractors or owners removing LBP from exterior of buildings or structures must notify owners and occupants of buildings and businesses within 50 ft. of structure as well as principal and chief administrative officer of schools within 50 ft. of structure. Must follow work practice standards that include containment, clean-up and the prohibition of certain paint removal techniques.
NJ	*Work practice standards and training requirements.* Applies to: Pre-1978 rental housing	5:10-6.6: Requires that anyone disturbing over 2 sq. ft. of interior LBP or 20 sq. ft. of exterior LBP in multi-family housing be trained in and follow lead-safe work practices (including occupant protection, worksite preparation, avoidance of certain work practices and dust sampling). Dust sampling must be performed by a person trained as a Lead-Sampling Technician.
VT	*Work practice standards* Applies to: Pre-1978 rental housing	18 V.S.A. § 1759: Requires owners of rental target housing and childcare facilities to "take all reasonable precautions to avoid creating lead hazards during… renovation, remodeling… or repair project." Lists prohibited paint removal techniques and requires use of lead-safe work practices such as limiting work area access to workers, covering work area with plastic sheeting and requiring protective clothing. Requires clean-up of work area following renovation work. Rental property owners, managers and their employees must be trained in essential maintenance practices.
OH	*Voluntary*	Renovation contractors can get trained and certified as Lead-Safe Renovators. There are currently no regulations requiring lead-safe work practices.
WI	*Voluntary*	Owner may certify property as Lead-Safe to obtain immunity from civil and criminal liability on his/her property. Chapter HFS 163: RRP projects on Lead-Safe properties may only be performed by trained lead-safe renovators using lead-safe work practices.
MI	*Voluntary*	Michigan Compiled Laws Service 333.5473a(2-3) "requires department to establish and conduct educational programs to educate homeowners and remodelers of lead-safe practices and methods of lead-hazard reduction activities."
IA	*Voluntary*	Iowa Code §135.105A requires creation of voluntary program for training of remodelers.

Sources: CA DHS 1999 and 2003; State of Maine 2004; Rhode Island Department of Health 1992; New Jersey Department of Community Affairs 2004; Lamberti 2005; Vermont Statutes Online 2005; Indiana State Department of Health 2001; The Commonwealth of Massachusetts 1999; Holston 2005; Wisconsin Department of Health and Family Services 2003; National Council of State Legislatures 2005; OR DHS; OR DHS 2003; RI DEM

Prohibition of Lead Hazards or Lead Threats

Emergency provisions of Maine's Lead Abatement regulations require that "a person engaged in any renovation, remodeling… or repair project involving lead-based paint not subject to the licensing and certification requirements… shall take reasonable precautions to prevent the release of lead to the environment, including cleanup, removal and appropriate disposal of all visible lead-based paint debris generated by the project." The regulations list examples of work practices that may result in the release of lead to the environment, and stipulate that if the commissioner finds that the location of lead dust or debris resulting from the project poses a danger to public health, the commissioner may order the responsible party to mitigate the threat, and may also order an immediate stop to the project (State of Maine 2004).

Similarly to Maine, the state of California does not dictate specific work practice standards for renovation and remodeling projects. California's Title 17 and Senate Bill 460, however, make it illegal to create a lead hazard on either the interior or the exterior of any residential or public building. A "lead hazard" as defined in Title 17 is "deteriorated lead-based paint, lead contaminated soil, disturbing lead-based paint… without containment, or any other nuisance which may result in persistent and quantifiable lead exposure" (CA DHS 1999). As such, similarly to EPA's RRP regulations, California's regulations require the use of containment when disturbing more than a small area of lead-based paint. A small area is defined as less than 2 sq. ft. of paint on the interior or less than 20 sq. ft. of paint on the exterior of a building. If RRP activity results in the creation of a lead hazard, local and state agencies can "issue orders to abate or otherwise correct" the hazard. They can also order an immediate stop to the project (CA DHS 2003). Local and state agencies depend primarily on citizen complaints to enforce these regulations (Frazier 2005).

While Title 17 and SB 460 do not require training for renovation workers, CalOSHA's Construction Safety Orders (Section 1532.1) states that any employee performing lead-related construction work (which includes renovation of public or residential buildings) and is exposed to lead dust concentrations above the permissible exposure limit must be trained by an accredited training provider and certified by the California Department of Health Services. The permissible exposure limit (as specified in CalOSHA regulations) is equal to an average of $50 \mu g/m^3$ average over an 8-hour period. If an employee works more than 8 hours in a workday, the allowable exposure limit is reduced to $400 \mu g/m^3$ divided by the number of hours worked. Because little information is available on the dust concentrations generated during renovation, repair and painting projects, it is not possible to determine what percentage of California's RRP contractors are required to be trained under the CalOSHA regulations.

Prohibition of Certain Work Practices

Unlike California and Maine regulations, which do not explicitly require the use or avoidance of particular work practices, Indiana and Oregon seek to protect workers and occupants through the prohibition of certain lead-based paint removal techniques.

Indiana's 326 IAC 23-5-2 regulations prohibit anyone disturbing over 20 sq. ft. of exterior paint or 2 sq. ft. of interior paint in pre-1960 target housing or child-occupied facilities from using various methods of removing lead-based paint. Prohibited practices include, but are not limited to, open flame burning and machine sanding/grinding or abrasive blasting/sandblasting without high efficiency particulate air local exhaust control. For exterior renovations, the regulations also require that all visible lead-based paint on soil or other horizontal exterior surfaces be removed within 48 hours after the end of activity (Indiana State Department of Health 2001).

In Oregon, contractors hired to remove or stabilize lead-based paint must apply to the Department of Human Services for a permit. As part of the permit application, contractors pledge not to use prohibited work practices such as uncontained hydro/other power blasting or sanding and agree to post a sign warning the public of possible lead-based paint hazards. Other prohibited work practices include, but are not limited to open-flame burning/torching and dry-scraping unless combined with a heat gun (OR DHS, OR DHS 2003).

Work Practice Requirements Applicable to All Housing

Massachusetts regulations (454 CMR 22.11) also prohibit the use of open flame burning as a method of LBP removal during renovation projects. In addition, the state has promulgated work practice requirements that are relatively similar to EPA's proposed RRP standards. For example, Massachusetts requires that the HVAC system be shut down during renovations that disturb LBP and that any HVAC ducts exposed to the work area be sealed off. All movable objects must be removed from the work area, while non-movable objects must be covered with plastic sheeting. Clean-up requirements include cleaning any surfaces contaminated with lead debris or dust using a HEPA vacuum, wet wiping or another acceptable method (Commonwealth of Massachusetts 1999).

While Massachusetts does not require lead-safe work practice training for renovation workers, minors may not work on projects involving lead-based paint, and all workers must be trained according to OSHA Lead in Construction Standard (29 CFR Part 1926.26(1)).

The Rhode Island Department of Environmental Management (DEM) regulates all work involving the removal of lead-based paint from the exteriors of buildings and structures. Air Pollution Control Regulation No. 24 establishes detailed work practice standards for exterior lead-based paint removal. Requirements include, but are not limited to, covering or removing any toys, furnishings or play equipment within 50 ft. of the structure, covering the ground within an impenetrable material to contain all debris, abrasives and paint, and using vertical containment if there is "visible movement of abrasive material, paint dust and/or other debris beyond ground sheeting." The regulations state that certain paint removal techniques may only be used in conjunction with a HEPA vacuum unit and/or vertical containment, while others (open flame burning) may not be used at all. Furthermore, the regulations list clean-up procedures to be conducted at the end of each day and at the end of the project (RI DEM).

In addition to these work practice requirements, DEM regulations require that anyone removing lead-based paint notify a) adults residing in or within 50 ft. of the structure from which the paint is being removed, b) the owner of the structure or of any building or business located within 50 ft. of the structure, and c) the principal and chief administrative officer of any school within 50 ft of the structure five days prior to the start of the project. The notification must provide the location, start and completion dates of the project, a description of lead-paint removal procedures, contact information for the firm conducting the project, and a warning statement regarding the dangerous nature of lead-based paint (RI DEM).

Although DEM regulations do not require training or certification, in April 2005 the Department implemented a voluntary certification program for contractors involved in removing exterior lead-based paint. To participate in the program, the contractor must read a Certification Workbook, complete a Participation Form and Certification Checklist stating that he/she abides by the Air Pollution Control Regulation No. 24, and present a completed copy of a project checklist to the owner/occupant of each structure the contractor conducts work on. As of August 2005, approximately 20 contractors have become certified with DEM through this program (RI DEM 2005 a-c).

Work Practice and Training Requirements for RRP in Certain Types of Housing

In addition to work practice standards/prohibitions, New Jersey, Vermont and Rhode Island regulations require the use of trained contractors and in the case of New Jersey, post-renovation dust testing. In New Jersey and Vermont, however, these regulations apply only to multi-family housing. In Rhode Island they apply mainly in cases involving a child with an increased blood lead level.

New Jersey regulations require that all work that may disturb painted surfaces (over 2 sq. ft. of paint on the interior and over 20 sq. ft. of paint on the exterior) in multi-unit housing (except owner-occupied units) be performed by trained workers in accordance with HUD rules 24 CFR 35. The regulations require that steps be taken to protect occupants and prepare the worksite, and prohibit the use of some work practices, including open flame burning, power sanding and uncontained water blasting. Training options include the HUD-EPA Lead Safety for Remodeling, Repair and Painting course. Furthermore, following any project which disturbs lead-based paint, the dust sampling must be performed by a person trained as a Lead-Sampling Technician (NJ DCA 2004, Lamberti 2005).

Vermont requires owners and managers of rental target housing and child-care facilities be trained in and perform essential maintenance practices on their properties. These practices include "tak[ing] all reasonable precautions to avoid creating lead hazards during any renovation, remodeling, maintenance or repair project that disturbs a lead-based painted surface pursuant to guidelines issued by the department." Guidelines include the prohibition of work practices such as "burning, water blasting, dry scraping, power sanding, or sandblasting, unless authorized by the department." The regulations further require the use of good work practices, including, but not limited to "limiting access to work areas to workers, covering the work area with six mil polyethylene plastic … protecting belongings of occupants by covering or removing them from the work area." Finally, the regulations require specialized cleaning of the work area using recommended methods (Vermont Statutes Online 2005).

In Rhode Island, the Department of Health regulates Lead Hazard Reduction and Lead Hazard Control activities as well as renovation, repair and painting projects on certain properties.

Lead Hazard Reduction activities are defined as

> "Any activity which reduces the risk of human exposure to lead-based paint or lead containing materials or substances in a regulated facility through environmental

> modification. Such activity includes, but is not limited to: repair, enclosure, encapsulation, removal and/or replacement of lead-based paint or painted surfaces, materials, or components in a building or structure (RI DOH 1992)."

Lead Hazard Reduction activities may only be performed by licensed Lead Hazard Reduction Contractors, who require 40 hours of training for certification. The regulations stipulate a variety of work practice standards, clean-up and clearance inspection/dust testing requirements. The regulations exclude activities that disturb less than 15 sq. ft. of paint in any one unit, or 3 sq. ft. of paint in any common area. Note that a Lead Hazard Reduction Contractor is not required for exterior abatement activity (RI DOH 1992).

Lead Hazard Control activities include paint stabilization and treatments of friction and impact surfaces where the lead levels are above the permitted standard. Window and door removal may also qualify as a Lead Hazard Control activity as long as the process does not involve paint removal and all resulting dust/debris are immediately cleaned up. Lead Hazard Control activities may only be performed by Lead Renovators/ Remodelers, who require eight hours of training. The regulations stipulate notification, work practice standards, clean-up and clearance inspection/ dust sampling requirements for Lead Hazard Control activities. Again, regulations exclude activities that disturb less than 15 sq. ft. of paint in any one unit, or 3 sq. ft. of paint in any common area (RI DOH 1992).

For the majority of residential units, Lead Hazard Reduction and Lead Hazard Control activities do not include renovation, repair and painting work (although Lead Hazard Reduction may be required if a renovation project results in the generation of lead dust). However, properties that:

- Have received a Notice of Violation or Order;
- Have been cited by the Department of Health for "significant childhood lead poisoning involving three or more children [under age 6] in the previous seven years at units in which the owner has or had a financial interest ";
- Receive funding from an agency that requires this level of protection; or
- Request this level of protection

and are disturbing more than the exempt amount of paint during an RRP project must either conduct an inspection to show that no lead-based paint is present, or assume that there is lead-based paint and conduct the renovation/remodeling activity as if it were a Lead Hazard Reduction activity, following all relevant regulations.

Similarly, properties that:

- Have received a Notice to Abate;
- Must comply with lead-hazard control requirements dictated by HUD;
- Receive funding from an agency that requires this level of protection; or
- Request this level of protection

and are disturbing more than the exempted amount of paint must either conduct an inspection to show that no lead-based paint is present, or assume that there is lead-based paint and conduct the renovation/remodeling project as if it were a Lead Hazard Control activity, following all relevant regulations (RI DOH 1992).

Additional Regulations that may Affect RRP Projects

In addition to the regulations discussed above, two states (Rhode Island and Maryland) have promulgated housing standards that may impact renovation events in rental units. In both states, owners of rental housing constructed prior to 1978 in Rhode Island and prior to 1950 in Maryland are required to bring their properties into compliance with certain standards for the maintenance of surfaces covered with lead-based paint. In addition, these owners are required to perform visual inspections and maintenance/clean-up at tenant turnover (RI HRC 2003, State of Maryland 1994). Maryland Housing Bill 760 also requires that if a repair project takes place while a unit is occupied, all children and pregnant women must be relocated and all other occupants must be kept out of the work area (State of Maryland 1994). Neither of the laws, however, explicitly dictates any work practices or training requirements for renovation, repair or painting projects. Thus, although these state laws are likely to result in thorough clean-up at the end of a project (so as not to violate the housing standards, which prohibit the presence of chipped or deteriorating lead-based paint in rental housing), they do not regulate the manner in which a renovation is performed.

State Voluntary Programs

Whereas some states have promulgated regulations that may limit lead exposure from renovation and remodeling activities, others have turned to voluntary programs as a way of encouraging contractor training and the use of lead-safe work practices.

In Ohio, for example, contractors may choose to take a 6-hour class and become trained as Lead-Safe Renovators. Lead abatement supervisors and lead abatement workers are automatically eligible for certification as lead-safe renovators. There are currently no work practice standards in place for certified lead-safe renovators and no enforcement activities to ensure that the renovations are in fact performed safely. In the past, some lead-safe renovators had to submit a notification prior to starting a renovation project. The notifications are no longer required, but some renovators submit them voluntarily. Currently, there are approximately 900 - 1,000 certified lead-safe renovators in Ohio (Holston 2005).

In Wisconsin, a property owner may choose to certify his or her property as lead-safe. Lead-safe status is granted following an inspection conducted by a certified inspector/risk assessor. The Lead Safe certificate “provides the listed "Property Owner" and his employees and agents immunity from civil and criminal liability on this property. Also, they may not be subject to a DHFS proceeding, except under circumstances cited in ch. 254.173(2), Wis. Stats.” Once a property is certified as lead-safe, however, any RRP activity performed on the property must be conducted by a trained Lead-Safe Renovator following lead-safe work practices (WI DHFS 2003). As of July 2004, the Wisconsin listing of lead-safe properties contained 39 residential structures (WI DHFS 2005).

Other voluntary initiatives include educational outreach in the form of suggested lead-safe work practices and periodic free training offered by health departments and housing agencies.

Local Initiatives

Similar to state programs, local lead-poisoning initiatives have had limited resources with which to carry out their programs. Differences between typical state and city programs lie more in the extent than in the substance of the activities. In general, city programs are more focused and seem to receive higher priority, which may be due to the urgency of the lead-paint problem in larger cities (HUD 1990).

In the *Comprehensive and Workable Plan for the Abatement of Lead-Based Paint in Privately Owned Housing* (HUD 1990), the Department of Housing and Urban Development outlined several distinguishing features of local programs as determined by studying ten selected cities:

- A city that is governed both by local ordinances and state regulations for lead-poisoning prevention and detection activities usually has local laws that are more stringent than state laws and may supersede the state requirements.
- In addition to providing intervention after cases of lead poisoning have been detected, local programs may require intervention as a result of targeted inspection of tenant complaints. Several cities, including Baltimore, Chicago, Louisville, New York, and Philadelphia, are authorized to take such preventive measures.
- In general, the city programs show more cooperation and coordination between agencies.
- City programs usually screen for high blood lead levels more systematically and target high-risk areas for screening.

Several cities have promulgated regulations that affect renovation, remodeling, and painting activities. These regulations are summarized in Table 3-2. Once again, it is possible that there are additional cities with similar regulations. However, similarly to state-level regulations, these rules are likely to fall short of correcting the market failure discussed in Section 3.2.1. and thus do not substitute for the federal Renovation Rule.

Local regulations, which are most often promulgated as city ordinances, are similar to state regulations in that they address the dangers posed by RRP activities in pre-78 housing via prohibiting the creation of lead hazards or the use of certain paint removal techniques, requiring the implementation of work practice standards, or requiring lead-safe work practices for projects in certain types of housing.

New York City currently has one of the most extensive local regulatory programs dealing with lead-based paint. The City recently promulgated a rule entitled Local Law 1, which applies to all units with a child under age 7 in pre-1960 multi-dwelling buildings and to common areas in these buildings. The regulations also apply to housing units in multi-dwelling buildings constructed between 1960 and 1978 where children reside and where the owner knows there is lead paint, as well as to common areas in these buildings. When disturbing between 2 sq. ft. and 100 sq. ft. of paint in the interior of these buildings, the owner must hire workers trained in lead-safe practices. Work practices must be no less stringent than Health Code §173.14 and dust tests must be performed. If work disturbs over 100 sq. ft. or more than one window within the interior of the building, the owner must hire an EPA-certified firm and follow the same work practices as for the disruption of areas between 2 sq. ft. and 100 sq. ft. Furthermore, notification is required for projects disturbing over 100 sq. ft. Relocation may be required for any project where work cannot be performed safely. According to the Department of Housing Preservation and Development's *Local Law 1/2004 – Section by Section Analysis*, it is not clear from the statute whether the over 100 sq. ft. project requirements apply to private dwellings (NYC DHPD 2004a-b).

Chapter 36 of San Francisco's Building Code, *Work Practices for Exterior Lead-based Paint,* is another example of a city-level regulation that addresses renovation and remodeling. It should be noted that Chapter 36 establishes far more detailed requirements than do California Title 17 and SB460. The San Francisco regulations apply to any work that disturbs over 10 sq. ft. of lead-based paint on the exterior of pre – 1978 buildings or steel structures. The regulations require the use of containment for all regulated jobs and prohibit the use of paint removal techniques such as "acetylene or propane burning and torching, hydroblasting or high pressure blasting without containment barriers [and] heat guns operating above 1,100 degrees Fahrenheit." The party responsible for the project must also perform a clean-up of all visible lead-based paint debris prior to finishing the project. The regulations further require that the owner notify all contract bidders of any paint inspection reports related to lead-based paint in the regulated area of the project. The owner or contractor must also notify the Department of Building Inspection and the tenants prior to the start of work, and must post a sign warning of the presence of lead-based paint (National Center for Healthy Housing, DBI 1999).

Although Cleveland's lead paint regulations focus primarily on lead abatement, they do provide requirements for safe work practices and clean-up during any type of lead-based paint removal. Ordinance 1027-04 applies to all pre-1978 buildings except residences of the elderly or disabled where children under six years of age do not and will not reside or any zero bedroom dwelling. The regulations prohibit all open flame burning as well as power-assisted paint removal techniques that do not immediately capture dust and debris in a closed container (this method is likely to involve power-assisted machines with HEPA vacuum attachments). The law requires that notification be given to occupants of the building and to any occupants of neighboring buildings within 30 ft. of the worksite. Preparation of an exterior worksite includes attaching plastic sheeting to the foundation of the structure and extending it 10 ft. from the foundation. For an interior paint removal task, preparation consists of laying plastic sheeting over an area "sufficiently large" to protect the surrounding environment from contamination and to capture dust and debris. Clean-up entails the rolling up and disposal of plastic sheeting along with the removal of all paint debris and dust (City of Cleveland, 2004).

The Kansas City Lead Ordinance (Article X: Lead Poisoning Control, Sec. 34-401 – 34-409) includes a general statement regarding renovations, remodeling projects, and demolitions. While it does not mandate detailed guidelines, the ordinance makes it illegal for workers involved in these activities to create lead hazards and expose themselves, occupants of the building, or occupants of adjacent properties to lead-containing debris and dust. The rule applies to all housing types but is particularly important in areas where children under the age of six are likely to be exposed (Kansas City Health Department).

Similar to Kansas City, the Chicago Department of Public Health issued a nonspecific lead-based paint regulation. The law, as outlined in *Control and Mitigation of Lead Bearing Substances*, applies to facilities and premises that are frequented by children who are of age six or younger. It simply states that workers cannot create lead hazards while performing any work on lead bearing substances in these facilities and premises. This includes containing and removing "any visible dust, chips, or debris" from lead-based paint. The regulation further prohibits the use of certain work practices, as described in Table

3-2. Similar to the California regulations, this ordinance implicitly requires renovators to contain lead-based paint dust and debris (City of Chicago Department of Public Health, 2004).

Table 3-2: Local RRP Regulations

City, State	Type of RRP Regulations and Applicability	Comments
New York City, NY	*Training and work practices* Applies to: All Pre-1960 multiple dwellings; Multiple dwellings built between 1960 and 1978 with knowledge of lead paint (interior work)	NYC Local Law 1: Regulation applies to all units with a child under age 7 in pre-1960 (as well as buildings constructed between 1960 and 1978 where the owner knows there is lead paint) multi-dwelling buildings and to common areas in these buildings. When disturbing between 2 and 100 sq. ft. of LBP, owner must hire workers trained in lead-safe practices. Work practices must be no less stringent than Health Code §173.14 and dust tests must be performed. If work disturbs over 100 sq. ft., must hire EPA-certified firm and follow same work practices as for disruption of 2 to 100 sq. ft. Notification is required for projects disturbing over 100 sq. ft. The 100 sq. ft. regulations may or may not apply to private residential dwellings.
San Francisco, CA	*Work practices prohibited* Applies to: Pre-1978 buildings (exterior work)	Chapter 36 of the San Francisco Building Code: Regulation applies to any work disturbing over 10 sq. ft. of LBP on the exterior of buildings and steel structures. Requires containment barriers for all jobs disturbing more than the exempted amount of paint. Prohibits use of some paint removal techniques and requires clean-up of all visible LPB debris. Requires notification of the Department of Building Inspection and of tenants prior to start of work. Requires the postage of sign warning of presence of LBP. No specialized training is required.
Chicago, IL	*Cannot create lead hazard* Applies to: Pre-1978 buildings frequented by children six years old and younger	Chicago Department of Public Health prohibits the presence of lead hazards (definition of "Lead Hazard" includes uncontained lead dust or debris created during RRP activity) in residential housing and child-occupied facilities/premises. Prohibits use of work practices (including open flame burning, dry sanding, dry scraping, heat guns, mechanical paint removers without HEPA dust containment, uncontained hydro or abrasive blasting, and chemical strippers) that may create a lead hazard. City inspectors may order abatement or mitigation of any lead hazards. No specialized training is required.
Kansas City, MO	*Cannot create lead hazard* Applies to: Pre-1978 buildings, particularly areas where children under age 6 may be exposed to lead paint	Kansas City Lead Ordinance (Article X: Lead Poisoning Control, Sec. 34-401 – 34-409) makes it illegal for any person to "repair, renovate or demolish any dwelling in such a manner that any occupant, worker or any person on any adjacent property(ies) may be exposed or have access to the resulting dust, contaminants or debris from lead-bearing substances." No specialized training is required.

Table 3-2: Local RRP Regulations		
City, State	**Type of RRP Regulations and Applicability**	**Comments**
New Orleans, LA	*Cannot create lead hazard* Applies to: Pre-1978 buildings or metal structures	New Orleans City Ordinance No. 20345 regulates activities that disturb LBP on and in pre-1978 buildings and all steel structures. Prohibits the use of certain paint removal practices including scraping, hydro blasting or sandblasting without containment, heat removal and chemical removal. Requires containment for exterior work using power sanding. Requires notification of tenants and other affected parties and postage of signs if power sanding is used. Requires notification of the Director of the Department of Safety and Permits if power sanding is used on exterior of building or structure. No specialized training is required.
Cleveland, OH	*Work practices and prohibitions for paint removal* Applies to: Pre-1978 target housing	Cleveland Ordinance 1027-04 provides prohibitions and guidelines for paint removal. It prohibits open flame burning and power-assisted paint removal unless debris and dust are immediately captured in a closed container before being released into the environment. Plastic cloths are to be attached to the foundation and extended out 10 ft. for exterior paint removal and laid in an area "sufficiently large" for interior. Vents, windows, and ducts are to be closed. Upon completion of work, cloths are to be wet wiped, rolled up, and disposed of. All paint or paint dust is to be removed from the premises. The law requires that notification be given to occupants of the building and occupants within 30 ft. of paint removal. No specialized training is required.
Sources: National Center for Healthy Housing; NYC DHPD 2004a-b; DBI 1999; CDPH 2004; Kansas City Health Department; City of New Orleans 2001; City of Cleveland 2004.		

Licensing Regulations For Childcare Facilities

In addition to governing target housing units, several states also regulate LRRP practices in child-occupied facilities. The following information provides a more complete overview of state involvement in LRRP activities in child-occupied facilities.

The licensing requirements that must be met in order to open a childcare facility vary dramatically among states (also within states, across different types of childcare facilities) in regard to the presence and handling of lead-based paint. While many states do not specifically regulate renovations, they do require initial inspections for lead-based paint, either in all childcare facilities, in pre-1978 childcare facilities, or in pre-1960 childcare facilities. A less strict precaution required by even more states requires that there can be no peeling, chipped, or flaking paint in childcare facilities; for many states, this requirement applies to only certain areas of the childcare facility (toys, equipment, objects within a child's reach, etc.). In terms of renovation-related regulations, 29 states require notification to either the state's Department of Health or the childcare facility licensing agency whenever a renovation occurs in a childcare facility.[5]

[5] The definition of renovation, however, varies from state to state. For example, in Colorado, notification is required for "extensive remodeling," whereas in Iowa notification is required only for changes that affect capacity.

The majority of state licensing requirements do not include renovation and remodeling activities. Several states, however, have promulgated regulations that require contractors to either take precautions (e.g. minimize or prohibit lead hazards, or create work standards) when working with lead-based paint. There are seven states with state-level regulatory requirements that specifically address RRP activities in childcare facilities. These state regulations are summarized in Table 3-3. In general, identified state regulations address RRP activities in one of three ways: by minimizing the creation of lead hazards (Wyoming), by prohibiting the creation of lead hazards (Colorado and Ohio), and by creating work practices standards (Vermont, Oregon, Indiana and Pennsylvania).

Table 3-3: State Childcare facility RRP regulations

State	Type of Childcare Facility RRP Regulations and Applicability	Comments
CO	*Cannot Create Lead Hazard* Applies to: All Childcare facilities	Section 3-103 in the "Rules and Regulations Governing the Health and Sanitation of Childcare Facilities in the State of Colorado" prohibits the creation of a lead hazard during RRP activities The text of this document reads that "alterations of finishes shall be done in a manner that prevents hazards associated with lead." Furthermore, the text reads "construction, remodeling, or alterations of childcare facilities shall be done in a manner that does not create a health hazard." The document, however, does not prohibit or require any particular work practices.
OH	*Cannot Create Lead Hazard* Applies to: All Childcare facilities	Chapter 12 of Ohio's Administrative Code, entitled "Rules for Licensed Childcare Centers," deals with renovations in child-occupied facilities that might disturb lead-based paint. The text reads that "renovations and remodeling to areas in which childcare is provided shall be conducted in a safe manner to ensure that lead poison hazards are not introduced into the environment as required by section 3742 of the Revised Code." A 'lead poison hazard' refers to material that is likely to cause lead exposure and endanger an individual's health.
VT	*Work Practice Standards Applies to: All Childcare facilities*	18 V.S.A. Chapter 38 (Childhood Lead Poisoning Prevention Law) states the requirements for renovations that might disturb lead based paint in childcare facilities in Vermont. To begin with, all paint is presumed to be lead-based unless a certified inspector has said otherwise. Parties must "take all reasonable precautions to avoid creating lead hazards during any renovation, remodeling, maintenance or repair that disturbs a lead-based painted surface." There is a prohibition against certain kinds of lead-based paint removal (dry scraping, for example). The use of good work practices to prevent the spread of lead dust is required (this includes limiting access to areas to workers, covering the work area, etc.). Following an RRP activity, an on-site inspection is required.
WY	*Minimize Lead Hazards* Applies to: Pre-1978 Childcare facilities	Section 4 of the document "Wyoming Childcare Licensing Rules - Administrative Rules for Certification of Childcare Facilities" outlines the sanitation requirements for childcare facilities. One of such requirements reads that "lead-poisoning hazards shall be minimized during lead-based paint removal and remodeling of all pre-1978 facilities."
OR	*Work Practice Standards Applies to: Pre-1978 Childcare facilities*	Oregon Administrative Rule (OAR) 333-069 requires that any person removing or stabilizing paint on housing or childcare settings built before 1978 must obtain a permit from the Department of Human Services. Furthermore, there are various work practice standards which must be upheld. For example, the air must be monitored to make sure workers are not being exposed to hazardous levels of lead, fume and dust collection systems must be used, and protective equipment must be provided.
IN	*Work Practice Standards* Applies to: Pre-1960 Childcare facilities	326 IAC 23-5-1 and 326 IAC 23-5-2 of Article 23 of Indiana's Administrative Code outlines regulations for RRP activities in Childcare facilities built before 1960. Indiana law presumes that paint is lead-based. It prohibits the use of dangerous work practices such as dry-sanding, dry scraping, etc. Furthermore, it requires exterior clean-up of visible paint chips or painted debris within 48 hours of completion of the work.
PA	*Work Practice Standards Applies to: All Childcare facilities*	Chapters 3270, 3280, and 3290 of Pennsylvania's Code, the official publication of rules and regulations, addresses renovation activities in childcare facilities. For all childcare facility types, the regulations require that children are not present during the removal of paint, that abrasive removal methods that permit the release of particulate matter are prohibited, and that childcare can only resume after all accompanying debris is removed. Child Day Care Centers and Group Child Day Care Homes face slightly more stringent regulations in terms of removal, clean-up and disposal.

Sources: State of Colorado 2005; Ohio Administrative Code 2006ab; The Ohio Department of Jobs and Family Services 2005; State of Vermont 2001; State of Wyoming 2001; Oregon Department of Human Services 2006; Indiana Department of Environmental Management 2003; State of Pennsylvania 2005.

Minimize Lead Hazards

The Wyoming Childcare Licensing Rules outline the administrative rules that must necessarily be met in order to certify a childcare facility and in the process, creates a minimum standard of operation. In the discussion of the sanitation requirements for floor and ceiling surfaces, the document requires that building components that have been painted with lead-based paint shall have the paint a) removed, b) covered over, or c) maintained to ensure that dust lead levels do not exceed one hundred micrograms per square foot. While such a precaution is not unusual in childcare facility licensing documents, Wyoming is one of the few states with LRRP requirements. The document goes on to state that "lead-poisoning hazards shall be minimized during lead-based paint removal and remodeling of all pre-1978 facilities." Wyoming, however, does not dictate the work practice standards necessary to minimize the lead-poisoning hazards.

Cannot Create Lead Hazards

While Wyoming requires only that lead hazards be minimized in renovation activities in childcare facilities, licensing standards in Ohio and Colorado dictate that lead hazards be prevented.

Section 3-103 of the "Rules and Regulations Governing the Health and Sanitation of Childcare Facilities in Colorado" outlines the requirements for finishes. The document expands upon a common initial requirement that painted finishes be free of peeling or chipped paint by requiring that "alterations of finishes shall be done in a manner that prevents hazards associated with lead." Colorado does not prohibit or require any work practices to accomplish this goal.

Chapter 12 of Ohio's Administrative Code establishes the rules necessary to be met in order to open a Childcare Center.[6] It first requires that "equipment, materials and furniture" be free of paint that contains lead. Like Wyoming, Ohio also has childcare facility renovation requirements, stating that "renovations and remodeling to areas in which childcare is provided shall be conducted in a safe manner to ensure that lead poison hazards are not introduced into the environment as required by section 3742 of the Revised Code." Also like Wyoming, Ohio does not establish any work practice standards for LRRP activities in childcare facilities.

Work Practice Standards

While none of the earlier-mentioned state programs establish work practice standards for LRRP activities in childcare facilities, a few states do.

Vermont's Childhood Lead Poisoning Prevention Act establishes renovation requirements in childcare facilities. Prior to the initial licensure, and annually thereafter, childcare facilities are required to have essential maintenance practices a) applied by someone who was certified by the Vermont Department of

Health or b) supervised by someone who is certified. Essential maintenance practices include identifying deteriorated paint in areas that children frequent, stabilizing that paint if more than one square foot is found, cleaning the window wells with a HEPA filter vacuum, and posting a notice stressing the importance of proper and routine maintenance. Furthermore, the Act states that workers take "responsible precautions" when disturbing lead-based paint to prevent the spread of dust. Responsible precautions include "limiting access to work areas to workers, covering the work area with six millimeter polyethylene plastic or the equivalent, wearing of protective clothing by workers, protecting belongings of occupants by covering or removing them from the work area, misting painted surfaces before disturbing the paint and wetting sweeping debris." The Act also prohibits the use of "burning, water blasting, dry scraping, power sanding or sandblasting" painted surfaces. At the end of the renovation, the area is required be cleaned with a HEPA vacuum (State of Vermont 2001).

Indiana has very similar rules to Vermont, except the universe of regulated entities is smaller since Indiana only regulates renovation activities in pre-1960 childcare facilities. Sections 326 IAC 23-5-1 and 326 IAC 23-5-2 of Article 23 of Indiana's Administrative Code outlines regulations for RRP activities in childcare facilities built before 1960. Indiana law presumes that paint is lead-based unless a licensed risk assessor or inspector certifies that it is not lead-based paint. In order to classify as a renovation, more than twenty square feet of exterior painted surfaces or two square feet of interior surfaces must be disturbed. While Indiana does not require the use of certain work practices like Vermont, it does prohibit certain work practices, such as removing paint with an open flame, machine sanding or grinding, abrasive blasting or sandblasting, using a heat gun, dry scraping, and dry sanding. Furthermore, at the conclusion of renovation activities on painted surfaces, Indiana law requires that there be no "visible chips or painted debris…on the soil, pavement, or other exterior horizontal surface for more than forty-eight hours" (Indiana Department of Environmental Management 2003)

Chapters 3270, 3280, and 3290 of Pennsylvania's Code, the official publication of rules and regulations, address renovation activities in childcare facilities. Pennsylvania prohibits the presence of children during the removal of paint. It also prohibits the use of certain abrasive paint removal processes, including "dry sanding, electrical sanding, sandblasting, open flame burning" or, more generally, any process that permits the release of particulate matter into the environment. Childcare can only resume when the resulting debris is removed. Day Care Centers and Group Child Day Care Homes in Pennsylvania face an additional regulation that the "removal, clean-up and disposal of leaded paint dust and debris" be done in a manner that prevents the spread of dust into the environment.

Oregon Administrative Rule (OAR) 333-069 requires that any person removing or stabilizing paint on housing or childcare settings built before 1978 obtain a permit from the Department of Human Services. Oregon law requires that work areas be closed or contained in order to prevent the dispersal of lead dust. Children and residents are not prohibited onto the premises during the activity period. The use of safe work practices is required, including using HEPA attachments on tools to capture dust, wetting painted surfaces before sanding or scraping, and covering storm drains to prevent the spread of debris. Furthermore, workers are required to wear respirators and protective clothing. Lastly, at the conclusion of the renovation activity, dust and debris generated by the renovation activity must be contained and cleaned. Workers' clothing must also be cleaned in order to prevent the spread of lead dust.

[6] Similar documents, with the same wording, exist for Type A and Type B Childcare Homes in Ohio.

Conclusions

While the regulatory and non-regulatory initiatives undertaken at the federal, state, and local level to reduce exposure to lead are extensive, they are not sufficient to ensure that lead exposure resulting from renovation activities is reduced to the levels of the LRRP regulations. Very few of the existing programs address renovation or consider the release of lead into the surrounding environment that frequently occurs during renovation. Even childhood blood-lead screening programs, which should act as a monitoring system by identifying exposure problems that do develop, are not universal — many states and communities have yet to institute such testing programs and even where they exist, they often miss many children. Even if these blood-lead screening programs were more uniformly applied across states and at risk children, such an *ex-ante* approach to limiting exposure would only address the issue after it becomes a significant health concern (i.e., children will suffer from increased blood-lead before intervention occurs).

3.3 Regulatory Options for Reducing Lead Exposure Resulting from Renovation

In drafting the LRRP rule, EPA considered various regulatory approaches, including, but not limited to: (1) information provision and labeling, (2) required work practice standards, including bans or restrictions on use, and (3) economic incentives. The first and second of these instruments are most closely linked to the problems contributing to the market failure described in Section 3.2. Consequently, directly addressing the lack of adequate information and external costs through information provision, and the establishment of work practice standards, prohibitions and restrictions on the use of certain practices, are the focus of this section and the analysis presented in this report.

3.3.1 Information Provision

The objective of the regulation is to reduce exposure to lead from renovation projects and thereby protect children and adults from health hazards posed by lead. Due to the nature of the problem, uncertainty currently exists on the part of consumers about the quality of lead-safe renovation services and their likely benefits. The lack of information regarding the benefits of and the lack of confidence in the quality of a good or service generally leads to a lower demand and a lower willingness-to-pay for that good or service. Thus, if consumers of renovation services (i.e. property owners and COF operators) are not aware of the dangers posed by lead dust generated during renovation, or if they are not confident that a contractor who claims to use lead-safe work practices has been properly trained, they may not be willing to pay the additional costs of contractors who voluntarily abide by these work practice standards. The rule will assure consumers that trained and certified personnel are qualified to control lead-based paint hazards. This provision of information will act as an important instrument in alleviating the problems contributing to undue lead exposure. An example of the market failure stemming from the lack of perfect information is presented in the previous section and is shown graphically in Exhibit 3-1.

An additional information flow will occur under these regulations. The teaching of safe work practices to contractors and other personnel performing RRP events will provide them with information they need to undertake renovation activities in ways that will not expose the occupants of the building. The training course will also provide information about the hazards associated with lead and renovation activities, which contractors will pass along to their clients. This provision of information is likely to increase the demand for lead-safe work practices and assist in eliminating the market failure that currently exists due to incomplete or misinformation.

Information provision will occur in several ways under this rule, in conjunction with other sections of Title X. Consumers will be directly informed about lead-based paint hazards and risks associated with renovation work through educational programs and through the expanded notification requirements. The aim of these programs will be to educate the property owner about the risks associated with lead-based paint hazards and having renovation work done in areas with such hazards, the significance of these risks, what can be accomplished to reduce those risks through specific work practices, and how much these practices cost. In addition, requiring training of professionals who carry out renovation projects will provide these individuals information about the hazards of lead exposure and the use of appropriate procedures to reduce exposure during their work. Similarly, the entity certification process will act as an indirect form of information provision to the consumer by assuring them that the services they are purchasing will reduce or eliminate lead exposure.

All these forms of information provision will aid in reducing the extent of the market failure that currently exists for lead-safe renovation services. However, relying solely on information provision is unlikely to be enough because of the nature of the lead problem. The lead in lead-based paint cannot be seen on visual inspection, and thus the consumer or occupant does not know if lead is present and whether a lead exposure hazard actually exists. Likewise, the adverse health effects are not noticeable for several years, and the source may not be recognized. In such situations, education may not be sufficient and other mechanisms are needed to ensure that if a potential risk exists, it is suitably addressed. The LRRP rule introduces other mechanisms for the elimination of lead-hazards during renovation work. These include training requirements for personnel engaged in renovation work, and standard practices for the containment and cleanup of lead dust and debris generated during the project and the banning of certain high-hazard techniques.

3.3.2 Work Practice Standards

The regulatory options include required elements, such as warning signs, containment barriers, and specialized cleaning, but allow flexibility for the certified renovator to tailor these requirements to the specific job at hand, such as the discretion to define the specific size and configuration of the containment above a specified minimum size to accommodate the variability in size and scope of renovations. Renovators with perfect information and total flexibility in work practice standards would contain/clean the minimum area necessary to prevent the spread of lead dust and debris. This would lead to cost savings for some percentage of jobs where a greater level of containment is not necessary (but would have been prescribed), resulting in an efficiency gain for society as a whole. However, renovators do not have perfect information and EPA's studies indicate that few, if any, renovations that disturb painted surfaces can be performed in such a way that dust and debris from the activity is confined to a smaller areas established in the rule.

The work practices in the rule are not effective at containing the spread of leaded dust when certain high dust generating practices are used, or at cleaning up lead-based paint hazards created by these practices. Thus, the work practices are not effective at minimizing exposure to lead-based paint hazards created during renovation activities when these activities are used. Accordingly, the rule prohibits or restricts the use of certain work practices during regulated renovations.

3.3.3 Alternative Regulatory Options

In light of the prior discussion, the regulatory options analyzed attempt to provide flexibility while also providing information on what action renovators and property owners need to consider undertaking in order to contain and clean-up potential lead contamination. These work practices are combined with training to ensure that renovators will have the information they need to properly conduct RRP events in a protective manner.

Several alternative regulatory options are considered. The main difference among the options is the scope of the target housing units and public or commercial building COFs subject to the regulation based on year built (1978 or 1960) and whether all target housing of the specified vintage are covered, or only rental units and units where a child under the age of six resides. The use of lead-based paint declined rapidly during the 1950s and 1960s, so buildings built between 1960 and 1978 are much less likely to have lead-based paint than those built before 1960 (See Chapter 2 for further discussion).

The LRRP Rule allows renovators to use a lead-based paint (LBP) test kit to determine whether lead-based paint is present in a building, but test kits currently on the market have false positive rates that range from 47 to 78 percent. Because pre-1960 units are more likely to contain lead-based paint than units constructed between 1960 and 1978, the LBP test kits will return more false positives for these newer units. EPA plans to develop a more accurate LBP test kit, which is expected to have a false positive rate of only 10 percent or less and to be available by the second year that the regulation is in effect. As such, by promulgating an option such as Options A or B that applies only to older units in the first year and to newer units in the second year, EPA could reduce the costs of the rule in the first year. Options C and D are not phased but cover a smaller universe, as they do not expand in scope in the second year. ~~Option~~Options E ~~is~~and F are also not phased in. More information on the options is provided in Chapter 4.

Appendix 3A: The Role of Elasticities in Determining the Impacts of a Rule

EPA is often faced with deciding on a regulatory policy in the absence of good information about the likely effects of the policy on consumers and producers. In particular, data on the own-price elasticity of supply and demand often are uncertain. This appendix provides background information on the likely effects of own-price elasticity of demand and supply on the outcomes of EPA's regulatory efforts. The bulk of the discussion focuses on the case of perfect competition, not because the majority of markets EPA is likely to affect will exhibit competitive behavior, but simply because the theory is clearly defined in this case. However, this appendix also examines the likely impacts of relaxing the assumption of perfect competition. It focuses on two general classes of regulatory options: regulations that alter the market outcome by imposing additional costs upon producers, and regulations that alter the market by providing information to consumers.

3A.1 Elasticities of Supply and Demand

The market equilibrium for a commodity (e.g., purchasing renovation, remodeling or painting (RRP) work that uses lead-safe work practices) is determined by the intersection of the aggregate demand and supply curves. The aggregate demand curve depicts consumer behavior and is based on consumer income and preferences. Likewise, the aggregate supply curve describes the behavior of producers in the market, and is dependent upon the costs of production. At market equilibrium, the price is referred to as market clearing. In other words, at this price, the quantity demanded by consumers and supplied by producers are equal and neither the consumer nor producer has any incentive to move away from this steady state as long as current demand and supply conditions prevail.

However, when demand and supply conditions do change, for example when new information causes consumers to adjust their preferences and thus shift the demand curve, or changes in input prices affect costs of production and shift the supply curve, the market gravitates to a new equilibrium. This new equilibrium is represented by a new combination of market clearing price and quantity. The magnitude of the change in price and quantity is dependent not only upon the extent of the shift in the demand or supply curve, but also on the own-price elasticity of demand and supply for the commodity.

The own-price elasticity of demand is defined as the ratio of the percent change in quantity demanded to the percent change in price, and is reflected in the slope of the demand curve, similarly for the own-price elasticity of supply. By determining the level of change in price and quantity, the elasticities of the two curves also determine the distribution of the burden or benefit between the consumer and producer resulting from a change in equilibrium conditions. Analyzing changes in consumer and producer surpluses provides a means for quantifying such distributional changes.

Figure 3A-1 below provides a hypothetical example of how the effects of regulation may impact consumer and producer surpluses. In the baseline, the supply curve is represented by S_1, and producers supply Q_1 at a price P_1. On all the inframarginal units supplied, producers receive a price above the cost of production. The difference between the price and the cost of production represents the producer surplus resulting from supplying Q_1 at price P_1 (triangle P_1CD). Similarly, in the baseline consumers demand quantity Q_1 at price P_1. For all the inframarginal units demanded, consumers would be willing to pay more than that price and thus receive a surplus. The difference between what consumers are willing to pay as measured by the height of the demand curve, and what they have to pay is the consumer surplus (triangle ACP_1).

So what are the effects of regulation? In Figure 3A-1, the upward shift in the supply curve to S_2 (say from a rise in production costs due to the implementation of the RRP rule which requires use of the more costly lead-safe work practices) results in a new equilibrium at the point B, with a new market price of P_2 and quantity of Q_2. Note that producer surplus decreases from P_1CD to EBP_2 and the consumer surplus also decreases from ACP_1 to ABP_2. Thus, in the arbitrary case drawn in Figure 3A-1, the social costs of the regulation are born by both consumers and producers of the pollution-generating good. This result turns out to be a function of the way the supply and demand curves have been drawn, and the distribution of costs between consumers and producers depends on the slope (elasticity) of the demand and supply curves.

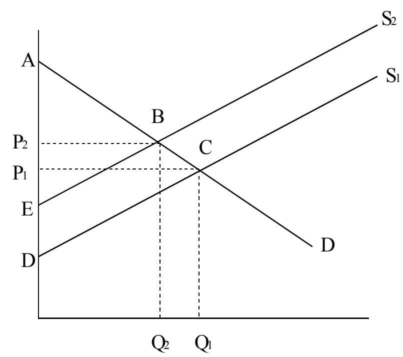


Figure 3A-1: Effect on consumer and producer surplus due to a supply curve shift

In general, for a given production cost increase, the more elastic the demand curve, the greater the inability on the part of the producers to pass the additional costs of production on to the consumers. As shown in Figure 3A-2 (a) and 3A-2 (b) below, the differing slopes of the demand curve lead to differential impacts on the consumer and producer surplus. In Figure 3A-2 (a) demand for the good is relatively price elastic, while in Figure 3A-2 (b) the good has a relatively inelastic demand. Notice that when demand is less elastic, the price increase resulting from a shift in supply is greater and consumers bear a greater share of the loss in consumer surplus. On the other hand, with a more elastic demand, the overall price increase is smaller and the share of total costs born by producers is larger.

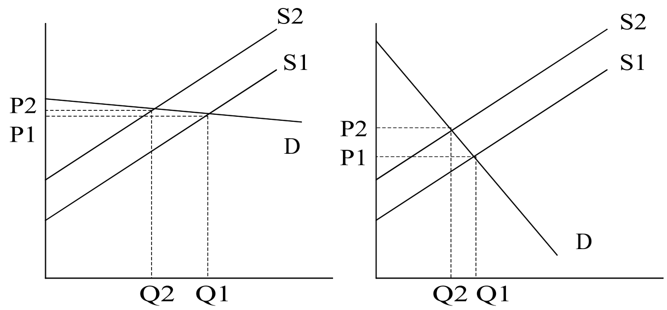


Figure 3A-2(a) Figure 3A-2(b)
2(a): Effect of a change in input prices when demand is elastic
2(b): Effect of a change in input prices when demand is inelastic

The elasticity of demand is determined in general by the existence of suitable substitutes for a commodity. If several commodities exist in the market that are considered to be close substitutes for each other, then a consumer is likely to have a great deal of choice available to him while making his consumption decision. This being the case, if the price of the commodity that he is presently consuming happens to rise, he is easily able to reduce his current consumption level of that commodity and switch over to consuming more of one of the substitutes. This flexibility limits the ability of the producer to pass on the burden of the cost increase on to the consumer. Thus, the availability of close substitutes in the market explains why the demand curve for a commodity will be relatively elastic, and why the rise in price will be relatively small. On the other hand, if substitutes are lacking for a commodity that experiences a price increase (and it is not a luxury good), then the consumer has little choice but to carry on consuming similar quantities of the same product. Thus, in this situation he will have to shoulder a larger share of the increased costs by paying a much higher price, and this rigidity in his consumption behavior explains the inelastic nature of the demand curve for that commodity.

Recognizing that most markets are not perfectly competitive, product differentiation allows firms to charge prices higher than marginal costs and charge different prices for similar goods. The degree to which producers can pass on the cost of production depends heavily on the degree to which they can convince consumers that their product is different from other products. In its limit this argument is just a restatement of the fact that markets with lower elasticities of demand will experience higher price increases. If "market demand" is defined to be the demand for a single brand of good, then the number of substitutes for the good affects its demand elasticity and thus affects the degree to which the producer can pass on cost increases. If the firm can convince consumers that the product is distinct then it in essence lowers the elasticity of demand for its product.

The own price elasticity of supply, on the other hand, is dependent on the degree of specialization of inputs. If the inputs are highly specialized or firms are locked into long-term contracts then firms in this industry can be left with substantial sunk investments creating high transition costs which are reflected in an inelastic supply curve. However, if supply is highly elastic then firms can easily switch production to other uses and minimize the effect of the demand shock. In essence the elasticity of supply measures the amount of resources lost or tied up indefinitely when consumption patterns change suddenly.

The EPA seeks to reduce hazards from lead-based paint by two separate pathways of regulatory impact. First, it hopes to reduce exposure to lead-based paint by regulating the "method of production" of RRP work in target housing and COFs by establishing standards for such activities and through requiring certifications and/or training. This is likely to result in an increase in the "costs of production" of RRP work thereby affecting the supply curve for such activities. Second, the LRRP rule will provide information to consumers. In this case EPA is likely to alter the market outcomes by changing the demand for products (lead-safe and non lead-safe work practices). To the extent that the demand and supply of RRP work will be affected by the rule, one must consider the price elasticities involved to determine the distributive impact of the rule on consumers and producers.

An important factor on which the price elasticity will depend is the number of substitutes that exist for the RRP service that is sought in the market. As previously explained, the greater the number of available substitutes, the more elastic the demand and lesser the burden of a production cost increase likely to fall on the consumer. Under this rule three classes of substitutes may be said to exist for RRP services. These are (1) professionals using lead-safe work practices, (2) professionals using non lead-safe work practices, and (3) the do-it-yourself jobs. Thus, a certain amount of flexibility is available to the consumer when it comes to hiring RRP services.

Currently a sizeable number of RRP firms may not necessarily be following lead-safe work practices thereby limiting the size of the class of firms that do so. However, with the implementation of the LRRP rule, a much larger number of firms are expected to adhere to these practices in the future, thus enlarging the size of this class. In addition, this increase in the number of professionals using lead-safe work practices will also have a geographical impact. Presently, the limited number of professionals who use lead-safe work practices are concentrated in a select number of locations where state and local regulations have fostered their development. As a result, in many parts of the country the choice of hiring "lead-safe" professionals currently does not exist. But this situation will change as a larger number of firms switch to lead-safe work practices once the LRRP rule come into effect.

However, if the increase in production costs from the rule is extremely high such a large transition of firms from using lead-unsafe to lead-safe work practices may not occur. This is because the cheaper option of using non-certified (non lead-safe work practice using) RRP workers or doing the work yourself will limit the ability of the certified (lead-safe work practice using) professional to charge the consumer for all or a large portion of this significant cost increase. In this situation a large number of lead-unsafe firms may remain in existence. Thus, one may assume that as long as an appreciable difference exists between "costs of production" of lead-safe and non lead-safe work practices, firms of both types will continue to exist. The continued existence of firms using non lead-safe practices also depends on the extent and effectiveness of enforcement activities. The greater the cost differential between lead-safe and non lead-safe practices, the greater the need for enforcement activities.

In addition to the number of substitutes, the closeness of substitutes in their ability to replace one another needs to be judged. The important question is whether RRP work done by uncertified professionals and the do-it-yourself efforts are substantially less safe than the services of certified professionals. To the extent an appreciable difference exists between the quality of service (in terms of preventing or reducing lead-based paint hazards) provided by the two groups, they will not be perceived as close substitutes for each other and their demand curves will not be as elastic as they would have been if they were considered close substitutes. In such a situation, consumers feel that a sufficiently differentiated product is being offered by the two groups, and thus their choice is limited.

This judgment on the degree of closeness of substitutes will to some extent depend upon the importance that lead safety holds with the property owner compared to other priorities. To the extent that the priority assigned to lead exposure is relatively small, the uncertified professionals and do-it-yourself jobs will tend to be seen as closer substitutes for certified professionals, than if lead-based paint hazards are perceived as a larger threat by the property owner. Thus, the elasticity of demand will also vary according to owner priorities, and in this regard, the informational aspect of the LRRP rule may in fact assist in raising more awareness, resulting in lead safety being assigned a higher priority.

Of a related nature, the firm certification aspect of the rule is likely to increase consumer ability to differentiate between the services being offered by the three classes of substitutes. The certification process will create a distinct divide which will permit the property owner to get a better appreciation of the varied benefits to be gained from the alternatives at hand. This is likely to reduce to some extent the perceived closeness of the substitutes and thereby make the demand more inelastic for each class of RRP service.

3A.2 How Price Elasticity of Demand Affects the RRP Rule

As discussed above, EPA foresees two separate pathways by which the LRRP rule will take affect; increasing costs of production leading to a shift in supply and provision of information to consumers leading to a shift in demand. The way these two effects will play out and the role that price elasticities will play in the adjustment of prices and quantities under the two scenarios is discussed below.

3.3.4 *3A.2.1 Effect of RRP Rule on the Cost of Production (Supply Shift)*

EPA seeks to reduce exposure to lead-based paint hazards by the introduction of lead-safe work practices during RRP work. These practices involve the use of increased precautions in situations where lead-based paint hazards may potentially be created during RRP work, and as a result costs of RRP work are likely to increase above current levels. Since producers seek to maximize profits and in the baseline will produce goods using the lowest-cost combination of inputs, a rule requiring producers to change their input mix will necessarily increase the cost of production. Thus, one impact of the rule will be to increase the production costs, leading the supply curve to shift upward and to the left.

Figures 3A-2(a) and 3A-2(b) demonstrate the distributional affects of such a hypothetical shift in supply in markets with different elasticities of demand. The price increase is much higher (P1 to P2) and the decrease in quantity demanded is much lower (Q1 to Q2) with a given shift in supply when demand is less elastic (as shown in Figure 3A-2(b)) as compared to the elastic demand scenario in Figure 3A-2(a). Thus, the consumers bear a higher share of the total social cost from the regulation (represented by the relatively larger decrease in the consumer surplus compared to that in the producer surplus). On the other hand, Figure 3A-2(a) shows that the higher the elasticity of demand, the lower the overall price increase, the larger the reduction in quantity demanded, and thus the larger the share of total costs to be born by producers (represented similarly by the larger decrease in producer surplus as compared to the consumer surplus).

3A.2.2 Effect of LRRP Rule on the Provision of Information to Consumers (Demand Shift)

The alternative regulatory approach is to provide information to consumers in the hopes that they will make more environmentally friendly consumption choices. In this case EPA alters the market outcomes by changing the demand for products. Figures 3A-3(a) and 3A-3(b) depict such a hypothetical example. In these cases the commodity in question (non lead-safe work practices) has negative environmental effects (byproducts). By educating consumers about these byproducts and alternative products that have lower levels of adverse effects (lead-safe work practices), EPA can change consumer preferences and shift demand for the "bad product" inward and to the left. This lower demand curve would more accurately reflect the true "social" marginal benefits of consuming the product.

What are the likely distributional and efficiency effects of this type of regulatory policy? Figures 3A-3(a) and 3A-3(b) reveal that under both scenarios (for an elastic and inelastic supply curve), the downward shift in the demand curve will lead to a decrease in price and quantity demanded of the commodity. However, in the case of an elastic supply curve when the transition costs associated with switching to the production of other products is relatively low, the decrease in price of the commodity is smaller and the decrease in quantity demanded larger, as compared to the changes in the case of an inelastic supply curve involving high transition costs. Restated in terms of changes in producer and consumer surpluses, the producer surplus is reduced under each scenario, but the elastic supply curve causes a relatively smaller burden to fall on the producer than the inelastic supply curve. Similarly, the consumer receives a reduction in social benefit under each scenario, however, the magnitude of this reduction is larger under the inelastic supply curve case.

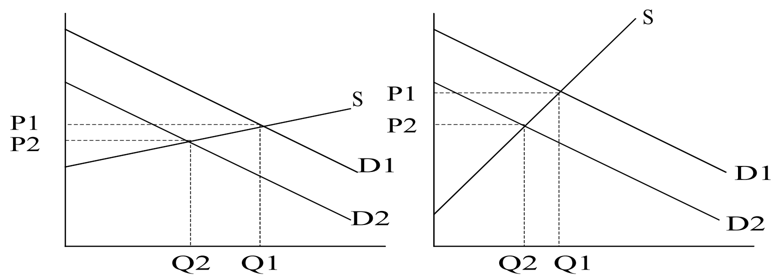


Figure 3A-3(a) Figure 3A-3(b)
3(a): Effects of a regulation-induced change in demand when supply is elastic
3(b): Effects of a regulation-induced change in demand when supply is inelastic

3.3.5 3A.2.3 Application to Renovation

In the LRRP rule, EPA is both affecting production and providing information. The likely effects of the regulation on prices and welfare are difficult to discuss without more accurate information on the supply and demand elasticities. However, some general observations are warranted.

The welfare effects of the regulation will likely be driven by the supply side rather than the demand side. This is because the elasticity of supply for RRP services is likely to be relatively higher than the elasticity of demand. Supply elasticities are expected to be relatively high because there are relatively few barriers to entering or leaving this industry. Little capital equipment or specialized labor skills are needed for RRP work, and what is needed is easily transferred from non-compliant renovation to “lead-safe” projects. On the demand side, there are two primary categories of RRP events – those of a maintenance character and those of an improvement character. Maintenance activities usually cannot be postponed and thus are not particularly sensitive to price. Improvement projects, however, can more easily be postponed and thus tend to be more price elastic. Complicating matters, however, are the existence of different categories of purchasers. Some place a high premium on quality and timeliness, while others actively seek low prices. Appendix 3B discusses some of the empirical evidence on elasticities of demand and supply.

However, the analysis does not suggest that the education factor is unimportant. If the regulation is not accompanied by education efforts and enforcement, then EPA could unintentionally drive up demand for non-compliant renovation projects creating additional welfare losses. These losses are the result of the fact that if consumers were aware of the lead paint issues their true marginal valuation for the non-compliant projects is lower than the price of these projects. Thus, if enforcement is not perfect, education is essential. EPA can compensate for the fact that it is raising the costs of lead-free renovation on the supply side by educating consumers on the environmental effects of non-compliant renovations thereby making these cheaper, non-compliant projects less attractive.

Appendix 3B: Elasticities of Demand and Supply for Housing / Renovation Services

As described in Chapter 3 and Appendix 3A, the impact of increases in the cost of RRP services on demand for RRP will depend on both the size of the cost increase and the elasticity of demand for these services. Likewise, the impact on the supply of RRP services will depend on both the size of the cost increase and the elasticity of supply for these services. These impacts are expressed in terms of changes in price and in the quantity of services purchased. Chapter 4 estimates the cost increases due to the requirements of the various regulatory options, based on the increased labor and materials costs of complying with the containment and clean-up requirements, as well as the training and certification costs imposed by the requirements. This appendix reviews the existing literature on residential demand elasticities.

Unfortunately, RRP has received relatively little attention by housing economists. While there are many studies that estimate elasticities for new construction, these studies have only limited applicability to renovation and remodeling. The income elasticity of demand for housing is generally estimated to be somewhat inelastic (in the 1.0 to 0.8 range). This is consistent with housing being a necessity – expenditures on housing do not increase as rapidly as income (Green and Malpezzi 2003). Demand for housing is also considered to be somewhat price inelastic, with generally accepted values either in the range of -0.5 to -1.0 or -0.75 to -1.2 (Mayo 1981, Malpezzi and Maclennan 2001, Ellwood and Polinski 1979). One study is available that estimated a renovation demand elasticity (Gyourko and Saiz 2003). This study found renovation demand to be very inelastic, with an elasticity estimated to be –0.28.

On the other hand, housing supply appears to be very elastic – consistent with the highly competitive nature of the residential construction market and the large number of small contractors. Because it is very easy to enter (and to leave) the construction business, supply is very responsive to changes in prices, especially in the long run.[7] Based on the literature surveyed, estimates of housing supply elasticities tend to range from 1.0 to 4.0, but a couple of studies found elasticities as high as 13 or higher (DiPasquale and Wheaton 1994, Topel and Rosen 1988, Blackley 1999, Malpezzi and Maclennan 2001). No elasticity numbers specific to the supply of renovation services could be found.

Several characteristics of RRP tend to make its demand more price elastic than the demand for housing in general. For example:

- The existence of close substitutes to compliant RRP. These substitutes include:
    - Do-It-Yourself RRP –owners of buildings may be tempted to do their own RRP work without proper training and certification.
    - Firms that do not complying with the regulations. These regulations may be difficult to enforce against contractors, particularly the large number of small contractors who may be hard to identify and monitor.

[7] Note – stock adjustment models give lower elasticities than flow models. Malpezzi and Maclennan (2001).

  - Reductions in the scope of the projects, or postponement of the projects, to compensate for the price increase. Purchasers can reduce other RRP-related costs by substituting lower-priced fixtures/finishes and/or less extensive remodeling.
- Many RRP projects are discretionary. The price elasticity of discretionary projects is likely to be higher than replacement projects (e.g. new roof). For discretionary RRP projects, it is relatively easy for the purchaser to reduce the scale/scope of the project, postpone the project, or never do it.

Offsetting these characteristics that foster higher elasticities of demand, are ones that foster lower elasticities. The major one is that the product purchased cannot be separated from the firm providing the product, which is true of all services. In addition to the various RRP events analyzed in the subsequent chapters, RRP firms themselves are relatively differentiated. Some firms specialize in high-end, complicated projects (e.g. elaborate new kitchens) while other firms specialize in performing small routine tasks (repainting apartments at tenant turn-over). Some firms only work in historic or Victorian homes, while others will work on any type of home. Some firms do only one type of project (e.g. replacing siding) while other firms will do any and all types of RRP work. This differentiation results in lower demand elasticities, because producers may not be considered particularly close substitutes.

- To the extent that lead-safe work can be distinguished from non-lead-safe work, a higher price can be charged for it.

- Many contractors already employ lead-safe practices (or at least control the dispersion of dust and clean well before leaving). The regulations will serve to reduce this differentiation.

Second, the nature of RRP projects may also reduce price competition. For relatively small jobs, property owners frequently will not get multiple bids – the assumed cost of the job does not warrant the effort. In this case, the compliance cost can be passed on without fear of losing the work. In the case of large jobs, where owners will get bids, compliance costs will make up a relatively small proportion of the total cost and, again, passing on the costs may be easy.

Characteristics of the purchaser of the RRP services may also affect their demand price elasticity. High-income purchasers are likely to be less price sensitive than low-income purchasers. In addition, owners of rental properties may be more price sensitive than owner occupants because they have different objective functions. Owner-occupants operate so as to maximize their utility (their enjoyment of the house) and asset growth is likely to enter their decision as a secondary factor. Owners of rental housing, on the other hand, are assumed to be maximizing their profits. It is reasonable to expect that the optimal level of capital of an absentee landlord's rental building is lower than that of an owner-occupier's house, since the landlord's marginal rent revenue from renovations is likely to be less than the homeowner's marginal utility.

Because of the lack of detailed price elasticity estimates for RRP, the analysis in the Chapters 4, 5 and 6 do not incorporate any reduction in professional RRP activities in response to the cost increases resulting from the regulation.

References:

Blackley, D.M. 1999. "The Long-Run Elasticity of New Housing Supply in the United States: Empirical Evidence for 1950 to 1994." *Journal of Real Estate Finance and Economics*, 18: 25-42.

California Department of Health Services (CA DHS). 1999. Title 17, California Code of Regulations, Division 1, Chapter 8: Accreditation, Certification, and Work Practices for Lead-Based Paint and Lead Hazards. Available at: http://www.dhs.ca.gov/childlead/pdfs/Title17.pdf

California Department of Health Services (CA DHS). 2003. Summary of California's Lead Hazard Reduction Enforcement: Senate Bill 460. Available at: http://www.lacity.org/lahd/SB460.pdf

Center for Disease Control. 1997. "Children with Elevated Blood Lead Levels Attributed to Home Renovation and Remodeling Activities -- New York, 1993-1994." *Morbidity and Mortality Weekly Reports*. 45(51&52);1120-3. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/00045033.htm.

Center for Disease Control. 2002. Managing Elevated Blood Lead Levels Among Young Children (March).

Center for Disease Control. 2004. Preventing Lead Exposure in Young Children: A Housing Based Approach to Primary Prevention of Lead Poisoning: Recommendations from the Advisory Committee on Childhood Lead Poisoning Prevention (October).

Center for Disease Control. 2005. "Blood Lead Levels --- United States, 1999—2002." *Morbidity and Mortality Weekly Reports.* 54(20);513-516. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5420a5.htm#tab1.

City of Cleveland. 2004. *Ordinance No. 1027-04.* Available at: http://www.ehw.org/Lead/documents/finalleadordinance.pdf

City of New Orleans. 2001. *Ordinance No. 20345 Mayor Council Series*. Available at: https://secure.cityofno.com/resources/portal47/finordin.pdf

City of New Orleans. *Work Practices for Renovations to Buildings Containing Lead-Based Paint*. Available at: https://secure.cityofno.com/resources/portal37/leadpaint.pdf

Chicago Department of Public Health (CDPH). *City of Chicago Department of Public Health Control and Mitigation of Lead Bearing Substance.* Available at: http://egov.cityofchicago.org/webportal/COCWebPortal/COC_EDITORIAL/LeadReg.5.19.04_3.pdf.

Commonwealth of Massachusetts. 1999. *454 CMR 22.00: Deleading Regulations.*

DiPascale, Denise and William C. Wheaton. 1994. "Housing Market Dynamics and the Future of Housing Prices." Journal of Urban Economics, 35: 1-27.

Ellwood, David and Mitchell Polinski. 1979. "An Empirical Reconciliation of Micro and Grouped Estimates of the Demand for Housing," Review of Economics and Statistics, 61:199-205.

Frazier, Kendra, California Department of Health Services, Compliance and Enforcement. Personal communication, August 2005.

Green, Richard K. and Stephen Malpezzi, 2003, A Primer on U.S Housing Markets and Housing Policy, AREUEA Monograph Series No. 3, The Urban Institute Press, Washington DC.

Gyourko, Joseph and Albert Saiz. 2003. *Urban Decline and Housing Reinvestment: The Role of Construction Costs and the Supply Side*. Federal Reserve Bank of Philadelphia. Working Paper 03-9.

Holston, David. Ohio Department of Health Lead Poisoning Prevention Program. Personal communication, August 2005.

Indiana State Department of Health. 2001. Article 23. Lead-based Paint Program. Available at: http://www.ai.org/legislative/iac/T03260/A00230.PDF.

Indiana Department of Environmental Management. 2003. "Lead Poisoning Prevention in Indiana – Reducing Lead Hazards During Maintenance, Renovation and Abatement." Available at: http://www.in.gov/idem/your_environment/lead/catalog/lead_contractor.pdf. Downloaded: (9/11/2006).

Kansas City Health Department. *Article X. Lead Poisoning Control.* Available at: http://www.kcmo.org/health.nsf/web/ordinance?opendocument.

Lamberti, Paul. Supervisor, Lead/Asbestos Unit at the New Jersey Department of Community Affairs. Personal communication. August 2005.

Malpezzi, Stephen and Duncan Maclennan. 2001. "The Long-Run Price Elasticity of Supply of New Residential Construction in the United States and the United Kingdom," Journal of Housing Economics, 10: 278-306.

Mayo, Steven K. 1981. "Theory and Estimation in the Economics of Housing Demand, Journal of Urban Economics, 10 (January) 95-116.

National Center for Healthy Housing. 1999. "San Francisco Ordinance." http://www.centerforhealthyhousing.org/SF_Lead_Ordinance.pdf

National Council of State Legislatures. 2005. *State Lead Statutes*. Available at: http://www.cdc.gov/nceh/lead/Legislation%20&%20Policy/State%20Lead%20Statutes%20Jan%205,%202005%20NCSL.PDF.

New Jersey Department of Community Affairs (NJ DCA). 2004. Regulations for Lead-Safe Maintenance of Rental Property. Available at: http://www.state.nj.us/dca/codes/lead_safe/combined_lead_regs.pdf.

New York City Department of Housing Preservation and Development (NY DHPD). 2004a. *Local Law 1/2004 – Section by Section Analysis.*

New York City Department of Housing Preservation and Development (NY DHPD). 2004b. *Local Laws of the City of New York for the Year 2004: No. 1*. Available at: http://dhfs.wisconsin.gov/waldo/Registry/index.htm.

Ohio Administrative Code. 2006a. "Rules for Licensed Child Care Centers." Available at: http://jfs.ohio.gov/cdc/docs/PDF-Chapter12.pdf. Downloaded (8/17/2006).

Ohio Administrative Code. 2006b. "Rules for Licensed Type A Child Care Homes." Available at:. Downloaded (8/17/2006).

Oregon Department of Human Services Office of Public Health Systems (OR DHS). 2003. *Oregon Administrative Rule (OAR) 333-069.* Available at: http://arcweb.sos.state.or.us/rules/OARs_300/OAR_333/333_069.html.

Oregon Department of Human Services Office of Public Health Systems (OR DHS). Lead-Based Paint Permit Application. Available at: http://www.oregon.gov/DHS/ph/leadpaint/docs/permitapp.pdf.

Oregon Department of Human Services. 2006. "Lead Safe Guide – Fact Sheet." Available at: http://www.oregon.gov/DHS/ph/leadpaint/docs/leadsafeguide.pdf. Downloaded (1/18/2007).

Ohio Department of Jobs and Family Services. 2005. "Regulations for Certified Type B Home Providers." Available at: http://www.odjfs.state.oh.us/forms/file.asp?id=43684. Downloaded (8/17/2006).

President's Task Force on Environmental Health Risks and Safety Risks to Children. 2000. Eliminating Childhood Lead Poisoning: A Federal Strategy Targeting Lead Paint Hazards (February).

Residential Lead-Based Paint Hazard Reduction Act of 1992, Pub. L. no. 102-550. 106 Stat. 3672 (1992).

Rhode Island Department of Environmental Management (RI DEM). Air Pollution Control Regulation No. 24: Removal of Lead Based Paint from Exterior Surfaces. Available at: http://www.dem.ri.gov/pubs/regs/regs/air/air24_93.pdf.

Rhode Island Department of Environmental Management Office of Technical and Customer Assistance (RI DEM). 2005a. Exterior Lead Paint Removal Certification Program (Brochure). Available at: http://www.dem.ri.gov/programs/benviron/assist/extlead/pdfs/mailer.pdf.

Rhode Island Department of Environmental Management Office of Technical and Customer Assistance (RI DEM). 2005b. *Environmental Compliance Certification Program: Certification Checklist Package for Exterior Lead Paint Removal Contractors*. Available at: http://www.dem.ri.gov/programs/benviron/assist/extlead/pdfs/cheklist.pdf

Rhode Island Department of Environmental Management Office of Technical and Customer Assistance (RI DEM). 2005c. *Certified Contractor List*. Available at: http://www.dem.ri.gov/programs/benviron/assist/extlead/pdfs/conlist.pdf.

Rhode Island Department of Health (RI DOH). 1992. *Rules and Regulations for Lead Poisoning Prevention [r23-24.6-pb]*. Available at: http://www.rules.state.ri.us/rules/released/pdf/DOH/DOH_3357.pdf.

Rhode Island Housing Resources Commission. 2003. Lead Hazard Mitigation Regulations. Available at: http://www.hrc.ri.gov/pdf/LeadHazard_Mitigation_Regs.pdf.

San Francisco Department of Building Inspection. (DBI) 1999. Chapter 36 of the *San Francisco Building Code*. Available at: http://www.centerforhealthyhousing.org/SF_Lead_Ordinance.pdf.

State of Colorado. 2005. "Rules and Regulations Governing the Health and Sanitation of Child Care Facilities in the State of Colorado." Available at: http://nrc.uchsc.edu/STATES/CO/co_facility.htm. Downloaded (7/20/2006).

State of Maine. 2004. Title 38, Chapter 12-B, Lead Abatement (Heading: PL 1997, c.375, @14(new)). Available at: http://janus.state.me.us/legis/statutes/38/title38ch12-B.pdf.

State of Maryland. 1994. *The Lead Poisoning Prevention Program. Environmental Article 6-8 (Housing Bill 760).*

State of Vermont. 2001. "State of Vermont Early Childhood Program Licensing Standards." Available at: http://nrc.uchsc.edu/STATES/VT/vt_early.html. Downloaded (1/8/2006).

State of Pennsylvania. 2005. "Chapter 3270: Child Day Care Centers." Available at: http://nrc.uchsc.edu/STATES/PA/pa_centersTOC.htm. Downloaded (8/29/2006).

State of Wyoming. 2001. "Wyoming Child Care Licensing Rules - Administrative Rules for Certification of Child Care Facilities." Available at: http://nrc.uchsc.edu/STATES/WY/wy_all.htm#pgfId-384631. Downloaded (8/29/2006).

Topel, R. and S. Rosen. 1988. "Housing Investment in the United States." *Journal of Political Economy*, 96: 718-740.

U.S. Department of Housing and Urban Development (HUD). 1990. *Comprehensive and Workable Plan for the Abatement of Lead-Based Paint in Privately Owned Housing: Report to Congress*. Washington, DC, February.

U.S. Department of Housing and Urban Development (HUD). 1995. Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing (June).

U.S. Department of Housing and Urban Development (HUD). Data as of August, 2000. *National Survey of Lead and Allergens in Housing.* Office of Healthy Homes and Lead Hazard Control, Washington, DC.

U.S. Department of Housing and Urban Development (HUD). 2004b. Requirements for Notification, Evaluation, and Reduction of Lead-based Paint Hazards in Housing Receiving Federal Assistance and Federally Owned Residential Property Being Sold (Lead Safe Housing Rule); Final Rule, Conforming Amendments and Corrections. Federal Register (69 FR 34262, June 21, 2004).

U.S Department of Housing and Urban Development (HUD) and U.S. EPA. 1996. Lead; Requirements for Disclosure of Known Lead-Based Paint and/or Lead-Based Paint Hazards in Housing; Final Rule. Federal Register (61 FR 9064, March 6, 1996)

U.S. Department of Labor, Occupational Safety and Health Administration (OSHA). 1993. Lead Exposure in Construction; Interim Final Rule. Federal Register (58 FR 26590, May 4, 1993).

U.S. EPA. 1984. EPA Policy for the Administration of Environmental Programs on Indian Reservations (November 8).

U.S. EPA. 1995. Lead Hazard Information Pamphlet; Notice of Availability. Federal Register (60 FR 39167, August 1, 1995).

U.S. EPA. 1996. Lead; Requirements for Lead-Based Paint Activities in Target Housing and Child-Occupied Facilities: Final Rule. Federal Register (61 FR 5778, August 29, 1996).

U.S. EPA. 1997. "Reducing Lead Hazards When Remodeling Your Home." Available at: http://www.epa.gov/oppt/lead/pubs/rrpamph.pdf

U.S. EPA. 1998. Lead; Requirements for Hazard Education Before Renovation of Target Housing; Final Rule. Federal Register (63 FR 29908, June 1, 1998).

U.S. EPA. 1999. Lead; Fees for accreditation of Training Programs and Certification of Lead-based Paint Activities Contractors; Final Rule. Federal Register (64 FR 31092, June 9, 1999).

U.S. EPA. 2001b. Lead; Identification of Dangerous Levels of Lead; Final Rule. Federal Register (66 FR 1206, January 5, 2001)

U.S. EPA. 2004a. Lead; Notification Requirements for Lead-Based Paint Abatement Activities and Training; Final Rule. Federal Register (69 FR 18489, April 8, 2004)

U.S. EPA. 2004b. Targeted Grants to Reduce Childhood Lead Poisoning; Notice of Funds Availability. Federal Register (69 FR 69913, December 1, 2004).

U.S. Environmental Protection Agency (EPA). 2005c. Air Quality Criteria for Lead (First External Review Draft). EPA/600/R-05/144aA-bA. December. **http://cfpub2.epa.gov/ncea/cfm/recordisplay.cfm?deid=141779**

U.S. EPA, Consumer Product Safety Commission, U.S. Department of Housing and Urban Development (HUD). 2003. Protect Your Family From Lead in Your Home (EPA 747-K-99-001, June 2003).

Vermont Statutes Online. 2005. *Title 18: Health. Chapter 38: Lead Poisoning.* Available at: http://www.leg.state.vt.us/statutes/fullchapter.cfm?Title=18&Chapter=038

Wisconsin Department of Health and Family Services (WI DHFS). 2003. *Chapter HFS 163. Certification for the Identification, Removal and Reduction of Lead-Based Paint Hazards.* Available at: http://www.legis.state.wi.us/rsb/code/hfs/hfs163.pdf.

Wisconsin Department of Health and Family Services (WI DHFS). 2005. *Lead-Free/Lead-Safe Registry*. Available at: http://dhfs.wisconsin.gov/waldo/Registry/index.htm.

4. Compliance Costs of the Renovation, Repair, and Painting Rule

The costs associated with the regulatory impact of the §402(c) Lead Renovation, Repair, and Painting (LRRP) Rule are divided into four categories for the purposes of this analysis: (1) work practice costs, (2) training costs, (3) certification costs (which include the firm's paperwork burden and EPA administrative and enforcement costs), and (4) pre-renovation education costs. The general approach of the analysis is to first estimate the number of affected activities or entities, then estimate the incremental regulatory cost per-activity or entity affected. Finally, the incremental costs and the number of affected activities and entities are combined to estimate the total costs. The analysis first estimates the total costs associated with the first four years of regulation; then, the analysis extrapolates to the costs of the regulation over a fifty year period—estimated with three and seven percent discount rates.

The chapter is organized as follows: Section 4.1 defines the regulatory options considered in this analysis; Section 4.2 estimates the number of regulated renovation, repair, and painting events under the various regulatory scenarios; Section 4.3 presents the estimated costs of using the required work practices; Section 4.4 presents the estimated number of firms, renovators, and workers seeking training and certification; Section 4.5 presents the incremental training costs; Section 4.6 presents the estimated certification, administrative and enforcement cost estimates; Section 4.7 presents the pre-renovation education cost estimates; Section 4.8 presents the total costs of the regulation; and Section 4.9 presents the total costs associated with various alternative regulatory options. Section 4.10 presents the cost estimates for Option F, which is the option selected for the final rule.

4.1 Definitions of Options

This analysis examines six report analyzes seven regulatory options. Six final rule options (Options A through E differ in terms of the universe of the structuresF) were analyzed; they affect indiffer from each year (rule other in the scope of the housing units and phasing in of coverage). Option P is the option that was proposed COFs covered by EPA in 2006, including the supplemental requirements proposed in 2007the rule. Specifically, the options differ in terms of:

- When the buildings were built (i.e. pre-1960 or pre-1978);
- Whether all owner-occupied housing units are covered or only owner-occupied units where a pregnant woman or child under the age of six resides;[1] and
- Whether the coverage is the same in all years or phased in over the first two years.

Options A though F are compared to Option P, the option that was previously analyzed in the economic analyses of the 2006 proposed rule and the 2007 supplemental proposal. Option P is included for comparison purposes, and is reanalyzed here using the cost and benefit models and assumptions developed for this report. The regulated universe under Option P is the same as under Option B. Option P, however, does not include any requirements for using vertical containment during certain exterior jobs, nor does it prohibit a prohibition on the use of any paint removal techniques for . By contrast, in renovations that requirefor which lead-safe work practices under the rule. Table 4-1 summarizes the options considered in this analysis; theyare required under the rule, Options A through F prohibit or restrict open-flame burning or torching of LBP; using machines that remove LBP through high speed

[1] The coverage of rental units does not depend on whether a pregnant woman or child is in residence.

operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are used with HEPA exhaust control; and operating a heat gun on LBP at 1100° F or higher. Option F (the Final Rule) covers the same housing units and COFs as Option E, but has a broader definition of minor maintenance exception and provides for 5-year certification and training periods as opposed to a 3-year period.[2]

The seven options are described in more detail below.

Table 4-1: Options Included in Economic Analysis

. For each option, the table describes the scope; the application of the minor maintenance exception; certification and training periods; the additional training required for previously trained individuals; how exterior containment requirements are described in the rule; whether any paint removal practices are prohibited for renovations requiring lead-safe work practices under the rule; and whether digital photographs are required as part of trainee registration.

Options P, A, and B are limited to Pre-1960 structures during Phase 1 of the regulation and their scope is expanded to structures built between 1960 and 1978 in Phase 2. Options C and D are limited to Pre-1960 structures in Phase 1 and Phase 2. Finally, Option Options E includes and F include Pre-1978 structures in Phase 1 and Phase 2. Options A and C include all public or commercial building COFs and target housing units within the vintage categories specified above. Options P, B, and D, include all rental units, all target housing COFs, and all owner-occupied target housing units where a child under the age of 6 resides within the vintage categories specified above—owner-occupied target housing units that are not COFs and where no child under the age of 6 resides are excluded. Option Options E includesand F include all rental units, all target housing COFs, and all owner-occupied target housing units where a child under the age of 6six or a woman who is or may be pregnant woman resides within the vintage categories specified above—owner-occupied target housing units that are not COFs and where no child under the age of 6six or woman who is or may bea pregnant woman resides are excluded. All Options consider compensation for renovation to include pay for renovation work or rental payments, but not payments for childcare.

[2] The minor maintenance exception is defined as 6 ft^2 or less per room for interiors or 20 ft^2 or less for exteriors, excluding renovations involving prohibited activities, demolition or window replacement. This different definition in Option F impacts the number of renovation events required to use lead-safe work practices. However, the difference between the number of events under Options E and F could not be estimated because sufficient data were not available.

Table 4-1: Options Included in Economic Analysis

Option	Scope: First Year	Scope: Second Year	Minor Maintenance Exception**	Digital Trainee Photos	Previously Trained Individuals	Exterior Containment	Prohibited Practices‡
Option P – *Proposed Rule Option*	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*	<2 ft^2 per component for interiors, <20 ft^2 for exteriors.	No	Certification given to those with previous relevant training.	Cover the ground a sufficient distance to collect falling paint debris.‡	None
Option A	All pre-1960 target housing and COFs.*	All target housing and COFs.	<2 ft^2 per room for interiors, <20 ft^2 for exteriors.	Yes	Certification given to those with previous training only if they complete a refresher course.	Cover the ground a sufficient distance to collect falling paint debris, with a minimum of 10 feet required. Ground covering would be supplemented with vertical containment where necessary.	Open-flame burning or torching of LBP; using machines that remove LBP through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are used with HEPA exhaust control; and operating a heat gun on LBP at 1100° F or higher.
Option B	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*					
Option C	All pre-1960 target housing and COFs.*						
Option D	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**						
Option E – *Preferred Option for Final Rule*	All rental target housing and COFs, and owner-occupied target housing *where a child under the age of six or a woman who is or may be pregnant resides.*						

* Plus all target housing units built before 1978 where a child with an increased blood-lead level resides, where an increased blood-lead level is defined as greater than or equal to 10 µg/dL or a State or local government level of concern, if lower.
** Not analyzed due to limitations with the data on the incidence of renovation, repair, and painting events.

~~† The use of vertical containment was implicit in the proposed rule, but was not included in the economic analysis of the proposal.~~
~~‡ Practices are prohibited or restricted for renovations requiring lead-safe work practices under the rule.~~

	Option	Scope: First Year	Scope: Second Year	Minor Maintenance Exception**	Certification & Training Periods	Previously Trained Individuals	Exterior Containment	Prohibited Practices	Digital Trainee Photos
Proposed Rule	P	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*	<2 ft^2 per component.	Firm certification and renovator training periods are 3 years each	Certification given to those with previous relevant training.	Cover the ground a sufficient distance to collect falling paint debris. †	None	No
Final Rule Options	A	All pre-1960 target housing and COFs.*	All target housing and COFs.	<2 ft^2 per room for interiors, <20 ft^2 for exteriors.		Certification given to those with previous training only if they complete a refresher course.	Cover the ground a sufficient distance to collect falling paint debris, with a minimum of 10 feet required.	Yes ‡	Yes
	B	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*						
	C	All pre-1960 target housing and COFs.*							
	D	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 where a child under the age of six resides.*							
	E	All rental target housing and COFs, and owner-occupied target housing *where a child under the age of 6 or a pregnant woman resides.*							
	F **Final Rule**	All rental target housing and COFs, and owner-occupied target housing *where a child under the age of 6 or a pregnant woman resides.*		<6 ft^2 per room for interiors, <20 ft^2 for exteriors.	Firm certification and renovator training periods are 5 years each				

* Plus all target housing units built before 1978 where a child with an increased blood-lead level resides.
** Not analyzed due to limitations with the data on the incidence of renovation, repair, and painting events. The minor maintenance exception is only available for renovations that do not use prohibited or restricted practices, and that do not involve window replacement or demolition of painted surfaces areas.
† The use of vertical containment was implicit in the proposed rule, but was not included in the economic analysis of the proposal.
‡ Practices prohibited or restricted for renovations requiring lead-safe work practices under the rule or qualifying for the minor maintenance exception: Open-flame burning or torching of LBP; using machines that remove LBP through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are

used with HEPA exhaust control; and operating a heat gun on LBP at 1100° F or higher.

4.1.1 Affected Universe

The term "target housing" is defined in TSCA Section 401 as any housing constructed before 1978, except housing for the elderly or persons with disabilities (unless any child under 6 resides or is expected to reside in such housing) or any 0-bedroom dwelling. A child-occupied facility (COF) is defined as ''a building, or portion of a building, constructed prior to 1978, visited regularly by the same child, under the age of six, on at least 2 different days within any week (Sunday through Saturday period), provided that each day's visit lasts at least 3 hours and the combined weekly visits last at least 6 hours, and the combined annual visits last at least 60 hours. Child-occupied facilities may include, but are not limited to, day-care centers, preschools and kindergarten classrooms." COFs include, but are not limited to, the following categories:

- **Kindergartens:** Located in public and private schools.
- **Pre-Schools and Daycare centers:** Organized (licensed) facilities located in public or commercial buildings.
- **Family daycare:** Organized (licensed) daycare facilities located in the provider's home.
- **Informal daycare:** Informal (i.e. not licensed) day care providers, including relatives and non-relatives. Some of these providers may be paid for their services.

Some COFs are also target housing (e.g., daycare facilities located in the provider's home).

4.1.2 Proposed Containment, Cleaning, and Verification Standards, by Option

The ~~proposed~~ containment, cleaning, and verification standards mentioned in this section are the same for Options A-~~E~~F. Option P, however, does not ~~include any requirements for using vertical containment during certain exterior jobs, nor does it~~ ban the use of any paint removal techniques.

Occupant protection

Under Section 745.85(a)(1), work areas must be clearly defined with signs warning occupants and other persons not involved in renovation activities to remain outside of the work area. These signs must be posted before beginning the renovation and must remain in place until the renovation has been completed and the work area has been verified to have been adequately cleaned. If warning signs have been posted in accordance with HUD's Lead Safe Housing Rule (24 CFR §35.1345(b)(2)) or OSHA's Lead in Construction Standard (29 CFR §1926.62(m)), additional signs are not required by this proposal.

Containing the work area

Under Section 745.85(a)(2), a firm must contain the work area so that no visible dust or debris leaves the work area while the renovation is being performed. Containment refers to methods of preventing leaded dust from migrating beyond the work area. It includes everything from the simple use of disposable plastic drop cloths to the sealing of openings with plastic sheeting.

Interior renovations

When planning a renovation project, special consideration should be given to determining the type of work site preparation necessary to prevent dust and debris from leaving the work area.

Renovation projects generate varying amounts of leaded dust, paint chips, and other lead-contaminated materials depending on the type of work, area affected, and applied work methods. For example, repairing a small area of damaged drywall would likely generate less lead-contaminated dust and debris than sanding a large area in preparation for painting.

Exterior renovations

For exterior projects, the firm preparing the work area would be required to close all doors and windows within and below the area undergoing renovation, and to cover the ground with plastic sheeting or other disposable impermeable material extending out from the edge of the structure a sufficient distance to collect falling paint debris. In addition, doors within the work area that must be used while the job is being performed would have to be covered with plastic sheeting to prevent dust and debris from entering the building.

Waste from renovations

Renovation projects can generate a considerable amount of waste material. Lead-contaminated building components and work area debris must be handled carefully to prevent the release of lead-contaminated dust and debris. Under Section 745.85(a)(3), a firm would be required to contain the waste from renovation activities to prevent releases of dust and debris before the waste is removed from the work area for storage or disposal. If a chute is used to remove waste from the work area, it must be covered. At the conclusion of each work day and at the conclusion of the renovation, waste that has been collected from renovation activities must be stored under containment, or behind a barrier that prevents release of dust and debris out of the work area and prevents access to dust and debris.

In addition, transporting lead-based paint waste in uncovered vehicles is a possible source of releases of paint chips or dust. Therefore, lead-based paint waste from RRP activities would be required to be transported under containment that prevents identifiable releases (e.g., inside a plastic garbage bag).

Cleaning the work area

Under Section 745.85(a)(4), a firm would be required to clean the work area until no visible dust, debris, or residue remains. The firm would also be required to conduct a more thorough, specialized cleaning, which would remove both visible debris and dust particles too small to be seen by the naked eye.

Cleaning verification

A firm would be required to conduct an additional cleaning verification step following the visual inspection. This step would involve wiping the windowsills and floors with specialized cleaning cloths and comparing them to a cleaning verification card developed and distributed, or otherwise approved, by EPA for the purpose of determining, through comparison of disposable cleaning cloths with the card, whether post renovation cleaning has been properly completed.

Exemptions

~~Under~~As defined in Section 745.~~82~~83, minor repair and maintenance activities (including minor electrical work and plumbing) are not considered renovations and would be exempt from the work practice requirements described above if they disrupt ~~2~~6 square feet or less of a painted surface per component.room for interior renovations or 20 square feet or less for exterior renovations. Such activities are only considered minor maintenance if they do not involve prohibited or restricted practices, window replacement, or demolition of painted surface areas.[3]

Section 745.82 would also exempt renovations from the work practice requirements of the rule if the renovations only affect painted components that a certified inspector or risk assessor has determined do not contain regulated lead-based paint (at least 1.0 mg/cm^2 or 0.5% by weight lead). Furthermore, Section 745.82 would exempt renovations that only affect painted components that have been demonstrated to be free of regulated lead-based paint through the use of an EPA-recognized test kit by a certified renovator. Test kits for LBP that are currently available have false positive rates that range from 47 percent to 78 percent. EPA believes that by the end of the first year of the regulation, improved test kits will be developed that will have a false positive rate of 10 percent or less.

4.2 Estimating the Number of Regulated Renovation, Repair, and Painting Events

4.2.1 Estimating the Number of Regulated Renovation, Repair, and Painting Events in Target Housing

To achieve the rule's objective of controlling lead exposure through containment, cleanup, and verification, most of the compliance costs associated with the RRP rule's work practices pertain to the room or area where the renovation work is performed. Therefore, this analysis defines a regulated event as any group of renovation tasks where two or more square feet of a painted surface are disturbed in a specific room or area of a housing unit. The 2003 American Housing Survey (AHS) is the primary data source for the estimates of regulated RRP events that occur in owner-occupied housing. The 1995 Property Owners and Managers Survey (POMS) is the primary data source utilized for estimating the number of regulated events in renter-occupied housing.

Event counts are estimated separately for single-family owner-occupied, single-family renter-occupied and multi-family units since compliance costs for the three types of housing differ (because the average unit size differs). In addition, the counts of exterior events for multi-family housing units are adjusted to correspond to building-specific compliance costs.[4]

Available renovation data do not include information specific enough to determine when a renovation task disturbs a painted surface, or when renovation tasks are performed together in the same room or area. Thus, it was necessary to make some assumptions about which types of renovation tasks are likely to disturb painted surfaces and which sets of tasks are likely to be performed together as part of one renovation project.

[3] Options P and A through E use a different definition for the minor maintenance exception than the final rule, but these differences were not analyzed due to limitations with the data on the incidence of renovation, repair, and painting events.

[4] For example, when siding is replaced on the outside of a three-unit building, the analysis accounts for this as *one* siding replacement event rather than the siding replacement outside of *three* units.

Data Sources

U.S. Census: American Housing Survey

According to the U.S. Census (2005g):

> The survey is conducted by the Bureau of the Census for the Department of Housing and Urban Development (HUD).
>
> The American Housing Survey (AHS) collects data on the Nation's housing, including apartments, single-family homes, mobile homes, vacant housing units, household characteristics, income, housing and neighborhood quality, housing costs, equipment and fuels, size of housing unit, and recent movers. National data are collected in odd numbered years, and data for each of 47 selected Metropolitan Areas are collected currently about every six years.

The surveys utilized in this analysis, 1997 and 2003, have sample sizes of 45,932 and 55,452, respectively. Of the housing units sampled, 33,549 and 35,996, for the 1997 and 2003 surveys respectively, have at least one bedroom, are not public housing, receive no rent subsidies, and were built before 1980. The 2003 AHS groups housing units built in the 1970's as units built between 1970-74 or 1975-1979, so this analysis counts all housing units built before 1980 in the pre-1978 regulated universe.

The sample weights provided by the U.S. Census for analyzing the AHS data were designed so that estimates using the provided sample weights would represent the population of housing in the nation. However, the U.S. Census weights were not designed to correct for underreporting within housing units—such as information reported on occupants living in the housing units. Since there is underreporting within-housing units, estimates of the number of individuals calculated using the U.S. Census weights results in lower population estimates than those estimated using other U.S. Census population data sources. In addition, according to Harvard's Joint Center for Housing Studies (personal communication with Kermit Baker August 2005), it appears that the 2003 survey labels too many housing units as vacant; these units are actually occupied by individuals that did not respond to the survey. To correct for this bias, the Joint Center for Housing Studies has adjusted the weights provided by the U.S. Census for the 2003 AHS. These adjusted weights provided by the Joint Center for Housing Studies are utilized for all of the calculations using the 2003 AHS in this analysis; population estimates calculated from the AHS are more closely aligned with other U.S. Census population estimates when calculated with these adjusted weights.

U.S. Census: Property Owners and Managers Survey

According to the U.S. Census (2005h):

> The Property Owners and Managers Survey (POMS) was designed to learn more about rental housing and the providers of rental housing. The purpose was to gain a better

understanding of the property owners and managers on whom the nation depends to provide affordable rental housing and what motivates their rental and maintenance policies. Interviewing for the survey was done between November 1995 and June 1996.

A nationwide sample of approximately 16,300 housing units which were rented or vacant-for-rent in the 1993 American Housing Survey National Sample (AHS-N) was selected, and a questionnaire was mailed to the property owner, manager, or other agent of the owner of each property containing a selected unit. Detailed information was collected on maintenance, management practices, tenant policy, financial aspects of rental property ownership, owner characteristics, and related topics.

POMS Sample Areas
The addresses included in the POMS sample were limited to counties and independent cities in the 438 sampling areas used for the Census Bureau's 1993 American Housing Survey (AHS) National Sample.

Units Included
A unit (and the property containing the unit) was included in the survey if it was a privately owned rental unit in the 1993 AHS-N, and was still rental at the time of the POMS (November 1995 to June 1996). A unit was considered rental if it was either rented for cash rent, occupied by someone other than the owner without payment of cash rent, or vacant but available for rent.

Since the POMS survey is relatively old (1995), this analysis first calculates the percentage of rental-housing units performing renovations according to the POMS and then applies these percentages to the corresponding number of rental-housing units in 2003 according to calculations using the AHS. This is described in greater detail in the section below.

Number of Regulated Events in Owner-Occupied Housing Units

The 2003 AHS is the primary data source used for estimating the number of RRP events in owner-occupied housing for which compliance costs will be incurred. The 1997 AHS is also used for estimating the number of RRP events since it contains some more specific renovation information that was not included in the 2003 survey. AHS respondents report information about the ages of householders, who are defined by the survey as persons who live or sleep there most of the time. Thus, child-occupied households are defined as those households with a householder under the age of 6 at the time of the RRP. This is estimated as households with a householder between the ages of one and seven at the time of the survey since it is assumed that any RRP reported occurred a year earlier (RRP performed up to two years earlier may be reported). It follows that a household is defined as being occupied by a ~~woman who is or may be~~ pregnant woman if there is a childbearing-aged woman and a child who is under the age of one at the time of the survey. This section describes how the numbers of events are estimated from the renovation module of the AHS and the methodology for estimating the number of Interior Painting and Exterior Painting events using data from the (one-time) 1997 lead paint module of the AHS.

AHS Renovation Tasks

The 2003 AHS allows respondents to report 40 different renovation tasks; this analysis categorized 24 of these 40 as tasks that may disturb more than 2 square feet of a painted surface. Since tasks performed within two years of the survey can be reported, it is assumed that half occurred in the first year and half occurred in the second (i.e. the total number of events counted for the two year period is divided by two). Since do-it-yourself RRP is not covered by the rule, only tasks that are reported to be performed by professionals are included in the analysis.

Table 4-2 lists these 24 renovation tasks by their event category. Note that while the respondents do not specifically report whether or not painted surfaces were disturbed, the survey instrument instructed them to only include major work.[5] The seven event categories (bathroom event, kitchen event, addition event, window/door event, wall-disturbing event, whole exterior event, contained exterior event) are defined based on the room or area where each renovation task is likely to be performed. When a household reports multiple tasks listed under the same event category, it is assumed that these tasks are performed together in the same area; therefore, one set of compliance costs are assumed to apply to each event. For example, a household reporting replacing their air conditioning system and replacing their heating system is assumed to incur the compliance costs associated with one wall-disturbing event. Similarly, when a household reports a wall-disturbing task that is not specific to a particular room as well as a room-specific task—e.g. remodeling the kitchen (specific to the kitchen) and replacing water pipes (not room-specific), the analysis accounts for the costs associated with whichever task requires a larger work area. In other words, when tasks specific to a room are reported together with tasks that are not specific to a room, it is assumed that the work area includes the specific rooms where other tasks are reported. However, if a household reports multiple room-specific events (such as remodeling the kitchen and bathroom), all of the room-specific events are counted.

As shown in Table 4-2 and discussed above, some tasks are not necessarily confined to a specific room or area of the unit. Most of these tasks are likely to involve disturbing a wall or the ceiling (e.g., replacing wiring or pipes); in these cases, the tasks are assigned to a wall-disturbing event. In addition, replacing windows or doors could be reported, these tasks are assigned to a window/door replacement event. The analysis differentiates between tasks that are likely to only disturb painted surfaces on walls or ceilings and those that involve adding and/or replacing windows and/or doors because lead-based paint (LBP) is more likely to be found on windows and doors; therefore, a LBP test kit result is more likely to be positive for LBP when testing these surfaces.

As stated above, the 2003 AHS did not explicitly ask respondents whether a renovation task involved disturbing a painted surface. Therefore, assumptions are made about which tasks might disturb paint in order to estimate the number of events subject to the rule's requirements. In general, when a reported task will sometimes involve disturbing a painted surface, it is assumed

[5] Specifically, the survey instrument instructed respondents with the following language: "We are only interested in jobs that were MAJOR alterations or improvements, such as rewiring, a new roof, new windows or doors. Do NOT include minor repairs or other routine maintenance."

that compliance costs are incurred each time that task is reported. For example, replacing internal water pipes will sometimes, but not always, require disturbing painted walls to access old pipes and replace them with new ones. However, the analysis makes no adjustment to account for the instances where no painted surfaces are disturbed (or when less than two square feet of a painted surface is disturbed). Sufficient data for making such an adjustment are not available. Thus, these assumptions may lead to an overestimate of the number of regulated events.

In the case of adding or replacing heating equipment (AHS task 58) and/or central air conditioning equipment (AHS task 57)—Heating Ventilation and Air Conditioning (HVAC) tasks—it is assumed that only a fraction of these HVAC tasks require disturbing a painted surface. In addition, 18 percent of the households reporting tasks listed in Table 4-2 reported at least one HVAC task without reporting any other wall-disturbing task. Therefore, assuming that all HVAC work requires disturbing painted surfaces would be likely to result in a substantial overestimate of regulated wall-disturbing events.

The percentages of HVAC tasks that are assumed to disturb painted surfaces are estimated using the 1997 AHS. Unlike the 2003 AHS, the 1997 AHS distinguishes between installing new HVAC equipment and replacing existing equipment. Since disturbing a painted surface is most likely to occur while performing work on the HVAC ducts (which often are behind painted walls), it is assumed that this occurs when new systems are installed but not when existing systems are replaced.[6]

In addition to these seven event definitions, Interior Painting events and Exterior Painting events are also estimated. The remodeling module of the 2003 AHS data does not cover these types of activities, so data from the 1997 (one-time) lead module are utilized to estimate the number of these events.

[6] When heating equipment work (but not air conditioning work) is reported, 7 percent and 9 percent of these tasks involve adding a new system for single- and multi-family units, respectively. When air conditioning equipment work (but not heating work) is reported, 36 percent and 17 percent of these tasks involve adding a new system for single- and multi-family units, respectively. When both heating and air-conditioning equipment work is reported, 52 percent and 29 percent of the households install a new system for single- and multi-family units, respectively.

Table 4-2: List of 2003 AHS Renovation Tasks, Grouped by Room or Area	
AHS Task ID	**Task Description**
	Bathroom Event
71	Remodeled bathroom
	Kitchen Event
72	Remodeled Kitchen
	Addition Event
7	Added Bathroom onto home
8	Added Kitchen onto home
9	Added Bedroom onto home
10	Added other inside room onto home
35	Bedroom created through structural changes
36	Other room created through structural changes
73	Bathroom created through structural changes
	Window/Door Event
45	Added/Replaced doors/windows to home
	Wall-Disturbing Event
40	Added/replaced internal water pipes in home
42	Added/replaced electrical wiring, fuse boxes, or breaker switches in home
47	Added/Replaced plumbing fixtures in home
55	Installed paneling or ceiling tiles
57	Added/replaced central air conditioning
58	Added/replaced built-in heating equipment
64	Other major improvements or repairs (up to three could be reported)
74	Added/replaced security system in home
	Whole Exterior Event
38	Added/replaced siding on home
	Contained Exterior Event
11	Added attached garage onto home
12	Added porch onto home
13	Added deck onto home
14	Added carport onto home
69	Added/replaced shed, detached garage, or other building

Interior Painting Events

In the 1997 AHS, respondents were asked two questions related to painting activities that are used to estimate the number of Interior Painting events. Respondents were asked:

- Was there any painting done on the inside of the unit?
- Before painting, did anyone sand or scrape off any of the old paint?

In contrast with the other AHS renovation questions, respondents were not asked to specify whether the work was performed by a professional. Thus, obtaining a count of the number of

Interior Painting events is not as simple as adding up the number of respondents that answered yes to both of these questions. It is also necessary to estimate: (1) how many of the respondents that had painting done with sanding or scraping hired a professional to do the work, and (2) how many of these events occur in conjunction with other professional events reported (so the analysis does not double count if, for example, someone painted with sanding or scraping in their kitchen and reported both painting with sanding or scraping and remodeling their kitchen).

It was assumed that 44 percent of the interior painting with sanding and scraping reported was performed by professionals. An Angie's List (Bucksot 2006) online poll found that 44 percent of respondents reported that they hired professionals to perform painting rather than doing it themselves. Since Angie's List is used to find professional contractors it seems likely that respondents would be more likely to hire professionals than the general population. Thus, this assumption may lead to an overstatement of the number of interior painting events that are subject to the rule.

Exterior Painting Events

This analysis assumes that exteriors of 100 percent of homes with some paint on their exterior are painted with sanding or scraping every eight years.[7] Since data on the percentage of homes with some paint on their exteriors are not available, it is assumed that 75 percent of homes have some exterior paint; this assumption is based on data from HUD's (2001) *National Survey of Dust Lead Hazards and Allergens in Housing,* which indicates that 70 percent of pre-1960 homes have some lead paint on their exterior. Since nearly all exterior painted surfaces on pre-1960 homes are likely to have some lead paint, it was assumed that slightly more, 75 percent, of all pre-1978 homes have exterior painted surfaces. The annual number of Exterior Painting events is estimated as one eighth of the number of regulated structures with exterior paint.

Number of Regulated Events in Renter-Occupied Housing Units

The 1995 POMS is the primary data source used for estimating the number of RRP events in renter occupied housing where compliance costs will be incurred. The 1997 and 2003 AHS are also used for estimating the number of renter-occupied RRP events, since these data contain more current estimates of the number of potentially regulated households as well as some other information not available from the POMS.

This section first describes how the POMS data are used to obtain the annual percentage of renter-occupied housing units where there is a regulated RRP event. Second, it describes the methods employed for combining the percentages estimated from the POMS and the AHS data to obtain an estimate of regulated RRP events in renter-occupied units for the first year the rule is in effect.

[7] According to the Painting and Decorating Council, exteriors of homes are usually painted every 4-12 years; thus, the analysis uses the midpoint, eight, for estimating the number of Exterior Painting events.

POMS Data

The POMS data generally has less detail then the AHS but is still the best source of renter-occupied renovation information available. The POMS asked property owners or managers about 12 or 13 types of maintenance and repair activities (for single-family and multi-family units respectively) and about 11 types of capital improvements that may have been made to their properties. It is likely that 12 of these maintenance, repair, or upgrade activities require disturbing painted surfaces; these activities are listed in Table 4-3 according to the event category that they are classified by in this analysis.

The percentage of units where at least one of the RRP activities listed under each event was performed is calculated by type of unit (single- or multi-family). Similarly to the owner-occupied event estimates, when multiple tasks are reported, it is assumed that these tasks are performed together in the same area. Therefore the compliance costs are estimated based on those associated with the task with the largest work area. Unlike in the AHS data, respondents were not asked whether sanding or scraping was performed before painting (and painting without sanding or scraping is not subject to the rule's requirements). Therefore, it is assumed that 40 percent of the households reporting interior painting are subject to the rule's requirements; this is based on the percentage of rental households that reported sanding or scraping before painting in the AHS.[8]

The POMS questions about capital improvements were asked about the entire property, rather than about a specific unit. To account for this it was assumed that a specific unit was worked on 40% of the time an upgrade was reported for a property. Since properties average about three units each, this assumption results in more renovation compared to the assumption that upgrades are performed on one unit at a time. The assumption utilized in this analysis results in renovation frequencies in multi-family properties that are similar to those estimated for single-family properties.

Since the POMS does not ask respondents about replacing windows or doors, the frequency that these tasks are performed is assumed to be the same in rental units as observed in owner-occupied units; 3.7 and 3.4 percent of owner-occupied single- and multi-family units, respectively, replace windows or doors each year. Since these improvements are likely to be reported in the POMS data as 'other major upgrades,' the numbers of these tasks that are reported are adjusted downward to reflect this. In summary, 37 and 23 percent of 'other major upgrades' reported in the POMS are assumed to be window or door replacements, for single- and multi-family units respectively.

Similarly to the methodology for the owner-occupied RRP event estimates, it is assumed that HVAC related activities do not always incur compliance costs. The analysis assumes that compliance costs are incurred 28 percent and 15 percent of the time, for single- and multi-family units respectively, which is the percentage of the time new equipment is installed when HVAC work is performed in owner-occupied units according to the 1997 AHS.

---

[8] The 40 percent of rental units that reported sanding or scraping before painting in AHS compares to the 35 percent of owner-occupied units units that reported sanding or scraping before painting.

Table 4-3: List of 1995 POMS RRP Activities that are Grouped by a Room or Area Specific Event
Interior Painting Event
Any Interior Painting in 1995
Bathroom Event
Upgraded Bathroom in 1995
Kitchen Event
Upgraded Kitchen in 1995
Wall-Disturbing Event
Unit Rewired in 1995
Other major repairs in 1995[a]
Upgraded Plumbing in 1995
Upgraded Security System in 1995
Other Major Upgrade in 1995
Repaired Heat or AC in 1995
Upgraded Heat in 1995
Upgraded AC in 1995
Window/Door Replacement Event
Other Major Upgrade in 1995[a]
Exterior Painting Event
Any Exterior Painting in 1995 (single-family units only)
[a] Some 'Other Major Upgrades' are counted as wall-disturbing events, others are counted as Window/Door Replacement events. See text above for a description of how the task is apportioned.

Extrapolating from the POMS and AHS Data

After calculating the percentages of rental units that performed RRP in the event categories listed in Table 4-3, the number of renter-occupied events in these categories are calculated by applying the percentages calculated with the 1995 POMS data to the number of rental-units according to the 2003 AHS. It is assumed that Whole Exterior events and Contained Exterior events occur in rental units with the same frequency as they do in owner-occupied units (since data on these types of events are not available in the POMS). Addition events are not estimated for rental units since these renovation activities are fairly uncommon in rental units and likely to already be reported as 'other major upgrade' and counted as a wall-disturbing event.

Estimating the Number of Target Housing COF Events

Since the there is no way to identify COFs in the census data used to estimate the number of RRP activities, it was assumed that the type and frequency of RRP performed by target housing COFs is the same as observed in other target housing units. Thus, the estimate of the number of regulated contractor events in COFs that are also target housing was performed in two steps: (1) the number of target housing units that are also COFs was estimated, and (2) the frequency of

RRP events estimated for other target housing units was applied to the number of target housing COFs estimated in step 1. Numbers of target housing COFs and the corresponding RRP frequencies were divided into three types: owner-occupied units with children under six, owner-occupied units without children under six, and rental units.

Note that COFs in target housing include family daycare providers and the homes of family, friends, and neighbors who regularly care for someone else's children. The estimates include care provided with and without compensation, and rely primarily on estimates of the size of the childcare workforce (Center for the Child Care Workforce 2002). The Center for the Child Care Workforce (2002) report includes: (1) data on family child care providers caring for unrelated children in their own homes, (2) paid relatives and non-relatives providing child care, and (3) unpaid relatives and non-relatives providing child care.

The number of target housing COFs is projected based on estimates of the caregiver workforce in the Center for the Child Care Workforce (2002) report. Based on a Wilder Research Center report, it is assumed that 10 percent of family child care providers caring for unrelated children in their own homes employ 2 workers (Wilder Research Center 2001, p.16). For the remaining childcare providers, one worker is assumed per location. Based on 2003 American Housing Survey data for the general population of target housing, it is assumed that 65 percent of these housing units were built before 1978.

The number of target housing COFs are also adjusted to account for target housing units that are already included in the RRP rule universe or do not qualify as COFs because: (1) care is provided in a child's own home, or (2) less than six hours of care per-week is provided. In addition, the number of target housing COFs that are would be regulated without being COFs must be estimated to avoid double counting. The units that would be regulated event if they were not COFs include: (1) units where the caregiver is ~~or may be~~ pregnant or has a child under six living with them, and (2) units where the caregiver lives in a rental unit. The basis for these adjustments is discussed below.

Care Provided in Child's Own Home

It is assumed that 22 percent of relatives and non-relatives (paid or unpaid) provide care in the child's home; this is based on a Wilder Research Center (2005, p.28) report on the results of the 2004 Minnesota Statewide Household Child Care Survey.

Less Than Six Hours of Care Per-Week is Provided

Of those providing care in their own home, it is assumed that 27 percent of relatives and non-relatives (paid or unpaid) provide care for less than six hours a week (Wilder Research Center 2005, p.28). All family daycare providers caring for unrelated children in their own homes are assumed to care for at least one child for more than six hours a week.

Caregiver Lives in a Rental Unit

It is assumed that family, friend, and neighbor caregivers have the same likelihood of living in a rental unit as the general population of target housing occupants (39 percent).

Caregiver has a Child Under Six Living With Them

Based on the January 2006 Current Population Survey (U.S. Bureau of Labor Statistics 2006), 16 percent of Child Care Workers have children under six. Thus, it is assumed that 16 percent of in-home family daycare providers (formal care providers) caring for unrelated children in their own homes have children under the age of six. Based on the Wilder Research Center (2005, p.19) report, 57.5 percent of family, friend, and neighbor caregivers (informal care providers) have children under the age of 12. Thus it is assumed that half as many, or 29 percent, have children under the age of six.

Table 4-4 presents the estimated number of regulated target housing units.

Table 4-4: Number of Additional Pre-1978 Target Housing Units Regulated Under COF provisions of the ~~COF~~ rule

		Adjustments: Percent not Regulated						
Type of Care [a]	**Number of TH COFs (thousands)** [b]	***In child's own home***	***Less than 6-hours per-week***	***Post-78***	***In Rental Unit***	***In unit where a child under 6 resides***	**Total Adjustment: Percent not Regulated** [c]	**Total Regulated Units (thousands)** [d]
All Target Housing COF Units								
Paid In-Home Family Daycare	**591**	n.a.	n.a.	35%	n.a.	n.a.	**35%**	**384**
Paid Relative Care	**804**	22%	27%	35%	n.a	n.a	**63%**	**299**
Unpaid Relative and Non-Relative Care	**2,354**	22%	27%	35%	n.a	n.a	**63%**	**876**
Total (Pre-78)								**1,559**
Total (Pre-60) [e]								**823**
Target Housing COF Units, Excluding Rental Units and Units Where a Child Under 6 Resides								
Paid In-Home Family Daycare	**591**	n.a.	n.a.	35%	n.a.	16%	**45%**	**323**
Paid Relative Care	**804**	22%	27%	35%	39%	29%	**84%**	**130**
Unpaid Relative and Non-Relative Care	**2,354**	22%	27%	35%	39%	29%	**84%**	**380**
Total (Pre-78)								**833**
Total (Pre-60) [e]								**458**

a. Paid In-Home Family Daycare refers to formal licensed daycare located in the provider's home. Paid relative care is when family members are paid to care for the child in the family member's home (unlicensed care). Unpaid relative and non-relative care refers to informal unpaid care provided at the homes of family, friends or neighbors (unlicensed care).
b. Based on the size of the childcare workforce (Center for the Child Care Workforce 2002), assuming 1.1 workers per location for paid in-home family daycare and 1 worker per location for other types of care.
c. Calculated as one minus the product of one minus the adjustments. e.g., for the first row, 45% = 100% - (100%-35%)*(100%-16%).
d. Components may not sum to totals due to rounding. Not adjusted for compliance rates.
e. Adjusted based on number of target housing units.

Source: U.S. Census Bureau 1995, 1997, and 2003; EPA Calculations.

Estimating the Number of Contractor Events in Target Housing COFs

As described above, the frequency of RRP in target housing COFs is assumed to be the same as estimated for other residential housing units. As reported above, there are an estimated 1,559,000 pre-1978 target housing COFs subject to the rule's requirements. About 833,000 of these units are owner-occupied units where no child under the age of 6 resides.

Likelihood of Positive Test Kit Result for LBP

It is assumed that all certified renovators use a test kit for LBP before performing any RRP, because performing the relatively inexpensive test may allow the renovator to avoid the costs of using Lead-Safe Work Practices (LSWP) that are required when LBP is disturbed. Since LBP is most likely to be found on certain components of housing units—and therefore most likely to be disturbed during certain types of renovations—the analysis accounts for this by estimating LBP likelihoods specific to each event type. These LBP likelihoods are estimated using data from HUD's 2000 National Survey of Lead and Allergens in Housing (HUD 2001).[9] These data include information on approximately 630 housing units built before 1978, including data on the presence of LBP in certain rooms (e.g. kitchen) and on certain components or surfaces (e.g. floors, walls, ceilings, doors and windows).

The probability that LBP is disturbed during a RRP event is estimated as the probability of LBP in any of the rooms where RRP is performed or on any of the components that might be disturbed during the RRP event. This assumption leads to an upward bias in the estimates of the number of events where LSWP are required. For example, if there is LBP in the kitchen, it is assumed that a kitchen remodeling will disturb LBP. However, the LBP component(s) will not necessarily always be disturbed. For example, the LBP in the kitchen may be on the window trim, but the renovation may not disturb the window trim. Unfortunately, there is no reasonable basis for correcting this bias using currently available data. For the purposes of this analysis, data from HUD (2001) are used to estimate event-specific likelihoods of positive test kit results based on the estimated likelihood of disturbing LBP for each event type, as Table 4-5 describes.

[9] In addition to the likelihood of lead-based paint varying by age of housing, there is evidence that the concentration of lead in the paint varies by the age of housing. A review of the data in HUD 2000 is presented in EPA 2005c. This document is available in the docket for this rulemaking.

Table 4-5: Types of Estimates Used for Calculating the Likelihood of Disturbing LBP for Each Event Type	
Event Type	**Estimate of Likelihood of Disturbing LBP**
Kitchen	Likelihood of LBP in the kitchen
Bathroom	Likelihood of LBP in 'other room' (up to two 'other rooms' were inspected for LBP in each housing unit; these rooms might be bathrooms, living rooms, dens, or laundry rooms)
Additions	Likelihood of LBP on the interior or exterior of the unit (since these events typically require some demolition of the interior and exterior)
Wall-Disturbing	Likelihood of LBP on any walls, floors or ceilings of the housing unit
Window/Door Replacement	Likelihood of LBP anywhere on the interior or exterior of windows and doors
Interior Painting	Likelihood of LBP anywhere in interior of unit
Whole Exterior	Likelihood of LBP anywhere on exterior of unit
Contained Exterior	Likelihood of LBP anywhere on exterior walls of unit (since Contained Exterior events—such as replacing a porch—are likely to disturb exterior walls, but not very likely to disturb other exterior components such as windows
Exterior Painting	Likelihood of LBP anywhere on exterior of unit
EPA estimated LBP Likelihoods with room and component/surface specific data from HUD (2001).	

Test kits for LBP that are currently available have false positive rates that range from 47 percent to 78 percent; this analysis assumes a false positive rate of 63 percent, the midpoint, for the first year that the rule's requirements are effective. By the end of the first year of regulation it is assumedThis analysis assumes that an improved test kit will be developed that will have a false positive rate of 10 percent or less will be in use in the second year that all of the rule's requirements are in effect.[10] A false negative rate of 5 percent is also assumed for both the current and improved test kits. Thus, the likelihood of a positive test kit result in the first year is estimated as 95 percent of the likelihood of LBP, plus 63 percent of the percentage of homes without LBP. In the second year, the likelihood of a positive test kit result is estimated as 95 percent of the likelihood of LBP plus 10 percent of the percentage of homes without LBP. Table 4-6 shows the likelihoods of LBP that are used to estimate the percentage of events where LBP is disturbed.

[10] EPA believes that the sensitivity of test kits can be adjusted so the results reliably correspond to one of the two Federal standards for lead-based paint (1.0 mg/cm^2 and 0.5% by weight). EPA is planning to conduct research to further the development of test kits that accurately identify both the presence and absence of lead in paint at levels that exceed the Federal standards. EPA is confident that improved test kits can be commercially available within the next three years, i.e., by the timeSeptember 2010, although this analysis does not assume they will be in use until the second stageyear that all of the rule becomes effectiverule's requirements are in effect.

Table 4-6: Likelihood of LBP ~~and Positive Test Kit Results for LBP~~									
Year Built	**Kitchen**	**Bathroom**	**Addition**	**Wall-Disturbing**	**Window/ Door**	**Interior Painting**	**Whole Exterior**	**Contained Exterior**	**Exterior Painting**
Likelihood of LBP									
Pre-1930	53%	34%	87%	40%	81%	79%	70%	55%	70%
1930-1949	45%	27%	75%	25%	71%	64%	70%	35%	70%
1950-1959	23%	12%	67%	16%	56%	38%	55%	27%	55%
1960-1979	6%	4%	22%	5%	14%	14%	13%	10%	13%
Source: EPA calculations using HUD (2001)									

In cases where a household performed more than one interior event, the likelihood of disturbing LBP is estimated as the likelihood of LBP anywhere in the interior of the unit. There are two exceptions to this: (1) when one of the events is an Addition, the Addition likelihood is used, and (2) when the sum of the individual event probabilities is less than the likelihood of LBP anywhere in the interior of the unit, the sum of the event probabilities is used. These simplifying assumptions are necessary because the data are not sufficient for calculating the joint probabilities that would be necessary for relaxing this assumption. As a result, the estimates of the number of events where LSWP are used will be biased upward. That is, for a housing unit performing multiple interior events, it is assumed that if there is LBP in the housing unit, all the interior events in that unit require LSWP. However, the LBP component(s) may be disturbed only in certain areas throughout the house, requiring less containment than is assumed. Similar to the assumptions pertaining to households performing multiple interior events, for households performing multiple exterior events the likelihood of disturbing LBP is assumed to be the maximum likelihood for the events performed. Unlike for interior events, this is always the same as the largest and most costly exterior event that determines the housing unit's exterior compliance costs.

Event Sizes

For interior events, the average square footage of particular rooms was determined by taking the average square footage of the whole unit from the AHS and reviewing house plans for homes of similar square footage Homestyles.com 2002). The work area sizes for wall-disturbing events were estimated as follows:

Table 4-7: Kitchen and Bathroom Event Size Definitions	
Bathroom (one bathroom-sized work area)	One average work area size. *48 Square Feet.*
Kitchen (one ~~bathroom~~kitchen-sized work area)	One average work area size: *160, 120, and 80 Square Feet for single-family-owner, single-family-renter, and multi-family units, respectively.*

Table 4-8: Wall-Disturbing Event Size Definitions	
Small (bathroom-sized)	Where bathrooms were or were not remodeled, kitchens were not remodeled, rooms were not added, and less than 3 of the following tasks were performed: (1) Added/Replaced Internal Water Pipes In Home, (2) Added/Replaced Plumbing Fixtures In Home, (3) Added/Replaced Electrical Wiring To Home, (4) Installed Paneling Or Ceiling Tiles, (5) Added/Replaced Central Air Conditioning, (6) Added/Replaced Built-In Heating Equipment, (7) Added/Replaced Security System In Home, (8) HVAC work Where one room was added, bathrooms were not remodeled, kitchens were not remodeled, and less than 3 of the following tasks were performed: (1) Added/Replaced Internal Water Pipes In Home, (2) Added/Replaced Plumbing Fixtures In Home, (3) Added/Replaced Electrical Wiring To Home, (4) Installed Paneling Or Ceiling Tiles, (5) Added/Replaced Central Air Conditioning, (6) Added/Replaced Built-In Heating Equipment, (7) Added/Replaced Security System In Home, (8) HVAC work *48 Square Feet.*
Medium (kitchen-sized)	Where bathrooms were not remodeled, kitchens were or were not remodeled, rooms were not added, and less than 3 of the following tasks were performed: (1) Added/Replaced Internal Water Pipes In Home, (2) Added/Replaced Plumbing Fixtures In Home, (3) Added/Replaced Electrical Wiring To Home, (4) Installed Paneling Or Ceiling Tiles, (5) Added/Replaced Central Air Conditioning, (6) Added/Replaced Built-In Heating Equipment, (7) Added/Replaced Security System In Home, (8) HVAC work Where one room was added, bathrooms were not remodeled, kitchens were not remodeled, and 3 or more of the following tasks were performed: (1) Added/Replaced Internal Water Pipes In Home, (2) Added/Replaced Plumbing Fixtures In Home, (3) Added/Replaced Electrical Wiring To Home, (4) Installed Paneling Or Ceiling Tiles, (5) Added/Replaced Central Air Conditioning, (6) Added/Replaced Built-In Heating Equipment, (7) Added/Replaced Security System In Home, (8) HVAC work *160, 120, and 80 Square Feet for single-family-owner, single-family-renter, and multi-family units, respectively.*
Large (size of a bathroom and kitchen)	Where bathrooms and kitchens were remodeled, rooms were not added, and at least 1 of the following tasks were performed:(1) Added/Replaced Internal Water Pipes In Home, (2) Added/Replaced Plumbing Fixtures In Home, (3) Added/Replaced Electrical Wiring To Home, (4) Installed Paneling Or Ceiling Tiles, (5) Added/Replaced Central Air Conditioning, (6) Added/Replaced Built-In Heating Equipment, (7) Added/Replaced Security System In Home, (8) HVAC work Where at least two rooms were added and at least 1 of the following tasks were performed:(1) Added/Replaced Internal Water Pipes In Home, (2) Added/Replaced Plumbing Fixtures In Home, (3) Added/Replaced Electrical Wiring To Home, (4) Installed Paneling Or Ceiling Tiles, (5) Added/Replaced Central Air Conditioning, (6) Added/Replaced Built-In Heating Equipment, (7) Added/Replaced Security System In Home, (8) HVAC work *208, 168, and 128 Square Feet for single-family-owner, single-family-renter, and multi-family units, respectively.*

Table 4-9: Addition Event Size Definitions	
Small (bathroom-sized)	Where one room was added, and fewer than three of the following tasks were performed: (1) Added/Replaced Internal Water Pipes In Home, (2) Added/Replaced Plumbing Fixtures In Home, (3) Added/Replaced Electrical Wiring To Home, (4) Installed Paneling Or Ceiling Tiles, (5) Added/Replaced Central Air Conditioning, (6) Added/Replaced Built-In Heating Equipment, (7) Added/Replaced Security System In Home, (8) HVAC work, (9) Remodeled Bathroom, (10) Remodeled Kitchen. *48 Square Feet.*
Medium (kitchen-sized)	Where one room was added, and three or more of the following tasks were performed: (1) Added/Replaced Internal Water Pipes In Home, (2) Added/Replaced Plumbing Fixtures In Home, (3) Added/Replaced Electrical Wiring To Home, (4) Installed Paneling Or Ceiling Tiles, (5) Added/Replaced Central Air Conditioning, (6) Added/Replaced Built-In Heating Equipment, (7) Added/Replaced Security System In Home, (8) HVAC work, (9) Remodeled Bathroom, (10) Remodeled Kitchen. *160, 120, and 80 Square Feet for single-family-owner, single-family-renter, and multi-family units, respectively.*
Large (size of a bathroom and kitchen)	Where more than one room was added. *208, 168, and 128 Square Feet for single-family-owner, single-family-renter, and multi-family units, respectively.*

Table 4-10: Interior Painting Event Size Definitions	
Small (square root of 25% of the square footage times 5 feet)	Accounts for one third of all interior painting events. The square root of 25% of the total square footage times 5 feet representsis equivalent to the area along one wall and five feet out. *112, 96, and 84 Square Feet for single-family-owner, single-family-renter, and multi-family units, respectively.*
Medium (midpoint between small and large sized)	Accounts for one third of all interior painting events. *308, 232, and 184 Square Feet for single-family-owner, single-family-renter, and multi-family units, respectively.*
Large (25% of the total unit square footage)	Accounts for one third of all interior painting events. *504, 368, and 284 Square Feet for single-family-owner, single-family-renter, and multi-family units, respectively.*

Table 4-11: Window/Door Replacement Event Size Definitions	
Small (square root of a kitchen-sized work area times 5 feet)	Accounts for one third of window/door replacement events. In the 1997 AHS respondents who reported replacing windows or doors also reported how many windows and doors they repaired or replaced. These respondents were divided into three groups according to how many doors and windows they reported replacing. The average numbers or doors and windows reported repaired or replaced were 1, 3, and 12 for these three groups. The work area for replacing one window/door is assumed to be along one wall and five feet out, estimated as the square root of 25% of a kitchen-sized work area times 5 feet. *63, 55, and 45 Square Feet for single-family-owner, single-family-renter, and multi-family units, respectively.*
Medium (kitchen-sized work area)	Accounts for one third of window/door replacement events. In the 1997 AHS respondents who reported replacing windows or doors also reported how many windows and doors they repaired or replaced. These respondents were divided into three groups according to how many doors and windows they reported replacing. The average numbers or doors and windows reported repaired or replaced were 1, 3, and 12 for these three groups. The work area for replacing three windows/doors is assumed to be the size of a typical room (i.e., kitchen-sized). *160, 120, and 80 Square Feet for single-family-owner, single-family-renter, and multi-family units, respectively.*
Large (the size of 4 Rooms)	Accounts for one third of window/door replacement events. In the 1997 AHS respondents who reported replacing windows or doors also reported how many windows and doors they repaired or replaced. These respondents were divided into three groups according to how many doors and windows they reported replacing. The average numbers or doors and windows reported repaired or replaced were 1, 3, and 12 for these three groups. The work area for replacing 12 windows is assumed to be the size of 4 typical rooms (i.e., four times kitchen-size). *640, 480, and 320 Square Feet for single-family-owner, single-family-renter, and multi-family units, respectively.*

Table 4-12: Exterior Event Size Definitions	
1-Wall Exterior Painting	The perimeter estimates were calculated following the procedure used in EPA's Economic Analysis for the TSCA Section 403 rule (EPA 2000b). It was assumed that the home is rectangular with a front to side ratio of 2:3 and an average first floor area of 1,390 sq. feet.[a] This assumption leads to a perimeter of 152 feet for a single-family owner occupied home. The perimeter of a single-family renter unit was estimated to be 130 feet, which assumes that the proportion of a single-family renter unit has the same proportion of total square footage to square footage of the first floor of a single-family owner unit. The perimeter of a multi-family housing structure (which contains several multi-family units) was calculated assuming the first-floor area was three times as large as a single-family unit. This perimeter estimate is 264 feet. A 1-Wall Event is assumed to be ¼ of the full perimeter.
4-Wall Exterior Painting and Whole Exterior	The perimeter estimates were calculated following the procedure used in EPA's Economic Analysis for the TSCA Section 403 rule (EPA 2000b). It was assumed that the home is rectangular with a front to side ratio of 2:3 and an average first floor area of 1,390 sq. feet. [a] This assumption leads to a perimeter of 152 feet for a single-family owner occupied home. The perimeter of a single-family renter unit was estimated to be 130 feet, which assumes that the proportion of a single-family renter unit has the same proportion of total square footage to square footage of the first floor of a single-family owner unit. The perimeter of a multi-family housing structure (which contains several multi-family units) was calculated assuming the first-floor area was three times as large as a single-family unit. This perimeter estimate is 264 feet.
Contained Exterior	The structures in a Contained Exterior event are outside the main body of the house and the structural work and contamination is primarily outdoors. The perimeter of a contained exterior structure is estimated to be 60 feet (10'×20'). Containment is necessary along the entire perimeter of a detached structure. However, it is assumed that less containment is required for attached contained exterior structures, which are assumed to be attached to the main structure of the house along a 20 foot side of the detached contained exterior structure. The analysis assumes half are attached structures and half are detached structures.
[a] Estimated based on information from http://www.dreamhomesource.com (2005) on the average size of the first floor of nine 2,000 square foot two stories homes (1,280 sq. feet). The weighted average of a first floor was calculated using 2003 AHS data which shows that 85% of single-family housing units are two stories high and the remaining 15% of homes are one story (i.e., first floor is 2,016 sq. feet).	

Estimated Number of RRP Events in the First and Second Years

The numbers of regulated events are estimated using the methodology outlined above along with the assumption that 75 percent of the RRP events subject to the rule's requirements comply with the requirements. This assumption is based on compliance rates observed for the Occupational Safety and Health Administration's (OSHA) regulations for the construction industry (Gilkeya 2003 and Weil 1999). The variation in the number of regulated events in compliance under the different options reflects the variation in the regulated universe. Note that the estimated number of events does not account for the events that are regulated under Options P and A through D because a child with an increased blood-lead level is living in a unit built before 1978. It would be difficult to estimate this because triggers for increased blood lead levels vary from community to community. This provision of the rule is estimated to account for a very small number of events—less than 0.2 percent.[11]

Table 4-13 through Table 4-20 present the numbers of RRP events, by type of event, for the first and second year the rule is in effect. Each table shows the total number of events where compliance costs are incurred, labeled "All Events." This includes all the events where a test kit was used to test for LBP. The columns labeled "LBP Events" include all the events where test kits correctly identified that LBP was present; it does not include events where there was a false positive or a false negative test kit result. The columns labeled "LSWP Events" includes all events where there was a positive test kit results – including false positives. The LSWP event estimate is the estimated number of events where compliance costs associated with cleaning, containment, and verification are incurred. Table 4-21 through Table 4-28 present the likelihoods of events where LBP is correctly identified as well as those where there was a positive test kit result (LSWP Events).

[11] For example, there are an estimated 310,000 children with blood-lead levels greater than 10 µg/dL, a common community action threshold, and only about 75,000 are aware of their condition (MMWR 2003). If these children were equally likely to reside in housing units built in any year pre-1978, then about 46 percent would reside in units built between 1960 and 1980, and of these about 30 percent would have an RRP event in a year. Thus, under these assumptions, 10,000 additional events would be covered in the first year. This is likely to be a substantial overestimate, however, since other data show that children with an increased blood lead level are more likely to be living in older homes. Based on NHANES data for 1991-1994, about 8.6 percent of children living in pre-46 housing units had an increased blood lead level, while only 4.6% of children living in units built between 1946 and 1973 did (MMWR 1997). Thus the actual number of events due to children with increased blood lead levels living in housing units built between 1960 and 1980 is likely to be well below 10,000.

Table 4-13: Option P, Option B, and Option D: First Year (thousands)												
	All Events With Costs				LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	24	326	162	512	10	153	70	234	18	257	126	401
Kit	27	295	212	534	15	152	108	275	22	237	170	429
Ad-S	4	0	0	4	3	0	0	3	3	0	0	3
Ad-M	3	0	0	3	2	0	0	2	2	0	0	2
Ad-L	17	0	1	18	12	0	1	13	14	0	1	16
Wl-S	93	616	488	1,198	23	162	144	328	67	443	356	865
Wl-M	10	7	5	21	3	2	1	7	8	5	3	16
Wl-L	0	0	0	0	0	0	0	0	0	0	0	0
WD-S	21	61	38	120	14	40	26	81	18	52	33	103
WD-M	26	67	48	141	17	44	33	94	22	57	41	120
WD-L	39	82	64	185	26	55	44	124	33	70	55	159
IP-S	72	248	305	625	42	146	192	380	60	206	257	522
IP-M	39	144	214	397	23	85	134	242	32	120	180	332
IP-L	33	150	181	364	20	88	114	222	28	124	152	304
EP	251	735	528	1,513	155	461	337	953	211	618	446	1,274
C Ext	35	83	0	118	16	36	0	51	27	64	0	92
W Ext	28	80	55	163	17	50	35	103	24	67	47	137
Total	**723**	**2,895**	**2,300**	**5,918**	**398**	**1,473**	**1,241**	**3,112**	**589**	**2,320**	**1,867**	**4,776**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results.
See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-14: Options A and C: First Year (thousands)												
	All Events With Costs				LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	137	326	169	633	59	153	74	286	107	257	132	495
Kit	144	295	220	659	76	152	113	341	116	237	177	530
Ad-S	29	0	1	29	21	0	0	21	25	0	1	26
Ad-M	14	0	0	14	10	0	0	10	12	0	0	12
Ad-L	58	0	1	59	42	0	1	43	51	0	1	52
Wl-S	516	616	510	1,642	130	162	150	442	369	443	372	1,184
Wl-M	39	7	7	53	15	2	3	19	30	5	6	40
Wl-L	0	0	0	0	0	0	0	0	0	0	0	0
WD-S	131	61	42	235	84	40	29	153	111	52	37	200
WD-M	159	67	54	280	102	44	37	183	134	57	46	238
WD-L	220	82	75	377	142	55	52	249	187	70	65	321
IP-S	433	248	329	1,011	253	146	207	606	358	206	277	841
IP-M	240	144	227	612	140	85	143	368	198	120	191	509
IP-L	203	150	193	546	118	88	121	327	167	124	162	454
EP	1,653	735	599	2,987	1,019	461	383	1,862	1,385	618	506	2,509
C Ext	215	83	0	298	89	36	0	125	166	64	0	230
W Ext	210	80	65	356	130	50	42	222	176	67	55	299
Total	**4,403**	**2,895**	**2,494**	**9,791**	**2,428**	**1,473**	**1,356**	**5,258**	**3,592**	**2,320**	**2,028**	**7,939**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-15: Option E: First Year (thousands)												
	All Events With Costs				LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	56	555	330	941	14	174	82	269	40	408	235	683
Kit	63	503	433	998	19	172	125	316	46	375	315	736
Ad-S	12	0	0	13	5	0	0	5	9	0	0	10
Ad-M	7	0	0	7	3	0	0	3	6	0	0	6
Ad-L	33	0	2	35	15	0	1	17	26	0	1	27
Wl-S	193	1,048	997	2,238	29	181	168	378	131	722	685	1,537
Wl-M	20	11	9	41	4	2	2	8	14	8	7	29
Wl-L	0	0	0	0	0	0	0	0	0	0	0	0
WD-S	40	104	78	222	17	46	32	95	31	81	60	172
WD-M	48	114	97	259	21	51	40	111	37	89	74	200
WD-L	72	140	130	342	32	62	53	147	56	109	100	265
IP-S	120	422	622	1,164	51	170	236	457	93	323	471	887
IP-M	66	245	438	749	28	99	165	292	51	188	331	570
IP-L	54	255	370	678	23	103	140	266	42	195	280	517
EP	492	1,250	1,079	2,821	192	522	403	1,118	375	963	816	2,154
C Ext	71	142	0	213	20	41	0	61	52	103	0	155
W Ext	63	136	113	312	23	57	42	122	47	104	86	238
Total	**1,410**	**4,925**	**4,698**	**11,032**	**497**	**1,680**	**1,489**	**3,666**	**1,055**	**3,669**	**3,461**	**8,185**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-16: Option P and Option B: Second Year (thousands)												
	All Events With Costs				LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	52	553	328	933	13	173	82	267	17	210	106	333
Kit	61	501	431	993	18	171	125	314	22	203	155	381
Ad-S	11	0	0	11	4	0	0	4	5	0	0	5
Ad-M	7	0	0	7	3	0	0	3	3	0	0	3
Ad-L	31	0	2	32	15	0	1	16	16	0	1	18
Wl-S	175	1,044	992	2,212	27	181	167	374	42	266	248	556
Wl-M	18	11	9	38	4	2	2	8	5	3	2	11
Wl-L	0	0	0	0	0	0	0	0	0	0	0	0
WD-S	37	103	78	218	16	46	32	94	18	51	36	106
WD-M	44	113	96	254	19	51	39	109	22	57	45	123
WD-L	66	139	129	335	30	62	53	145	33	70	60	163
IP-S	110	421	618	1,149	47	169	234	451	53	193	272	518
IP-M	62	244	436	742	26	99	165	289	29	113	191	333
IP-L	51	254	368	672	22	102	139	264	25	117	161	303
EP	459	1,245	1,074	2,778	180	520	401	1,101	207	590	466	1,263
C Ext	68	141	0	209	19	41	0	60	24	51	0	75
W Ext	58	135	113	306	21	56	42	119	24	64	49	137
Total	**1,309**	**4,905**	**4,675**	**10,889**	**463**	**1,673**	**1,482**	**3,618**	**546**	**1,987**	**1,793**	**4,326**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-17: Option A: Second Year (thousands)												
	All Events With Costs				LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	306	553	346	1,205	73	173	86	333	96	210	112	418
Kit	317	501	453	1,271	93	171	131	395	115	203	163	481
Ad-S	66	0	1	67	29	0	1	29	32	0	1	33
Ad-M	28	0	0	28	13	0	0	13	14	0	0	14
Ad-L	116	0	3	119	54	0	1	55	60	0	2	61
Wl-S	1,028	1,044	1,038	3,111	153	181	174	508	240	266	260	766
Wl-M	67	11	13	91	16	2	3	21	22	3	4	28
Wl-L	0	0	0	0	0	0	0	0	0	0	0	0
WD-S	260	103	85	449	101	46	35	182	117	51	40	208
WD-M	303	113	107	523	121	51	44	216	139	57	50	246
WD-L	411	139	146	697	169	62	61	293	193	70	70	332
IP-S	690	421	658	1,768	288	169	252	709	326	193	291	811
IP-M	387	244	459	1,090	160	99	175	433	182	113	202	497
IP-L	324	254	388	966	134	102	148	385	153	117	171	441
EP	3,161	1,245	1,220	5,626	1,195	520	456	2,171	1,385	590	530	2,505
C Ext	416	141	0	558	109	41	0	150	139	51	0	190
W Ext	398	135	128	661	152	56	49	257	176	64	57	296
Total	**8,279**	**4,905**	**5,044**	**18,229**	**2,861**	**1,673**	**1,617**	**6,151**	**3,387**	**1,987**	**1,951**	**7,326**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-18: Option C: Second Year (thousands)

	All Events With Costs				LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	137	325	169	630	59	152	73	285	67	169	83	318
Kit	143	294	219	657	75	152	113	340	82	165	123	370
Ad-S	28	0	1	29	21	0	0	21	21	0	0	22
Ad-M	14	0	0	14	10	0	0	10	10	0	0	10
Ad-L	58	0	1	59	41	0	1	43	43	0	1	44
Wl-S	514	614	508	1,635	130	161	150	440	168	205	185	557
Wl-M	39	7	7	53	15	2	3	19	17	2	3	22
Wl-L	0	0	0	0	0	0	0	0	0	0	0	0
WD-S	131	61	42	234	83	40	29	153	88	42	30	160
WD-M	158	67	54	279	102	44	37	183	107	46	38	191
WD-L	219	82	74	376	142	54	52	248	149	57	54	259
IP-S	431	247	328	1,006	252	145	207	603	268	155	218	641
IP-M	239	144	226	609	139	85	143	367	149	90	150	389
IP-L	202	149	192	543	117	88	121	326	125	94	127	346
EP	1,647	732	596	2,975	1,014	459	381	1,854	1,072	484	401	1,957
C Ext	214	83	0	297	89	35	0	124	101	40	0	141
W Ext	210	79	65	354	129	50	42	221	137	52	44	233
Total	**4,385**	**2,883**	**2,483**	**9,751**	**2,418**	**1,467**	**1,351**	**5,236**	**2,602**	**1,601**	**1,457**	**5,660**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-19: Option D: Second Year (thousands)												
	All Events With Costs				LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	24	325	161	510	10	152	70	233	12	169	79	259
Kit	27	294	211	532	15	152	108	274	16	165	117	298
Ad-S	4	0	0	4	3	0	0	3	3	0	0	3
Ad-M	3	0	0	3	2	0	0	2	2	0	0	2
Ad-L	17	0	1	18	12	0	1	13	12	0	1	13
Wl-S	93	614	486	1,193	23	161	143	327	30	205	177	412
Wl-M	10	7	5	21	3	2	1	7	4	2	2	8
Wl-L	0	0	0	0	0	0	0	0	0	0	0	0
WD-S	21	61	38	120	14	40	26	80	14	42	27	84
WD-M	26	67	47	140	17	44	33	94	18	46	34	98
WD-L	39	82	64	184	25	54	44	124	27	57	46	129
IP-S	72	247	304	623	42	145	191	378	44	155	201	401
IP-M	39	144	213	395	23	85	134	241	24	90	141	256
IP-L	33	149	180	363	19	88	113	221	21	94	119	234
EP	250	732	525	1,507	155	459	336	949	164	484	353	1,000
C Ext	35	83	0	118	16	35	0	51	18	40	0	58
W Ext	28	79	55	163	17	50	35	102	18	52	37	108
Total	**720**	**2,883**	**2,291**	**5,893**	**396**	**1,467**	**1,236**	**3,099**	**427**	**1,601**	**1,335**	**3,362**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-20: Option E: Second Year (thousands)

	All Events With Costs				LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	55	553	328	937	14	173	82	268	18	210	106	334
Kit	63	501	431	994	19	171	125	315	23	203	155	381
Ad-S	12	0	0	13	5	0	0	5	5	0	0	5
Ad-M	7	0	0	7	3	0	0	3	3	0	0	3
Ad-L	33	0	2	35	15	0	1	16	17	0	1	18
Wl-S	192	1,044	993	2,229	29	181	167	377	45	266	249	560
Wl-M	20	11	9	41	4	2	2	8	6	3	2	11
Wl-L	0	0	0	0	0	0	0	0	0	0	0	0
WD-S	40	103	78	222	17	46	32	95	19	51	36	107
WD-M	48	113	97	258	21	51	39	111	23	57	45	125
WD-L	71	139	129	340	31	62	53	147	35	70	60	165
IP-S	119	421	619	1,159	51	169	235	455	57	193	272	523
IP-M	66	244	436	746	28	99	165	291	31	113	191	335
IP-L	54	254	368	675	23	102	139	265	26	117	161	304
EP	490	1,245	1,075	2,809	192	520	402	1,113	220	590	467	1,277
C Ext	71	141	0	212	20	41	0	61	25	51	0	76
W Ext	63	135	113	311	23	56	42	122	27	64	49	140
Total	**1,404**	**4,905**	**4,678**	**10,987**	**495**	**1,673**	**1,483**	**3,651**	**583**	**1,987**	**1,795**	**4,365**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-21: Likelihoods of LBP and LSWP –Option P, Option B, and Option C, First Year								
	LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	44%	47%	43%	46%	78%	79%	78%	78%
Kit	54%	52%	51%	52%	81%	80%	80%	80%
Ad-S	74%	-	82%	74%	88%	-	91%	88%
Ad-M	74%	-	-	74%	88%	-	-	88%
Ad-L	71%	-	82%	72%	87%	-	91%	87%
Wl-S	25%	26%	29%	27%	71%	72%	73%	72%
Wl-M	34%	27%	30%	31%	74%	72%	73%	73%
Wl-L	-	-	-	-	-	-	-	-
WD-S	65%	66%	69%	67%	85%	85%	86%	86%
WD-M	66%	66%	69%	67%	85%	85%	86%	86%
WD-L	66%	66%	69%	67%	85%	85%	86%	86%
IP-S	58%	59%	63%	61%	83%	83%	84%	83%
IP-M	59%	59%	63%	61%	83%	83%	84%	84%
IP-L	58%	59%	63%	61%	83%	83%	84%	84%
EP	62%	63%	64%	63%	84%	84%	85%	84%
C Ext	45%	43%	-	43%	78%	77%	-	78%
W Ext	61%	63%	64%	63%	84%	84%	85%	84%
Total	**55%**	**51%**	**54%**	**53%**	**82%**	**80%**	**81%**	**81%**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-22: Likelihoods of LBP and LSWP – Option A and D, First Year								
	LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	43%	47%	44%	45%	78%	79%	78%	78%
Kit	53%	52%	51%	52%	81%	80%	80%	80%
Ad-S	73%	-	82%	73%	88%	-	91%	88%
Ad-M	70%	-	-	70%	87%	-	-	87%
Ad-L	72%	-	82%	72%	87%	-	91%	87%
Wl-S	25%	26%	29%	27%	72%	72%	73%	72%
Wl-M	37%	27%	35%	36%	76%	72%	75%	75%
Wl-L	-	-	-	-	-	-	-	-
WD-S	64%	66%	69%	65%	84%	85%	86%	85%
WD-M	64%	66%	69%	66%	85%	85%	86%	85%
WD-L	65%	66%	69%	66%	85%	85%	86%	85%
IP-S	58%	59%	63%	60%	83%	83%	84%	83%
IP-M	58%	59%	63%	60%	83%	83%	84%	83%
IP-L	58%	59%	63%	60%	83%	83%	84%	83%
EP	62%	63%	64%	62%	84%	84%	85%	84%
C Ext	41%	43%	-	42%	77%	77%	-	77%
W Ext	62%	63%	64%	62%	84%	84%	85%	84%
Total	**55%**	**51%**	**54%**	**54%**	**82%**	**80%**	**81%**	**81%**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-23: Likelihoods of LBP and LSWP – Option E, First Year								
	LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	24%	31%	25%	29%	71%	74%	71%	73%
Kit	30%	34%	29%	32%	73%	75%	73%	74%
Ad-S	38%	-	23%	38%	76%	-	71%	76%
Ad-M	41%	-	-	41%	77%	-	-	77%
Ad-L	46%	-	81%	48%	78%	-	90%	79%
Wl-S	15%	17%	17%	17%	68%	69%	69%	69%
Wl-M	21%	18%	17%	19%	70%	69%	69%	70%
Wl-L	-	-	-	-	-	-	-	-
WD-S	42%	45%	41%	43%	77%	78%	77%	77%
WD-M	44%	45%	41%	43%	78%	78%	77%	77%
WD-L	44%	45%	41%	43%	78%	78%	77%	78%
IP-S	43%	40%	38%	39%	77%	77%	76%	76%
IP-M	42%	40%	38%	39%	77%	77%	76%	76%
IP-L	43%	40%	38%	39%	78%	77%	76%	76%
EP	39%	42%	37%	40%	76%	77%	76%	76%
C Ext	28%	29%	-	29%	72%	73%	-	73%
W Ext	37%	42%	37%	39%	75%	77%	76%	76%
Total	**35%**	**34%**	**32%**	**33%**	**75%**	**74%**	**74%**	**74%**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-24: Likelihoods of LBP and LSWP –Option P and Option B, Second Year

	LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	25%	31%	25%	29%	32%	38%	32%	36%
Kit	30%	34%	29%	32%	37%	41%	36%	38%
Ad-S	41%	-	23%	40%	46%	-	31%	46%
Ad-M	41%	-	-	41%	47%	-	-	47%
Ad-L	48%	-	81%	49%	53%	-	83%	54%
Wl-S	15%	17%	17%	17%	24%	25%	25%	25%
Wl-M	22%	18%	17%	20%	30%	26%	25%	28%
Wl-L	-	-	-	-	-	-	-	-
WD-S	43%	45%	41%	43%	48%	50%	46%	48%
WD-M	44%	45%	41%	43%	50%	50%	47%	49%
WD-L	45%	45%	41%	43%	50%	50%	47%	49%
IP-S	43%	40%	38%	39%	48%	46%	44%	45%
IP-M	42%	40%	38%	39%	48%	46%	44%	45%
IP-L	43%	40%	38%	39%	49%	46%	44%	45%
EP	39%	42%	37%	40%	45%	47%	43%	45%
C Ext	28%	29%	-	29%	35%	36%	-	36%
W Ext	36%	42%	37%	39%	42%	47%	43%	45%
Total	**35%**	**34%**	**32%**	**33%**	**42%**	**41%**	**38%**	**40%**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-25: Likelihoods of LBP and LSWP – Option A, Second Year								
	LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	24%	31%	25%	28%	31%	38%	32%	35%
Kit	29%	34%	29%	31%	36%	41%	36%	38%
Ad-S	43%	-	62%	44%	49%	-	65%	49%
Ad-M	45%	-	-	45%	50%	-	-	50%
Ad-L	46%	-	54%	46%	51%	-	58%	52%
Wl-S	15%	17%	17%	16%	23%	25%	25%	25%
Wl-M	24%	18%	22%	23%	32%	26%	30%	31%
Wl-L	-	-	-	-	-	-	-	-
WD-S	39%	45%	41%	41%	45%	50%	47%	46%
WD-M	40%	45%	41%	41%	46%	50%	47%	47%
WD-L	41%	45%	42%	42%	47%	50%	48%	48%
IP-S	42%	40%	38%	40%	47%	46%	44%	46%
IP-M	41%	40%	38%	40%	47%	46%	44%	46%
IP-L	41%	40%	38%	40%	47%	46%	44%	46%
EP	38%	42%	37%	39%	44%	47%	43%	45%
C Ext	26%	29%	-	27%	33%	36%	-	34%
W Ext	38%	42%	39%	39%	44%	47%	44%	45%
Total	**35%**	**34%**	**32%**	**34%**	**41%**	**41%**	**39%**	**40%**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-26: Likelihoods of LBP and LSWP – Option C, Second Year								
	LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	43%	47%	44%	45%	49%	52%	49%	50%
Kit	53%	52%	51%	52%	57%	56%	56%	56%
Ad-S	73%	-	82%	73%	75%	-	84%	76%
Ad-M	70%	-	-	70%	73%	-	-	73%
Ad-L	72%	-	82%	72%	74%	-	84%	74%
Wl-S	25%	26%	29%	27%	33%	33%	36%	34%
Wl-M	37%	27%	35%	36%	43%	34%	41%	42%
Wl-L	-	-	-	-	-	-	-	-
WD-S	64%	66%	69%	65%	67%	69%	72%	69%
WD-M	64%	66%	69%	66%	67%	69%	72%	69%
WD-L	65%	66%	69%	66%	68%	69%	72%	69%
IP-S	58%	59%	63%	60%	62%	63%	66%	64%
IP-M	58%	59%	63%	60%	62%	63%	66%	64%
IP-L	58%	59%	63%	60%	62%	63%	66%	64%
EP	62%	63%	64%	62%	65%	66%	67%	66%
C Ext	41%	43%	-	42%	47%	48%	-	47%
W Ext	62%	63%	64%	62%	65%	66%	67%	66%
Total	**55%**	**51%**	**54%**	**54%**	**59%**	**56%**	**59%**	**58%**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-27: Likelihoods of LBP and LSWP - Option D: Second Year

	LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	
Bath	44%	47%	43%	46%	49%	52%	49%	51%
Kit	54%	52%	51%	52%	59%	56%	56%	56%
Ad-S	74%	-	82%	74%	77%	-	84%	77%
Ad-M	74%	-	-	74%	76%	-	-	76%
Ad-L	71%	-	82%	72%	74%	-	84%	74%
Wl-S	25%	26%	29%	27%	32%	33%	36%	35%
Wl-M	34%	27%	30%	31%	40%	34%	37%	37%
Wl-L	-	-	-	-	-	-	-	-
WD-S	65%	66%	69%	67%	68%	69%	72%	70%
WD-M	66%	66%	69%	67%	69%	69%	72%	70%
WD-L	66%	66%	69%	67%	69%	69%	72%	70%
IP-S	58%	59%	63%	61%	62%	63%	66%	64%
IP-M	59%	59%	63%	61%	63%	63%	66%	65%
IP-L	58%	59%	63%	61%	62%	63%	66%	64%
EP	62%	63%	64%	63%	65%	66%	67%	66%
C Ext	45%	43%	-	43%	50%	48%	-	49%
W Ext	61%	63%	64%	63%	65%	66%	67%	66%
Total	**55%**	**51%**	**54%**	**53%**	**59%**	**56%**	**58%**	**57%**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-28: Likelihoods of LBP and LSWP –Option E, Second Year								
	LBP Events				LSWP Events			
	SF-O	SF-R	Multi	Total	SF-O	SF-R	Multi	Total
Bath	24%	31%	25%	29%	32%	38%	32%	36%
Kit	30%	34%	29%	32%	37%	41%	36%	38%
Ad-S	38%	-	23%	38%	44%	-	31%	44%
Ad-M	41%	-	-	41%	47%	-	-	47%
Ad-L	46%	-	81%	48%	51%	-	83%	53%
Wl-S	15%	17%	17%	17%	24%	25%	25%	25%
Wl-M	21%	18%	17%	19%	29%	26%	25%	27%
Wl-L	-	-	-	-	-	-	-	-
WD-S	42%	45%	41%	43%	48%	50%	46%	48%
WD-M	44%	45%	41%	43%	49%	50%	46%	48%
WD-L	44%	45%	41%	43%	49%	50%	47%	49%
IP-S	43%	40%	38%	39%	48%	46%	44%	45%
IP-M	42%	40%	38%	39%	48%	46%	44%	45%
IP-L	43%	40%	38%	39%	49%	46%	44%	45%
EP	39%	42%	37%	40%	45%	47%	43%	45%
C Ext	28%	29%	-	29%	35%	36%	-	36%
W Ext	37%	42%	37%	39%	43%	47%	43%	45%
Total	**35%**	**34%**	**32%**	**33%**	**42%**	**41%**	**38%**	**40%**

Notes: Events where compliance costs are incurred include those that are: (1) subject to the rule's requirements, and (2) in compliance. Thus, this includes some events where LSWP are not required because a test kit indicates that LBP is not present. It excludes the 25% of regulated events that are assumed to be noncompliant. A "-" indicates that zero events were estimated; a "0" indicates that fewer than 500 events were estimated. All Events With Costs include those where there is a negative test kit result for LBP. LBP events exclude events where there is a false negative test kit result for LBP. LSWP events include all events with test kit results that are positive for LBP, including false positive results. See

Table 4-1: Options Included in Economic Analysis

for options descriptions. Note that the number of LSWP events is equal to the number of LBP events (which exclude false negatives) plus the number of false positive events; i.e., (LSWP Events) = (LBP Events) + ((All Events With Costs) – (LBP Events)/0.95) * (False Positive Rate).

Abbreviations:
SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

4.2.2 Estimating the Number of Regulated Renovation, Repair, and Painting Events in COFs in Public or Commercial Building COFs

This section describes the proposed methodology for estimating the number of events in daycare centers, pre-schools and kindergartens—i.e., COFs in public or commercial buildings— affected by the proposed rule. These estimates rely on HUD's First National Health Survey of Child Care Centers. The survey data were collected in 2001 and were published in 2003; they include data on 98 childcare centers that are known to have been built before 1978. Note that while the data only includes child care centers, some of these centers are located in schools and the information on lead likelihoods, characteristics of classrooms and the frequencies of painting are extrapolated to elementary schools with pre-schools or kindergartens.

Data Sources

This section provides a brief summary of the primary data sources used to estimate the number of RRP events in COFs in Public or Commercial Buildings.

HUD's (2003) First National Health Survey of Child Care Centers

HUD's (2003) First National Environmental Health Survey of Child Care Centers was conducted under the sponsorship of the Department of Housing and Urban Development (HUD), the Environmental Protection Agency (EPA), and the Consumer Product Safety Commission (CPSC) to assess children's potential exposure to lead, allergens, and pesticides in licensed child care centers. This survey can be used to estimate lead levels in dust, paint, and soil in childcare centers. This analysis uses these data to estimate: (1) likelihoods of LBP on various components that might be disturbed during RRP, (2) various characteristics of the rooms and buildings (such as the size and number of rooms, windows, and doors), and (3) the frequency of interior painting, exterior painting, and cleaning.

Whitestone (2006) Building Maintenance and Repair Cost Reference 2006-2007

Whitestone Research is a commercial service that provides data on the frequency of different types of maintenance activities and their costs, for use by building managers and investors. For over 50 building types (including both elementary schools and childcare centers), Whitestone defines a typical building and lists the building components they are likely to contain (e.g. type of windows, type of interior and exterior wall coverings, type of heating system, etc.). Whitestone lists the frequency and type of repairs each building component will need, including replacements. The Whitestone data can be used to estimate the types and frequency of RRP work for COFs in public and commercial buildings.

Description of Methodology for Estimating the Number of RRP Events in COFs in Public or Commercial Buildings

The basic steps for estimating the number of events are:
1. Estimate the number of COFs (rooms and buildings),
2. Estimate the frequency of performing an event,
3. Estimate the likelihood that an event will be affected by the rule (disturbing paint, disturbing LBP).
4. Combine the results of the above three steps to estimate: (1) annual number of buildings and classrooms where more than two square feet of a painted surface is disturbed, (2) annual number of buildings and classrooms where *lead-based paint (LBP)* is disturbed and detected, and (3) annual number of buildings and classrooms disturbing paint that falsely tests positive for LBP.

The methodology for performing these steps is described below in more detail.

Step 1: Estimate the Number of Public or Commercial Building COFs (rooms and centers)

Based on the number of daycarecenters reported to be located in schools according to the HUD (2003) data, 22 percent of the estimated 115,000 centers are estimated to be located in elementary schools. Thus, these 25,300 daycare centers are assumed to be accounted for in the estimated 40,190 elementary schools with pre-schools and kindergartens. Although an additional 1,421 pre-schools are located in schools without kindergarten programs (such as middle or high schools), these pre-schools are included in the count of daycare centers for the purposes of the total cost analysis. In summary, there are 40,190 elementary schools with pre-schools and kindergartens, 37,049 elementary schools with kindergartens but no pre-school, and 89,261 daycare centers (See Section 2.9 of Chapter 2).[12] Using CBECs (DOE 2003) data for education buildings, it was estimated that 58 percent of buildings are pre-1978. The HUD (2003) data was used to estimate the relative number of pre-1960 buildings. The resulting estimates are presented in Table 4-29.

This analysis considers three categories of COFs in public or commercial buildings: (1) daycare centers, (2) elementary schools with kindergartens only, and (3) elementary schools with kindergartens and pre-schools. The analysis distinguishes between these types of buildings because of their different sizes and thus, their different compliance costs. The number of childcare center classrooms was estimated using the HUD (2003) data. The estimated numbers of pre-kindergarten and kindergarten classrooms per building are 3.8 and 6.7 for elementary schools with kindergartens and elementary schools with pre-schools and kindergartens, respectively. The number of pre-school classrooms per building was estimated based on the number of pre-kindergarten schools and classes reported in the *NCES Prekindergarten in U.S. Public Schools 2000-2001 Report* (U.S. Department of Education 2003). The number of kindergarten classrooms per building was estimated based on the number of kindergarten schools and classes reported in the *Full-Day and Half-Day Kindergarten in the United States 1998-1999* (U.S. Department of Education 2003). In addition, this analysis accounts for costs, but not benefits, of RRP in spaces in the public or commercial buildings that might be visited by children under the age of six on a regular basis.

Spaces in Addition To Regular Kindergarten and Pre-Kindergarten Classrooms Regularly Visited by Children Under Age Six

Children under the age of 6 are in some first grade classrooms, at least for part of the year. In addition, in some schools children under the age of 6 might use other rooms on a regular basis, including libraries, cafeterias, gyms, computer rooms, and music and/or art rooms. Note that because of uncertainties about how many first grade classrooms and other school rooms might be ~~use~~used by ~~a child~~children under the age of six on a routine basis, the benefits analysis does not account for RRP performed in these areas.

[12] The 89,261 daycare centers include 1,421 schools with pre-kindergarten but no kindergarten, and 87,840 daycare centers located outside of schools (See Section 2.9 of Chapter 2).

According to NCES's 2005 *After-School Programs and Activities Survey of the National Household Education Surveys Program* data, just under 0.5 percent of all first graders are 5 years old. Thus there are nearly 19,000 first graders who are age 5 (NCES 2005). The survey collected age data as of December 31st of 2004 and as such does not include children who turned 6 after the start of the school year in September but before the end of December. Thus it is thus likely that this figure underestimates the number of children who are 5 years old when they enter first grade. While the total number of five year olds in first grade is relatively small, any class with one of these children is subject to the rule.

Unlike for pre-kindergartens or kindergartens, there is no data on the number of first grade classrooms in the United States. The number of first grade classrooms was estimated based on student enrollment and the average number of first graders in a typical classroom. Data on the average number of students in first grade were obtained from four states – Texas, New Hampshire, New York, and Illinois (Texas Education Agency 1999; New Hampshire Department of Education 2006; New York State Office of the State Comptroller 2005; ASU 2007). The number of students per classroom reported in these states ranged from 18 to 21.6, with an average of 20 students per classroom. To estimate the total number of first grade classrooms, the total number of first graders (3,663,005 in public schools + 439,510 in private schools) was divided by the average of 20 students per first-grade class. The resulting number of classrooms (205,126) was divided by the total number of schools with a first grade (51,572 public schools + 22,362 private schools) to estimate the average number of classrooms per school.[13] Based on these calculations, there is an average of 2.8 first grade classrooms per school.

Data were not available on the amount of the school day or week that kindergartners and first graders spend outside of their primary classroom, or the rooms they visit. Nor were data available on the average size of these rooms in older elementary schools. Thus the following assumptions were made:

- Gyms are about the size of 5 classrooms. This estimate is based on the assumption that most elementary school gyms will accommodate a basketball court. A basketball court is 3,108 square feet and an average classroom is 729 square feet (ProDunkHoops 2006; HUD 2003). Thus, a basketball court is about 4.25 classrooms, which was rounded up to 5 to accommodate bleachers, etc.
- Cafeterias are about the same size as an elementary school gym.
- Elementary school libraries are about the size of 2 classrooms
- Students were also assumed to regularly spend time in at least one other classroom (e.g. computer room, music or art room).

[13] The numbers of first graders in public and private schools were drawn from NCES's *Overview of Public Elementary and Secondary Students, Staff, Schools, School Districts, Revenues, and Expenditures: School Year 2004-2005 and Fiscal Year 2004* (NCES 2006a) and *Characteristics of Private Schools in the United States: Results From the 2003-2004 Private School Universe Survey* (NCES 2006e), respectively. The numbers of public and private schools with first grades were calculated using NCES's *Common Core of Data Public Elementary/Secondary School Universe Survey Data, 2004-2005* (NCES 2006b) and *2003-2004 Private School Universe Survey Data (NCES 2006f),* respectively.

Estimates were generated using data on the percentage of public elementary schools that have various non-classroom facilities as follows:

- Cafeteria 98%[14] (NCES 2006g)
- Library 95% (NCES 2004)
- Gymnasium 80% (NCES 2007)

Using these percentages and the classroom-equivalent sizes for rooms specified above, the equivalent of an additional 12 rooms was assumed to be covered by the rule because children under the age of 6 use them in addition to their regular classrooms. The calculation is:

98% * (1 cafeteria)*(5 classroom equivalents) + 95% * (1 library)*(2 classroom equivalents) + 80% * (1 gym)*(5 classroom equivalents) + (1 extra room) = 12 classroom equivalents.

In addition, 2.8 first grade classrooms are assumed to be covered by the rule, making the total number of additional classroom equivalents 14.8. The estimated numbers of pre-kindergarten and kindergarten classrooms per building with are 3.8 and 6.7 for elementary schools with kindergartens and elementary schools with pre-schools and kindergartens, respectively. Thus, the numbers of classrooms and classroom equivalents covered under the rule are 18.6 and 21.5 for elementary schools with kindergartens and elementary schools with pre-schools and kindergartens, respectively.

Table 4-29: Number of Regulated Buildings and Classrooms, by Building Type and Year Built

	Daycare Centers		**Elementary Schools with Kindergartens Only**		**Elementary Schools with Pre-Schools and Kindergartens**	
	Buildings	*Classrooms*	*Buildings*	*Classrooms*	*Buildings*	*Classrooms*
Pre-1978	51,771	170,472	21,488	399,685	23,310	501,169
Pre-1960	28,687	103,566	11,907	242,817	12,917	304,471

Source: Calculated using HUD 2003 data.

Step 2: Estimate the frequency of performing an event

Interior Painting

Respondents to the HUD (2003) survey were asked how often they repainted the interior; they could respond: (1) every 1 to 4 years, (2) every 5 to 10 years, or (3) every 10 to 20 years. The average frequency of painting was estimated using the midpoints for these ranges (weighted averages were calculated using the buildings' survey weight). On average, building interiors are painted every 4.4 years. It is assumed that 35% involve sanding and/or scraping before painting, based on data for housing units (EPA 2006).

[14] This figure is based on the number of schools providing food services in a cafeteria or lunch room. Since many elementary schools use the gymnasium as a lunch room, there may be substantial overlap between cafeterias and gymnasiums. Thus, this may overestimate the areas in schools potentially impacted by the rule.

Exterior Painting
Respondents to the survey were asked how often they repainted the exterior; they could respond: (1) every 1 to 4 years, (2) every 5 to 10 years, or (3) every 10 to 20 years. The average frequency of painting was estimated using the midpoints for these ranges (weighted averages were calculated using the building's survey weight); on average, buildings paint their exterior every 7 years. Thus, the analysis assumes that buildings with exterior paint (about 90 percent of the buildings have exterior paint) are painted every seven years. Following the assumptions in the analysis for the 2006 proposed rule, it is assumed that the exterior is always sanded or scraped before painting (EPA 2006).

Wall Disturbing Events
The number of events where walls are disturbed is considered separately from those events that generally disturb trim, doors, and windows, which have higher likelihoods of LBP. The number of wall disturbing events is estimated using the Whitestone Maintenance and Repair (M&R) Cost Reference. The Whitestone M&R Cost Reference provides information on the frequency of a wide variety of maintenance and repair activities. As described in their Preface, the book is intended for two audiences.

> "The first group has a common need to know the long-term M&R costs of specific buildings. This group consists of analysts, developers, architects, bankers, investors and others who must account for M&R costs that, over a 50-year building lifetime, can easily exceed the cost of construction. … The second audience consists of facility managers and all those responsible for estimating and justifying facility maintenance budgets."

The bulk of the reference is composed of detailed lists of building components and M&R tasks, along with their average size, frequency of the M&R tasks, trade involved (e.g. plumber, carpenter) and estimated cost. The reference also provides building profiles for 56 different building types, including childcare centers and elementary schools. Each profile lists the typical building components for that building type and then generates a 50-year stream of expenditures that cover these building components.

The number of wall disturbing events is estimated based on the following categories of RRP events:

- Replace Plumbing Pipes and Fixtures
- Replace HVAC Systems
- Replace Electrical System and Fixtures

Using the frequencies of major renewal and replacement tasks that are likely to disturb lead-based paint for the building components described in the childcare center and elementary school profiles, this analysis developed the assumed frequency of RRP events shown in Table 4-30.

Table 4-30: Frequency of Wall Disturbing RRP Events

Category of RRP Event and Whitestone Components and Frequencies Used to Estimate Frequency of RRP Events	Assumed Average Frequency of Performing RRP Event	Resulting Total Number of RRP Events per Classroom per Year
RRP Event - Replace Plumbing Pipes and Fixtures Pipe & Fittings, 3/4" Copper, Cold Water Replace 10' section every 20 years, replace all pipes and fittings every 25 years. Pipe & Fittings, 3/4" Copper, Hot Water Replace 10' section every 13 years, replace all pipes and fittings every 25 years. Pipe & Fittings, 2" Copper, Cold Water Replace 10' section every 20 years, replace all pipes and fittings every 25 years. Pipe & Fittings, 6" Cast Iron Replace 10' section every 13 years, replace all pipes and fittings every 75 years. Pipe & Fittings, 10" Cast Iron Replace 10' section every 13 years, replace all pipes and fittings every 75 years. Pipe & Fittings, 4" DWV PVC Replace 10' section every 10 years, replace all pipes and fittings every 30 years.	Since replacing 10' sections of pipes is done as often as once every 10 years, the analysis assumes 1 job per classroom every 10 years – ½ are assumed to be large and ½ are assumed to be small (0.05 small jobs and 0.05 large jobs per year)	Each of the 4 categories is considered a separate event. Aggregating the frequencies provides annual averages of: 0.34 jobs, composed of: 0.23 small jobs 0.11 large jobs
RRP Event - Replace HVAC Systems Pipes & Fittings, 4" Steel, Gas Replace 10' section every 12 years, replace all pipes and fittings every 75 years.	Rounding to the nearest 10 years, it is assumed that there is 1 job per classroom every 10 years. Since 10' sections are replaced about every 10 years and all pipes and fittings are replaced about every 80 years, it is assumed that 1/8 are large jobs and 7/8 are small jobs. (0.0875 small jobs and 0.0125 large jobs per year)	
RRP Event - Replace Electrical System and Fixtures Fluorescent Lighting Fixture, 160 W Replace every 20 Years	1 job per classroom every 20 years, assumed to be large* (0.05 large jobs per year)	
RRP Event - Unscheduled Maintenance	Assumes a small job is performed in 1 out of every 11 classrooms each year. This is equivalent to one job per building on average.	

* All unplanned maintenance events are assumed to be small jobs.
Source: Derived from Whitestone M&R Reference (2006).

Because historical data on M&R activities for wall disturbing events in these buildings are not available, and to simplify the calculations, it is assumed that the RRP events are evenly spread over the population of buildings. In other words, if a plumbing replacement job typically occurs once every 10 years, the analysis assumes that one-tenth of the buildings experience this RRP event in any given year. Thus in any given year, it is assumed that plumbing is replaced in 10 percent of buildings, HVAC systems are replaced in 10 percent of buildings and electrical systems are replaced in 5 percent of buildings. If multiple jobs are occurring in the same building, the analysis assumes they occur at different times in the year and thus each incurs its own work practice costs. To the extent that these events are actually occurring at the same time, the analysis overestimates the work practice costs. The Whitestone data does not include information on the frequency of unscheduled maintenance events. Instead, this analysis assumes that 1 out of 11 classrooms have an unscheduled maintenance job performed in a given year – this is approximately one job per building. The number of unscheduled maintenance events is based on an assumption, and not on empirical data.

Window and Door Replacement Events

The number of events where windows and doors are disturbed is also estimated using the Whitestone M&R Cost Reference, which listed the frequency with which door and window types typically found in elementary schools and daycare centers must be replaced—about every 20 years. Thus, in any given year, windows and doors are assumed to be replaced in 5 percent of buildings.

Step 3: Estimate the likelihood that an event will be affected by the rule (disturbing paint, disturbing LBP).

The next step is to estimate how many events in public or commercial building COFs will be affected by the rule, either because they disturb a painted surface (and must test for LBP) or they disturb LBP (and must use LSWP). This analysis considers four types of events for public or commercial buildings: (1) Interior Painting, (2) Exterior Painting, (3) Window Replacement, and (4) Wall Disturbing Events (e.g., plumbing, electrical). Thus, it is necessary to estimate likelihoods of disturbing LBP that are specific to these events. This is done as follows:

- **Interior Painting:** the likelihood of disturbing LBP during the interior painting with sanding or scraping of a classroom is estimated as the likelihood of any interior LBP in a classroom.
- **Exterior Painting:** the likelihood of disturbing LBP during the exterior painting with sanding or scraping of a center is estimated as the likelihood of any exterior LBP on a building.
- **Window Replacements:** the likelihood of disturbing LBP during window replacement is estimated as the likelihood of LBP on the interior or exterior of any windows in a classroom. Since the HUD (2003) data only tested the exterior paint for one window per building, the presence of exterior LBP in each classroom was based on this observation.
- **Wall Disturbing Events:** the likelihood of disturbing LBP during any interior wall disturbing event in a classroom is estimated as the likelihood of any interior LBP on walls in a classroom.

Note that this analysis estimates interior event costs and LBP likelihoods at the classroom level (instead of the building level), because this allows for attributing costs only to the rooms that test positive for LBP.

Table 4-31 shows the likelihood of lead-based paint (LBP) on surfaces in daycare centers, which is also used to estimate the likelihood of lead-based paint (LBP) on surfaces in public and private elementary schools. The likelihood of any interior LBP in a classroom (row 1, columns 1 and 4) is used to estimate the number of classroom-level interior painting events where LBP is disturbed. The likelihood of any exterior LBP on a center (row 2, columns 1 and 4) is used to estimate the number of building-level exterior painting events where LBP is disturbed. The likelihood of LBP on any windows in a room (row 3, columns 1 and 4) is used to estimate the number of room-level window and door replacement events where LBP is disturbed. The likelihood of LBP on any interior walls or floors in a room (row 4, columns 1 and 4) is used to estimate the number of room-level wall disturbing events where LBP is disturbed. Wall disturbing events are analogous to the non-room-specific wall disturbing events in the target housing. Jobs such as plumbing, electrical, and HVAC may involve disturbing walls, but are unlikely to disturb paint on surfaces such as windows, doors, or trim.

Note that while all classrooms in the sample had at least one painted surface, and all classrooms had at least one painted window or door, some buildings had no paint on their exteriors and some classrooms had no paint on their walls.[15] This analysis accounts for these unpainted surfaces; for example, for pre-1960 wall disturbing events, it is assumed that: (a) 6% of events disturb LBP, (b) 58% (63% of 92%) of events have false positive results in Phase 1 of the rule and 9% (10% of 92%) of events have false positive results in Phase 2, (c) 5% of the 6% of events that disturb LBP will have false negative test kit results, and (d) 2% of events do not require a spot test.[16]

[15] Note that wallpaper over a painted surface is considered a painted surface in the survey.

[16] It is assumed that tests kits are used to test for LBP before each RRP event; they are inexpensive to use and a negative result will allow the renovator to forgo the more costly containment, cleaning and verification requirements. Lead test kits currently can be purchased in bulk at a cost of approximately $0.50 per test; it is assumed that testing four samples will require about 15 minutes of a certified renovator's time. Thus, testing using the test kits is estimated to cost $10 per event. Test kits for LBP that are currently available have false positive rates that range from 47 percent to 78 percent; this analysis assumes a false positive rate of 63 percent, the midpoint, for the first year that the rule's requirements are effective. By the end of the first year of regulation it is assumed that an improved test kit will be developed that will have a false positive rate of 10 percent or less. EPA believes that the sensitivity of test kits can be adjusted so the results reliably correspond to one of the two Federal standards for lead-based paint (1.0 mg/cm2 and 0.5% by weight). EPA is planning to conduct research to further the development of test kits that accurately identify both the presence and absence of lead in paint at levels that exceed the Federal standards. EPA is confident that improved test kits can be commercially availableby the end of the first yar of the regulation.

Table 4-31: Likelihood of Lead-Based Paint, Lead-Free Paint, and Unpainted Surfaces in Child Occupied Facilities in Public or Commercial Buildings							
		Pre-1960			**1960-1978**		
row	**Surface/Component**	*LBP (1)*	*Non-LBP (2)*	*No Paint (3)*	*LBP (4)*	*Non-LBP (5)*	*No Paint (6)*
(1)	*Any Interior Surfaces in Room*	23%	77%	0%	8%	92%	0%
(2)	*Any Exterior Surfaces in Bldg*	33%	54%	13%	12%	81%	7%
(3)	*Windows and Doors in Room*	29%	71%	0%	3%	97%	0%
(4)	*Interior Walls in Room*	6%	92%	2%	6%	91%	3%

Note that the sample size did not allow distinguishing pre-1950 buildings from those built between 1950 and 1960. The pre-1960 data are applied to the pre-1950 structures.
Source: EPA calculations using HUD (2003).

Step 4: Combine the results:

Looking at Table 4-32, the product of the number of COF classrooms (column 1), the percent of rooms painted annually (column 2), and the percent of jobs with sanding or scraping (column 3), gives the number of painting jobs with sanding or scraping (column 4). Under the assumption of 75 percent compliance, 75 percent of column 4 gives the number of test kits that would be required annually. If column 4 is multiplied by the LBP likelihood (column 5) and 95% (to account for false negatives), the results are the number of rooms painted with sanding or scraping LBP that is detected (column 6). Taking 63%, the false positive rate in Year 1, of the difference between columns 4 and 6, yields the number of false positive interior painting events (column 7) [17]. Under the assumption of 75 percent compliance, 75 percent of the sum of column 6 and 7 yields the number of interior rooms painted annually using the required containment, cleaning, and verification practices.

[17] The Year 2 results are estimated using a false positive rate of 10%, assuming that improved test kits become available in that year.

Table 4-32: Interior Painting Events in Daycare Centers, Schools with Kindergartens Only, and Schools with Pre-Schools and Kindergartens								
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Year Built	***Number of Classrooms***	***Percent of Rooms Where Activity is Performed[a]***	***Percent of Jobs Disturbing Painted Surfaces***	***Number of Jobs Disturbing Painted Surfaces***	***LBP %***	***Number of Jobs Disturbing LBP, excluding false negatives (5 percent)***	***Number Jobs with a False Positive Test Kit Result [b]***	***Number of Jobs Using LSWP (75% Compliance)***
Year 1: Daycare Centers								
1960-1978	66,907	23%	35%	5,361	8%	409	3,106	2,636
Pre-1960	103,566	23%	35%	8,298	23%	1,793	4,039	4,374
All Pre-78	**170,472**			**13,659**		**2,202**	**7,145**	**7,010**
Year 2: Daycare Centers								
1960-1978	66,632	23%	35%	5,339	8%	408	491	674
Pre-1960	103,141	23%	35%	8,264	23%	1,785	639	1,818
All Pre-78	**169,774**			**13,603**		**2,193**	**1,129**	**2,492**
Year 1: Schools with Kindergartens Only								
1960-1978	156,868	23%	35%	12,569	8%	960	7,282	6,180
Pre-1960	242,817	23%	35%	19,455	23%	4,203	9,470	10,255
All Pre-78	**399,685**			**32,025**		**5,163**	**16,752**	**16,435**
Year 2: Schools with Kindergartens Only								
1960-1978	156,224	23%	35%	12,518	8%	956	1,151	1,580
Pre-1960	241,822	23%	35%	19,376	23%	4,186	1,497	4,261
All Pre-78	**398,046**			**31,894**		**5,142**	**2,648**	**5,842**
Year 1: Schools with Kindergartens and Pre-Schools								
1960-1978	196,698	23%	35%	15,761	8%	1,204	9,131	7,750
Pre-1960	304,471	23%	35%	24,396	23%	5,270	11,875	12,859
All Pre-78	**501,169**			**40,156**		**6,474**	**21,005**	**20,609**
Year 2: Schools with Kindergartens and Pre-Schools								
1960-1978	195,891	23%	35%	15,696	8%	1,199	1,443	1,983
Pre-1960	303,223	23%	35%	24,296	23%	5,248	1,877	5,343
All Pre-78	**499,114**			**39,992**		**6,447**	**3,321**	**7,326**

a. The difference between the frequency of painting older and newer buildings reflects the difference in the percentage of buildings with interior paint.
b. The false positive test kit rate is assumed to be 63 percent in the first year and 10 percent after the first year.
c. The false negative test kit rate is assumed to be 5 percent.

Note: Following EPA (2006), it is assumed that 75 percent of COFs comply with the rule.

Source: Calculated using HUD 2003.

Looking at Table 4-33, the product of the number of buildings (column 1), the percent of buildings painted annually (column 2), and the percent of jobs with sanding or scraping (column 3), gives the number of painting jobs with sanding or scraping (column 4). Under the assumption of 75 percent compliance, 75 percent of column 4 gives the number of kit tests that would be required annually. If column 4 is multiplied by the LBP likelihood (column 5) and 95% (to account for false negatives), the result is the number of buildings painted with sanding or scraping LBP that is detected (column 6). Taking 63%, the false positive rate in Year 1, of the difference between columns 4 and 6, yields the number of false positive exterior painting events (column 7) [18]. Under the assumption of 75 percent compliance, 75 percent of the sum of column 6 and 7 yields the number of exterior buildings painted annually using the required containment, cleaning, and verification practices.

[18] The Year 2 results are estimated using a false positive rate of 10%, assuming that improved test kits become available in that year.

Table 4-33: Exterior Painting Events in Daycare Centers, Schools with Kindergartens Only, and Schools with Pre-Schools and Kindergartens								
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Year Built	***Number of Buildings***	***Percent of Buildings Where Activity is Performed***[a]	***Percent of Jobs Disturbing Painted Surfaces***	***Number of Jobs Disturbing Painted Surfaces***	***LBP %***	***Number of Jobs Disturbing LBP, excluding false negatives (5 percent)***	***Number Jobs with a False Positive Test Kit Result*** [b]	***Number of Jobs Using LSWP (75% Compliance)***
Year 1: Daycare Centers								
1960-1978	23,084	13%	100%	3,076	13%	391	1,679	1,552
Pre-1960	28,687	12%	100%	3,576	38%	1,286	1,400	2,015
All Pre-78	**51,771**			**6,652**		**1,677**	**3,079**	**3,567**
Year 2: Daycare Centers								
1960-1978	22,989	13%	100%	3,063	13%	389	265	491
Pre-1960	28,570	12%	100%	3,562	38%	1,281	221	1,126
All Pre-78	**51,559**			**6,625**		**1,670**	**487**	**1,617**
Year 1: Schools with Kindergartens Only								
1960-1978	9,581	13%	100%	1,277	13%	162	697	645
Pre-1960	11,907	12%	100%	1,484	38%	534	581	836
All Pre-78	**21,488**			**2,761**		**696**	**1,278**	**1,481**
Year 2: Schools with Kindergartens Only								
1960-1978	9,542	13%	100%	1,271	13%	161	110	204
Pre-1960	11,858	12%	100%	1,478	38%	532	92	467
All Pre-78	**21,400**			**2,750**		**693**	**202**	**671**
Year 1: Schools with Kindergartens and Pre-Schools								
1960-1978	10,393	13%	100%	1,385	13%	176	756	699
Pre-1960	12,917	12%	100%	1,610	38%	579	631	907
All Pre-78	**23,310**			**2,995**		**755**	**1,386**	**1,606**
Year 2: Schools with Kindergartens and Pre-Schools								
1960-1978	10,351	13%	100%	1,379	13%	175	119	221
Pre-1960	12,864	12%	100%	1,604	38%	577	100	507
All Pre-78	**23,214**			**2,983**		**752**	**219**	**728**

a. The difference between the frequency of painting older and newer buildings reflects the difference in the percentage of buildings with exterior paint.

b. The false positive test kit rate is assumed to be 63 percent in the first year and 10 percent after the first year.

Note: Following EPA (2006), it is assumed that 75 percent of COFs comply with the rule.

Source: Calculated using HUD 2003.

Looking at Table 4-34, the product of the number of classrooms (column 1), the percent of classrooms replacing windows and doors annually (column 2), and the percent of jobs disturbing LBP (column 3), gives the number of window and door replacements disturbing painted surfaces (column 4). Under the assumption of 75 percent compliance, 75 percent of column 4 gives the number of kit tests that would be required annually. Multiplying column 4 by the LBP likelihood (column 5) and 95% (to account for false negatives), yields the number of classrooms disturbing LBP that is detected (column 6). Taking 63%, the false positive rate in Year 1, of the difference between columns 4 and 6, yields the number of false positive events (column 7) [19]. Under the assumption of 75 percent compliance, 75 percent of the sum of column 6 and 7 gives the number of classrooms using the required containment, cleaning, and verification practices each year.

[19] The Year 2 results are estimated using a false positive rate of 10%, assuming that improved test kits become available in that year.

Table 4-34: Window and Door Replacement Events in Daycare Centers, Schools with Kindergartens Only, and Schools with Pre-Schools and Kindergartens								
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Year Built	***Number of Classrooms***	***Percent of Classrooms Where Activity is Performed***[a]	***Percent of Jobs Disturbing Painted Surfaces***	***Number of Jobs Disturbing Painted Surfaces***	***LBP %***	***Number of Jobs Disturbing LBP, excluding false negatives (5 percent)***	***Number Jobs with a False Positive Test Kit Result***[b]	***Number of Jobs Using LSWP (75% Compliance)***
Year 1: Daycare Centers								
1960-1978	66,907	5%	100%	3,345	3%	82	2,053	1,602
Pre-1960	103,566	5%	100%	5,178	29%	1,447	2,303	2,812
All Pre-78	**170,472**			**8,524**		**1,530**	**4,356**	**4,414**
Year 2: Daycare Centers								
1960-1978	66,632	5%	100%	3,332	3%	82	325	305
Pre-1960	103,141	5%	100%	5,157	29%	1,441	364	1,354
All Pre-78	**169,774**			**8,489**		**1,523**	**689**	**1,659**
Year 1: Schools with Kindergartens Only								
1960-1978	156,868	5%	100%	7,843	3%	193	4,813	3,756
Pre-1960	242,817	5%	100%	12,141	29%	3,393	5,399	6,593
All Pre-78	**399,685**			**19,984**		**3,586**	**10,212**	**10,349**
Year 2: Schools with Kindergartens Only								
1960-1978	156,224	5%	100%	7,811	3%	192	761	714
Pre-1960	241,822	5%	100%	12,091	29%	3,379	853	3,176
All Pre-78	**398,046**			**19,902**		**3,572**	**1,614**	**3,890**
Year 1: Schools with Kindergartens and Pre-Schools								
1960-1978	196,698	5%	100%	9,835	3%	242	6,035	4,710
Pre-1960	304,471	5%	100%	15,224	29%	4,255	6,769	8,267
All Pre-78	**501,169**			**25,058**		**4,497**	**12,805**	**12,977**
Year 2: Schools with Kindergartens and Pre-Schools								
1960-1978	195,891	5%	100%	9,795	3%	241	954	896
Pre-1960	303,223	5%	100%	15,161	29%	4,237	1,070	3,982
All Pre-78	**499,114**			**24,956**		**4,478**	**2,024**	**4,878**

a. The difference between the frequency of painting older and newer buildings reflects the difference in the percentage of buildings with paint on windows or doors.
b. The false positive test kit rate is assumed to be 63 percent in the first year and 10 percent after the first year.
c. The false negative test kit rate is assumed to be 5 percent.

Note: Following EPA (2006), it is assumed that 75 percent of COFs comply with the rule.

Source: Calculated using HUD 2003.

Looking at Table 4-35, the product of the number of rooms (column 1), the percent of classrooms with annual wall-disturbing events (column 2), and the percent of jobs disturbing painted surfaces (column 3), gives the number of events disturbing painted surfaces (column 4). Under the assumption of 75 percent compliance, 75 percent of column 4 gives the number of kit tests that would be required annually. Multiplying column 4 by the LBP likelihood (column 5) and 95% (to account for false negatives), yields the number of events disturbing LBP that is detected (column 6). Taking 63%, the false positive rate in Year 1, of the difference between columns 4 and 6, yields the number of false positive events (column 7) [20]. Under the assumption of 75 percent compliance, 75 percent of the sum of column 6 and 7 gives the number of events using the required containment, cleaning, and verification practices each year.

[20] The Year 2 results are estimated using a false positive rate of 10%, assuming that improved test kits become available in that year.

Table 4-35: Wall Disturbing Events in Daycare Centers, Schools with Kindergartens Only, and Schools with Pre-Schools and Kindergartens								
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Year Built	***Number of Classrooms***	***Percent of Rooms Where Activity is Performed[a]***	***Percent of Jobs Disturbing Painted Surfaces [a]***	***Number of Jobs Disturbing Painted Surfaces***	***LBP %***	***Number of Jobs Disturbing LBP, excluding false negatives (5 percent)***	***Number Jobs with a False Positive Test Kit Result [b]***	***Number of Jobs Using LSWP (75% Compliance)***
Year 1: Daycare Centers								
1960-1978	66,907	34%	97%	22,101	6%	1,335	13,038	10,780
Pre-1960	103,566	34%	98%	34,469	6%	1,968	20,411	16,784
All Pre-78	**170,472**			**56,570**		**3,302**	**33,449**	**27,564**
Year 2: Daycare Centers								
1960-1978	66,632	34%	97%	22,010	6%	1,329	2,061	
Pre-1960	103,141	34%	98%	34,328	6%	1,960	3,226	
All Pre-78	**169,774**			**56,338**		**3,289**	**5,288**	
Year 1: Schools with Kindergartens Only								
1960-1978	156,868	34%	97%	51,817	6%	3,129	30,570	25,275
Pre-1960	242,817	34%	98%	80,815	6%	4,613	47,854	39,351
All Pre-78	**399,685**			**132,632**		**7,743**	**78,424**	**64,626**
Year 2: Schools with Kindergartens Only								
1960-1978	156,224	34%	97%	51,605	6%	3,117	4,832	5,961
Pre-1960	241,822	34%	98%	80,484	6%	4,594	7,565	9,120
All Pre-78	**398,046**			**132,089**		**7,711**	**12,397**	**15,082**
Year 1: Schools with Kindergartens and Pre-Schools								
1960-1978	196,698	34%	97%	64,974	6%	3,924	38,332	31,692
Pre-1960	304,471	34%	98%	101,335	6%	5,785	60,005	49,343
All Pre-78	**501,169**			**166,309**		**9,709**	**98,336**	**81,035**
Year 2: Schools with Kindergartens and Pre-Schools								
1960-1978	195,891	34%	97%	64,708	6%	3,908	6,059	7,475
Pre-1960	303,223	34%	98%	100,919	6%	5,761	9,486	11,436
All Pre-78	**499,114**			**165,627**		**9,669**	**15,545**	**18,911**

a. The difference between the frequency of painting older and newer buildings reflects the difference in the percentage of buildings with paint on interior walls.
b. The false positive test kit rate is assumed to be 63 percent in the first year and 10 percent after the first year.
c. The false negative test kit rate is assumed to be 5 percent.

Note: Following EPA (2006), it is assumed that 75 percent of COFs comply with the rule.

Source: Calculated using HUD 2003.

Summary of Events in COFs in Public or Commercial Buildings

Table 4-36 summarizes the number of events were a test using a test kit will be performed as well as the number of events requiring cleaning, containment, and verification following a positive test kit result. The rates of false positive test kit results are 63 percent and 10 percent in the first and subsequent years, respectively.

Table 4-36: Summary of the Number of Public or Commercial Building COF Events

	Events Using Test Kits				**Events with Cleaning, Containment, and Verification (LSWP)**			
	Interior Painting	Exterior Painting	Window and Door Disturbing Events	Wall Disturbing Events	Interior Painting	Exterior Painting	Window and Door Disturbing Events	Wall Disturbing Events
	Option E, Year 1							
Daycare Centers	10,244	4,989	6,393	42,427	7,010	3,567	4,414	27,564
Kindergartens Only	24,018	2,071	14,989	99,473	16,435	1,481	10,349	64,626
Kindergartens and Pre-Schools	30,116	2,246	18,795	124,730	20,609	1,606	12,977	81,035
All Public or commercial building COFs	**64,378**	**9,306**	**40,177**	**266,630**	**44,054**	**6,654**	**27,740**	**173,225**
	Options P, A, B, C, D, Year 1							
Daycare Centers	6,224	2,682	3,884	25,852	4,374	2,015	2,812	16,784
Kindergartens Only	14,593	1,113	9,106	60,612	10,255	836	6,593	39,351
Kindergartens and Pre-Schools	18,298	1,208	11,419	76,002	12,859	907	8,267	49,343
All Public or commercial building COFs	**39,115**	**5,003**	**24,409**	**162,466**	**27,488**	**3,758**	**17,672**	**105,478**
	Options P, A, B, and E, Year 2							
Daycare Centers	10,202	4,969	6,367	42,253	2,492	1,617	1,659	6,433
Kindergartens Only	23,920	2,063	14,928	99,065	5,842	671	3,890	15,082
Kindergartens and Pre-Schools	29,993	2,237	18,718	124,219	7,326	728	4,878	18,911
All Public or commercial building COFs	**64,114**	**9,268**	**40,012**	**265,537**	**15,660**	**3,017**	**10,427**	**40,426**
	Options C and D, Year 2							
Daycare Centers	6,198	2,671	3,868	25,746	1,818	1,126	1,354	3,890
Kindergartens Only	14,533	1,108	9,069	60,363	4,261	467	3,176	9,120
Kindergartens and Pre-Schools	18,223	1,203	11,372	75,690	5,343	507	3,982	11,436
All Public or commercial building COFs	**38,955**	**4,982**	**24,309**	**161,800**	**11,422**	**2,100**	**8,512**	**24,446**

Note: Following EPA (2006), it is assumed that 75 percent of COFs comply with the rule. See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations

4.3 Work Practice Compliance Costs

RRP projects generate varying amounts of leaded dust, paint chips, and other lead-contaminated materials depending on the type of work, size of area affected, and work methods used. For example, repairing a small area of damaged drywall is likely to generate less lead-contaminated dust and debris than sanding a large area in preparation for painting. Because of this variability, the size of the area that must be isolated and the containment methods used will vary from project to project. Large renovation projects could involve one or more rooms and potentially encompass an entire home or building, while small projects may involve a portion of a room or a building's exterior. The necessary work area preparations will depend on the size of the surface(s) being disturbed, the method used in disturbing the surface, and the building layout. The certified renovator assigned to a renovation would weigh all of these factors in determining the appropriate work area size for that particular situation. For example, repairing a small area of damaged drywall would probably require a smaller work area while demolition work would probably require a larger work area in order to prevent the migration of dust and debris from the work area.

4.3.1 LBP Test Kit Compliance Costs

It is assumed that spot test kits are used to test for LBP before each RRP event where a lead inspection has not been performed; they are inexpensive to use and a negative result will allow the renovator to forgo the more costly containment, cleaning and verification requirements. Lead test kits currently can be purchased in bulk at a cost of approximately $0.50 per test; it is assumed that testing four samples will require about 15 minutes of a certified renovator's time. Thus, testing using the spot test kits is estimated to cost $10 per event.

RRP purchasers may choose to have XRF testing conducted to detect the presence of LBP instead of using a test kit. XRF testing has the advantage of having lower false positive rates, but the testing cost per event is much higher than a test kit. Therefore, it is assumed that test kits are used in lieu of XRF testing.

4.3.2 Containment, Cleaning, and Verification

The containment and cleaning practices covered in the cost estimates are:[21]

For large interior events:

- Remove or cover all objects in the room where the renovation will be performed, including furniture, rugs, and window coverings.
- Close and cover all ducts opening into the room with taped-down plastic sheeting or other impermeable material.
- Close windows and doors in the work area. Doors must be covered with plastic sheeting or other impermeable material. Doors used as an entrance to the work area must be covered with plastic sheeting or other impermeable material in a manner that allows workers to pass through while confining dust and debris to the work area.[22]
- Cover the floor with taped-down plastic sheeting or other impermeable material. Place a tack pad at the edge of the sheeting at the entrance to the room. Cover paths through the rest of the buildings used by persons performing the renovation with plastic sheeting or other impermeable material.

For small interior events:

[21] For the purposes of simplifying the modeling of the costs, some of the work practices described here are slightly different than those practices required by the rule. The costs of these practices are expected to be representative of the practices required by the rule.

[22] This analysis assumes that contractors will meet the entrance door requirement by creating an airlock using two sheets of plastic.

- Remove or cover all objects within five feet of the work area, including furniture, rugs, and window coverings.
- Close all windows, doors, and ducts within five feet of the work area. Cover ducts with plastic sheeting or other impermeable material.
- Cover the floor within five feet of the work area with taped-down plastic sheeting or other impermeable material.
- Wear disposable shoe covers and vacuum clothes.

For large and small exterior events:

- Cover the ground with plastic sheeting or other disposable impermeable material extending out from the edge of the structure a sufficient distance to collect falling paint debris.
- Ensure that doors within the work area that must be used while the job is being performed are covered with plastic sheeting or other impermeable material in a manner that allows workers to pass through while confining dust and debris to the work area.

For all events:

- Post signs warning occupants and other persons not involved in renovation activities to remain outside of the work area.
- Isolate the work area so that no visible dust or debris leaves the work area while the renovation is being performed.
- Contain waste from renovation activities to prevent releases of dust and debris before the waste is removed from the work area for storage or disposal.
- At the conclusion of each workday, store waste from renovation activities under containment, in an enclosure, or behind a barrier that prevents release of dust and debris and prevents access to dust and debris.
- Pick up all paint chips and debris.
- Remove plastic sheeting from objects in the work area and the floor or ground. Mist the sheeting before folding it, fold the dirty side inward, and tape shut to seal. Dispose of the sheeting as waste.

Additional Cleaning for interior events

- Clean all objects and surfaces in and around the work area for interior events in the following manner, cleaning from higher to lower:
  a. Thoroughly vacuum all surfaces and objects in the work area, including furniture and fixtures, with a vacuum equipped with a high-efficiency particulate air (HEPA) filter. Where feasible, floor surfaces underneath a rug or carpeting must also be thoroughly vacuumed with a HEPA vacuum.
  b. Wipe all surfaces and objects in the work area with a damp cloth (except for walls, ceilings, carpeted surfaces and upholstered surfaces).
  c. Mop uncarpeted floors thoroughly, using a two-bucket mopping method that keeps the wash water separate from the rinse water, or using a wet mopping system.

Post-renovation cleaning verification for interior events:

- A certified renovator must perform a visual inspection to determine if visible amounts of dust, debris or residue are still present. If visible amounts of dust, debris or residue are present, these conditions must be eliminated by re-cleaning and another visual inspection must be performed.

- After a successful visual inspection, a certified renovator must:
    a. Wipe uncarpeted floors within the work area with a disposable wet cleaning cloth. The cloth must remain damp at all times while it is being used to wipe the floor for post-cleaning verification. If the floor surface within the work area is greater than 40 square feet, the floor within the area must be divided into roughly equal sections that are less than 40 square feet. Wipe each such section separately with a new disposable cleaning cloth. If the cloths used to wipe each section of the floor within the work area match the cleaning verification card, that section of the floor has been adequately cleaned.
    b. If the cloth used to wipe a particular section of floor does not match the cleaning verification card, re-clean that section of the floor using the two-bucket mopping method. Then wipe that section of the floor using a new wet cleaning cloth. If the cloth matches the cleaning verification card, that section of the floor has been adequately cleaned.
    c. If the second cloth used to wipe a particular floor section does not match the cleaning verification card, re-clean that section of the floor using the two-bucket mopping method described above and allow the entire floor within the work area to dry completely. After the entire floor within the work area has completely dried, wipe the floor with electrostatic cleaning cloths until a cloth that has wiped the entire floor matches the cleaning verification card.[23]
    d. Wipe the windowsills in the work area following the same protocol as used for floors, but with one wet-wipe per-windowsill.
    e. When the area passes the post-renovation cleaning verification, remove the warning signs.

Post-renovation cleaning verification for exterior events:

- A certified renovator must perform a visual inspection to determine if visible amounts of dust, debris or residue are still present. If visible amounts of dust, debris or residue are present, these conditions must be eliminated by re-cleaning and another visual inspection must be performed. When the area passes the visual inspection, remove the warning signs.

[23] It is assumed that a second cleaning is required 30 percent of the time and a third cleaning is required 2 percent of the time.

4.3.3 Cost of Each Containment and Cleaning Practice

The primary source of information on the cost of containment and cleaning practices, equipment and materials was the Means CostWorks Repair & Remodeling Cost Data (R.S. Means 2005). The data is designed to help contractors estimate the cost of a renovation project. The database provides the total labor and material costs of different renovation components on a unit basis. Most of the costs used from the R.S. Means database are for an asbestos abatement project, which requires much more elaborate containment and clean up than required under the analyzed options. The R.S. Means labor estimates have been adjusted downwards to reflect the less stringent requirements of the LRRP rule. Depending on the type of activity, the unit may be a square foot, each item, or some other measure. Table 4-37 and Table 4-38 show the material costs, labor requirements and total cost for the containment and cleaning practices for interior events and exterior events, respectively.

Table 4-37: Unit Costs of RRP Interior Activities (2005$)				
Cost Type	**Material Cost**	**Units**	**Labor Hours**	**Total Cost[a]**
Containment				
Sign	$0.11[b]	Ea.	0	$0.11
Floors (labor): Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	$0.00	S.F.	0.006	$0.12
Floors (materials): Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	$0.08[c]	S.F.	0.000	$0.08
Walls[d]: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	$0.08[c]	S.F.	0.008	$0.25
Tack pad	$0.51[e]	Per sheet	0	$0.51
Disposable shoe covers	$0.38[f]	Per pair	0	$0.38
Roll down polyethylene sheeting	$0.00	S.F.	0.002	$0.03
Bag polyethylene sheeting	$1.15	Ea.	0.05	$2.24
Cleaning				
HEPA vacuum for work area	$0.63[g,h]	Ea.	0	$0.63
HEPA vacuum use (floor)	$0.01	S.F.	0.002	$0.05
HEPA vacuum use (walls)	$0.01	S.F.	0.002	$0.05
HEPA vacuum clothes	$0.00	Hours	0.167	$3.44
Wet wipe, flat surfaces (cleaning)	$0.01	S.F.	0.002	$0.06
Verification				
Wet wipe, flat surfaces (verification)	$0.01	S.F.	0.002	$0.06
Electrostatic cloth sweeper	$0.01[g,i]	Ea.	0	$0.01
Disposable wet cloth	$0.01[j]	S.F.	0.002[k]	$0.05
Disposable dry cloth	$0.01[j]	S.F.	0.002[k]	$0.05

[a] Using a mean loaded wage rate of $20.62 (2005$) based on the wages of three construction laborers and one supervisor from the May, 2004 Occupational Employment Statistics data from the Bureau of Labor Statistics.
[b] The cost of a 9”x12” aluminum sign is $10.99; assumed to be used 100 times.
[c] Based on a web search, which showed that duct tape costs $0.02 per square foot and 6 mil. polyethylene sheeting costs $0.06 per square foot.
[d] Estimate used for plastic on the doors, windows, and ducts.
[e] Based on a review of price lists on the web, which showed that the average cost per disposable sheet is $0.51.
[f] Based on a review of price lists on the web, which showed that the average cost per pair of shoe covers is $0.38.
[g] Assumes that it will be used for 1,000 events.
[h] Based on a review of price lists on the web that showed that the average cost for a HEPA vacuum is $626.
[i] Based on a review of price lists on the web that showed that the average cost of an electrostatic cloth sweeper is $13.60.
[j] Based on a review of price lists on the web that showed that the average cost of an electrostatic cloth wet cloth is $0.46. Also based on clearance requirements that the work area must be divided into roughly equal sections that are 40 square feet, therefore it costs $0.01 per square foot.
[k] Based on EPA’s (2005b) “Disposable Cleaning Cloth (DCC) Lead Clearance Field Study” document that it would take 5 minutes per cleaning cloth and clearance requirements that the work area must be divided into roughly equal sections that are 40 square feet that is equivalent to 0.125 minutes per square foot or 0.002 hours per square foot.
Abbreviations: S.F. = Square Feet; Ea. = Each Item
Source: RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4-38: Unit Costs of RRP Exterior Activities (2005$)				
Cost Type	**Material Cost**	**Units**	**Labor Hours**	**Total Cost[a]**
Sign	$0.11[b]	Ea.	0	$0.11
Ground: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	$0.06[c]	S.F.	0.001	$0.08
Doors[d]: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	$0.08[c]	S.F.	0.008	$0.25
Roll down polyethylene sheeting[e]	$0.00	S.F.	0.0005	$0.01

[a] Based on a mean loaded wage rate of $20.62 (2005$) based on the wages of three construction laborers and one supervisor from the May, 2004 Occupational Employment Statistics data from the Bureau of Labor Statistics.
[b] The cost of a 9"x12" aluminum sign is $10.99 and it is assumed that the sign will be used 100 times.
[c] Based on a web search that showed that duct tape costs $0.02 per square foot and 6 mil. polyethylene sheeting costs $0.06 per square foot. Based on the EPA 2000a Model Renovation Training Course, duct tape will be used to tape the plastic to the building and rocks or other heavy objects will be used to weight down the edges therefore it is assumed that only ¼ of the duct tape is needed for floors.
[d] Estimate used for plastic on the doors.
[e] Assume that for exterior events the contractor would tape the plastic up rather than bagging it.
Abbreviations: S.F. = Square Feet; Ea. = Each Item
Source: RS Means 2005; U.S. Bureau of Labor Statistics 2005a and 2005b.

4.3.4 Quantities of Each Containment and Cleaning Practice

Table 4-39 and Table 4-40 describe how the number of units required for each work practice is estimated for the various event types. This is the same methodology used to estimate work practice costs in the proposed rule analyses (EPA 2006 and 2007). Appendix 4A presents the resulting estimates for each type of event. The number of units is multiplied by the per-unit costs, which can be per-each, per-square foot, or per hour, as described above in section 4.3.3.

Table 4-39: Number of Units Required for RRP Interior Activities (2005$)		
Cost Type	**Units**	**Number of Units Required**
Containment		
(1) Sign	Ea.	Two signs are assumed to be required.
(2) Floors (labor): Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	S.F.	Estimated as 110% of the square footage of the work area plus 60 square feet of sheeting for paths (except for small events).
(3) Floors (materials): Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	S.F.	Same as (2).
(4) Walls[d]: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	S.F.	Estimated as the number of doors times 20 square feet (door size), plus 20 square feet (for an extra layer of plastic over the entry door), plus the number of ducts times 1 square foot (duct size).
(5) Tack pad	Per sheet	One tack pad per room affected.
(6) Disposable shoe covers	Per pair	Two for small jobs, none for large jobs.
(7) Roll down polyethylene sheeting	S.F.	(2) plus (4).
(8) Bag polyethylene sheeting	Ea.	(7) divided by 76.2 square feet (the amount of plastic that will fit in a bag).
Cleaning		
(9) HEPA vacuum for work area	Ea.	Estimated as 1.
(10) HEPA vacuum use (floor)	S.F.	Estimated as 110% (125% for kitchens and bathrooms) of the square footage of the work area plus the number of windows times 2/3 of a square foot (the size of a window sill).
(11) HEPA vacuum use (walls)	S.F.	Estimated as the square root of the square footage of the work area times 32 (4 eight foot tall walls).
(12) HEPA vacuum clothes	Hours	Estimated as ten minutes (small events only).
(13) Wet wipe, flat surfaces (cleaning)	S.F.	Estimated as the likelihood of uncarpeted floors multiplied by the square footage of the work area, plus 10% (or 25% for kitchens and bathrooms) of the square footage of the work area multiplied plus the number of windows times 2/3 of a square foot (the size of a window sill).
Verification		
(14) Wet wipe, flat surfaces (verification)	S.F.	Estimated as 31.8 percent (sum of first and second failure rates) multiplied by (13).
(15) Electrostatic cloth sweeper	Ea.	Estimated as 1.
(16) Disposable wet cloth	S.F.	Estimated as 131.8% multiplied by {the square footage of the work area, multiplied by the likelihood of uncarpeted floors plus the number of windows multiplied by 2/3 of a square foot (the size of a window sill)}.
(17) Disposable dry cloth	S.F.	Estimated as 1.8% (second failure rate), multiplied by the square footage of the work area, multiplied by the likelihood of uncarpeted floors.

Abbreviations: S.F. = Square Feet; Ea. = Each Item
Source: RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4-40: Number of Units Required for RRP Exterior Activities (2005$)		
Cost Type	**Units**	**Number of Units Required**
Containment		
(1) Sign	Ea.	Two signs are assumed to be required.
(2) Ground: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	S.F.	Estimated as the perimeter times 10 feet plus an extra 314 square feet for the corners.
(3) Doors: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	S.F.	Estimated as the number of doors multiplied by 40 square feet, less 20 square feet.
(4) Roll down polyethylene sheeting	S.F.	Estimated as the sum of (2) and (3).
Abbreviations: S.F. = Square Feet; Ea. = Each Item *Source: RS Means 2005; U.S. Bureau of Labor Statistics 2005b.*		

4.3.5 Frequency and Cost of Prohibited Practice Alternatives

Options B through E prohibit the use of several paint preparation and removal practices in renovations that require lead-safe work practices under the rule. A telephone questionnaire was administered to nine respondents to gather information on the use of certain paint removal practices. The respondents included six painting firms and three historic home restoration firms. The six painting firms were randomly drawn from the online sales lead provider, Salesgenie.com. The historic home restoration firms were drawn randomly from the Old House Journal's online restoration directory.

These firms were asked how often they used the following four (4) paint removal techniques on the interior and exterior of pre-1978 buildings:

1. Open flame burning or torching of paint
2. Using a heat gun above 1,100º F
3. Power sanding, grinding or abrasive blasting except when done with HEPA exhaust control
4. Dry scraping of lead based-paint

If the firms reported that they did not use the method they were asked why they did not use it and what alternatives they used instead. They were also asked how much they thought costs would increase if the specific removal technique was prohibited and if there were any situations where use of the method could not be avoided. When responding firms could not precisely state what percentage of the time they used a certain work practice they were prompted with never, rarely, sometimes, often or nearly always. These prompted answers are assumed to correspond with the following percentages:

Table 4-41: Response Categories and Corresponding Percentages	
Never	1.5%
Rarely	16%
Sometimes	50%
Often	84%
Nearly Always	99%

Table 4-42 shows the minimum, maximum and average work practice frequencies, by interior and exterior work events:

Table 4-42: Summary Statistics for Frequency of Work Practices Included in Telephone Questionnaire						
	Interior			Exterior		
Prohibited Practice	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**
Heat Gun (High Temp)	1.5%	16%	5%	1.5%	16%	5%
Open Flame Burning	1.5%	16%	3%	1.5%	16%	3%
Power Sanding	1.5%	99%	40%	1.5%	99%	47%
Dry Scraping	1.5%	99%	43%	1.5%	84%	30%

Based on these estimates it was estimated that interior and exterior painting jobs use various paint removal techniques with the frequencies presented in Table 4-43. Since several respondents indicated that they typically used heat guns at lower temperatures that would be allowed under the rule, it was assumed that 20 percent of paint removal was performed with low temperature heat guns. The remaining 80 percent of paint removal practices were assumed to occur proportionally to the frequencies in the telephone questionnaire responses, so that the sum of the frequencies for the five paint removal practices is 100 percent.

Table 4-43: Summary Statistics for Frequency of Paint Removal Work Practice Use		
Paint Removal Practice Practice	**Interior**	**Exterior**
Heat Gun (Low Temp)	20%	20%
Heat Gun (High Temp)	7%	4%
Open Flame Burning	n.a.	3%
Power Sanding	35%	44%
Dry Scraping	38%	29%
Benefits cannot be estimated for prohibiting interior open flame burning because the Dust Study did not include these activities. As a result, these activities are accounted for as interior high temperature heat gun activities.		

Estimating the Incremental Costs of Work Practice Prohibited Under the Preferred Option

Power Sanding without attachment to HEPA Vacuum

It is assumed that if power sanding, grinding, or abrasive blasting is prohibited for renovations requiring lead-safe work practices under the rule, except when done with HEPA exhaust control, that renovators would use power tools with HEPA exhaust controls.

The costs of requiring that power sanders be attached to vacuums with HEPA filters includes: (1) the cost of a sander capable of being attached to a HEPA vacuum, and (2) the cost of additional HEPA filters that will be required because of the increased vacuum use. The cost of a HEPA vacuum is not included as an incremental cost of this requirement since HEPA vacuum costs are already accounted for in the estimated costs of complying with the cleaning requirements under the rule.

To estimate the cost of the HEPA vacuum compatible power sanders, quotes for 27 power sanders were found through online queries; the average cost for such sanders was $209. It is assumed that each sander can be used for at least 200 jobs. Most power sanders have one-year warranties, thus 200 jobs represents the minimum lifespan. Thus the per-job cost of a new sander is $1.05 [$209/200].

The cost of extra HEPA filter was based on the cost of re-useable filters. Internet queries found that re-useable filters cost between $30 and $38 each, with an average price of about $35. It is assumed that each is good for the life of the sander (200 jobs), resulting in a cost per job of $.18 [$35/200].

Table 4-44: Per Job Equipment Costs as a Result of Prohibition on Power Sanding (Unless Done with HEPA Attachment)

Product	Average Cost	Expected Lifespan (# of Jobs)	Per Job Cost
Power Sander	$209	200	$1.05
HEPA Filter	$35	200	$0.18
Sum of Sander and Filter			$1.23

High Temperature Heat Guns and Open Flame Burning or Torching of Paint

It is assumed that if the use of high temperature heat guns (over 1,100 degrees F) and open flame burning or torching of paint is prohibited for renovations requiring lead-safe work practices under the rule, that renovators will use low temperature heat guns (under 1,100 degrees F) instead. The cost of switching to low temperature heat guns is described below for typical interior and exterior painting events where they may be used.

High Temperature Heat Guns and Open Flame Burning– Interior

An average interior heat gun event was assumed to involve paint removal from 144 sq. ft. of a 10' x 10' room. This includes 3" molding around the ceiling, 6" baseboard, 1 doorway, and two 3' x

5' windows. It was estimated that this would take 1.05 hours using a high temperature heat gun and 1.36 hours using a low temperature heat gun.[24] Thus, switching to a low temperature heat gun would require an additional 0.31 hours per job. At an hourly rate of $18/hr plus 60% overhead, the additional cost of using a low temperature heat gun rather than a high temperature heat gun is $8.93. Benefits cannot be estimated for prohibiting the use of open flame burning for interior events because the Dust Study did not include these activities. In order to maintain consistency in the cost and benefit analyses, these activities are accounted for as interior high temperature heat gun activities.

High Temperature Heat Guns and Open Flame Burning – Exterior

Assuming exterior paint removal from 2 doorways and 10 windows, the average event would include paint removal from 243 sq. ft. It was estimated that this would take 1.77 hours using a high temperature heat gun and 2.3 hours using a low temperature heat gun.[25] Thus, switching to a low temperature heat gun would require an additional 0.53 hours per job. At an hourly rate of $18/hr plus 60% overhead, the incremental cost of using a low temperature heat gun is $15.26 per job. The costof switching from using open flame burning or torching of paint to a low temperature heat gun is assumed to be the same as for switching from a high temperature heat gun to a low temperature heat gun.

Table 4-45: Time and Cost Associated with Using High and Low Temperature Heat Guns

Method	Interior Job			Exterior Job		
	Hours	Per Job Cost	Incremental Per Job Cost	Hours	Per Job Cost	Incremental Per Job Cost
High Temp	1.05	$30.24	-	1.77	$50.98	-
Low Temp	1.36	$39.17	$8.93	2.3	$66.24	$15.26

An average interior heat gun event was assumed to involve paint removal from 144 sq. ft. of a 10' x 10' room. This includes 3" molding around the ceiling, 6" baseboard, 1 doorway, and two 3' x 5' windows. An average heat gun even was assumed to involve paint removal 243 sq. ft., involving 2 doorways and 10 windows.

[24] According to Hunt (2003), a high temperature heat gun can remove the same amount of paint as dry scraping in 64 percent of the time required for dry scraping. It was estimated that dry scraping can be performed at a rate of 35-100 square feet per-hour, or 68 square feet per-hour on average (the rate of 35-100 square feet per-hour is from Painting and Decorating Contractors of America, 2003). Based on personal communications with industryindustry sources, low-temperature heat gun paint removal takes 30 percent longer than high-temperature heat gun paint removal.

[25] See footnote [25] See footnote 24..

Estimating Average Costs Per Interior Painting and Exterior Painting Job

The sections above described how the average costs per event using a prohibited practice were estimated. For cost estimating purposes an average cost across all jobs was estimated– including those without prohibited practices. Table 4-46 presents these estimates.

Table 4-46: Average Additional Cost of Prohibited Practice Alternative Over All Interior and Exterior Painting Jobs*

Prohibited Method	Average Interior Painting Job			Average Exterior Painting Job		
	Incremental Per Job Cost	Frequency as % of All Jobs	Average Cost Per Job	Incremental Per Job Cost	Frequency as % of All Jobs	Average Cost Per Job
High Temp	$8.93	7%	$0.63	$15.26	4%	$0.61
Open Flame	n.a.	n.a.	n.a.	$15.26	3%	$0.46
Power Sanding	$1.23	35%	$0.43	$1.23	44%	$0.54
All Prohibited Methods			**$1.06**			**$1.61**

*The average additional cost is a weighted average across all interior and exterior painting jobs, including those where prohibited practices are not used (and additional costs are not incurred).
Note that Benefits cannot be estimated for prohibiting interior open flame burning because the Dust Study did not include these activities. As a result, these activities are accounted for as interior high temperature heat gun activities.

4.3.6 Frequency and Cost of Vertical Containment

In certain situations, the renovation firm must take extra precautions in containing the work area to ensure that dust and debris from the renovation does not contaminate other buildings or other areas of the property or migrate to adjacent properties. These situations include work areas in close proximity to other buildings, work areas that abut a property line, and windy conditions. In some cases, it may be necessary to erect a system of vertical containment to prevent paint dust and debris from contaminating the ground or any object beyond the work area. Such vertical containment could take a number of forms, such as attaching plastic sheeting to a fence or other support at the property line, attaching the plastic to a building or a frame attached to the building, or attaching the plastic to scaffolding erected next to the building.

This section presents the calculations used to determine the total and incremental vertical containment costs for 1-, 2-, or 4-wall events in child-occupied facilities and target housing units. Since the hanging of disposable reinforced plastic sheeting constitutes the largest component of the vertical containment costs, the average height (necessary to determine the surface area of the sheeting) of the buildings must be calculated.

Information from the 2005 American Housing Survey (AHS) was used to calculate the average height of residential housing units. The AHS includes information on the number of stories in the buildings where housing units are located. The average heights of owner occupied units and renter occupied units are just under two stories and two-and-a-half stories, respectively.

Table 4-47: Average Height of Building for Owner and Renter Occupied Units, Total Housing Stock		
	Owner Occupied Units	Renter Occupied Units
Stories in Structure	Total Occupied Units	
1	26,278,000	8,537,000
2	24,026,000	12,257,000
3	16,375,000	7,340,000
4 to 6	2,248,000	2,880,000
7 or more	488,000	1,504,000
Total	69,415,000	32,518,000
Average	1.99	2.46
Sources: U.S. Census Bureau 2006. Note: To calculate the average, "4 to 6" was given a value of 5, and "7 or more" was given a value of 7		

In order to apply the average number of stories to the cost estimates, separate height estimates are needed for: Single-family owner occupied, Single-family rental, and Multi-family units. Data from the U.S. Census Bureau's American Factfinder was used to determine which average height values from Table 4-47 to apply to these three categories of residential housing units using information on the percent of units that are in single-family or multi-family buildings. Table 4-48 presents the number of owner-occupied and renter-occupied housing units, by the number of units in the structure. It also shows what percentage of the housing units are single-family homes and multi-family.

Table 4-48: Number of Housing Units, by Units in Structure				
Type of Structure	Owner-occupied housing units		Renter-occupied housing units	
	Number	Percentage	Number	Percentage
1, detached or attached	56,255,657	81%	8,531,853	24%
1, attached	3,819,810		2,087,994	
2	1,164,675	14%	3,301,854	70%
3 or 4	651,003		4,254,351	
5 or more	1,989,511		15,928,678	
Mobile home	5,850,241		1,534,035	
Boat, RV, Van, etc.	85,616		24,823	
Total	69,816,513		35,663,588	
Sources: U.S. Census Bureau 2000				

As shown in Table 4-48, the majority of owner-occupied housing units are in one-unit buildings, while the majority of rental housing units are in multi-family buildings. Thus the average height of owner-occupied housing (2.0 stories) is used to characterize all single-family housing (both rental and owner-occupied) and the average height of rental housing (2.5 stories) is used to characterize the height of multi-family housing.

The Commercial Buildings Energy Consumption Survey (CBECS) data were used to calculate the average number of stories for multi-purpose education buildings and stand-alone daycare facilities. The average height of a multi-purpose education building is estimated to be around one and half stories, while the average height of a stand-alone daycare facility is estimated at one and a third stories (U.S. DOE 2003). Table 4-49 summarizes the physical characteristics of the various building types. It assumes that the average height of a "story" is 12 feet.

Table 4-49: Physical Characteristics of Various Building, by Type								
Building Type	**Estimated Sq. ft. per floor**	**Estimated Perimeter (ft)**	**Estimated Front to Side Ratio**	**Estimated Width of Front (ft)**	**Estimated Width of Side (ft)**	**Average Number of Stories**	**Assumed height per story (ft)**	**Estimated Height of Building (ft)**
Multi-purpose education building	14,845	497	2 to 3	99.5	149.2	1.51	12	18
Stand-alone daycare facility	4,871	284	2 to 3	57.0	85.5	1.34	12	16
Single-family owner occupied home	1,390	152	2 to 3	30.4	45.6	1.99	12	24
Single-family renter unit	1,014	130	2 to 3	26	39	1.99	12	24
Multi-family housing structure	4,182	264	2 to 3	52.8	79.2	2.46	12	30
Sources: EPA Calculations, U.S. DOE 2003.								

Table 4-50 presents the total and incremental costs of a vertical containment event involving either one or four walls in the various residential housing units. It is assumed that vertical containment is used for 2% of exterior painting events. To calculate the necessary amount of disposable reinforced plastic sheeting, it was assumed that the workers would hang the sheeting not on the perimeter of the house but on the perimeter of the laid polyethylene sheeting. Furthermore, it is assumed that for those jobs using vertical containment, 50% of the events in residential units will not need scaffolding because they will use plastic at the fence line or attached to the building, and that 50% of those events that do need scaffolding for vertical containment are already using it for other reasons, and only incur incremental costs related to plastic sheeting. This means that only 25% of the residential units that undertake vertical containment will need incur incremental costs for scaffolding.

Table 4-50: Total and Incremental Costs of Vertical Containment Events Involving One and Four Walls in Residential Housing Units, by Type of Housing and Number of Walls													
Cost Type	**Cost Per Sq. Ft**	**Single Family Owner Occupied**				**Single Family Renter Occupied**				**Multi Family Housing**			
		1 Wall Event		4 Wall Event		1 Wall Event		4 Wall Event		1 Wall Event		4 Wall Event	
		# of sq. ft.	Cost	# of sq. ft.	Cost	# of sq. ft.	Cost	# of sq. ft.	Cost	# of sq. ft.	Cost	# of sq. ft.	Cost
Scaffolding, steel tubular, regular, labor only to erect and dismantle, bldg ext, wall face, 6'-4"x5' frames[a]	$1.82	1088.7	$495.4	3629.1	$1,651.2	931.3	$423.8	3104.4	$1,412.5	2338.1	$1,063.8	7793.7	$3,546.2
Scaffolding, steel tubular, regular for complete system for face of walls, 6'-4"x5' frames[a]	$0.38	1088.7	$5.1	3629.1	$68.0	931.3	$4.4	3104.4	$58.2	2338.1	$11.0	7793.7	$146.1
Disposable reinforced plastic sheet[b]	$.23[d]	1088.7	$250.4	5921.2	$1,361.9	931.3	$214.2	5396.9	$1,241.3	2338.1	$537.8	10627.8	$2,444.4
Plastic tape[c]	$0.02	18.1	$0.4	79.6	$1.6	15.5	$0.3	70.8	$1.4	39.0	$0.8	153.5	$3.1
Roll down polyethylene sheeting	$0.01	1088.7	$11.2	5921.2	$61.0	931.3	$9.6	5396.9	$55.6	2338.1	$24.1	10627.8	$109.6
Total			$762.5		$3,143.8		$652.2		$2,769.1		$1,637.5		$6,249.3
Average (2% of Total) [e]			$15.25		$62.88		$13.04		$55.38		$32.75		$124.79

Sources: RS Means 2005, EPA Calculations

a. The scaffolding costs take into account the assumption that only 25% of residential housing units with vertical containment will need incur incremental costs for scaffolding. It is assumed that the scaffolding is needed for one day per wall.

b. Based on a web search, which showed that reinforced plastic sheeting costs $.07 per square foot.

c. Based on a web search, which showed that duct tape costs $0.02 per square foot and 6 mil. polyethylene sheeting costs $0.06 per square foot.

d. This includes both material and labor costs.

e. It is assumed that 2% of exterior painting jobs require vertical containment; therefore the average presented is the average across all exterior
painting jobs, including those where vertical containment is not used.

Table 4-50 shows that the costs range in value from just over $760 for a one wall event in a single-family renter occupied unit, to just under $6,250 for a four wall event in a multi-family housing unit. On average, 59% of the total cost is due to the labor involved with erecting and dismantling the scaffolding.

Table 4-51 summarizes the total and incremental costs of vertical containment events involving one, two, and four walls in public or commercial buildings. It is assumed that scaffolding is already used on these jobs, and thus the incremental costs are only related to plastic and not scaffolding. The total values range from just under $330 for a one wall event in a stand-alone daycare facility to just under $1,470 for a four wall event. The majority of these total costs come from the disposable reinforced plastic sheeting, which accounts for 96% of this value.

Table 4-51: Total and Incremental Costs of Vertical Containment Events Involving One, Two and Four Walls in Public or Commercial Buildings, by Type and Number of Walls

Cost Type	Cost Per Sq. Ft	Stand Alone Daycare Facility				Multi Purpose Education Building			
		1 Wall Event		4 Wall Event		1 Wall Event		2 Wall Event	
		# of units	Cost	# of units	Cost	# of units	Cost	# of units	Cost
Disposable reinforced plastic sheet[a]	$.23[c]	1369.6	$315.0	6103.4	$1,403.8	2701.3	$621.3	4936.7	$1,135.4
Plastic tape[b]	$0.02	22.8	$0.5	88.7	$1.8	45.0	$0.9	82.3	$1.6
Roll down polyethylene sheeting	$0.01	1,369.6	$14.1	6103.4	$62.9	2701.3	$27.9	4936.7	$50.9
Total			$329.6		$1,468.5		$650.1		$1,188.0
Average (2% of Total) [d]			$6.59		$29.37		$13.00		$23.76

Sources: RS Means 2005, EPA Calculations.

a. Based on a web search, which showed that reinforced plastic sheeting costs $.07 per square foot.

b. Based on a web search, which showed that duct tape costs $0.02 per square foot and 6 mil. Per square foot Costs $0.06 per square foot.

c. This includes both material and labor costs.

d. It is assumed that 2% of exterior painting jobs require vertical containment; therefore the average presented is the average across all exterior painting jobs, including those where vertical containment is not used.

4.3.7 Baseline Work Practices

Some of the containment and cleaning practice standards specified by EPA under the rule are currently in use by some renovation contractors. The costs of work practices already in use are not incremental costs of the rule and are subtracted out of the cost estimates. In order to determine how often the required work practices are used without regulation, a telephone questionnaire was administered to 9 contractors to collect information on current industry practices. A series of questions was asked to determine if the listed work practices were currently in use and if they were, the frequency with which they occur.

The questionnaire's objective was to collect responses to two sets of questions. One set of questions dealt with current interior RRP work practices. The other dealt with exterior work practices. The calling list was generated from Salesgenie.com, an online service that contains contact information for over 14 million U.S. businesses. The service permitted companies to be selected based on their SIC Codes. The list for the questionnaire was generated by randomly selecting businesses with the following SIC Codes: 172101 (Painting Contractors), 1521 (General Contractors - Single-Family Houses), and 1522 (General Contractors - Residential Buildings Other Than Single-Family). The responding companies were comprised of four painting firms and five general contracting firms. All nine of the painting and general contracting firms answered both the interior and exterior surveys. The instrument used to administer the questionnaire is presented below (Figure 1 and Figure 2).

Figure 1: Questions Regarding Work Practices – Interior RRP

Question #	Practice	*Percent of Time Used*
1	• How often do you post signs warning residents to remain outside the work area?	
2	• While the work is being performed, how often do you keep all windows and doors within the work area closed, or covered with sheeting?	
3	• How often do you cover the floor within the work area with taped down sheeting?	
4	If > 0%, When you cover the floor with sheeting, do you dispose of the sheeting afterwards or do you reuse the sheeting for other jobs?	
5	If > 0%, When you cover the floor with disposable plastic sheeting how often do you, your crew or your subcontractors mist the sheeting, fold it dirty side inward, and tape it shut to seal or seal in heavy duty plastic bags before removing from the work area?	
6	• To prevent tracking dust outside the work area, how often do you place a tack-pad outside the work area to catch dust on your shoes?	
7	• To prevent tracking dust outside the work area, how often do you wear disposable shoe covers?	
8	• To prevent tracking dust outside the work area, how often do you vacuum your clothes, tools, and other items each time you leave the work area?	
9	• After completing the job, how often do you vacuum any surfaces in the work area	
10	If >0%, How often was a HEPA vacuum used for vacuuming floors?	
11	If >0%, How often do you vacuum the walls?	
12	• After completing the job, how often do you wipe all smooth surfaces with a damp cloth?	
13	• After completing a job where the floor is not carpeted, how often do you wet mop?	
14	If >0%, How often do you use a two-bucket mopping system? (Two-bucket mopping means using one bucket and mop with wash water and another bucket and mop with rinse water)	
15	• After completing a job where the floor is not carpeted, how often do you sweep with an electrostatic cloth sweeper (for example a Swiffer®)?	

Figure 2: Questions Regarding Work Practices – Exterior Painting	
Practice	***Percent of Time Practice Used***
(1) How often do you post signs warning residents to remain outside the work area?	
(2) While the work is being performed, how often do you keep all windows and doors within 20 feet of the work area closed, or covered with sheeting?	
(3) How often do you cover the ground with sheeting in order to collect falling paint debris?	

Table 4-52 presents the individual results of the surveys as well as overall statistics for across the surveys. It breaks down the data both by firm type (painting or general contracting), and survey type (interior or exterior questions).

Table 4-52: Summary of Baseline Work Practice Survey Results													
		Painting Firms				**General Contractors**					**Descriptive Statistics**		
		P1	**P2**	**P3**	**P4**	**G1**	**G2**	**G3**	**G4**	**G5**	**Min**	**Max**	**Average**
Interior	**1**	0%	5%	100%	0%	100%	100%	0%	0%	0%	0%	100%	34%
	2	80%	100%	75%	0%	100%	75%	100%	100%	50%	0%	100%	76%
	3	100%	100%	100%	100%	16%	100%	100%	25%	50%	16%	100%	77%
	4	Reuse	Reuse	Reuse	Reuse	Dispose	Dispose	Reuse	-	Dispose			-
	5	100%	-	100%	100%	16%	100%	0%	0%	100%	0%	100%	77%
	6	16%	0%	45%	0%	0%	100%	100%	0%	0%	0%	100%	29%
	7	0%	0%	0%	0%	0%	25%	100%	50%	0%	0%	100%	19%
	8	0%	0%	0%	0%	50%	50%	100%	50%	10%	0%	100%	29%
	9	100%	100%	25%	75%	100%	100%	100%	75%	50%	25%	100%	81%
	10	0%	0%	0%	100%	?	100%	100%	0%	0%	0%	100%	38%
	11	0%	0%	0%	0%	100%	100%	0%	75%	0%	0%	100%	31%
	12	100%	100%	15%	50%	100%	100%	100%	75%	90%	15%	100%	81%
	13	100%	50%	10%	0%	16%	100%	0%	75%	100%	0%	100%	50%
	14	0%	100%	100%	0%	0%	100%	0%	16%	0%	0%	100%	35%
	15	0%	60%	0%	0%	16%	0%	0%	0%	0%	0%	60%	8%
Exterior	**1**	0%	5%	100%	10%	100%	100%	0%	0%	0%	0%	100%	35%
	2	100%	100%	75%	100%	100%	100%	100%	75%	100%	75%	100%	94%
	3	0%	100%	100%	0%	100%	100%	100%	100%	0%	0%	100%	67%

Notes: When respondents gave a range of values for the percet of time they used a certain work practice, the midpoint of the range was used in calculating the average. When the respondant was unable to give a response, a question mark is presented and the value is excluded from the calculation.

Table 4-53 describes how the analysis estimated the incremental cost adjustment to account for the use of required work practices in the baseline. These calculations are based on the questionnaire responses and adjusted to account for the assumption in this analysis that there will be 75 percent compliance with the rule. For example, based on the average questionnaire response, signs are posted 34 percent of the time. Since it is assumed that signs will be posted 75 percent of the time after the rule, 45 percent (45% = 34%/75%) of the post-rule sign-posting costs are already incurred in the baseline. Thus, since it is estimated that posting a sign costs $0.11 per-event, the incremental impact of the rule's sign posting requirement is $0.07 ($0.11 * (1-45%)) after adjusting for baseline sign posting.

Table 4-53: Description of Calculations for Baseline Work Practice Factors					
	Work Practice	**Question Number(s)**	**Description of Calculation**	**Unadjusted Percentage**	**Compliance-adjusted Percentage[a]**
Interior	Sign	1	Simple average of responses	34%	45%
	Floors: Cover surfaces with polyethylene sheeting (labor)	3	Simple average of responses	77%	100%
	Floors: Cover surfaces with polyethylene sheeting (materials)	3,4	An average was calculated; those who stated that they reused the sheeting were coded as zeroes; the values given in question three were used for those who disposed of the sheeting.	21%	28%
	Walls: Cover surfaces with polyethylene sheeting	2	Simple average of responses	76%	100%
	Tack pad	6	Simple average of responses	29%	39%
	Pair of disposable shoe covers	7	Simple average of responses	19%	26%
	Roll down polyethylene sheeting	3,5	Product of 3 and 5	69%	92%
	Bag polyethylene sheeting	3,5	0% if Reuse, Product of 3 and 5 if Dispose.	19%	25%
	HEPA vacuum for work area (the actual vacuum)	10	An average was calculated; those who responded that they used a HEPA vacuum were coded a one, and those who stated that they didn't were coded a zero.	38%	50%
	HEPA vacuum use	10,11	An average of the responses to questions 10 and 11.	34%	45%
	vacuum use (floors)	9	Simple average of responses	81%	100%
	vacuum use (walls)	11	Simple average of responses	31%	41%
	HEPA vacuum clothes	8	Simple average of responses	29%	39%
	Wet wipe, flat surfaces	12	Simple average of responses	81%	100%
	Wet wipe, flat surfaces (verification)		Assume zero, this is the extra verification cleaning.	0%	0%
	Electrostatic cloth sweeper	15	An average was calculated; those who responded that they used an electorstatic cloth sweeper were coded as ones; those who responded that they didn't were coded as zeroes.	22%	30%
	Disposable wet cloth		Assume zero, this is the cleaning verification.	0%	0%
	Disposable dry cloth		Assume zero, this is the cleaning verification.	0%	0%
Exterior	Sign	1	Simple average of responses	35%	47%
	Ground: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	3	Simple average of responses	67%	89%
	Doors: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	2	Simple average of responses	94%	100%
	Roll down polyethylene sheeting[e]	3, interior 5	Product of 3 and interior 5	40%	53%

a. The compliance-adjusted work practice factor inflates the unadjusted value by incorporating an assumed 75% non-compliance rate and cannot be greater than 100%.

4.3.8 Summary of Incremental Pre-Event Work Practice Costs in COFs in Public or Commercial Buildings

Table 4-54 summarizes the incremental work practice costs associated with containment, cleaning, and verification in Public or Commercial Building COFs. The methodology behind these estimates is described in the preceding sections and more detailed data is presented in Appendix 2A4A. Following the assumptions of the economic analysis for the 2007 proposed supplemental to the LRRP rule (EPA 2007), exterior painting costs for daycare centers are estimated as the average of the four and the one exterior wall painting event costs. For elementary schools, it is assumed that only the walls on the outside of the classrooms of kindergarteners or preschoolers would require the containment practices. Thus, exterior painting costs for elementary schools are estimated as the average of the two and the one exterior wall painting event costs. Note that these are average expected costs so some individual events will be above the average and some will be below it.

Table 4-54: Average Incremental Work Practice Costs in Public or Commercial Building COFs (Adjusted for Baseline Work Practices, Assumes 75 Percent Compliance Rate)

Interior Events	**Cont.**	**Clean**	**Verif.**	**Tot.**
Interior Painting	$71	$34	$44	$150
Wall Disturbing Events (average)	*$31*	*$14*	*$20*	*$65*
Large Wall Disturbing Event	*$71*	*$34*	*$44*	*$149*
Small Wall Disturbing Event	*$11*	*$4*	*$8*	*$24*
Window and Door Replacement	$71	$34	$44	$149
Exterior Events	**Cont.**	**Proh.**	**V.C.**	**Tot.**
Exterior Painting Daycare Centers (average)	$28	$2	$18	$47
Painting One Exterior Walls	*$11*	*$2*	*$7*	*$19*
Painting Four Exterior Wall	*$44*	*$2*	*$29*	*$75*
Exterior Painting Elementary Schools (average)	$28	$2	$18	$48
Painting One Exterior Walls	*$19*	*$2*	*$13*	*$33*
Painting Two Exterior Wall	*$37*	*$2*	*$24*	*$63*

Notes: The sum of the containment, cleaning and verification costs may not equal the total per-event cost due to rounding. The costs associated with using prohibited practice alternatives are only included in the Total Per-Event Cost column. The prohibited practice alternatives costs are $1.06 for the interior painting events and $1.61 for exterior painting events.

Abbreviations: Cont. = Per Event Containment Costs; Clean = Per Event Cleaning Costs; Verif. = Per Event Verification Costs; Proh. = Per Event Incremental Cost of Prohibited Practice Alternatives; V.C. = Per Event Cost of Vertical Containment; Tot. = Total Per-Event Costs, including costs for prohibited practice alternatives.

Source: EPA Calculations

4.3.9 Summary of Incremental Work Practice Costs Per Event in Target Housing

Table 4-13 summarizes the incremental work practice costs associated with containment, cleaning, and verification in target housing. The methodology behind these estimates is described in the preceding sections and more detailed data is presented in Appendix 2A4A. Table 4-13 shows the average expected costs per-compliant event, accounting for the relative number of small and large events. These are average expected costs so some individual events will be above the average and some will be below it.

Table 4-55: Average Incremental Work Practice Costs in Residences (Adjusted for Baseline Work Practices, Assumes 75 Percent Compliance Rate)												
	Single-Family Owner-Occupied				Single-Family Renter-Occupied				Multi-Family			
Interior	Cont.	Clean.	Verif.	**Tot.**	Cont.	Clean.	Ver.	**Tot.**	Cont.	Clean.	Verif.	**Tot.**
Bath	$11	$7	$4	**$22**	$10	$7	$4	**$22**	$10	$7	$4	**$22**
Kit	$21	$15	$14	**$49**	$17	$12	$10	**$40**	$14	$10	$7	**$30**
Ad-S	$5	$9	$2	**$16**	$5	$9	$2	**$16**	$5	$9	$2	**$16**
Ad-M	$21	$13	$7	**$41**	$17	$11	$6	**$34**	$14	$9	$4	**$26**
Ad-L	$26	$15	$10	**$51**	$22	$13	$8	**$43**	$19	$12	$6	**$36**
Wl-S	$5	$9	$2	**$16**	$5	$9	$2	**$16**	$5	$9	$2	**$16**
Wl-M	$21	$13	$7	**$41**	$17	$11	$6	**$34**	$14	$9	$4	**$26**
Wl-L	$26	$15	$10	**$51**	$22	$13	$8	**$43**	$19	$12	$6	**$36**
WD-S	$6	$10	$3	**$19**	$5	$9	$3	**$17**	$5	$9	$2	**$15**
WD-M	$21	$13	$7	**$41**	$17	$11	$6	**$34**	$14	$9	$4	**$26**
WD-L	$66	$29	$29	**$124**	$52	$25	$22	**$98**	$38	$19	$15	**$72**
IP-S	$11	$11	$5	**$27**	$9	$10	$4	**$24**	$8	$9	$4	**$22**
IP-M	$33	$19	$14	**$67**	$26	$16	$10	**$54**	$22	$14	$8	**$46**
IP-L	$51	$25	$23	**$101**	$39	$21	$17	**$78**	$31	$18	$13	**$63**
Exterior	Cont.	Proh.	V.C.	**Tot.**	Cont.	Proh.	V.C.	**Tot.**	Cont.	Proh.	V.C.	**Tot.**
EP	$16	$2	$39	**$57**	$14	$2	$34	**$50**	$25	$2	$79	**$106**
C Ext	$10	-		**$10**	$10			**$10**	$10			**$10**
W Ext	$25			**$25**	$22			**$22**	$41			**$41**

Notes: The sum of the containment, cleaning and verification costs may not equal the total per-event cost due to rounding. The costs associated with using prohibited practice alternatives are only included in the Total Per-Event Cost column. The prohibited practice alternatives costs are $1.06 for the interior painting events and $1.61 for exterior painting events.

Abbreviations:
Cont. = Per Event Containment Costs (does not include vertical containment); Clean = Per Event Cleaning Costs; Verif. = Per Event Verification Costs; Tot. = Total Per-Event Costs, including costs for prohibited practice alternatives and vertical containment; Proh. = prohibited practice costs; V.C. = vertical containment costs; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

4.3.10 Total Work Practice Costs

Total Target Housing Work Practice Costs

Table 4-58 through Table 4-65 present the total work practice costs associated with target housing regulated under the rule for the first and second years after the rule goes into effect. For individual options the costs vary between the first and the second year for two primary reasons: (1) for some options, the scope of the regulated universe expands between the first and the second year, and (2) the improved spot test kits are assumed to become available by the second year of the rule. Increasing the scope of the regulated universe tends to increase costs and the availability of the improved test kits tends to decrease the costs (since improved test kits will lower the number of instances where LSWP costs are incurred when lead-based paint is not disturbed). After the second year, estimated work practice costs decline proportionally to the assumed decline in the stock of regulated buildings (a 0.41 percent decline per year). In addition, the costs are generally lower under Option P because it does not include costs associated with using alternatives to prohibited practices and vertical containment for exterior painting. The effect of this difference is illustrated by comparing Option P and Option B, which both have the same regulatory scope. Note that the vertical containment is the primary driver of this difference (See Table 4-13).

Table 4-56: Option P: First Year Target Housing Work Practice Costs

	Events (thousands)				Unit Costs				Total Costs (thousands)				
	All	LSWP			Spot Test	LSWP			Spot Test	LSWP			**Total Costs**
		SF-O	SF-R	Multi		SF-O	SF-R	Multi		SF-O	SF-R	Multi	
Bath	512	18	257	126	$10	$22	$22	$22	$5,118	$407	$5,656	$2,762	**$13,943**
Kit	534	22	237	170	$10	$49	$40	$30	$5,344	$1,088	$9,496	$5,093	**$21,021**
Ad-S	4	3	0	0	$10	$16	$16	$16	$39	$55	$0	$0	**$95**
Ad-M	3	2	0	0	$10	$41	$34	$26	$28	$100	$0	$0	**$128**
Ad-L	18	14	0	1	$10	$51	$43	$36	$181	$735	$0	$49	**$965**
Wl-S	1,198	67	443	356	$10	$16	$16	$16	$11,976	$1,067	$7,082	$5,691	**$25,816**
Wl-M	21	8	5	3	$10	$41	$34	$26	$215	$311	$162	$88	**$776**
Wl-L	0	0	0	0	$10	$51	$43	$36	$0	$0	$0	$0	**$0**
WD-S	120	18	52	33	$10	$19	$17	$15	$1,204	$340	$883	$497	**$2,924**
WD-M	141	22	57	41	$10	$41	$34	$26	$1,406	$909	$1,941	$1,069	**$5,325**
WD-L	185	33	70	55	$10	$124	$98	$72	$1,851	$4,091	$6,883	$3,981	**$16,806**
IP-S	625	60	206	257	$10	$26	$23	$21	$6,252	$1,547	$4,728	$5,392	**$17,919**
IP-M	397	32	120	180	$10	$66	$53	$45	$3,971	$2,128	$6,336	$8,102	**$20,537**
IP-L	364	28	124	152	$10	$99	$77	$62	$3,642	$2,734	$9,562	$9,448	**$25,387**
EP	1,513	211	618	446	$10	$16	$14	$25	$15,133	$3,370	$8,651	$11,147	**$38,301**
C Ext	118	27	64	0	$10	$10	$10	$10	$1,183	$274	$645	$0	**$2,102**
W Ext	163	24	67	47	$10	$25	$22	$41	$1,634	$591	$1,474	$1,921	**$5,620**
Total	**5,918**	**589**	**2,320**	**1,867**					**$59,177**	**$19,748**	**$63,500**	**$55,239**	**$197,664**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Abbreviations: SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-57: Options A and C: First Year Target Housing Work Practice Costs													
	Events (thousands)				Unit Costs				Total Costs (thousands)				
	All	LSWP			Spot Test	LSWP			Spot Test	LSWP			**Total Costs**
		SF-O	SF-R	Multi		SF-O	SF-R	Multi		SF-O	SF-R	Multi	
Bath	633	107	257	132	$10	$22	$22	$22	$6,331	$2,345	$5,656	$2,894	**$17,226**
Kit	659	116	237	177	$10	$49	$40	$30	$6,594	$5,683	$9,496	$5,309	**$27,083**
Ad-S	29	25	0	1	$10	$16	$16	$16	$292	$401	$0	$8	**$701**
Ad-M	14	12	0	0	$10	$41	$34	$26	$138	$490	$0	$0	**$628**
Ad-L	59	51	0	1	$10	$51	$43	$36	$595	$2,577	$0	$49	**$3,220**
Wl-S	1,642	369	443	372	$10	$16	$16	$16	$16,422	$5,905	$7,082	$5,949	**$35,359**
Wl-M	53	30	5	6	$10	$41	$34	$26	$534	$1,219	$162	$144	**$2,058**
Wl-L	0	0	0	0	$10	$51	$43	$36	$0	$0	$0	$0	**$0**
WD-S	235	111	52	37	$10	$19	$17	$15	$2,346	$2,109	$883	$548	**$5,887**
WD-M	280	134	57	46	$10	$41	$34	$26	$2,797	$5,514	$1,941	$1,207	**$11,459**
WD-L	377	187	70	65	$10	$124	$98	$72	$3,772	$23,145	$6,883	$4,647	**$38,446**
IP-S	1,011	358	206	277	$10	$27	$24	$22	$10,105	$9,667	$4,933	$6,097	**$30,803**
IP-M	612	198	120	191	$10	$67	$54	$46	$6,118	$13,298	$6,455	$8,807	**$34,679**
IP-L	546	167	124	162	$10	$101	$78	$63	$5,455	$16,913	$9,686	$10,227	**$42,282**
EP	2,987	1,385	618	506	$10	$57	$50	$106	$29,870	$78,932	$30,896	$53,669	**$193,367**
C Ext	298	166	64	0	$10	$10	$10	$10	$2,984	$1,655	$645	$0	**$5,285**
W Ext	356	176	67	55	$10	$25	$22	$41	$3,555	$4,406	$1,474	$2,270	**$11,706**
Total	**9,791**	**3,592**	**2,320**	**2,028**					**$97,909**	**$174,260**	**$86,194**	**$101,825**	**$460,188**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Abbreviations: SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-58: Options B and D: First Year Target Housing Work Practice Costs													
	Events (thousands)				Unit Costs				Total Costs (thousands)				
	All	LSWP			Spot Test	LSWP			Spot Test	LSWP			**Total Costs**
		SF-O	SF-R	Multi		SF-O	SF-R	Multi		SF-O	SF-R	Multi	
Bath	512	18	257	126	$10	$22	$22	$22	$5,118	$407	$5,656	$2,762	**$13,943**
Kit	534	22	237	170	$10	$49	$40	$30	$5,344	$1,088	$9,496	$5,093	**$21,021**
Ad-S	4	3	0	0	$10	$16	$16	$16	$39	$55	$0	$0	**$95**
Ad-M	3	2	0	0	$10	$41	$34	$26	$28	$100	$0	$0	**$128**
Ad-L	18	14	0	1	$10	$51	$43	$36	$181	$735	$0	$49	**$965**
Wl-S	1,198	67	443	356	$10	$16	$16	$16	$11,976	$1,067	$7,082	$5,691	**$25,816**
Wl-M	21	8	5	3	$10	$41	$34	$26	$215	$311	$162	$88	**$776**
Wl-L	0	0	0	0	$10	$51	$43	$36	$0	$0	$0	$0	**$0**
WD-S	120	18	52	33	$10	$19	$17	$15	$1,204	$340	$883	$497	**$2,924**
WD-M	141	22	57	41	$10	$41	$34	$26	$1,406	$909	$1,941	$1,069	**$5,325**
WD-L	185	33	70	55	$10	$124	$98	$72	$1,851	$4,091	$6,883	$3,981	**$16,806**
IP-S	625	60	206	257	$10	$27	$24	$22	$6,252	$1,607	$4,933	$5,648	**$18,441**
IP-M	397	32	120	180	$10	$67	$54	$46	$3,971	$2,160	$6,455	$8,282	**$20,869**
IP-L	364	28	124	152	$10	$101	$78	$63	$3,642	$2,789	$9,686	$9,600	**$25,719**
EP	1,513	211	618	446	$10	$57	$50	$106	$15,133	$12,005	$30,896	$47,265	**$105,299**
C Ext	118	27	64	0	$10	$10	$10	$10	$1,183	$274	$645	$0	**$2,102**
W Ext	163	24	67	47	$10	$25	$22	$41	$1,634	$591	$1,474	$1,921	**$5,620**
Total	**5,918**	**589**	**2,320**	**1,867**					**$59,177**	**$28,530**	**$86,194**	**$91,945**	**$265,847**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Abbreviations: SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-59: Option E: First Year Target Housing Work Practice Costs

	Events (thousands)				Unit Costs				Total Costs (thousands)				
	All	LSWP			Spot Test	LSWP			Spot Test	LSWP			**Total Costs**
		SF-O	SF-R	Multi		SF-O	SF-R	Multi		SF-O	SF-R	Multi	
Bath	941	40	408	235	$10	$22	$22	$22	$9,406	$872	$8,980	$5,180	**$24,438**
Kit	998	46	375	315	$10	$49	$40	$30	$9,984	$2,262	$14,984	$9,443	**$36,673**
Ad-S	13	9	0	0	$10	$16	$16	$16	$126	$149	$0	$3	**$278**
Ad-M	7	6	0	0	$10	$41	$34	$26	$72	$228	$0	$0	**$300**
Ad-L	35	26	0	1	$10	$51	$43	$36	$347	$1,328	$0	$49	**$1,725**
Wl-S	2,238	131	722	685	$10	$16	$16	$16	$22,381	$2,100	$11,546	$10,953	**$46,979**
Wl-M	41	14	8	7	$10	$41	$34	$26	$411	$586	$264	$169	**$1,430**
Wl-L	0	0	0	0	$10	$51	$43	$36	$0	$0	$0	$0	**$0**
WD-S	222	31	81	60	$10	$19	$17	$15	$2,225	$594	$1,374	$902	**$5,095**
WD-M	259	37	89	74	$10	$41	$34	$26	$2,587	$1,526	$3,019	$1,935	**$9,068**
WD-L	342	56	109	100	$10	$124	$98	$72	$3,415	$6,905	$10,708	$7,184	**$28,213**
IP-S	1,164	93	323	471	$10	$27	$24	$22	$11,639	$2,504	$7,759	$10,364	**$32,266**
IP-M	749	51	188	331	$10	$67	$54	$46	$7,493	$3,418	$10,151	$15,247	**$36,308**
IP-L	678	42	195	280	$10	$101	$78	$63	$6,782	$4,209	$15,230	$17,635	**$43,857**
EP	2,821	375	963	816	$10	$57	$50	$106	$28,207	$21,352	$48,162	$86,463	**$184,184**
C Ext	213	52	103	0	$10	$10	$10	$10	$2,128	$515	$1,032	$0	**$3,676**
W Ext	312	47	104	86	$10	$25	$22	$41	$3,118	$1,185	$2,298	$3,514	**$10,115**
Total	**11,032**	**1,055**	**3,669**	**3,461**					**$110,321**	**$49,735**	**$135,507**	**$169,042**	**$464,606**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Abbreviations: SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-60: Option P: Second Year Target Housing Work Practice Costs

	Events (thousands)				Unit Costs				Total Costs (thousands)				
	All	LSWP			Spot Test	LSWP			Spot Test	LSWP			**Total Costs**
		SF-O	SF-R	Multi		SF-O	SF-R	Multi		SF-O	SF-R	Multi	
Bath	933	17	210	106	$10	$22	$22	$22	$9,329	$366	$4,618	$2,333	**$16,647**
Kit	993	22	203	155	$10	$49	$40	$30	$9,925	$1,101	$8,127	$4,646	**$23,800**
Ad-S	11	5	0	0	$10	$16	$16	$16	$109	$78	$0	$1	**$188**
Ad-M	7	3	0	0	$10	$41	$34	$26	$72	$138	$0	$0	**$210**
Ad-L	32	16	0	1	$10	$51	$43	$36	$325	$832	$0	$45	**$1,202**
Wl-S	2,212	42	266	248	$10	$16	$16	$16	$22,116	$665	$4,256	$3,974	**$31,011**
Wl-M	38	5	3	2	$10	$41	$34	$26	$384	$217	$99	$62	**$761**
Wl-L	0	0	0	0	$10	$51	$43	$36	$0	$0	$0	$0	**$0**
WD-S	218	18	51	36	$10	$19	$17	$15	$2,182	$340	$875	$543	**$3,941**
WD-M	254	22	57	45	$10	$41	$34	$26	$2,536	$893	$1,923	$1,167	**$6,519**
WD-L	335	33	70	60	$10	$124	$98	$72	$3,352	$4,115	$6,820	$4,341	**$18,628**
IP-S	1,149	53	193	272	$10	$26	$23	$21	$11,488	$1,378	$4,450	$5,702	**$23,018**
IP-M	742	29	113	191	$10	$66	$53	$45	$7,419	$1,947	$5,969	$8,585	**$23,920**
IP-L	672	25	117	161	$10	$99	$77	$62	$6,724	$2,444	$9,014	$10,002	**$28,184**
EP	2,778	207	590	466	$10	$16	$14	$25	$27,776	$3,309	$8,255	$11,657	**$50,996**
C Ext	209	24	51	0	$10	$10	$10	$10	$2,094	$239	$510	$0	**$2,844**
W Ext	306	24	64	49	$10	$25	$22	$41	$3,055	$607	$1,407	$2,010	**$7,079**
Total	**10,889**	**546**	**1,987**	**1,793**					**$108,888**	**$18,669**	**$56,324**	**$55,067**	**$238,948**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Abbreviations: SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-61: Option A: Second Year Target Housing Work Practice Costs													
	Events (thousands)				Unit Costs				Total Costs (thousands)				
	All	LSWP			Spot Test	LSWP			Spot Test	LSWP			**Total Costs**
		SF-O	SF-R	Multi		SF-O	SF-R	Multi		SF-O	SF-R	Multi	
Bath	1,205	96	210	112	$10	$22	$22	$22	$12,051	$2,115	$4,618	$2,464	**$21,249**
Kit	1,271	115	203	163	$10	$49	$40	$30	$12,706	$5,625	$8,127	$4,882	**$31,341**
Ad-S	67	32	0	1	$10	$16	$16	$16	$671	$517	$0	$9	**$1,198**
Ad-M	28	14	0	0	$10	$41	$34	$26	$279	$576	$0	$0	**$854**
Ad-L	119	60	0	2	$10	$51	$43	$36	$1,186	$3,036	$0	$58	**$4,281**
Wl-S	3,111	240	266	260	$10	$16	$16	$16	$31,105	$3,841	$4,256	$4,158	**$43,361**
Wl-M	91	22	3	4	$10	$41	$34	$26	$913	$882	$99	$98	**$1,991**
Wl-L	0	0	0	0	$10	$51	$43	$36	$0	$0	$0	$0	**$0**
WD-S	449	117	51	40	$10	$19	$17	$15	$4,488	$2,218	$875	$597	**$8,179**
WD-M	523	139	57	50	$10	$41	$34	$26	$5,232	$5,698	$1,923	$1,309	**$14,162**
WD-L	697	193	70	70	$10	$124	$98	$72	$6,966	$23,881	$6,820	$5,005	**$42,672**
IP-S	1,768	326	193	291	$10	$27	$24	$22	$17,684	$8,812	$4,643	$6,406	**$37,545**
IP-M	1,090	182	113	202	$10	$67	$54	$46	$10,901	$12,178	$6,082	$9,298	**$38,459**
IP-L	966	153	117	171	$10	$101	$78	$63	$9,664	$15,416	$9,131	$10,779	**$44,989**
EP	5,626	1,385	590	530	$10	$57	$50	$106	$56,257	$78,968	$29,481	$56,150	**$220,855**
C Ext	558	139	51	0	$10	$10	$10	$10	$5,575	$1,390	$510	$0	**$7,475**
W Ext	661	176	64	57	$10	$25	$22	$41	$6,609	$4,388	$1,407	$2,331	**$14,735**
Total	**18,229**	**3,387**	**1,987**	**1,951**					**$182,286**	**$169,540**	**$77,973**	**$103,545**	**$533,345**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Abbreviations: SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-62: Option B: Second Year Target Housing Work Practice Costs

	Events (thousands)				Unit Costs				Total Costs (thousands)				
	All	LSWP			Spot Test	LSWP			Spot Test	LSWP			**Total Costs**
		SF-O	SF-R	Multi		SF-O	SF-R	Multi		SF-O	SF-R	Multi	
Bath	933	17	210	106	$10	$22	$22	$22	$9,329	$366	$4,618	$2,333	**$16,647**
Kit	993	22	203	155	$10	$49	$40	$30	$9,925	$1,101	$8,127	$4,646	**$23,800**
Ad-S	11	5	0	0	$10	$16	$16	$16	$109	$78	$0	$1	**$188**
Ad-M	7	3	0	0	$10	$41	$34	$26	$72	$138	$0	$0	**$210**
Ad-L	32	16	0	1	$10	$51	$43	$36	$325	$832	$0	$45	**$1,202**
Wl-S	2,212	42	266	248	$10	$16	$16	$16	$22,116	$665	$4,256	$3,974	**$31,011**
Wl-M	38	5	3	2	$10	$41	$34	$26	$384	$217	$99	$62	**$761**
Wl-L	0	0	0	0	$10	$51	$43	$36	$0	$0	$0	$0	**$0**
WD-S	218	18	51	36	$10	$19	$17	$15	$2,182	$340	$875	$543	**$3,941**
WD-M	254	22	57	45	$10	$41	$34	$26	$2,536	$893	$1,923	$1,167	**$6,519**
WD-L	335	33	70	60	$10	$124	$98	$72	$3,352	$4,115	$6,820	$4,341	**$18,628**
IP-S	1,149	53	193	272	$10	$27	$24	$22	$11,488	$1,431	$4,643	$5,974	**$23,536**
IP-M	742	29	113	191	$10	$67	$54	$46	$7,419	$1,976	$6,082	$8,776	**$24,253**
IP-L	672	25	117	161	$10	$101	$78	$63	$6,724	$2,493	$9,131	$10,163	**$28,512**
EP	2,778	207	590	466	$10	$57	$50	$106	$27,776	$11,787	$29,481	$49,425	**$118,469**
C Ext	209	24	51	0	$10	$10	$10	$10	$2,094	$239	$510	$0	**$2,844**
W Ext	306	24	64	49	$10	$25	$22	$41	$3,055	$607	$1,407	$2,010	**$7,079**
Total	**10,889**	**546**	**1,987**	**1,793**					**$108,888**	**$27,279**	**$77,973**	**$93,459**	**$307,599**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Abbreviations: SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-63: Option C: Second Year Target Housing Work Practice Costs

	Events (thousands)				Unit Costs				Total Costs (thousands)				
	All	LSWP			Spot Test	LSWP			Spot Test	LSWP			**Total Costs**
		SF-O	SF-R	Multi		SF-O	SF-R	Multi		SF-O	SF-R	Multi	
Bath	630	67	169	83	$10	$22	$22	$22	$6,305	$1,466	$3,715	$1,816	**$13,303**
Kit	657	82	165	123	$10	$49	$40	$30	$6,567	$4,009	$6,602	$3,684	**$20,863**
Ad-S	29	21	0	0	$10	$16	$16	$16	$290	$344	$0	$8	**$642**
Ad-M	14	10	0	0	$10	$41	$34	$26	$137	$410	$0	$0	**$547**
Ad-L	59	43	0	1	$10	$51	$43	$36	$592	$2,185	$0	$45	**$2,822**
Wl-S	1,635	168	205	185	$10	$16	$16	$16	$16,355	$2,681	$3,285	$2,954	**$25,275**
Wl-M	53	17	2	3	$10	$41	$34	$26	$531	$696	$76	$79	**$1,383**
Wl-L	0	0	0	0	$10	$51	$43	$36	$0	$0	$0	$0	**$0**
WD-S	234	88	42	30	$10	$19	$17	$15	$2,337	$1,668	$715	$454	**$5,173**
WD-M	279	107	46	38	$10	$41	$34	$26	$2,785	$4,374	$1,570	$1,000	**$9,729**
WD-L	376	149	57	54	$10	$124	$98	$72	$3,757	$18,456	$5,567	$3,854	**$31,634**
IP-S	1,006	268	155	218	$10	$27	$24	$22	$10,064	$7,242	$3,716	$4,787	**$25,808**
IP-M	609	149	90	150	$10	$67	$54	$46	$6,093	$9,950	$4,869	$6,915	**$27,828**
IP-L	543	125	94	127	$10	$101	$78	$63	$5,433	$12,624	$7,312	$8,025	**$33,393**
EP	2,975	1,072	484	401	$10	$57	$50	$106	$29,747	$61,123	$24,177	$42,490	**$157,536**
C Ext	297	101	40	0	$10	$10	$10	$10	$2,972	$1,008	$400	$0	**$4,380**
W Ext	354	137	52	44	$10	$25	$22	$41	$3,541	$3,414	$1,154	$1,800	**$9,908**
Total	**9,751**	**2,602**	**1,601**	**1,457**					**$97,507**	**$131,649**	**$63,157**	**$77,910**	**$370,223**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Abbreviations: SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-64: Option D: Second Year Target Housing Work Practice Costs													
	Events (thousands)				Unit Costs				Total Costs (thousands)				
	All	LSWP			Spot Test	LSWP			Spot Test	LSWP			**Total Costs**
		SF-O	SF-R	Multi		SF-O	SF-R	Multi		SF-O	SF-R	Multi	
Bath	510	12	169	79	$10	$22	$22	$22	$5,097	$257	$3,715	$1,729	**$10,798**
Kit	532	16	165	117	$10	$49	$40	$30	$5,322	$782	$6,602	$3,524	**$16,230**
Ad-S	4	3	0	0	$10	$16	$16	$16	$39	$48	$0	$0	**$87**
Ad-M	3	2	0	0	$10	$41	$34	$26	$28	$86	$0	$0	**$114**
Ad-L	18	12	0	1	$10	$51	$43	$36	$180	$620	$0	$45	**$845**
Wl-S	1,193	30	205	177	$10	$16	$16	$16	$11,926	$480	$3,285	$2,824	**$18,516**
Wl-M	21	4	2	2	$10	$41	$34	$26	$214	$167	$76	$44	**$501**
Wl-L	0	0	0	0	$10	$51	$43	$36	$0	$0	$0	$0	**$0**
WD-S	120	14	42	27	$10	$19	$17	$15	$1,199	$272	$715	$411	**$2,597**
WD-M	140	18	46	34	$10	$41	$34	$26	$1,401	$730	$1,570	$884	**$4,585**
WD-L	184	27	57	46	$10	$124	$98	$72	$1,844	$3,306	$5,567	$3,294	**$14,011**
IP-S	623	44	155	201	$10	$27	$24	$22	$6,227	$1,199	$3,716	$4,430	**$15,572**
IP-M	395	24	90	141	$10	$67	$54	$46	$3,955	$1,628	$4,869	$6,492	**$16,943**
IP-L	363	21	94	119	$10	$101	$78	$63	$3,627	$2,094	$7,312	$7,528	**$20,561**
EP	1,507	164	484	353	$10	$57	$50	$106	$15,071	$9,324	$24,177	$37,409	**$85,980**
C Ext	118	18	40	0	$10	$10	$10	$10	$1,178	$176	$400	$0	**$1,754**
W Ext	163	18	52	37	$10	$25	$22	$41	$1,627	$455	$1,154	$1,521	**$4,756**
Total	**5,893**	**427**	**1,601**	**1,335**					**$58,934**	**$21,624**	**$63,157**	**$70,134**	**$213,850**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Abbreviations: SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Table 4-65: Option E: Second Year Target Housing Work Practice Costs													
	Events (thousands)				Unit Costs				Total Costs (thousands)				
	All	LSWP			Spot Test	LSWP			Spot Test	LSWP			**Total Costs**
		SF-O	SF-R	Multi		SF-O	SF-R	Multi		SF-O	SF-R	Multi	
Bath	937	18	210	106	$10	$22	$22	$22	$9,367	$389	$4,618	$2,333	**$16,707**
Kit	994	23	203	155	$10	$49	$40	$30	$9,943	$1,138	$8,127	$4,646	**$23,854**
Ad-S	13	5	0	0	$10	$16	$16	$16	$125	$86	$0	$1	**$213**
Ad-M	7	3	0	0	$10	$41	$34	$26	$72	$138	$0	$0	**$210**
Ad-L	35	17	0	1	$10	$51	$43	$36	$346	$862	$0	$45	**$1,253**
Wl-S	2,229	45	266	249	$10	$16	$16	$16	$22,289	$726	$4,256	$3,977	**$31,248**
Wl-M	41	6	3	2	$10	$41	$34	$26	$409	$242	$99	$62	**$812**
Wl-L	0	0	0	0	$10	$51	$43	$36	$0	$0	$0	$0	**$0**
WD-S	222	19	51	36	$10	$19	$17	$15	$2,216	$366	$875	$543	**$4,001**
WD-M	258	23	57	45	$10	$41	$34	$26	$2,576	$962	$1,923	$1,168	**$6,629**
WD-L	340	35	70	60	$10	$124	$98	$72	$3,401	$4,367	$6,820	$4,343	**$18,932**
IP-S	1,159	57	193	272	$10	$27	$24	$22	$11,591	$1,552	$4,643	$5,983	**$23,770**
IP-M	746	31	113	191	$10	$67	$54	$46	$7,462	$2,109	$6,082	$8,779	**$24,432**
IP-L	675	26	117	161	$10	$101	$78	$63	$6,755	$2,629	$9,131	$10,167	**$28,682**
EP	2,809	220	590	467	$10	$57	$50	$106	$28,092	$12,562	$29,481	$49,482	**$119,617**
C Ext	212	25	51	0	$10	$10	$10	$10	$2,120	$249	$510	$0	**$2,879**
W Ext	311	27	64	49	$10	$25	$22	$41	$3,105	$672	$1,407	$2,010	**$7,194**
Total	**10,987**	**583**	**1,987**	**1,795**					**$109,869**	**$29,050**	**$77,973**	**$93,541**	**$310,432**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Abbreviations: SF-O = Single-Family Owner-Occupied Unit; SF-R = Single-Family Renter-Occupied Unit; Multi = Multi-Family Unit; Kit = Kitchen Event; Bath = Bathroom Event; Ad-S = Small Addition; Ad-M = Medium Addition; Ad-L = Large Addition; Wl-S = Small Wall-Disturbing Event; Wl-M = Medium Wall-Disturbing Event; Wl-L = Large Wall-Disturbing Event; WD-S = Small Window or Door Replacement Event; WD-M = Medium Window or Door Replacement Event; WD-L = Large Window or Door Replacement Event; IP-S = Small Interior Painting; IP-M = Medium Interior Painting; IP-L = Large Interior Painting; EP = Exterior Painting; C Ext = Contained Exterior Event; W Ext = Whole Exterior Event.

Total Public or Commercial Building COFs Work Practice Costs

Table 4-66 through Table 4-71 present the total work practice costs associated with public or commercial building COFs regulated under the rule for the first and second years after the rule goes into effect. For individual options the costs vary between the first and the second year for two primary reasons: (1) for some options, the scope of the regulated universe expands between the first and the second year, and (2) the improved spot test kits are assumed to become available by the second year of the rule. Increasing the scope of the regulated universe tends to increase costs and the availability of the improved test kits tends to decrease the costs (since improved test kits will lower the number of instances where LSWP costs are incurred when lead-based paint is not disturbed). After the second year, estimated work practice costs decline proportionally to the assumed decline in the stock of regulated buildings (a 0.41 percent decline per year). In addition, the costs are generally lower under Option P because it does not include costs associated with using alternatives to prohibited practices and vertical containment for exterior painting. The effect of this difference is illustrated by comparing Option P and Option B, which both have the same regulatory scope. Note that the vertical containment is the primary driver of this difference (See Table 4-54).

Table 4-66: Option P: First Year Public or Commercial Building COF Work Practice Costs

	Events (thousands)			Unit Costs			Total Costs (thousands)			
	All	LSWP		Spot Test	LSWP		Spot Test	LSWP		Total Costs
Event Type		**Center**	**School**		**Center**	**School**		**Center**	**School**	
Interior Painting	39	4	23	$10	$149	$149	$391	$652	$3,444	**$4,487**
Wall Disturbing	162	17	89	$10	$65	$65	$1,625	$1,091	$5,765	**$8,481**
Window and Door	24	3	15	$10	$149	$149	$244	$419	$2,214	**$2,877**
Exterior Painting	5	2	2	$10	$28	$28	$50	$56	$49	**$155**
Total	**231**	**26**	**128**				**$2,310**	**$2,218**	**$11,472**	**$16,000**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Note: schools include elementary schools with pre-kindergarten and those with pre-kindergarten and kindergarten.

Table 4-67: Options A, B, C, and D: First Year Public or Commercial Building COF Work Practice Costs

	Events (thousands)			Unit Costs			Total Costs (thousands)			
	All	LSWP		Spot Test	LSWP		Spot Test	LSWP		Total Costs
Event Type		**Center**	**School**		**Center**	**School**		**Center**	**School**	
Interior Painting	39	4	23	$10	$150	$150	$391	$656	$3,467	**$4,514**
Wall Disturbing	162	17	89	$10	$65	$65	$1,625	$1,091	$5,765	**$8,481**
Window and Door	24	3	15	$10	$149	$149	$244	$419	$2,214	**$2,877**
Exterior Painting	5	2	2	$10	$47	$48	$50	$95	$84	**$228**
Total	**231**	**26**	**128**				**$2,310**	**$2,261**	**$11,530**	**$16,101**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Note: schools include elementary schools with pre-kindergarten and those with pre-kindergarten and kindergarten.

Table 4-68: Option E: First Year Public or Commercial Building COF Work Practice Costs

	Events (thousands)			Unit Costs			Total Costs (thousands)			
	All	LSWP		Spot Test	LSWP		Spot Test	LSWP		Total Costs
Event Type		**Center**	**School**		**Center**	**School**		**Center**	**School**	
Interior Painting	64	7	37	$10	$150	$150	$644	$1,052	$5,557	**$7,252**
Wall Disturbing	267	28	146	$10	$65	$65	$2,666	$1,792	$9,468	**$13,926**
Window and Door	40	4	23	$10	$149	$149	$402	$658	$3,476	**$4,535**
Exterior Painting	9	4	3	$10	$47	$48	$93	$168	$148	**$409**
Total	**380**	**43**	**209**				**$3,805**	**$3,668**	**$18,648**	**$26,122**

Note: schools include elementary schools with pre-kindergarten and those with pre-kindergarten and kindergarten.

Table 4-69: Option P: Second Year Public or Commercial Building COF Work Practice Costs

	Events (thousands)			Unit Costs			Total Costs (thousands)			
	All	LSWP		Spot Test	LSWP		Spot Test	LSWP		Total Costs
Event Type		**Center**	**School**		**Center**	**School**		**Center**	**School**	
Interior Painting	64	2	13	$10	$149	$149	$641	$371	$1,962	**$2,974**
Wall Disturbing	266	6	34	$10	$65	$65	$2,655	$418	$2,210	**$5,283**
Window and Door	40	2	9	$10	$149	$149	$400	$247	$1,306	**$1,954**
Exterior Painting	9	2	1	$10	$28	$28	$93	$45	$39	**$177**
Total	379	12	57				**$3,789**	**$1,082**	**$5,517**	**$10,388**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Note: schools include elementary schools with pre-kindergarten and those with pre-kindergarten and kindergarten.

Table 4-70: Options A, B, and E: Second Year Public or Commercial Building COF Work Practice Costs										
	Events (thousands)			Unit Costs			Total Costs (thousands)			
	All	LSWP		Spot Test	LSWP		Spot Test	LSWP		Total Costs
Event Type		Center	School		Center	School		Center	School	
Interior Painting	64	2	13	$10	$150	$150	$641	$374	$1,975	**$2,990**
Wall Disturbing	266	6	34	$10	$65	$65	$2,655	$418	$2,210	**$5,283**
Window and Door	40	2	9	$10	$149	$149	$400	$247	$1,306	**$1,954**
Exterior Painting	9	2	1	$10	$47	$48	$93	$76	$67	**$236**
Total	**379**	**12**	**57**				**$3,789**	**$1,115**	**$5,558**	**$10,463**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Note: schools include elementary schools with pre-kindergarten and those with pre-kindergarten and kindergarten.

Table 4-71: Options C and D: Second Year Public or Commercial Building COF Work Practice Costs										
	Events (thousands)			Unit Costs			Total Costs (thousands)			
	All	LSWP		Spot Test	LSWP		Spot Test	LSWP		Total Costs
Event Type		Center	School		Center	School		Center	School	
Interior Painting	39	2	10	$10	$150	$150	$390	$273	$1,441	**$2,103**
Wall Disturbing	162	4	21	$10	$65	$65	$1,618	$253	$1,336	**$3,207**
Window and Door	24	1	7	$10	$149	$149	$243	$202	$1,066	**$1,511**
Exterior Painting	5	1	1	$10	$47	$48	$50	$53	$47	**$150**
Total	**230**	**8**	**38**				**$2,300**	**$780**	**$3,890**	**$6,971**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Note: schools include elementary schools with pre-kindergarten and those with pre-kindergarten and kindergarten.

Summary of Work Practice Costs

Table 4-72 presents a summary of the total work practice costs for the first and second years. Work practice cost are assumed to decline by 0.41% per year after the second year to account for a decline in the stock of buildings built before 1978.

Table 4-72: Summary of First and Second Year Total Work Practice Costs								
	Scope		Total Work Practice Costs (millions, 2005$)					
			Year 1			Year 2		
Option	Year 1	Year 2	Target Housing	Public or Commercial Building COFs	All Structures	Target Housing	Public or Commercial Building COFs	All Structures
P	Pre-60 R/C	Pre-78 R/C	$198	$16	$214	$239	$10	$249
A	Pre-60	Pre-78	$460	$16	$476	$533	$10	$544
B	Pre-60 R/C	Pre-78 R/C	$266	$16	$282	$308	$10	$318
C	Pre-60	Pre-60	$460	$16	$476	$370	$7	$377
D	Pre-60 R/C	Pre-60 R/C	$266	$16	$282	$214	$7	$221
E	Pre-78 R/C	Pre-78 R/C	$465	$26	$491	$310	$10	$321

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Notes:

All options include child-occupied facilities (COFs) that fall within the scope. R/C = All rental units plus owner-occupied units where children under 6 reside. Option P does not include costs associated with vertical containment or prohibited practice alternatives, but options A through E do include these costs.

4.4 Estimating the Number of Establishments and Personnel Obtaining Training and Certification to Meet the Demand for Lead-Safe RRP Services

The rule requires all entities that conduct RRP activities for compensation in regulated structures to become certified under the rule. The regulations also require firms to ensure that all persons performing renovation activities on behalf of the firm are either certified renovators or have been trained by a certified renovator in a manner specified by the rule. It is expected that two types of construction businesses will perform regulated RRP work – businesses with employees and non-employer, or self-employed, contractors. In addition, rental companies are likely to perform some of the RRP work on the properties they manage rather than hire an outside contractor. Likewise, all public and many private schools and daycare centers are likely to perform some or all of their RRP work with their own staff. The regulation requires that a certified renovator be physically present when warning signs are being posted, the work site is being contained, and when the post-renovation cleaning is being done. The certified renovator must be available, either on-site or by telephone, at all other times when regulated renovation activities are being performed. In addition, only a certified renovator may perform the cleaning verification step required by the rule. As such, each certified establishment with employees will need to have at least one certified renovator on staff. All self-employed contractors performing regulated RRP work will need to be trained as renovators, and upon satisfying the training requirements, will need to be certified as firms.

4.4.1 Residential Activities: Estimating the Number of Establishments and Personnel Obtaining Training and Certification to Meet the Demand for Lead-Safe RRP Services

This section describes how the analysis estimates the number of (1) firms obtaining certification, (2) renovators obtaining formal training, and (3) workers obtaining informal on-the-job training, in order to meet the demand for lead-safe RRP services in residential settings. The general approach was to obtain Census estimates of the total number of establishments and employees in affected industries and adjust these estimates to account for the fact that not all work performed in these industries is affected by the rule. The total numbers of establishments and employees are adjusted in two ways: (1) according to the share of their revenues that come from residential work, and (2) adjusted to reflect the share of the housing stock that is affected. These adjustments imply the assumption that there will be some degree of specialization in regulated work. They do not, however, imply full specialization in regulated work. No adjustment is made to account for the share of RRP work that either does not disturb any painted surfaces, or does not disturb more than two square feet of painted surface. In addition, the adjustments do not fully reflect the disproportionate amount of residential work that is related to new construction.

Estimating the Stock of Certified Firms Necessary to Meet Demand for Residential RRP

The numbers of firms seeking certification under the rule are estimated in three segments: (1) residential construction establishments with employees, (2) non-employer residential construction establishments, and (3) Residential Property Managers and Lessors.

Estimating the Number of Residential Construction Establishments with Employees

The rule requires firms that conduct RRP activities in regulated housing to become certified under the rule. Because the majority of firms involved in construction work are likely to be small, single establishment businesses, this analysis assumes that firms will seek certification at the establishment level. As demonstrated in Chapter 2, the eleven potentially affected construction sectors (Residential Remodelers and ten specialty contractor sectors: Plumbing and HVAC, Tile and Terrazzo, Painting and Wall Covering, Finish Carpentry, Glass and Glazing, Drywall and Insulation, Siding, Other Building Equipment, Other Building Finishing, and Electrical contractors) include over 357,000 establishments with employees. Because these establishments are involved in a variety of construction and non-construction activities, in all likelihood only some of them will seek certification under the rule. For example, only 54 percent of Residential Remodeling establishments specialize in residential work (i.e. derive at least 51 percent of their revenues from residential work). In addition, only 56 percent of the revenues of Residential Remodelers come from residential RRP activities. Establishments are likely to incur the cost of certification and of training their employees only if they derive a substantial portion of their revenues from residential Renovation, Repair, and Painting in housing affected by the regulations. Businesses that derive the majority of their revenues from new construction or from RRP activities in non-target housing are not likely to invest in certification.

Unfortunately, the U.S. Economic Census does not provide data on the number of establishments that specialize in residential RRP. The number of establishments estimated to specialize in residential RRP was estimated by multiplying the total number of establishments by each industry sector's ratio of RRP residential revenues to total construction revenues (See Table 4-73).

Table 4-73: Employer Construction Establishments, Total and Number Specializing in Residential RRP				
NAICS	**Description**	**Number of Employer Estab. in Industry**	**Residential Adjustment Factor: Residential Revenues as a Percent of Total Value of Construction**	**Number of Employer Estab. in Industry, Adjusted by Residential Adjustment Factor**
236118	Residential remodelers	82,747	56%	46,338
238170	Siding contractors	6,632	50%	3,316
238350	Finish carpentry contractors	35,087	50%	17,544
238290	Other building equipment contractors	6,087	33%	2,009
238390	Other building finishing contractors	3,729	30%	1,119
238340	Tile and terrazzo contractors	8,950	28%	2,506
238220	Plumbing and HVAC contractors	87,501	27%	23,625
238150	Glass and glazing contractors	5,294	26%	1,376
238320	Painting and wall covering contractors	38,943	25%	9,736
238210	Electrical contractors	62,586	23%	14,395
238310	Drywall and insulation contractors	19,598	21%	4,116
Total		**357,154**	**35%**	**126,080**
Source: U.S. Census Bureau 2003; U.S. Census Bureau 2005d,f; U.S. Small Business Administration 2005; EPA Calculations				

Estimating the Number of Non-Employer Residential Construction Firms

The number of self-employed (non-employer) firms in each of the eleven affected industry sectors is presented in Table 4-74. It was assumed that these firms will specialize in residential work with the same frequency as employer establishments in the same industry. In other words, to estimate the number of self-employed contractors specializing in residential work, the estimated number of non-employer establishments in each industry was multiplied by that industry's ratio of residential RRP revenues to total construction revenues (see Table 4-74).

Table 4-74: Non-Employer Construction Establishments, Total and Number Specializing in Residential RRP				
NAICS	**Description**	**Number of Non-Employer Estab. in Industry**	**Residential Adjustment Factor: Residential Revenues as a Percent of Total Value of Construction**	**Number of Non-Employer Estab. in Industry, Adjusted by Residential Adjustment Factor**
236118	Residential remodelers	194,182	56%	108,742
238170	Siding contractors	15,939	50%	7,970
238350	Finish carpentry contractors	185,118	50%	92,559
238290	Other building equipment contractors	9,710	33%	3,204
238390	Other building finishing contractors	19,674	30%	5,902
238340	Tile and terrazzo contractors	47,220	28%	13,222
238220	Plumbing and HVAC contractors	110,183	27%	29,749
238150	Glass and glazing contractors	12,723	26%	3,308
238320	Painting and wall covering contractors	205,462	25%	51,366
238210	Electrical contractors	102,219	23%	23,510
238310	Drywall and insulation contractors	103,398	21%	21,714
Total		**1,005,828**	**36%**	**361,246**
Source: U.S. Census Bureau 2003; U.S. Census Bureau 2005d,f; U.S. Small Business Administration 2005; EPA Calculations				

Estimating the Number of Property Managers and Lessors that Perform Residential RRP

Instead of hiring an outside contractor for RRP work on properties under their management, Residential Property Managers (NAICS 531311) and Lessors of Residential Buildings and Dwellings (NAICS 531110) may choose to do the renovation work with their own staff. Since all firms performing RRP work in regulated housing must be certified, establishments that choose to perform their own RRP work will seek certifications under the regulations. The estimated numbers of these establishments are presented in Table 4-75.

The U.S. Economic Census does not present any data on the amount of RRP work performed by Residential Property Managers on their own properties. Due to this lack of data, this analysis assumes that all Residential Property Management and Lessors of Residential Buildings and Dwellings establishments that have paid employees and manage housing regulated by the rule will seek certification and train their employees as certified renovators or workers. Although this assumption is likely to overestimate the number of establishments and personnel seeking certification and training, it is not unreasonable since performing minor renovation or maintenance work in-house is often less expensive than hiring an outside contractor. The vast majority of establishments that manage regulated housing may thus find certification worthwhile. Note that only establishments with employees are expected to seek certification; non-employers are unlikely to have the time or manpower to perform renovations themselves and are more likely to hire an outside contractor for work that disturbs more than 2 square feet of a painted surface.

Table 4-75: Property Managers and Lessor Establishments Performing RRP		
NAICS	**Description**	**Number of Estab. in Industry**
531311	Residential Property Managers	26,223
531110	Lessors or Residential Buildings and Dwellings	61,787
Total		**88,010**
Source: U.S. Census Bureau 2003; U.S. Census Bureau 2005d,f; U.S. Small Business Administration 2005; EPA Calculations		

Summary of Number of Establishments that Perform Residential RRP

Table 4-76 presents a summary of the estimated number of establishments specializing in residential RRP. The estimated number of residential RRP establishments was further reduced to account for the fact that only some of these entities will perform RRP work in target housing. The latter adjustment was made based on data obtained from the American Housing Survey on the percent of U.S. households residing in target housing, 65 percent.

Table 4-76: Total Number of Establishments Performing Residential RRP in Target Housing		
Type of Establishment	**Number Performing Residential RRP**	**Estimated Number of Firms Performing Residential RRP in Pre-1978 Housing**
Non-Employer Construction Establishments	361,246	234,810
Employer Construction Establishments	126,080	81,952
Property Manager and Lessor Establishments	88,010	57,207
Total	**575,336**	**373,968**
Source: U.S. Census Bureau 2003; U.S. Census Bureau 2005d,f; U.S. Small Business Administration 2005; EPA Calculations		

The estimated number of firms that perform residential RRP in Pre-1978 housing, 373,968, represents the estimated stock of firms that would be required to meet the demand for RRP using LSWP in target housing. To estimate the stock of certified firms under the various options, 373,968 is adjusted by 75 percent to account for the 75 percent rate of compliance assumed in this analysis. In addition, the compliance-adjusted estimate is adjusted to reflect the scope of each regulatory option, based on the percentage of all target housing RRP events regulated under each option. The estimated stock of certified firms under each option is presented in Table 4-77.

Table 4-77: Estimated Stock of Firms Certified to Perform RRP in Regulated Target Housing, by Option and Year						
	Option P	Option A	Option B	Option C	Option D	Option E
Year 1	90,680	150,030	90,680	150,030	90,680	169,051
Year 2	166,854	279,326	166,854	149,415	90,308	168,358
Year 3	166,170	278,181	166,170	148,802	89,938	167,668

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Estimating the Stock of Trained Construction Workers Necessary to Meet Demand for Residential RRP

The rule requires certified firms to ensure that employees involved in RRP activities are either formally trained as certified renovators or informally trained as workers. The regulation requires that a certified renovator be physically present when warning signs are being posted, the work site is being contained, and when the post-renovation cleaning is being done. The certified renovator must be available, either on-site or by telephone, at all other times when regulated renovation activities are being performed. In addition, only a certified renovator may perform the cleaning verification step required by the rule. As such, each certified establishment with employees will need to have at least one certified renovator on staff. All self-employed contractors performing regulated RRP work will need to be trained as renovators, and upon satisfying the training requirements, will need to be certified as firms.

Estimating the Number of Residential Construction Employees (excluding self-employed)

To estimate the number of construction employees that will train to become certified renovators, this analysis looked at the average number of construction employees in establishments performing residential RRP jobs. The average employment size was calculated by dividing the number of construction employees seeking training by the number of establishments certified in each industry (See Table 4-78). This analysis also assumed that establishments will employ one certified renovator per every five construction employees. In other words, establishments that have one to five construction workers on staff will employ one renovator, establishments with more than five and fewer than 10 construction workers on staff will employ two renovators, and those with 10 or more construction workers on staff will employ three renovators. The average number of construction workers per establishment was no higher than 15 in any affected sector.

To estimate the number of construction employees that would be trained as renovators, the estimated number of establishments seeking certification in each sector was multiplied by the expected number of renovators per establishment for that sector (see Table 4-78 and Table 4-79). Four of the affected sectors (Other Building Equipment Contractors, Other Building Finishing Contractors, Electrical Contractors and Drywall and Insulation Contractors) had, on average, between 10 and 15 construction employees per establishment and were assumed to have three renovators on staff each. The number of construction employees in each sector that will need to receive worker training was estimated by subtracting the number of people receiving renovator certification from the total number of people seeking training (see Table 4-79).

Table 4-78: Employer Construction Employees: Construction Workers in Supervisory Roles					
NAICS	**Description**	**Number of Employer Estab. in Industry**	**Number of Construction Workers Employed by Employer Establishments**	**Employees Per Establishment**	**Estimated Number of Renovators Per Establishment***
236118	Residential remodelers	82,747	207,633	2.5	1
238170	Siding contractors	6,632	30,284	4.6	1
238350	Finish carpentry contractors	35,087	129,888	3.7	1
238290	Other building equipment contractors	6,087	90,504	14.9	3
238390	Other building finishing contractors	3,729	37,353	10.0	3
238340	Tile and terrazzo contractors	8,950	44,729	5.0	1
238220	Plumbing and HVAC contractors	87,501	712,452	8.1	2
238150	Glass and glazing contractors	5,294	34,086	6.4	2
238320	Painting and wall covering contractors	38,943	184,328	4.7	1
238210	Electrical contractors	62,586	606,403	9.7	2
238310	Drywall and insulation contractors	19,598	261,239	13.3	3
Total		**357,154**	**2,338,899**	**6.5**	**2**

*It is assumed that establishments with 5 or fewer employees will have one construction worker in a supervisory role; establishments with more than 5 and fewer than 10 employees will have two construction workers in supervisory roles; establishments with 10 or more employees will have three construction workers in supervisory roles.

Source: U.S. Census Bureau 2003; U.S. Census Bureau 2005d,f; U.S. Small Business Administration 2005; EPA Calculations

The number of employee establishment personnel expected to seek training as either certified renovators or workers was estimated by applying the same approach used for the estimation of the number of establishments that will seek certification under the regulations (note: employee establishment personnel does not include the self-employed). It was assumed that the number of people who perform RRP work in each of the affected industries is proportional to the ratio of residential RRP revenues to the total construction revenues in that sector. In other words, it was assumed that since 28 percent of construction revenues in the Tile and Terrazzo contractor industry come from residential RRP, then 28 percent of the construction employees perform residential RRP work. The number of employees estimated to specialize in residential RRP was estimated by multiplying the total number of employees by each industry sector's ratio of RRP residential revenues to total construction revenues (See Table 4-79).

Table 4-79: Employer Construction Establishments, Total and Number Specializing in Residential RRP						
NAICS	**Description**	**Estimated Number of Construction Renovators**	**Estimated Number of Non-Supervisory Construction Workers**	**Residential Adjustment Factor: Residential Revenues as a Percent of Total Value of Construction**	**Estimated Number of Residential Construction Renovators**	**Estimated Number of Non-Supervisory Residential Construction Workers**
236118	Residential remodelers	82,747	124,886	56%	46,338	69,936
238170	Siding contractors	6,632	23,652	50%	3,316	11,826
238350	Finish carpentry contractors	35,087	94,801	50%	17,544	47,400
238290	Other building equipment contractors	18,261	72,243	33%	6,027	23,839
238390	Other building finishing contractors	11,187	26,166	30%	3,357	7,849
238340	Tile and terrazzo contractors	8,950	35,779	28%	2,506	10,018
238220	Plumbing and HVAC contractors	175,002	537,450	27%	47,250	145,112
238150	Glass and glazing contractors	10,588	23,498	26%	2,752	6,110
238320	Painting and wall covering contractors	38,943	145,385	25%	9,736	36,346
238210	Electrical contractors	125,172	481,231	23%	28,790	110,683
238310	Drywall and insulation contractors	58,794	202,445	21%	12,348	42,512
Total		**571,363**	**1,767,536**	**36%**	**179,964**	**511,631**
Source: U.S. Census Bureau 2003; U.S. Census Bureau 2005d,f; U.S. Small Business Administration 2005; EPA Calculations						

Estimating the Number of Property Managers and Lessors Employees that Perform Residential RRP

Based on 2002 U.S. Census Data, establishments in the Residential Property Manager industry employ about eleven people on average, it was estimated that each establishment will have two certified renovators on staff; the remainder of the employees will be trained as workers. This estimate is based on the fact that Residential Property Manager establishments are involved in a variety of non-construction activities; it is thus unlikely that these businesses will have more than one ten-person construction crew on staff. Lessors of Residential Buildings and Dwellings establishments employ about five people on average, and will thus each have one certified renovator on staff. The remaining employees involved in

RRP projects will be trained as workers. Table 4-80 presents the estimated number of employees seeking training in the residential property managers and lessors of residential buildings and dwellings industries.

Table 4-80: Property Managers and Lessor Establishments Performing RRP				
NAICS	**Description**	**Number of Estab. in Industry**	**Number of RRP Work Renovators**	**Number of RRP Workers (Non-Supervisors)**
531311	Residential Property Managers	26,223	52,446	237,424
531110	Lessors or Residential Buildings and Dwellings	61,787	61,787	230,618
Total		**88,010**	**114,233**	**468,042**
Source: U.S. Census Bureau 2003; U.S. Census Bureau 2005d,f; U.S. Small Business Administration 2005; EPA Calculations				

Summary of Number of Individuals Trained to Perform Residential RRP using LSWP

Table 4-81 presents a summary of the estimated number of construction renovators and workers specializing in residential RRP. The estimated number of residential RRP renovators and workers was further reduced to account for the fact that only some of these individuals will perform RRP work in target housing. The latter adjustment was made based on data obtained from the American Housing Survey on the percent of U.S. households residing in target housing, 65 percent.

Table 4-81: Total Number of Establishments Performing Residential RRP in Target Housing				
Type of Establishment	**Number of Renovators Performing Residential RRP**	**Number of Renovators Performing Residential RRP in Pre-1978 Housing**	**Number of Non-Supervisors Performing Residential RRP**	**Number of Non-Supervisors Performing Residential RRP in Pre-1978 Housing**
Non-Employer Construction Establishments	361,245	234,809	0	0
Employer Construction Establishments	179,964	116,977	511,631	332,560
Property Manager and Lessor Establishments	114,233	74,251	468,042	304,227
Total	**655,442**	**426,038**	**979,673**	**636,787**
Source: U.S. Census Bureau 2003; U.S. Census Bureau 2005d,f; U.S. Small Business Administration 2005; EPA Calculations				

The estimated number of renovators and workers that perform residential RRP in Pre-1978 housing, 426,038 and 636,787, respectively, represents the estimated stock of renovators and workers that would be required to meet the demand for lead-safe RRP in target housing. To estimate the stock of trained individuals under the various options, these estimates are adjusted by 75 percent to account for the 75 percent rate of compliance assumed in this analysis. In addition, the compliance-adjusted estimate is further adjusted to reflect the scope of each regulatory option, based on the percentage of all target housing RRP events regulated under each option. The estimated stock of trained renovators and workers under each option is presented in Table 4-82.

Table 4-82: Estimated Stock of Trained Individuals to Perform RRP in Regulated Target Housing, by Option and Year						
	Option P	Option A	Option B	Option C	Option D	Option E
Renovators						
Year 1	103,306	170,920	103,306	170,920	103,306	192,589
Year 2	190,086	318,218	190,086	170,219	102,882	191,799
Year 3	189,307	316,913	189,307	169,521	102,461	191,013
Workers						
Year 1	154,408	255,469	154,408	255,469	154,408	287,857
Year 2	284,117	475,633	284,117	254,422	153,775	286,677
Year 3	282,952	473,683	282,952	253,378	153,144	285,501

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Estimating the Number of Establishments and Personnel Seeking Certification and Training Each Year

The number of renovators and firms that seek training and certification in the first few years is estimated slightly differently for the options with a phase-in period (Options A and B) compared to those that do not phase-in regulated structures in the second year (Options C, D, and E).

The methodology employed to estimate the stock of renovators and firms required to meet the demand for lead-safe RRP services is described above and summarized in Table 4-77 and Table 4-82. The number of firms and individuals seeking training and certification in any given year is estimated from the stock of firms and individuals necessary to meet demand for lead-safe RRP services. The differences in the number of renovators and firms seeking training and certification across the options are proportional to the number of regulated RRP events. Table 4-83 presents a summary of the estimated number of establishments that will seek firm certification each year, as well as the estimated number of employees that will need to be trained as renovators and workers in years 1 through 3.

Options Without Phase-In (Options C, D, and E)

In the first year, it is assumed that the number of renovators and firms that seek training and certification is equal to the number that is necessary to meet the demand for lead-safe RRP services in that first year. Thus, under Option E, the stock of renovators and firms required to meet the demand for lead-safe RRP services in all pre-1978 structures seek training and certification. After the first year, it is assumed that one third of the necessary stock of individuals, and firms will obtain training and certification each year (since refresher-training and re-certification is required every three years). The entire stock of workers is assumed to receive informal training each year.

Options With Phase-In (Option P and Options A and B):

In the first year, it is assumed that the number of renovators and firms that seek training and certification is equal to the number that is necessary to meet the demand for lead-safe RRP services in that first year. Thus, under Options P, A, and B, the stock of renovators and firms required to meet the demand for lead-safe RRP services in all pre-1960 structures seek training and certification. In the second year, this analysis makes the simplifying assumption that one third of the number who were trained and certified in the first year will seek initial- or re-certification.[26] In addition, the stock of individuals and firms required to meet the additional demand in the newly regulated structures obtain initial training and certification (1960 to 1978 structures for Options P, A, and B). In later years, it is assumed that one third of the necessary stock of individuals and firms will obtain training and certification each year (since refresher-training and re-certification is required every three years). The entire stock of workers is assumed to receive informal training each year.

Training and Certification after the Initial Years

As indicated above, this analysis assumes a steady annual number of firm and individual certifications after the second year of regulation with an annual decline of 0.41 percent. If all the individuals and firms needed to meet the demand for lead-safe RRP were trained and certified in the first and second years, one might expect a drop in the level of training and certification in the third year, followed by a spike in the next year. That is, one might expect a cyclical pattern of training and certification to emerge. However, it is difficult to predict how cyclical the training and certification demand might be, or how this cyclicality might diminish over time. Therefore, this analysis assumes that a typical amount of training and certification occurs each year after the first two years. Modeling a cyclical component would add little to the analysis without being able to estimate the extent of any cyclicality more precisely.

This analysis accounts for turnover in the regulated RRP industry by assuming a certain percentage of certifications each year are initial certifications. Specifically, after the first year, 52 percent of the renovators seeking training and certification are assumed to be seeking their initial certification. This is based on the relative number of Abatement Supervisors applying for initial certifications according to the Federal Lead-Based Paint Program (FLPP) database (EPA 2005). Similarly, 54 percent of firms seeking certification are assumed to be seeking their initial certification based on the relative frequency of initial certifications observed for abatement firms in the FLPP database.

[26] Adjusted by 0.41 percent annually to reflect the decline in the stock of pre-1978 buildings.

Table 4-83: Target Housing Activities: Estimated Number of Establishments Seeking Certification and Workers and Renovators Seeking Training						
	Option P	Option A	Option B	Option C	Option D	Option E
Year 1						
Total Number of Establishments (with Employees and without) Seeking Certification	90,680	150,030	90,680	150,030	90,680	169,051
Total Number of Renovators Seeking Training	103,306	170,920	103,306	170,920	103,306	192,589
Total Number of Workers Seeking Training	154,408	255,469	154,408	255,469	154,408	287,857
Year 2						
Total Number of Establishments (with Employees and without) Seeking Certification	104,156	175,592	104,156	49,805	30,103	56,119
Total Number of Renovators Seeking Training	118,645	200,018	118,645	56,740	34,294	63,933
Total Number of Workers Seeking Training	284,117	475,633	284,117	254,422	153,775	286,677
Year 3						
Total Number of Establishments (with Employees and without) Seeking Certification	55,390	92,727	55,390	49,601	29,979	55,889
Total Number of Renovators Seeking Training	63,102	105,638	63,102	56,507	34,154	63,671
Total Number of Workers Seeking Training	282,952	473,683	282,952	253,378	153,144	285,501

Note: Components may not add up to totals due to rounding. The number of firms and individuals certified and trained, respectively, are assumed to decline by 0.41 percent annually to account for the decline in the size of the regulated housing stock over time, and thus the demand for lead-safe renovation services. This table presents the numbers of renovators and firms seeking training and certification in a given year; therefore the numbers in years 2 and 3 differ from those presented in Table 4-77 and Table 4-82, which present the *stock* of trained renovators and certified firms (re-training and re-certification is required every three years). Workers receive training each year.
See

Table 4-1: Options Included in Economic Analysis

for options descriptions.
Source: EPA Calculations.

4.4.2 Activities in COFs in Public or Commercial Buildings: Estimating the Number of Establishments and Personnel Obtaining Training and Certification to Meet the Demand for Lead-Safe RRP Services

To estimate the number of individuals and firms trained and certified to perform work in COFs located in public or commercial buildings, this analysis first assessed which types of COF operators are likely to perform work in-house. Facilities where daycare center or school staff perform any regulated events will need to be certified as firms, and will need to train at least one staff member as a renovator, and if necessary, additional staff members as workers. As described in detail below, the analysis generates separate estimates of the number of public school, private school, daycare, and non-residential property lessor/manager staff that will need to be trained and certified.

To calculate the number of contractors working in public or commercial building COFs, the analysis first estimated the number of projects that COFs or their landlords perform in-house, and subtracted these events from the total number of regulated projects at these facilities. The analysis then estimated the number of contracting firms and employees that would need to obtain training and certification to perform the work not done in-house.

Public Schools

According to the American Schools and Universities (ASU) report on the extent to which public school districts outsource various non-educational services, the vast majority of public schools perform much of their routine maintenance and repair work in-house. This analysis thus assumes that all school districts with at least one pre-1978 building will perform some of the regulated RRP projects using their own maintenance staff. The analysis makes the following assumptions regarding the typical number of renovators and workers trained per district:

1. **Entities**: The analysis assumes that every school district with at least one pre-1978 building will obtain firm certification.
2. **Renovators:** The analysis assumes that districts with fewer than 20 pre-1978 buildings will have one renovator on staff. Districts with more than 20 pre-1978 schools will have one renovator on staff per every 20 buildings. Since schools are expected to perform only a portion of their own events in-house, and since a renovator does not need to personally supervise the project at all times, this analysis assumes that a single person can be responsible for renovations in up to 20 school buildings.
3. **Workers:** The analysis assumes that school districts will train one worker per pre-1978 building.

The number of small school districts with at least one regulated building was estimated for each option based on the number of school buildings in the district and the likelihood that any one of the buildings is old enough to be regulated.

Based on DOE's CBECS data, the probability that a particular school building was built after 1978 is 0.42 (1-0.58). The likelihood that a district has no pre-1978 buildings is a function of the number of buildings and 0.42 as follows[27]:

$(0.42)^X$, where X is the number of schools with kindergarten or pre-kindergarten in the district

For example, a district with three buildings has a (0.42)*(0.42)*(0.42) = 0.074 probability of containing no pre-1978 buildings. As such, 92.6 percent of districts with three school buildings will have at least one building that is pre-1978. The numbers of districts with at least one pre-1960 building was estimated as 55 percent of pre-1978 estimate, based on HUD (2003) data.

To estimate the total number of regulated pre-1978 school buildings (and as such the total number of workers trained), the total number of schools with kindergartens or pre-kindergartens was multiplied by the probability that a building was constructed before 1978 (58 percent). To calculate the number of renovators trained, the analysis calculated the average number of regulated buildings in districts with a particular number of schools with kindergarten or pre-kindergarten programs. For example, the average number of pre-1978 buildings in a 3-building district with at least one pre-1978 school was calculated by multiplying the total number of schools in all 3-building districts by the percent of schools constructed before 1978 (58 percent) and dividing the result by the number of districts with at least one pre-1978

[27] It is assumed that the age of each building is independent of the age of all other buildings in the district. This may somewhat overestimate the number of districts that have at least one pre-1978 buildings. But data are not available to calculate the joint probabilities.

school. Districts with fewer than 20 regulated buildings, on average, were then assigned one renovator, while districts with over 20 such schools were assigned one renovator per every 20 buildings.

Table 4-84 presents the resulting numbers of individuals trained as workers and renovators, and the numbers of districts seeking certification as firms. Note that all numbers have been adjusted to account for a 75 percent compliance rate.

Table 4-84: Number of Public School Districts Certified and Individuals Trained

	Option P	Option A	Option B	Option C	Option D	Option E
Year 1						
Total Number of Establishments (with Employees and without) Seeking Certification	4,280	4,280	4,280	4,280	4,280	7,782
Total Number of Renovators Seeking Training	4,394	4,394	4,394	4,394	4,394	7,990
Total Number of Workers Seeking Training	13,446	13,446	13,446	13,446	13,446	24,448
Year 2						
Total Number of Establishments (with Employees and without) Seeking Certification	4,908	4,908	4,908	1,421	1,421	2,583
Total Number of Renovators Seeking Training	5,039	5,039	5,039	1,459	1,459	2,652
Total Number of Workers Seeking Training	24,347	24,347	24,347	13,391	13,391	24,347
Year 3						
Total Number of Establishments (with Employees and without) Seeking Certification	2,573	2,573	2,573	1,415	1,415	2,573
Total Number of Renovators Seeking Training	2,641	2,641	2,641	1,453	1,453	2,641
Total Number of Workers Seeking Training	24,248	24,248	24,248	13,336	13,336	24,248

Notes: Components may not add up to totals due to rounding. The number of firms and individuals certified and trained, respectively, are assumed to decline by 0.41 percent annually to account for the decline in the size of the regulated housing stock over time, and thus the demand for lead-safe renovation services.
See

Table 4-1: Options Included in Economic Analysis

for options descriptions.
Source: EPA calculations

Private Schools

This analysis assumes that typical private schools with fewer than 100 students will not hire any maintenance staff and will contract out all of their renovation, repair, and painting work. Schools with more than 100 students, however, are typically expected to perform some renovation work in-house. In the absence of data on the number of maintenance staff employed by private schools, this analysis assumes that each regulated school will typically train one worker and one renovator to perform paint-disturbing projects.

As discussed in Chapter 2, based on 2003-2004 NCES data, it is estimated that 59 percent of all private schools with kindergartens and/or pre-kindergartens have more than 100 students. Using CBECS data on the age of educational buildings, the number of private schools with over 100 students was adjusted to estimate the numbers of private schools certified and individuals trained under the various options. Table 4-85 presents the resulting estimates, which have also been adjusted for an expected 75 percent compliance rate.

Table 4-85: Number of Private Schools Certified and Individuals Trained						
	Option P	Option A	Option B	Option C	Option D	Option E
Year 1						
Total Number of Establishments (with Employees and without) Seeking Certification	3,749	3,749	3,749	3,749	3,749	6,816
Total Number of Renovators Seeking Training	3,749	3,749	3,749	3,749	3,749	6,816
Total Number of Workers Seeking Training	3,749	3,749	3,749	3,749	3,749	6,816
Year 2						
Total Number of Establishments (with Employees and without) Seeking Certification	4,299	4,299	4,299	1,244	1,244	2,263
Total Number of Renovators Seeking Training	4,299	4,299	4,299	1,244	1,244	2,263
Total Number of Workers Seeking Training	6,788	6,788	6,788	3,733	3,733	6,788
Year 3						
Total Number of Establishments (with Employees and without) Seeking Certification	2,253	2,253	2,253	1,239	1,239	2,253
Total Number of Renovators Seeking Training	2,253	2,253	2,253	1,239	1,239	2,253
Total Number of Workers Seeking Training	6,760	6,760	6,760	3,718	3,718	6,760

Notes: Components may not add up to totals due to rounding. The number of firms and individuals certified and trained, respectively, are assumed to decline by 0.41 percent annually to account for the decline in the size of the regulated housing stock over time, and thus the demand for lead-safe renovation services.
See

Table 4-1: Options Included in Economic Analysis

for options descriptions.
Source: EPA calculations

Daycare Centers and Non-Residential Property Lessors and Managers

To determine the number of daycare centers likely to perform any renovation work in-house, this analysis relied on data from HUD's *First National Health Survey of Child Care Centers* and the DOE Energy Information Association's Commercial Building Energy Consumption Survey (CBECS).

HUD data provides information on the location of each center in the survey. Since, as discussed in Chapter 2, daycare centers in schools were excluded from center counts, the analysis removed these centers from the HUD data, and then recalculated the percent of centers located in each remaining setting. These settings were then grouped into three location categories: standalone buildings (which include single and multi-building establishments), church/home (all are assumed to be in churches or other religious establishments), and parts of other buildings (which include centers in office buildings, shopping malls, clinics, and recreation centers).[28]

[28] Centers in clinics and recreation centers make up about 2.5 percent of all centers outside of schools. Because these centers make up such a small percentage of the total, they are combined with centers located in other commercial buildings.

This analysis assumes that all centers located in other buildings, and none of the centers in religious establishments, rent their space. To estimate the number of standalone centers that rent their buildings, the analysis relied on CBECS data. CBECS identifies the primary activity taking place in each surveyed building, indicates whether the building hosts one or multiple types of businesses, and whether or not the building is occupied by the owner. The analysis identified buildings where Preschool/Daycare was the only type of activity taking place, and calculated the percent of such buildings where the occupant is not the owner of the building.

Table 4-86 reports the percent of centers located in standalone buildings, office/other buildings, and in religious establishments, as well as the percent of centers at each location that rent their space. The table then presents estimates of the total numbers of centers in each setting (out of the 50,947 pre-1978 centers identified in Chapter 2), as well as the number that rent and own their space. Note that because both the HUD and CBECS survey sample sizes are small, the analysis relied on the entire dataset in order to calculate the percentages in these tables, rather than on data for pre-1978 buildings only.

Table 4-86: Percent and Number of Daycare Centers by Location Type and Building Ownership (Pre-1978 Centers; Numbers not adjusted for compliance)

	Percent of Total	Percent Renting	Total Pre-1978 Centers	Pre-1978 Centers Renting Space	Pre-1978 Centers that Own Space
Total Stand alone[a]	45%	47%	22,898	10,762	12,136
Part of Church/home[b]	41%	0%	21,106	0	21,106
Part of Other Building[c]	14%	100%	6,943	6,943	0
Total			50,947	17,705	33,242

a. Includes centers in single and multi-building centers
b. Assumed to be located in churches or other religious organizations. Since the HUD survey looks at daycare centers, not in-home daycare, no centers are assumed to be located in homes.
c. Includes centers in office buildings, recreational centers, shopping malls, and clinics.

Source: HUD 2003; DOE 2003; NARA 2005

As demonstrated in Table 4-86, an estimated 17,705 daycare centers rent space in pre-1978 buildings. The analysis assumes that daycare centers that rent space do not perform any of their own repair, painting, or renovation work. Projects at these centers are assumed to be performed either by property lessor/manager staff, or by contractors. Thus, all centers that are part of office or other buildings are assumed to perform no RRP work themselves.

For standalone buildings and daycare centers in churches and other religious establishments, the analysis relied on HUD survey data to estimate the percentage of daycare centers where building staff perform painting projects. According to the HUD survey, 45 percent of standalone daycare centers, and 73 percent of centers in religious establishments perform painting projects using building staff. Since the percent of standalone centers where building staff perform painting projects is smaller than the percent of centers that rent their space, this analysis assumes that painting in standalone centers is always performed either by landlords or contractors. The analysis assumes that center staff perform painting projects in 73 percent of daycare centers in religious establishments. The remaining 27 percent of these centers are assumed to contract out the work.

Table 4-87 summarizes these assumptions and presents estimates of the number of centers where some work may be done by center or landlord staff (All numbers are for pre-1978 buildings and are not adjusted for compliance).

Table 4-87: Number and Percent of Centers where Center or Landlord Staff Perform Some RRP Work (Pre-1978 Centers; Numbers not adjusted for compliance)			
	Assumption	**Number of Centers**	**Percent of Centers**
Center staff and contractor staff	73 percent of centers in religious establishments	15,428	30.3%
Landlord staff and contractor staff	All centers renting space (47 percent of stand-alone centers and all centers in other buildings)	17,705	34.8%
Contractor only	23 percent of centers in religious establishments and 53 percent of standalone centers	17,814	35.0%
Source: HUD 2003, DOE 2003; NARA 2005			

Numbers of centers certified and individuals trained

As demonstrated in Table 4-87, 73 percent of centers in religious establishments are expected to perform some of their own RRP work. This analysis estimates that each of these centers will train one staff member as a renovator. Because center staff is expected to perform very few events each year, centers are not expected to train any workers. Each center, however, will need to obtain firm certification.

Table 4-88 presents the numbers of centers certified and individuals trained. All numbers have been adjusted for the facts that only 75 percent of centers in regulated buildings are expected to comply with the rule. The number of centers regulated under each option has been adjusted for building age using CBECS data.

Number of non-residential lessor/ manager firms certified and individuals trained

As discussed in Chapter 2, because daycare centers are only one of many types of tenants renting space in non-residential buildings, and because the rule applies only to buildings constructed prior to 1978, each non-residential lessor or manager firm is expected to own only one regulated building. This analysis assumes that all firms that rent space to a COF in a pre-1978 building will perform some renovation, repair, and painting work in-house. While this assumption may overstate the number of in-house jobs, little data is available on the percent of renovation work performed by landlords in their own buildings.

This analysis assumes that each non-residential lessor and manager firm that owns a regulated building will train one renovator and one worker, and will seek firm certification. Table 4-89 presents the estimated numbers of lessor/manager firms certified and individuals trained. All numbers have been adjusted for 75 percent compliance and building age.

Table 4-88: Number of Daycare Centers in Religious Establishments Certified and Individuals Trained						
	Option P	**Option A**	**Option B**	**Option C**	**Option D**	**Option E**
Year 1						
Total Number of Establishments (with Employees and without) Seeking Certification	6,364	6,364	6,364	6,364	6,364	11,571
Total Number of Renovators Seeking Training	6,364	6,364	6,364	6,364	6,364	11,571
Total Number of Workers Seeking Training	0	0	0	0	0	0
Year 2						
Total Number of Establishments (with Employees and without) Seeking Certification	7,298	7,298	7,298	2,113	2,113	3,841
Total Number of Renovators Seeking Training	7,298	7,298	7,298	2,113	2,113	3,841
Total Number of Workers Seeking Training	0	0	0	0	0	0
Year 3						
Total Number of Establishments (with Employees and without) Seeking Certification	3,825	3,825	3,825	2,104	2,104	3,825
Total Number of Renovators Seeking Training	3,825	3,825	3,825	2,104	2,104	3,825
Total Number of Workers Seeking Training	0	0	0	0	0	0

Notes: Components may not add up to totals due to rounding. The number of firms and individuals certified and trained, respectively, are assumed to decline by 0.41 percent annually to account for the decline in the size of the regulated housing stock over time, and thus the demand for lead-safe renovation services.
See

Table 4-1: Options Included in Economic Analysis

for options descriptions.
Source: EPA calculations

Table 4-89: Number of Non-Residential Property Lessor/Manager Firms Certified and Individuals Trained						
	Option P	Option A	Option B	Option C	Option D	Option E
Year 1						
Total Number of Establishments (with Employees and without) Seeking Certification	7,303	7,303	7,303	7,303	7,303	13,279
Total Number of Renovators Seeking Training	7,303	7,303	7,303	7,303	7,303	13,279
Total Number of Workers Seeking Training	7,303	7,303	7,303	7,303	7,303	13,279
Year 2						
Total Number of Establishments (with Employees and without) Seeking Certification	8,375	8,375	8,375	2,424	2,424	4,408
Total Number of Renovators Seeking Training	8,375	8,375	8,375	2,424	2,424	4,408
Total Number of Workers Seeking Training	13,224	13,224	13,224	7,273	7,273	13,224
Year 3						
Total Number of Establishments (with Employees and without) Seeking Certification	4,390	4,390	4,390	2,415	2,415	4,390
Total Number of Renovators Seeking Training	4,390	4,390	4,390	2,415	2,415	4,390
Total Number of Workers Seeking Training	13,170	13,170	13,170	7,244	7,244	13,170

Notes: Components may not add up to totals due to rounding. The number of firms and individuals certified and trained, respectively, are assumed to decline by 0.41 percent annually to account for the decline in the size of the regulated housing stock over time, and thus the demand for lead-safe renovation services.
See

Table 4-1: Options Included in Economic Analysis

for options descriptions.
Source: EPA calculations

Number of Contractors Working in Public or Commercial Building COFs

Construction establishments will perform jobs that are not performed in-house by public or commercial building COFs or their landlords. To estimate the additional number of contractors needed to work in public or commercial building COFs, this analysis calculated the number of events performed by contractors in these buildings, and then calculated the number of firms, renovators, and workers that would need to obtain training and certification assuming that the ratio of contracting firms and individuals to RRP events would be the same in public or commercial buildings as estimated for target housing.

To estimate the number of events performed by contractors in public or commercial building COFs, this analysis assumed that all COFs and landlords that perform any of their own work would perform the following projects using their own staff:

- All painting projects, and
- Window/Door Projects, and
- Unscheduled Maintenance.

Because plumbing, HVAC, and electrical projects often require special training and licensing, it is assumed that these events will always be performed by contractors. Thus, contractors are expected to perform plumbing, HVAC and electrical projects in all buildings. In addition, contractors will perform all of the work in COFs that do not employ any maintenance staff, such as private schools with fewer than 100 students and standalone daycare centers that own their building.

Table 4-90 presents the pre-1978 numbers and percentages of schools and daycare centers according to whether or not they perform any of their own renovation work. For each group of COFs, the table indicates the types of projects performed in-house by COF or landlord staff, as well as the types of projects performed by contractors. As mentioned in Section 4.2, because of differences in assumptions about the number of rooms per building between schools with and without kindergartens, all schools with pre-kindergarten but no kindergarten were included in the count of centers. As such, these schools are also included in center counts and excluded from the school counts in this table (see table footnotes). Note that all numbers have been adjusted for 75 percent compliance.

Table 4-90: Number and Percentage of Pre-1978 Daycare Centers and Schools by Type of Staff Performing Work					
	Total Pre-1978 Buildings	Percent of Schools or Centers	Maintenance Staff	Landlords	Contractors
Public Schools with Kindergarten[a]	22,067	65.68%	All painting events All window events All unscheduled maintenance events	NONE	All scheduled plumbing and electrical events
Private Schools with Kindergarten and <100 kids[a]	4,716	14.04%	NONE	NONE	ALL EVENTS
Private Schools with Kindergarten and >100 kids[a]	6,816	20.29%	All painting events All window events All unscheduled maintenance events	NONE	All scheduled plumbing and electrical events
Total School Buildings	**33,599**				
Daycare Centers that perform work using center staff[b]	12,183	31.38%	All painting events All window events All unscheduled maintenance events	NONE	All scheduled plumbing and electrical events
Daycare Centers that rent space	13,279	34.20%	NONE	All painting events All window events All unscheduled maintenance events	All scheduled plumbing and electrical events
Daycare Centers that own space and do not perform any events in-house[c]	13,365	34.42%	NONE	NONE	ALL EVENTS
Total Centers	**38,828**				

a. All school counts exclude schools with pre-kindergarten but no kindergarten (609 public schools, 7 private schools with fewer than 100 students and 5 private schools with more than 100 students)
b. Count of centers includes 73 percent of centers in religious establishments, as well as public schools with a pre-kindergarten but no kindergarten (609 total) and private schools with a pre-kindergarten and no kindergarten, and over 100 students in total (5 total).
c. Count of includes 53 percent of standalone centers, 27 percent of centers in religious establishments, and 7 private schools with pre-kindergarten and no kindergarten, and fewer than 100 students.

The total estimated numbers of events performed in schools and daycare centers in the first year under Option E are presented in Table 4-91. To calculate the number of events performed by contractors, this analysis assumes that the average number of events per school or center is the same regardless of who performs the work. As such the analysis applied the percentages in Table 4-91 to the first-year numbers of events to estimate the numbers of projects performed by in-house staff, landlord staff, and contractors. For example, since 86 percent of schools perform their own painting projects, 86 percent of painting projects are assumed to be performed by school staff, while the remaining 14 percent are assumed to be performed by contractors. Table 4-91 presents the percentage of jobs performed by COF staff, landlord staff, and contractor staff by building and event type. Table 4-92 then uses these percentages to calculate the number of events performed by each group of entities.

Table 4-91: Percent of Public or Commercial Building COF Events Performed by School/Center Staff, Landlord Staff, and Contractors			
Event Type	**Percent by School or Center Staff**	**Percent by Landlord Staff**	**Percent by Contractor**
School Events			
Interior Painting	85.96%	0.00%	14.04%
Exterior Painting	85.96%	0.00%	14.04%
Window/Door	85.96%	0.00%	14.04%
Scheduled Plumbing, Electrical, HVAC	0.00%	0.00%	100.00%
Unscheduled Maintenance	85.96%	0.00%	14.04%
Center Events			
Interior Painting	31.38%	34.20%	34.42%
Exterior Painting	31.38%	34.20%	34.42%
Window/Door	31.38%	34.20%	34.42%
Scheduled Plumbing, Electrical, HVAC	0.00%	0.00%	100.00%
Unscheduled Maintenance	31.38%	34.20%	34.42%

Table 4-92: Number of Public or Commercial Building COF Events Performed by School/Center Staff, Landlord Staff, and Contractors				
Event Type	**Total Number of Events (Option E, Year 1)**	**Number Performed by School or Center Staff**	**Number Performed by Landlord Staff**	**Number Performed by Contractor**
School Events				
Interior Painting	54,134	46,536	0	7,598
Exterior Painting	4,317	3,711	0	606
Window/Door	33,784	29,042	0	4,742
Unscheduled Carpentry	220,130	0	0	220,130
Plumbing, HVAC, and remaining Unscheduled	4,073	3,501	0	572
Subtotal, School Events	*316,438*	*82,790*	*0*	*233,648*
Center Events				
Interior Painting	10,244	3,214	3,503	3,526
Exterior Painting	4,989	1,565	1,706	1,717
Window/Door	6,393	2,006	2,186	2,201
Unscheduled Carpentry	37,721	0	0	37,721
Plumbing, HVAC, and remaining Unscheduled	4,706	1,477	1,610	1,620
Subtotal, Center Events	*64,053*	*8,262*	*9,005*	*46,785*
Total Events, Schools and Centers	**380,491**	**91,052**	**9,005**	**280,434**

As demonstrated in Table 4-92, contractors are expected to perform just over 280,000 events in public or commercial building COFs in the first year under Option E. Assuming that the ratio of contracting firms and individuals to RRP events is the same in public or commercial buildings as estimated for target housing, the analysis estimates that under Option E, an additional 3,223 construction establishments will become certified, 3,672 renovators will be trained, and 5,488 workers will be trained.

Since the numbers of establishments and individuals certified and trained vary with the size of the regulated building stock, the certification and training numbers under the other options are estimated as being proportional to the stock of regulated buildings. The resulting estimates of the numbers of public or commercial building COF contractor establishments and employees certified and trained are presented in Table 4-93.

Table 4-93:**Number of Construction Establishments Certified and Individuals Trained**

	Option P	Option A	Option B	Option C	Option D	Option E
Year 1						
Total Number of Establishments (with Employees and without) Seeking Certification	1,773	1,773	1,773	1,773	1,773	3,223
Total Number of Renovators Seeking Training	2,019	2,019	2,019	2,019	2,019	3,672
Total Number of Workers Seeking Training	3,018	3,018	3,018	3,018	3,018	5,488
Year 2						
Total Number of Establishments (with Employees and without) Seeking Certification	2,033	2,033	2,033	588	588	1,070
Total Number of Renovators Seeking Training	2,316	2,316	2,316	670	670	1,219
Total Number of Workers Seeking Training	5,465	5,465	5,465	3,006	3,006	5,465
Year 3						
Total Number of Establishments (with Employees and without) Seeking Certification	1,066	1,066	1,066	586	586	1,066
Total Number of Renovators Seeking Training	1,214	1,214	1,214	668	668	1,214
Total Number of Workers Seeking Training	5,443	5,443	5,443	2,994	2,994	5,443

Notes: Components may not add up to totals due to rounding. The number of firms and individuals certified and trained, respectively, are assumed to decline by 0.41 percent annually to account for the decline in the size of the regulated housing stock over time, and thus the demand for lead-safe renovation services.
See

Table 4-1: Options Included in Economic Analysis

for options descriptions.
Source: EPA calculations

Table 4-94 presents the total numbers of firms, renovators, and workers obtaining training and certification.

Table 4-94: Public or Commercial Building COF Activities: Estimated Number of Establishments Seeking Certification and V Training

	Option P	Option A	Option B	Optio
Year 1				
Total Number of Establishments (with Employees and without) Seeking Certification	23,469	23,469	23,469	23,4
Total Number of Renovators Seeking Training	23,830	23,830	23,830	23,8
Total Number of Workers Seeking Training	27,517	27,517	27,517	27,5
Year 2				
Total Number of Establishments (with Employees and without) Seeking Certification	26,914	26,914	26,914	7,79
Total Number of Renovators Seeking Training	27,328	27,328	27,328	7,9
Total Number of Workers Seeking Training	49,825	49,825	49,825	27,4
Year 3				
Total Number of Establishments (with Employees and without) Seeking Certification	14,107	14,107	14,107	7,7
Total Number of Renovators Seeking Training	14,324	14,324	14,324	7,8
Total Number of Workers Seeking Training	49,621	49,621	49,621	27,2

Note: Components may not add up to totals due to rounding. The number of firms and individuals certified and trained, respectively, are assumed to for the decline in the size of the regulated housing stock over time, and thus the demand for lead-safe renovation services.
See

Table 4-1: Options Included in Economic Analysis

for options descriptions.
Source: EPA Calculations.

4.4.3 All Activities: Estimating the Number of Establishments and Personnel Obtaining Training and Certification to Meet the Demand for Lead-Safe RRP Services

Table 4-95 combines the totals presented in Table 4-83 (target housing) and Table 4-94 (public or commercial buildings) to arrive at the total number of firms and individuals seeking training and certification for the first three years of the rule.

Table 4-95: All Activities: Estimated Number of Establishments Seeking Certification and Workers and Renovators Seeking Training						
	Option P	Option A	Option B	Option C	Option D	Option E
Year 1						
Total Number of Establishments (with Employees and without) Seeking Certification	114,149	173,499	114,149	173,499	114,149	211,721
Total Number of Renovators Seeking Training	127,136	194,750	127,136	194,750	127,136	235,916
Total Number of Workers Seeking Training	181,925	282,986	181,925	282,986	181,925	337,887
Year 2						
Total Number of Establishments (with Employees and without) Seeking Certification	130,424	201,860	130,424	57,596	37,894	70,284
Total Number of Renovators Seeking Training	145,315	226,687	145,315	64,651	42,205	78,316
Total Number of Workers Seeking Training	333,942	525,458	333,942	281,826	181,179	336,502
Year 3						
Total Number of Establishments (with Employees and without) Seeking Certification	69,497	106,834	69,497	57,360	37,738	69,996
Total Number of Renovators Seeking Training	77,427	119,962	77,427	64,385	42,032	77,995
Total Number of Workers Seeking Training	332,573	523,303	332,573	280,670	180,436	335,122

Note: Components may not add up to totals due to rounding. The number of firms and individuals certified and trained, respectively, are assumed to decline by 0.41 percent annually to account for the decline in the size of the regulated housing stock over time, and thus the demand for lead-safe renovation services.
See

Table 4-1: Options Included in Economic Analysis

for options descriptions.
Source: EPA Calculations.

4.5 Training Costs

Training costs include the cost of the time spent on training activities as well as the associated travel and tuition costs. Note that tuition costs are assumed to include the costs associated with training provider accreditation. In other words, it is assumed that accredited training providers pass along their accreditation fees and other administrative costs through their tuition. These accreditation fees and other administrative costs are estimated in the paperwork burden analysis but are only implicitly accounted for (as part of tuition costs) in the estimates of the total cost of the rule.

4.5.1 Training Burden Per Individual

To estimate the incremental burden of training, several cost components are calculated, including tuition rates, wage rates, and travel and expense costs. Each certified renovator will participate in 8 hours of formal initial training. Refresher renovator certification training is required every three years; the refresher course is only four hours. Workers receive informal, on-the-job training; it is assumed that, on average, three workers are trained at a time by a certified renovator and the training requires one hour.

Tuition for the initial certified renovator training class is estimated to be $186; the corresponding refresher course tuition is estimated to be $93 (EPA 2006). This estimate relies on the assumption that the average hourly tuition is equal to the observed rates for the accredited lead abatement and evaluation courses ($23.26).[29] Additional travel and meal costs associated with training are assumed to be $121 (EPA 2006).[30] Digital photos of each certified renovator are also added into the additional costs. The total cost for a one-time use digital camera that takes 25 pictures is $14 ($0.56 per picture taken). The total time allotted to taking and processing these photos is estimated at 3 minutes ($1.20). This comes to a total cost of $1.76 (rounded to $2 in the total cost estimates). For a class size of 10 students, 3 minutes per student is equivalent to a total time of 30 minutes to take the digital photos, associate them with the appropriate students, and insert the photos onto the training certificates.

The value of the time for certified renovators to receive formal initial training is $253 (8 hours at a loaded wage rate of $31.64/hour); the refresher training is half this amount, or $127 (EPA 2006). Certified renovators may be self-employed or might be employed by a larger company. Therefore, the value of time is likely to represent a mix of lost wages and additional overhead to firms. Assuming one certified renovator trains three workers at a time, and this informal training requires an hour, informal training is estimated to cost $27 per worker trained (EPA 2006). Thus, the aggregated incremental cost of training is $560 for initial certified renovator training, $341 for refresher certified renovator training and $27 for informal worker training (EPA 2006).

Table 4-96: Incremental Training Costs (2005$)

	Tuition	Value of Time	Travel and Meals	Digital Photo	Total
Initial Training					
Certified Renovator	$186	$253	$121	$2	$562
Worker	$0	$27	$0	$0	$27
Refresher Training					
Certified Renovator	$93	$127	$121	$0	$341
Source: EPA Calculations.					

4.5.2 Total Training Costs

Table 4-97 through Table 4-99 present the total training costs of the rule for the first three years. The time profile of renovators and workers seeking training is described in Section 4.4, the value of training time for renovators and workers is described in Section 4.5.1. The average training cost per renovator varies in the initial years of the regulation according to the relative number percentage of initial and refresher trainings. After the second year, 52 percent of contractors and public or commercial building renovators receive initial training and the rest obtain refresher training. Note that an individual who received initial training and let their certification expire must retake the initial training. After the third year, the number of renovators and workers seeking training, and thus the undiscounted total training costs, decline by 0.41 percent annually to account for the decline in the demand for lead-safe renovation services as stock of regulated structures declines over time.

[29] The average of the hourly tuition rates are used rather than picking a single similar course because no single course is similar enough to the renovator course. For example, the initial courses are the only courses with hands-on training, but they are also longer than the renovator course. The refresher courses are more similar in length, but have no hands on requirements.

[30] Travel costs include 2 hours of travel time ($63), meals ($9), and mileage costs (50 miles, $49).

Table 4-97: Total Training Costs for Renovators and Workers: First Year of Regulation				
	Number of Renovators Seeking Training	Average Cost of Training	Total Renovator Training Cost	Total Work Cost (27 Pe
			Year 1	
			Initial Training Renovators	
Option P				
Public/Com Bldg	23,830	$560	$13,344,800	
TH	103,306	$560	$57,851,360	
Total	127,136	$560	$71,196,160	
Option A				
Public/Com Bldg	23,830	$562	$13,392,460	
TH	170,920	$562	$96,057,040	
Total	194,750	$562	$109,449,500	
Option B				
Public/Com Bldg	23,830	$562	$13,392,460	
TH	103,306	$562	$58,057,972	
Total	127,136	$562	$71,450,432	
Option C				
Public/Com Bldg	23,830	$562	$13,392,460	
TH	170,920	$562	$96,057,040	
Total	194,750	$562	$109,449,500	
Option D				
Public/Com Bldg	23,830	$562	$13,392,460	
TH	103,306	$562	$58,057,972	
Total	127,136	$562	$71,450,432	
Option E				
Public/Com Bldg	43,327	$562	$24,349,774	
TH	192,589	$562	$108,235,018	
Total	235,916	$562	$132,584,792	

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Table 4-98: Total Training Costs for Renovators and Workers: Second Year of Regulation				
	Number of Renovators Seeking Training	**Average Cost of Training**	**Total Renovator Training Cost**	**Total Worker Training Per Worker)**
		Year 2		
		Initial Training Renovators		
Option P				
Public/Com Bldg	23,531	$560	$13,177,170	$1,3
TH	105,037	$560	$58,820,691	$7,6
Total	128,568	$560	$71,997,861	$9,0
Option A				
Public/Com Bldg	23,531	$562	$13,224,231	$1,3
TH	177,503	$562	$99,756,896	$12,8
Total	201,034	$562	$112,981,127	$14,1
Option B				
Public/Com Bldg	23,531	$562	$13,224,231	$1,3
TH	105,037	$562	$59,030,765	$7,6
Total	128,568	$562	$72,254,996	$9,0
Option C				
Public/Com Bldg	4,114	$562	$2,311,842	$7
TH	29,505	$562	$16,581,622	$6,8
Total	33,618	$562	$18,893,465	$7,6
Option D				
Public/Com Bldg	4,114	$562	$2,311,842	$7
TH	17,833	$562	$10,022,122	$4,1
Total	21,947	$562	$12,333,964	$4,8
Option E				
Public/Com Bldg	7,479	$562	$4,203,323	$1,3
TH	33,245	$562	$18,683,817	$7,7
Total	40,724	$562	$22,887,140	$9,0
		Refresher Training Renovators		
Option P				
Public/Com Bldg	3,139	$341	$1,070,396	-
TH	13,608	$341	$4,640,300	-
Total	16,747	$341	$5,710,696	-
Option A				
Public/Com Bldg	3,139	$341	$1,070,396	-
TH	22,514	$341	$7,677,386	-
Total	25,653	$341	$8,747,783	-
Option B				
Public/Com Bldg	3,139	$341	$1,070,396	-
TH	13,608	$341	$4,640,300	-
Total	16,747	$341	$5,710,696	-
Option C				
Public/Com Bldg	3,797	$341	$1,294,834	-
TH	27,235	$341	$9,287,161	-
Total	31,032	$341	$10,581,995	-
Option D				
Public/Com Bldg	3,797	$341	$1,294,834	-
TH	16,461	$341	$5,613,266	-
Total	20,258	$341	$6,908,100	-
Option E				
Public/Com Bldg	6,904	$341	$2,354,229	-
TH	30,688	$341	$10,464,574	-
Total	37,592	$341	$12,818,803	-

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Table 4-99: Total Training Costs for Renovators and Workers: Third Year of Regulation				
	Number of Renovators Seeking Training	**Average Cost of Training**	**Total Renovator Training Cost**	**Total Worker Trainin Per Worker)**
			Year 3	
			Initial Training Renovators	
Option P				
Public/Com Bldg	7,449	$560	$4,171,192	$
TH	32,813	$560	$18,375,407	$
Total	40,262	$560	$22,546,600	$
Option A				
Public/Com Bldg	7,449	$562	$4,186,089	$
TH	54,932	$562	$30,871,575	$1
Total	62,380	$562	$35,057,665	$1
Option B				
Public/Com Bldg	7,449	$562	$4,186,089	$
TH	32,813	$562	$18,441,034	$
Total	40,262	$562	$22,627,123	$
Option C				
Public/Com Bldg	4,097	$562	$2,302,364	
TH	29,384	$562	$16,513,638	$
Total	33,480	$562	$18,816,001	$
Option D				
Public/Com Bldg	4,097	$562	$2,302,364	
TH	17,760	$562	$9,981,031	$
Total	21,857	$562	$12,283,395	$
Option E				
Public/Com Bldg	7,449	$562	$4,186,089	$
TH	33,109	$562	$18,607,214	$
Total	40,557	$562	$22,793,303	$
			Refresher Training Renovators	
Option P				
Public/Com Bldg	6,876	$341	$2,344,577	-
TH	30,289	$341	$10,328,594	-
Total	37,165	$341	$12,673,171	-
Option A				
Public/Com Bldg	6,876	$341	$2,344,577	-
TH	50,706	$341	$17,290,786	-
Total	57,582	$341	$19,635,363	-
Option B				
Public/Com Bldg	6,876	$341	$2,344,577	-
TH	30,289	$341	$10,328,594	-
Total	37,165	$341	$12,673,171	-
Option C				
Public/Com Bldg	3,782	$341	$1,289,525	-
TH	27,123	$341	$9,249,084	-
Total	30,905	$341	$10,538,609	-
Option D				
Public/Com Bldg	3,782	$341	$1,289,525	-
TH	16,394	$341	$5,590,252	-
Total	20,175	$341	$6,879,777	-
Option E				
Public/Com Bldg	6,876	$341	$2,344,577	-
TH	30,562	$341	$10,421,670	-

Total	37,438	$341	$12,766,246	-

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

4.6 Certification Costs: Firm Paperwork Burden and EPA Administrative and Enforcement Costs

Under this rule, states are given the option of administering the regulations as long as the state implementation plan is approved by EPA. EPA will directly administer programs in states that do not have an approved implementation plan. This section of the analysis estimates costs that EPA expects to incur while administrating and enforcing the LRRP rule under the assumption that EPA administers the program everywhere. States that choose to implement the rule themselves are expected to incur similar costs in lieu of EPA.

EPA will perform three tasks as part of administering the LRRP rule: accrediting training providers, certifying firms, and processing training provider notifications. In addition to administrative costs, EPA will also incur costs to enforce the LRRP rule. To reduce the burden on the regulated community, EPA has decided not to require formal certification for renovators and workers.

In the economic analysis of the 2006 proposed LRRP TH rule (EPA 2006) it was estimated that the enforcement activities will require 2 Headquarters and 10 Regional FTEs for enforcement activities under each regulatory Option. An additional 3.7 Regional FTE's were assumed to be required for enforcement activities related to child occupied facilities. Headquarters enforcement costs were calculated by loading the 2005 Washington/Baltimore area annual salary rates for a GS-12, Step 1 employee ($100,618). Regional enforcement costs were estimated using the GS-12, Step 1 employee salary listed in the 2005 General Schedule ($86,754).[31] Based on these salaries and the indicated numbers of FTEs, total annual enforcement costs are estimated at $1,389,766. EPA assumed that enforcement costs associated with training providers is equal to 0.4 percent of the total enforcement costs, or $5,559 per year. Thus, costs of ensuring certified firm compliance account for 99.6 percent of the enforcement burden, or $1,384,207 per year. As discussed in section 4.2.1, incremental costs and benefits are estimated assuming a 75 percent compliance rate with the rule. Given the limited government resources expected to be available for enforcement and compliance assurance, EPA does not anticipate achieving full compliance with the rule. An increase in staff, beyond the assumed level of 2 Headquarters and 13.7 Regional FTEs, would be likely to increase the compliance rate, while a decrease in staff would be likely to decrease the compliance rate.

Accreditation/certification cost estimates are based on the estimates developed for the economic analysis of the 2006 proposed LRRP TH rule (EPA 2006). This analysis utilizes the estimate for administrative-related certification costs, $318 per firm, from that analysis. The enforcement-related costs for target housing are estimated based on the estimate of $1,389,766 per-year. Note that there are also

[31] These salaries are fully loaded, and were calculated using the standard government multiplier of 1.6 to cover overhead and fringe benefits.

administrative and enforcement costs related to accrediting training providers, but these costs are also assumed to be recovered through tuition charges and are therefore accounted for through the tuition costs.

4.6.1 Administrative and Enforcement Costs: Contribution to Total Costs

Similar to the regulations governing abatement, EPA is likely to recover its administrative and enforcement costs from certified firms and accredited training providers through their certification and accreditation fees, respectively. However, these fees will be set by a separate rulemaking and may be apportioned differently than assumed in this analysis. Thus, while the estimation of these fees is outside the scope of this analysis, EPA's administrative and enforcement costs are considered a part of the regulatory impact estimated here. Simply adding these costs to the other cost components, however, will result in some double counting. Specifically, this analysis assumes that training providers will recover their accreditation fees (which in turn cover the administrative and enforcement costs of training provider accreditation) through the tuition they charge. Thus, only costs associated with certified firms are used to calculate the certification cost impact of the rule; EPA's burden of administering and enforcing the rule will be higher. The EPA costs that will be recovered from RRP firms in a given year are thus calculated as follows:[32]

$$\text{EPA Administrative and Enforcement Costs that will be recovered from Firms}_{\text{Year X}} = \$318 * \#\text{ of Firms Certified}_{\text{Year X}} + \text{Enforcement Costs}$$

4.6.2 Firm Paperwork Burden

The paperwork-related cost estimates are based on the methodology employed in the economic analysis of the 2006 proposed LRRP TH rule (EPA 2006). It is estimated that paperwork costs were $263 in initial certification years, $168 in re-certification years and $152 in other years. It is estimated that firms will spend a total of three hours to familiarize themselves with the LRRP rule's requirements and a half an hour to fill out and mail the one-page application for renovator certification. In addition, each year time is spent keeping records that demonstrate compliance with the LRRP training and work-practice requirements. Additional costs are minor; these costs include: one application printout, one photocopy for personal records, an envelope, and a stamp.

Table 4-100: Costs to Firms Associated with Information Collection

	First Year/Initial Certification Year	Re-Certification Year	Non-Certification Years
Rule Familiarization (3 hours)	$94.93	$0	$0
Certification Form (half hour)	$15.82	$15.82	$0
Recordkeeping (4.8 hours per firm)	$151.89	$151.89	$151.89
2 photocopies	$0.16	$0.16	$0
1 envelope	$0.02	$0.02	$0
1 Stamp	$0.37	$0.37	$0
Total[a]	**$263**	**$168**	**$152**

[a] Rounded to nearest dollar.

Source: EPA Calculations and U.S. Bureau of Labor Statistics 2005a.

[32] The administrative costs associated with firm certification are estimated to be $318 per firm seeking certification; the annual costs of ensuring certified firm compliance is estimated to be $1.38 million.

4.6.3 Total Certification Costs: Firm Paperwork and EPA Administrative and Enforcement Costs

Table 4-101 shows the total certification costs for the LRRP rule in the first year. Table 4-102 through Table 4-107 show the total certification costs by initial certification firms, refresher certification firms, and firms not seeking certification for the LRRP rule in the second and third years, respectively. The certification costs decline by 0.41 percent each year after the third year, accounting for the expected decline in regulated universe as older schools and housing units are replaced with newer structures. Total costs per-firm are the sum of EPA's administrative costs per firm and the firm's costs for paperwork and recordkeeping. This cost per firm is multiplied by the number of establishments estimated to provide lead-safe RRP services (see Section 4.4).

In the first year, all the firms listed in the number of establishments' column are presumed to seek initial certification, paying their share of EPA's administrative costs ($318 per firm, see Section 4.6.1) and their share of the enforcement costs. In addition, they have a cost for paperwork and recordkeeping.

Table 4-101: Firm Annual Certification Costs: Firm Paperwork and Fees in the First Year of Regulation (including EPA Adm				
	EPA Administrative Costs	**Paperwork Costs**	**Number of Establishments**	**Annual Enforcer Costs, Total (2005, discounting)**
		Year 1		
		Initial Certification Firms		
Option P				
Public/Com Bldg	$318	$263	23,469	$3
TH	$318	$263	90,680	$1,0
Total			114,149	$1,3
Option A				
Public/Com Bldg	$318	$263	23,469	$3
TH	$318	$263	150,030	$1,0
Total			173,499	$1,3
Option B				
Public/Com Bldg	$318	$263	23,469	$3
TH	$318	$263	90,680	$1,0
Total			114,149	$1,3
Option C				
Public/Com Bldg	$318	$263	23,469	$3
TH	$318	$263	150,030	$1,0
Total			173,499	$1,3
Option D				
Public/Com Bldg	$318	$263	23,469	$3
TH	$318	$263	90,680	$1,0
Total			114,149	$1,3
Option E				
Public/Com Bldg	$318	$263	42,670	$3
TH	$318	$263	169,051	$1,0
Total			211,721	$1,3

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

In subsequent years, EPA administrative costs per-firm and the firm paperwork costs are estimated based on the costs presented in Table 4-102 and Table 4-107 and the relative number of firms seeking initial-certification, re-certification, and not seeking certification. Section 4.4 describes and presents these estimates. The number of establishments is shown for firms seeking initial certification, recertification, and not seeking certification.

Table 4-102: Firm Annual Certification Costs: Initial Certification Firm Paperwork and Fees in the Second Year of Regulatio Enforcement Costs)

	EPA Administrative Costs	Paperwork Costs	Number of Establishments	Annual Enforce Costs, Total (2 before discoun
			Year 2	
			Initial Certification Firms	
Option P				
Public/Com Bldg	$318	$263	23,329	$
TH	$318	$263	92,801	$
Total			116,131	$
Option A				
Public/Com Bldg	$318	$263	23,329	$
TH	$318	$263	156,806	$
Total			180,135	$
Option B				
Public/Com Bldg	$318	$263	23,329	$
TH	$318	$263	92,801	$
Total			116,131	$
Option C				
Public/Com Bldg	$318	$263	4,207	
TH	$318	$263	26,895	$
Total			31,102	$
Option D				
Public/Com Bldg	$318	$263	4,207	
TH	$318	$263	16,255	$
Total			20,463	$
Option E				
Public/Com Bldg	$318	$263	7,649	
TH	$318	$263	30,304	$
Total			37,954	$

[a] Enforcement costs are estimates; based on the corresponding number of establishments within each firm type compared to the total a types.

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Table 4-103: Firm Annual Certification Costs: Refresher Certification Firm Paperwork and Fees in the Second Year of Regul... and Enforcement Costs)				
	EPA Administrative Costs	Paperwork Costs	Number of Establishments	Annual Enfor... Costs, Total ... before discou...
			Year 2	
			Refresher Certification Firms	
Option P				
Public/Com Bldg	$318	$174	2,939	
TH	$318	$174	11,355	
Total			14,293	
Option A				
Public/Com Bldg	$318	$174	2,939	
TH	$318	$174	18,786	
Total			21,725	
Option B				
Public/Com Bldg	$318	$174	2,939	
TH	$318	$174	11,355	
Total			14,293	
Option C				
Public/Com Bldg	$318	$174	3,584	
TH	$318	$174	22,910	
Total			26,494	
Option D				
Public/Com Bldg	$318	$174	3,584	
TH	$318	$174	13,847	
Total			17,431	
Option E				
Public/Com Bldg	$318	$174	6,516	
TH	$318	$174	25,815	
Total			32,331	

[a] Enforcement costs are estimates; based on the corresponding number of establishments within each firm type compared to the total a... types.

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Table 4-104: Firm Annual Certification Costs: Non-Certification Firm Paperwork and Fees in the Second Year of Regulation Enforcement Costs)				
	EPA Administrative Costs	Paperwork Costs	Number of Establishments	Annual Enfor Costs, Total (before discou
Year 2				
Non-Certification Year Firms				
Option P				
Public/Com Bldg	$3180	$152	16,227	
TH	$3180	$152	62,698	
Total	-		78,925	
Option A	-			
Public/Com Bldg	$3180	$152	16,227	
TH	$3180	$152	103,734	
Total	-		119,961	
Option B	-			
Public/Com Bldg	$3180	$152	16,227	
TH	$3180	$152	62,698	
Total	-		78,925	
Option C	-			
Public/Com Bldg	$3180	$152	15,582	
TH	$3180	$152	99,610	
Total	-		115,192	
Option D	-			
Public/Com Bldg	$3180	$152	15,582	
TH	$3180	$152	60,205	
Total	-		75,787	
Option E	-			
Public/Com Bldg	$3180	$152	28,330	
TH	$3180	$152	112,239	
Total	-		140,569	

[a] Enforcement costs are estimates; based on the corresponding number of establishments within each firm type compared to the total a types.

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Table 4-105: Firm Annual Certification Costs: Initial Certification Firm Paperwork and Fees in the Third Year of Regulation Enforcement Costs)				
	EPA Administrative Costs	Paperwork Costs	Number of Establishments[a]	Annual Enfor Costs, Total (before discou
		Year 3		
		Initial Certification Firms		
Option P				
Public/Com Bldg	$318	$263	7,618	
TH	$318	$263	29,911	
Total			37,528	
Option A				
Public/Com Bldg	$318	$263	7,618	
TH	$318	$263	50,073	
Total			57,690	
Option B				
Public/Com Bldg	$318	$263	7,618	
TH	$318	$263	29,911	
Total			37,528	
Option C				
Public/Com Bldg	$318	$263	4,190	
TH	$318	$263	26,784	
Total			30,974	
Option D				
Public/Com Bldg	$318	$263	4,190	
TH	$318	$263	16,189	
Total			20,379	
Option E				
Public/Com Bldg	$318	$263	7,618	
TH	$318	$263	30,180	
Total			37,798	

[a] Assumed to decline by 0.41 percent each year, accounting for the decline in the stock of pre-78 structures.

[b] Enforcement costs are estimates; based on the corresponding number of establishments within each firm type compared to the total a types.

See

Table 4-1: Options Included in Economic Analysis

for options descriptions..

Source: EPA Calculations.

Table 4-106: Firm Annual Certification Costs: Refresher Certification Firm Paperwork and Fees in the Third Year of Regula and Enforcement Costs)

	EPA Administrative Costs	Paperwork Costs	Number of Establishments[a]	Annual Enfor Costs, Total (before discou
			Year 3	
			Refresher Certification Firms	
Option P				
Public/Com Bldg	$318	$174	6,489	
TH	$318	$174	25,479	
Total			31,969	
Option A				
Public/Com Bldg	$318	$174	6,489	
TH	$318	$174	42,654	
Total			49,144	
Option B				
Public/Com Bldg	$318	$174	6,489	
TH	$318	$174	25,479	
Total			31,969	
Option C				
Public/Com Bldg	$318	$174	3,569	
TH	$318	$174	22,816	
Total			26,385	
Option D				
Public/Com Bldg	$318	$174	3,569	
TH	$318	$174	13,790	
Total			17,360	
Option E				
Public/Com Bldg	$318	$174	6,489	
TH	$318	$174	25,709	
Total			32,198	

[a] Assumed to decline by 0.41 percent each year, accounting for the decline in the stock of pre-78 structures.

[b] Enforcement costs are estimates; based on the corresponding number of establishments within each firm type compared to the total a types.

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Table 4-107: Firm Annual Certification Costs: Non-Certification Firm Paperwork and Fees in the Third Year of Regulation (i Enforcement Costs)				
	EPA Administrative Costs	**Paperwork Costs**	**Number of Establishments[a]**	**Annual Enforce Costs, Total (2 before discount**
			Year 3	
			Non-Certification Year Firms	
Option P				
Public/Com Bldg	$~~318~~0	$152	28,214	$
TH	$~~318~~0	$152	110,780	$
Total			138,994	$
Option A				
Public/Com Bldg	$~~318~~0	$152	28,214	$
TH	$~~318~~0	$152	185,454	$
Total			213,668	$
Option B				
Public/Com Bldg	$~~318~~0	$152	28,214	$
TH	$~~318~~0	$152	110,780	$
Total			138,994	$
Option C				
Public/Com Bldg	$~~318~~0	$152	15,518	$
TH	$~~318~~0	$152	99,202	$
Total			114,719	$
Option D				
Public/Com Bldg	$~~318~~0	$152	15,518	$
TH	$~~318~~0	$152	59,959	$
Total			75,477	$
Option E				
Public/Com Bldg	$~~318~~0	$152	28,214	$
TH	$~~318~~0	$152	111,778	$
Total			139,992	$

[a] Assumed to decline by 0.41 percent each year, accounting for the decline in the stock of pre-78 structures.

[b] Enforcement costs are estimates; based on the corresponding number of establishments within each firm type compared to the total a types.

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

4.7 Pre-Renovation Education Costs

4.7.1 Provision of information to landlords and/or COFs

The rule extends the pre-renovation information dissemination requirements to renovation projects performed by contractors or landlords in commercial or public building COFs. This analysis assumes that all public or commercial building COF contractors will work both in COFs that rent space, and in those that own space. Landlords will only perform work in the buildings that they own.

Estimated Burden Per Event

Landlords and contractors working in COFs that own their own space will need to prepare one set of acknowledgement and certification forms, distribute the pamphlet to the COF owner only, and obtain proof that the pamphlet was provided to the COF owner. Contractors working in COFs that are renting space will need to prepare two sets of acknowledgement and certification forms (one for the building owner, and the other for the COF owner), distribute the pamphlet to two individuals, and obtain proof that both individuals have received the pamphlet.

This analysis estimates the per-event burden of preparing acknowledgement and certification forms, photocopying pamphlets, distributing pamphlets, and obtaining proof of pamphlet receipt based on the Information Collection Request (ICR) for the Lead-Based Paint Pre-Renovation Information Dissemination Rule (TSCA Sec. 406(b); EPA ICR No. 1669.04). The ICR estimated that contractors or landlords will need two minutes to prepare each set of acknowledgement and certification forms and an additional two minutes to deliver the pamphlet to each individual involved and obtain proof of pamphlet receipt. Furthermore, it is estimated that contractors will need a total of three minutes to file all of the signed acknowledgement forms or mailing certificates. Table 4-108 presents total per-event burden estimates.

Table 4-108: Per-Event Pre-Renovation Education Burden Estimates by Task (In Hours)

Activity	Burden Hours	
	Landlord Event or Contractor Event in COF that Owns Space	Contractor Event in COF that Rents Space
Preparing Written Acknowledgement	0.033	0.066
Photocopy Pamphlet	0.033	0.066
Distribution of Pamphlet	0.033	0.066
Filing and Retaining Acknowledgement	0.050	0.050
Total	0.15	0.25

Sources: EPA ICR No. 1669.04 (2003) Lead-Based Paint Pre-Renovation Information Dissemination - TSCA Sec. 406(b).

Total Cost of Extending the Pre-Renovation Information Dissemination Requirements

Table 4-109 presents the total cost of extending the pre-renovation education requirements to renovation projects performed by contractors or landlords in commercial or public building COFs. The labor cost per event is estimated using the burden estimates presented in Table 4-108 and a wage rate of $31.64. The materials cost is estimated to be $0.56 per pamphlet. This requirement does not apply to events where a test kit indicates that LBP is not present, therefore it is assumed that costs for information dissemination are incurred only for events where LSWP are used.

Table 4-109: Cost of Pre-Renovation Education Requirements – Provision of Information to Landlords and/or COFs (2005$)					
	Number of LSWP Events	**Event Labor Cost[a]**	**Event Materials Cost[b]**	**Total Event Cost**	**Total Cost**
Year 1					
Options P, A, B, C, and D					
Contractor Event in COF that Rents Space	4,713	$7.91	$1.12	$9.03	$42,561
Landlord Event or Contractor Event in COF that Owns Space	94,424	$4.75	$0.56	$5.31	$501,014
Total	*99,137*				*$543,575*
Option E					
Contractor Event in COF that Rents Space	8,570	$7.91	$1.12	$9.03	$77,383
Landlord Event or Contractor Event in COF that Owns Space	171,680	$4.75	$0.56	$5.31	$910,935
Total	*180,250*				*$988,318*
Year 2					
Options P, A, B, and E					
Contractor Event in COF that Rents Space	2,000	$7.91	$1.12	$9.03	$18,059
Landlord Event or Contractor Event in COF that Owns Space	42,819	$4.75	$0.56	$5.31	$227,200
Total	*44,819*				*$245,258*
Options C and D					
Contractor Event in COF that Rents Space	1,100	$7.91	$1.12	$9.03	$9,932
Landlord Event or Contractor Event in COF that Owns Space	23,551	$4.75	$0.56	$5.31	$124,960
Total	*24,651*				*$134,892*
50-Year Annualized Costs[c]					
				Total Cost (3 percent)	**Total Cost (7 percent)**
Options P, A and B				$246,959	$272,094
Options C and D				$145,334	$167,376
Option E				$264,244	$304,320

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

a. Calculated using Burden Estimates presented in Table 4-1 and a wage rate of $31.64.

b. The estimated cost of a pamphlet is $0.56, 8 pages at $0.07 each.

c. After the second year, the number of events, and thus the costs, decline by 0.041% each year to account for the decline in the stock of regulated structures.

Source: EPA Calculations

4.7.2 Provision of information to parents or guardians

The rule would require that the renovation firm either distribute the pamphlet and general information on the renovation project to the parents or guardians of children using the facility, or post informational signs describing the general nature and locations of the project and the anticipated completion date. These signs must be posted in areas where they can be seen by the parents or guardians of the children frequenting the child-occupied facility. The signs must be accompanied by a posted copy of the lead hazard information pamphlet or information on how interested parents and guardians can review a copy of the pamphlet or obtain a copy from the renovation firm at no cost to the parent or guardian.

To comply with this requirement it is assumed that a copy of the pamphlet will be posted together with the information specific to the planned renovation. This requirement does not apply to events where a test kit indicates that LBP is not present, therefore it is assumed that these costs are only incurred for events where LSWP are used. The labor burden associated with this activity is assumed to be three minutes and the estimated wage rate is $31.64. Thus, the total labor cost per-activity is estimated to be $1.58. The materials cost per-activity is estimated as the cost of a copy of the pamphlet, $0.56, plus one additional $0.07 copy of the job-specific renovation information.

Table 4-110: Cost of Pre-Renovation Education Requirements – Provision of Information to Parents or Guardians (2005$)					
	Number of LSWP Events	Event Labor Cost[a]	Event Materials Cost[b]	Total Event Cost	Total Cost
Year 1					
Options P, A, B, C, and D	103,007	$1.58	$0.63	$2.21	$227,645
Option E	180,330	$1.58	$0.63	$2.21	$398,529
Year 2					
Options P, A, B, and E	92,621	$1.58	$0.63	$2.21	$204,692
Options C and D	70,868	$1.58	$0.63	$2.21	$156,619
50-Year Annualized Costs [c]					
				Total Cost (3 percent)	**Total Cost (7 percent)**
Options P, A and B				$197,327	$210,711
Options C and D				$153,061	$165,099
Option E				$203,968	$223,093

See **Table 4-1: Options Included in Economic Analysis** for options descriptions.

a. Calculated assuming a three-minute time burden per event and a wage rate of $31.64.

b. The estimated cost of a pamphlet is $0.56, 8 pages at $0.07 each. An additional $0.07 is assumed for the renovation-specific information to be posted.

c. After the second year, the number of events, and thus the costs, decline by 0.041% each year to account for the decline in the stock of regulated structures.

Source: EPA Calculations

4.8 Total Costs

This section presents the total costs of the regulation. Total costs are estimated for the first, second, and third years of regulation. Also calculated are total 50-year costs and 50-year annualized costs. Estimates are calculated using discount rates of both 3 and 7 percent.

4.8.1 Total Costs in the First Year of Regulation

Table 4-111 presents the total first year costs of the LRRP rule. Total containment, cleaning, and verification costs are calculated by adding the cost of testing using the LBP test kits to the costs of containment, cleaning, and verification. The total costs of containment, cleaning, and verification are calculated by multiplying the number of events requiring work practices (Section 4.2) by the corresponding incremental costs (Section 4.3). The total cost of conducting LBP tests using test kits is estimated as the number of events (Section 4.2) multiplied by the cost of conducting the test, $10 (see Section 4.3.1). Total training costs are calculated by multiplying the number of trained individuals (Section 4.4) by the corresponding incremental training costs (Section 4.5). Total certification costs are calculated by multiplying the number of firms (Section 4.4) by the corresponding incremental costs (Section 4.6). The pre-renovation education costs estimates are described in Section 4.7.

The total costs in the first year of regulation are highest under Option E ($758.2 million). Both Options B and D regulate the same universe of facilities in the first year, all pre-1960 target housing and child occupied facilities, and have the same first year costs ($426.8 million). Options A and C have first year costs of $696.3 million. Option P has the lowest first year costs of $358.2 million.

Table 4-111: Total First Year Costs of the Rule (millions 2005$)				
	Option P	**Option A**	**Option B**	**Option C**
		First Year		
		Public or Commercial Building COFs		
Total Work Practice Costs	$16.0	$16.1	$16.1	$16.1
Total Training Costs	$14.1	$14.1	$14.1	$14.1
Total Certification Costs	$14.0	$14.0	$14.0	$14.0
Pre-Renovation Ed. Costs	$0.5	$0.5	$0.5	$0.5
Total Costs	**$44.6**	**$44.7**	**$44.7**	**$44.7**
		Target Housing		
Total Work Practice Costs	$197.7	$460.2	$265.8	$460.2
Total Training Costs	$62.0	$103.0	$62.2	$103.0
Total Certification Costs	$53.7	$88.2	$53.7	$88.2
Pre-Renovation Ed. Costs	$0.2	$0.2	$0.2	$0.2
Total Costs	**$313.7**	**$651.6**	**$382.1**	**$651.6**
		Total: All Activities		
Total Work Practice Costs	$213.7	$476.3	$281.9	$476.3
Total Training Costs	$76.1	$117.1	$76.4	$117.1
Total Certification Costs	$67.7	$102.2	$67.7	$102.2
Pre-Renovation Ed. Costs	$0.8	$0.8	$0.8	$0.8
Total Costs	**$358.2**	**$696.3**	**$426.8**	**$696.3**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

4.8.2 Total Costs in the Second and Third Years of Regulation

Table 4-112 through Table 4-115 show that the total costs differ across the options. Despite the second year expansion of the number of regulated events under the Option P and Options A and B, the total work practice costs are only slightly higher than in the first year. This modest increase results from the improved effectiveness of the test kit, from a false positive rate of 63 percent to a 10 percent rate, which offsets a portion of the cost increase associated with the larger universe of regulated events.

In the second year, the training and certification costs are highest under Option A, and are relatively higher under the Option P and Option B. This reflects the delayed start-up costs associated with training and certifying the additional individuals and firms needed to meet the demand increase that corresponds with the expansion in the regulated universe (to include all pre-1978 child occupied facilities). From the third year forward, the training and certification costs are the same under the Option P and Options B and E, and are highest under Option A.

Table 4-112: Total Second Year Costs of the Rule, 3 Percent Discount Rate (millions 2005$)				
	Option P	**Option A**	**Option B**	**Option C**
	3 Percent Discount Rate			
	Second Year			
	Public or Commercial Building COFs			
Total Work Practice Costs	$10.1	$10.2	$10.2	$6.8
Total Training Costs	$15.1	$15.2	$15.2	$4.2
Total Certification Costs	$17.3	$17.3	$17.3	$6.7
Pre-Renovation Ed. Costs	$0.2	$0.2	$0.2	$0.1
Total Costs	**$42.7**	**$42.9**	**$42.9**	**$17.8**
	Target Housing			
Total Work Practice Costs	$232.0	$517.8	$298.6	$359.4
Total Training Costs	$69.1	$116.8	$69.3	$31.8
Total Certification Costs	$68.1	$113.8	$68.1	$41.8
Pre-Renovation Ed. Costs	$0.2	$0.2	$0.2	$0.2
Total Costs	**$369.3**	**$748.5**	**$436.2**	**$433.2**
	Total: All Activities			
Total Work Practice Costs	$242.1	$528.0	$308.8	$366.2
Total Training Costs	$84.2	$132.0	$84.4	$36.0
Total Certification Costs	$85.3	$131.0	$85.3	$48.5
Pre-Renovation Ed. Costs	$0.4	$0.4	$0.4	$0.3
Total Costs	**$412.0**	**$791.4**	**$479.0**	**$451.0**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Table 4-113: Total Second Year Costs of the Rule, 7 Percent Discount Rate (millions 2005$)				
	Option P	**Option A**	**Option B**	**Option C**
7 Percent Discount Rate				
Second Year				
Public or Commercial Building COFs				
Total Work Practice Costs	$9.7	$9.8	$9.8	$6.5
Total Training Costs	$14.6	$14.6	$14.6	$4.1
Total Certification Costs	$16.6	$16.6	$16.6	$6.4
Pre-Renovation Ed. Costs	$0.2	$0.2	$0.2	$0.1
Total Costs	**$41.1**	**$41.2**	**$41.2**	**$17.1**
Target Housing				
Total Work Practice Costs	$223.3	$498.5	$287.5	$346.0
Total Training Costs	$66.5	$112.4	$66.7	$30.6
Total Certification Costs	$65.5	$109.5	$65.5	$40.3
Pre-Renovation Ed. Costs	$0.2	$0.2	$0.2	$0.1
Total Costs	**$355.5**	**$720.6**	**$419.9**	**$417.0**
Total: All Activities				
Total Work Practice Costs	$233.0	$508.2	$297.3	$352.5
Total Training Costs	$81.1	$127.0	$81.3	$34.7
Total Certification Costs	$82.1	$126.1	$82.1	$46.7
Pre-Renovation Ed. Costs	$0.4	$0.4	$0.4	$0.3
Total Costs	**$396.6**	**$761.8**	**$461.1**	**$434.2**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Table 4-114: Total Third Year Costs of the Rule, 3 Percent Discount Rate (millions 2005$)				
	Option P	**Option A**	**Option B**	**Option C**
3 Percent Discount Rate				
Third Year				
Public or Commercial Building COFs				
Total Work Practice Costs	$9.8	$9.8	$9.8	$6.5
Total Training Costs	$7.4	$7.4	$7.4	$4.1
Total Certification Costs	$11.5	$11.5	$11.5	$6.5
Pre-Renovation Ed. Costs	$0.2	$0.2	$0.2	$0.1
Total Costs	**$28.9**	**$29.0**	**$29.0**	**$17.2**
Target Housing				
Total Work Practice Costs	$224.3	$500.7	$288.8	$347.5
Total Training Costs	$34.3	$57.5	$34.3	$30.7
Total Certification Costs	$45.1	$74.8	$45.1	$40.5
Pre-Renovation Ed. Costs	$0.2	$0.2	$0.2	$0.1
Total Costs	**$303.8**	**$633.1**	**$368.3**	**$418.9**
Total: All Activities				
Total Work Practice Costs	$234.1	$510.5	$298.6	$354.1
Total Training Costs	$41.7	$64.9	$41.7	$34.8
Total Certification Costs	$56.6	$86.3	$56.6	$46.9
Pre-Renovation Ed. Costs	$0.4	$0.4	$0.4	$0.3
Total Costs	**$332.7**	**$662.1**	**$397.3**	**$436.1**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Table 4-115: Total Third Year Costs of the Rule, 7 Percent Discount Rate (millions 2005$)				
	Option P	**Option A**	**Option B**	**Option C**
7 Percent Discount Rate				
Third Year				
Public or Commercial Building COFs				
Total Work Practice Costs	$9.0	$9.1	$9.1	$6.1
Total Training Costs	$6.9	$6.9	$6.9	$3.8
Total Certification Costs	$10.7	$10.7	$10.7	$6.0
Pre-Renovation Ed. Costs	$0.2	$0.2	$0.2	$0.1
Total Costs	**$26.8**	**$26.9**	**$26.9**	**$16.0**
Target Housing				
Total Work Practice Costs	$207.9	$463.9	$267.6	$322.0
Total Training Costs	$31.7	$53.2	$31.8	$28.5
Total Certification Costs	$41.8	$69.3	$41.8	$37.5
Pre-Renovation Ed. Costs	$0.2	$0.2	$0.2	$0.1
Total Costs	**$281.5**	**$586.6**	**$341.3**	**$388.2**
Total: All Activities				
Total Work Practice Costs	$216.9	$473.0	$276.7	$328.1
Total Training Costs	$38.6	$60.1	$38.7	$32.3
Total Certification Costs	$52.4	$80.0	$52.4	$43.5
Pre-Renovation Ed. Costs	$0.4	$0.4	$0.4	$0.3
Total Costs	**$308.3**	**$613.5**	**$368.2**	**$404.1**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

4.8.3 Total 50-Year and 50-Year Annualized Costs

The total costs are also calculated discounted over a 50-year period. Discounting refers to the economic conversion of future costs (and benefits) to their present values, accounting for the fact that society tends to value future costs or benefits less than comparable near-term costs or benefits. Discounting is important when the values of costs or benefits occur over a multiple year period and may vary from year to year. Discounting enables the accumulation of the cost and benefit values from multiple years at a single point in time, accounting for the difference in how society values those costs and benefits depending on the year in which the values are estimated to occur.

The 50-year costs were estimated by developing a profile of the compliance costs associated with each option over a 50-year period. (The 50-year period was chosen to be consistent with the economic analysis done for the TSCA Section 403 Lead-Based Paint Hazard Standards.) The profile of costs over time was developed by estimating an annual decline in pre-1978 housing stock of 0.41 percent per-year, and assuming that the regulated universe would decrease by that rate every year. That rate was calculated using the average annual compound rate of change in the pre-1980 housing stock using data from the 1990 and 2000 Decennial Census (U.S. Census Bureau 1990 and 2000c). This rate affects costs because it decreases the number of events and number of workers trained every year.

As discussed above, the first year training and certification costs account for the training and certification of all certified renovators and the certification of all certified firms to meet the demand for lead-safe RRP services in the first year. Similarly for the phase-in options (Option P and Options A and B) in the second year, it is assumed that the additional individuals and firms needed to meet the demand increase associated with the larger regulated universe will obtain training and certification. In subsequent years, it is assumed that one third of the necessary stock of individuals and firms will obtain training and certification each year (since refresher-training and re-certification is required every three years).

In fact, if all the individuals and firms needed to meet the demand for lead-safe RRP are trained and certified in the first and second years, one might expect a drop in the level of training and certification in the third year, followed by a spike in the next year. That is, one might expect a cyclical pattern of training and certification to emerge. This analysis assumes a typical amount of training and certification occurs each year because modeling such a trend would add little to the analysis without being able to precisely estimate the extent of any cyclicality.

The total 50-year costs and the 50-year annualized costs are discounted using rates of 3 and 7 percent. These discount rate values reflect guidance from the Office of Management and Budget regulatory analysis guidance document, Circular A-4 (OMB, 2003).

The following formula was used to calculate the present value (PV) of the time stream of costs:

$$PV = \frac{Cost_{x,t}}{(1+r)^{(t-1)}}$$

where:

$Cost_t$	=	Costs in year t;
r	=	Discount rate (3 percent and 7 percent); and
t	=	Year in which cost is incurred.

This analysis also presents the 50-year annualized costs of the rule. Conceptually, the 50-year annualized cost is the level annual payment that one would have to make to pay off a debt equal to the present value total 50-year cost for a given interest rate (the discount rate).

The following formula is used to calculate the 50-year annualized cost.

$$AC = PV_r \times \frac{r \times (1+r)^{50}}{(1+r)^{(50)} - 1}$$

where:

AC	=	Annualized 50-Year Costs;
PV_r	=	Present Value Total 50-Year Costs assuming a discount rate of r; and
r	=	Discount rate (3 percent and 7 percent)

Table 4-116 and Table 4-117 show the present value of the total 50-year costs and Table 4-118 and Table 4-119 show the annualized 50-year costs for the options considered. Because the test kits available for the first year have a high false positive rate, including the newer units in the regulated universe is relatively costly. This is because the high rate of false positives will require many units without LBP to use the more costly work practices.

Table 4-116: Total Present Value 50 Year Costs of the Renovation, Repair, and Painting Rule, 3 Percent Discount Rate (millio				
	Option P	Option A	Option B	Option C
3 Percent Discount Rate				
Total 50 Year Costs				
Public or Commercial Building COFs				
Total Work Practice Costs	$262.1	$264.0	$264.0	$181.3
Total Training Costs	$208.4	$208.9	$208.9	$117.1
Total Certification Costs	$310.8	$310.8	$310.8	$177.9
Pre-Renovation Ed. Costs	$6.4	$6.4	$6.4	$3.7
Total Costs	**$787.7**	**$790.0**	**$790.0**	**$480.0**
Target Housing				
Total Work Practice Costs	$5,858.8	$13,096.1	$7,553.4	$9,231.5
Total Training Costs	$960.2	$1,610.3	$962.2	$878.6
Total Certification Costs	$1,214.6	$2,013.7	$1,214.6	$1,111.3
Pre-Renovation Ed. Costs	$5.1	$5.1	$5.1	$3.9
Total Costs	**$8,038.6**	**$16,725.2**	**$9,735.2**	**$11,225.3**
Total: All Activities				
Total Work Practice Costs	$6,120.9	$13,360.1	$7,817.4	$9,412.7
Total Training Costs	$1,168.7	$1,819.2	$1,171.0	$995.7
Total Certification Costs	$1,525.3	$2,324.5	$1,525.3	$1,289.3
Pre-Renovation Ed. Costs	$11.4	$11.4	$11.4	$7.7
Total Costs	**$8,826.3**	**$17,515.2**	**$10,525.2**	**$11,705.4**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Table 4-117: Total Present Value 50 Year Costs of the Renovation, Repair, and Painting Rule, 7 Percent Discount Rate (millio				
	Option P	**Option A**	**Option B**	**Option C**
7 Percent Discount Rate				
Total 50 Year Costs				
Public or Commercial Building COFs				
Total Work Practice Costs	$152.0	$153.1	$153.1	$107.4
Total Training Costs	$124.6	$124.8	$124.8	$71.1
Total Certification Costs	$180.1	$180.1	$180.1	$104.5
Pre-Renovation Ed. Costs	$3.8	$3.8	$3.8	$2.3
Total Costs	$460.4	$461.8	$461.8	$285.2
Target Housing				
Total Work Practice Costs	$3,326.6	$7,444.0	$4,293.7	$5,308.1
Total Training Costs	$572.3	$959.6	$573.5	$531.6
Total Certification Costs	$703.8	$1,167.0	$703.8	$653.4
Pre-Renovation Ed. Costs	$2.9	$2.9	$2.9	$2.3
Total Costs	$4,605.5	$9,573.6	$5,573.8	$6,495.3
Total: All Activities				
Total Work Practice Costs	$3,478.6	$7,597.1	$4,446.8	$5,415.4
Total Training Costs	$696.8	$1,084.4	$698.3	$602.7
Total Certification Costs	$883.9	$1,347.1	$883.9	$757.8
Pre-Renovation Ed. Costs	$6.7	$6.7	$6.7	$4.6
Total Costs	$5,065.9	$10,035.4	$6,035.6	$6,780.6

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Table 4-118: Annualized 50 Year Costs of the Renovation, Repair, and Painting Rule, 3 Percent Discount Rate (millions 2005$				
	Option P	Option A	Option B	Option C
3 Percent Discount Rate				
Annualized 50 Year Costs				
Public or Commercial Building COFs				
Total Work Practice Costs	$10.2	$10.3	$10.3	$7.0
Total Training Costs	$8.1	$8.1	$8.1	$4.6
Total Certification Costs	$12.1	$12.1	$12.1	$6.9
Pre-Renovation Ed. Costs	$0.2	$0.2	$0.2	$0.1
Total Costs	**$30.6**	**$30.7**	**$30.7**	**$18.7**
Target Housing				
Total Work Practice Costs	$227.7	$509.0	$293.6	$358.8
Total Training Costs	$37.3	$62.6	$37.4	$34.1
Total Certification Costs	$47.2	$78.3	$47.2	$43.2
Pre-Renovation Ed. Costs	$0.2	$0.2	$0.2	$0.2
Total Costs	**$312.4**	**$650.0**	**$378.4**	**$436.3**
Total: All Activities				
Total Work Practice Costs	$237.9	$519.2	$303.8	$365.8
Total Training Costs	$45.4	$70.7	$45.5	$38.7
Total Certification Costs	$59.3	$90.3	$59.3	$50.1
Pre-Renovation Ed. Costs	$0.4	$0.4	$0.4	$0.3
Total Costs	**$343.0**	**$680.7**	**$409.0**	**$454.9**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

Table 4-119: Annualized 50 Year Costs of the Renovation, Repair, and Painting Rule, 7 Percent Discount Rate (millions 2005$				
	Option P	**Option A**	**Option B**	**Option C**
7 Percent Discount Rate				
Annualized 50 Year Costs				
Public or Commercial Building COFs				
Total Work Practice Costs	$11.0	$11.1	$11.1	$7.8
Total Training Costs	$9.0	$9.0	$9.0	$5.1
Total Certification Costs	$13.0	$13.0	$13.0	$7.6
Pre-Renovation Ed. Costs	$0.3	$0.3	$0.3	$0.2
Total Costs	**$33.4**	**$33.5**	**$33.5**	**$20.7**
Target Housing				
Total Work Practice Costs	$241.0	$539.4	$311.1	$384.6
Total Training Costs	$41.5	$69.5	$41.6	$38.5
Total Certification Costs	$51.0	$84.6	$51.0	$47.3
Pre-Renovation Ed. Costs	$0.2	$0.2	$0.2	$0.2
Total Costs	**$333.7**	**$693.7**	**$403.9**	**$470.7**
Total: All Activities				
Total Work Practice Costs	$252.1	$550.5	$322.2	$392.4
Total Training Costs	$50.5	$78.6	$50.6	$43.7
Total Certification Costs	$64.0	$97.6	$64.0	$54.9
Pre-Renovation Ed. Costs	$0.5	$0.5	$0.5	$0.3
Total Costs	**$367.1**	**$727.2**	**$437.3**	**$491.3**

See

Table 4-1: Options Included in Economic Analysis

for options descriptions.

Source: EPA Calculations.

4.9 Alternative Regulatory Options

Options A through E differ only in the scope of their regulated universes. Option P has the same scope as Option B, but it does not include a ban on any paint removal techniques or explicitly require vertical containment for exterior events. This section presents cost estimates for various regulatory alternatives, including: (1) requiring interior containment without any cleaning or verification requirements, (2) requiring interior cleaning without any containment or verification requirements, (3) requiring interior cleaning and verification without any interior containment requirements, (4) no ban on prohibited practices and no exterior vertical containment requirements, and (5) requiring 8-hour training for workers instead of informal on the job training.

4.9.1 Alternative Interior Containment, Cleaning, and Verification Requirements

Section 4.3 presents the work practice unit costs for the following three components: (1) containment, (2) cleaning, and (3) verification. Under the alternative regulatory options presented in Table 4-120, not all of these work practice components are required, and therefore compliance costs are lower. Note that costs associated with prohibited practice alternatives and vertical containment are included under these alternative regulatory options. Not requiring any interior cleaning or verification, but requiring rule-style containment, lowers the total annualized costs by about 14 percent. Requiring rule-style interior cleaning and verification, but not requiring interior containment lowers the annualized total costs of the rule by 12 percent. Not requiring any interior containment or verification, but requiring rule-style cleaning, results in the largest decline in total annualized costs, about 17 percent.

Table 4-120: Alternative Interior Containment, Cleaning, and Verification requirements

	3 Percent Discount Rate		**7 Percent Discount Rate**	
Option	Annualized Costs	Percent Change from Primary Option	Annualized Costs	Percent Change from Primary Option
Primary Option: E	$423		$460	
No Interior Cleaning or Verification Required	$364	-14%	$396	-14%
No Interior Containment Required	$372	-12%	$405	-12%
No Interior Containment or Verification Required	$349	-17%	$380	-17%

4.9.2 Regulatory Alternative without a Prohibited Practice Ban

This alternative regulatory option has the same work practice requirements and scope as Option E, but not paint removal techniques are prohibited. Without the additional costs of prohibited practice alternatives total annualized costs would be 1 percent lower.

Table 4-121: Alternative Interior Containment, Cleaning, and Verification requirements

	3 Percent Discount Rate		**7 Percent Discount Rate**	
Option	Annualized Costs	Percent Change from Primary Option	Annualized Costs	Percent Change from Primary Option
Primary Option: E	$423		$460	
Option E without Prohibited Practice Ban	$419	-1%	$456	-1%

4.10 Option F: The Final Rule Regulatory Option

This section summarizes the analysis of Option F, which is the option selected for the final rule. The costs for Option F are estimated using the same general methodology used for the other options discussed earlier in the chapter. This section explains how the calculations for Option F compare to those for the other options, and presents the summary results for the number of events, and the costs of the work practice, training, certification, and pre-renovation education requirements of the final rule.

The scope of Option F is the same as Option E (all rental target housing and COFs, and owner-occupied target housing where a child under the age of six or a pregnant woman resides). The differences between

Options E and F include the length of time for which firm certification and renovator training are valid, the definition of the minor maintenance exception, and the cleaning verification protocol.

Under Option F, firm certification and renovator training are valid for five years (instead of three years under the other options). Because certification and training do not take place as frequently, costs for these activities are estimated to decrease, as described below.

Option F also includes a different definition of the minor maintenance exception (6 ft^2 or less per room, or 20 ft^2 or less for exteriors, excluding renovations involving prohibited practices, demolition, or window replacement), compared to 2 ft^2 per component for interiors and exteriors under Option B and 2 ft^2 per room for interiors and 20 ft^2 for exteriors under Options A through E. The impact of the minor maintenance exception (at both the 2 ft^2 and 6 ft^2 levels) was not quantified due to limitations with the data on the incidence of renovation, repair, and painting events.[33] While the analysis is not able to quantify the impact of the minor maintenance exception, a larger size threshold (e.g., 6 ft^2) will exclude more renovations from the rule than a smaller threshold (e.g., 2 ft^2). A reduction in the number of events would reduce the estimated total work practice, training, certification, and pre-renovation education costs of the rule.

Option F uses a simpler cleaning verification protocol than Options P and A through E. Under these other options, renovators had to perform cleaning verification as many as three times, cleaning and/or wiping surfaces if they failed to pass the cleaning verification. Under the final rule, cleaning verification is performed twice if necessary, followed by a single dry wipe. The simplified protocol will reduce total costs, but these cost savings are not quantified in the analysis. For the sake of simplicity, the analysis uses the same cleaning verification costs for all of the options.

Option F Number of Events

Table 4-1: Options Included in Economic Analysis

presents the first and second year number of events under Option F. This is the same number of events predicted for Option E. As described above, the actual number of events under Option F will be lower than they would be under Option E (due to the difference in the definition of the minor maintenance exception between the two options), but the impact on the number of regulated events is not quantified.

Table 4-122: Option F – Number of Events With Lead-Safe Work Practices			
Number of Events (Millions)			
Year 1		**Year 2**	
Total Events	**LSWP Events**	**Total Events**	**LSWP Events**
11.4	8.4	11.4	4.4

[33] The Census surveys that are used to estimate the number of events instructed respondents to report only major alterations or improvements, and not to report minor repairs or other routine maintenance. The Census instructions did not provide a size threshold for minor repairs or other routine maintenance, so data are not available to estimate the impact of changes in the definition of the minor maintenance exception under this rule.

LSWP = Lead-Safe Work Practices

Option F Work Practice Costs

The work practice costs for Option F are summarized in Table 4-123. Work practice costs are estimated to be the same under Option F as under Option E. Since the actual number of events under Option F will be lower than they would be under Option E (due to the difference in the definition of the minor maintenance exception between the two options), the actual work practice costs under Option F will be lower. However, the difference in the number of events between Options E and F was not quantified, so the impact of Option F's minor maintenance exception on work practice costs also was not quantified.

Table 4-123: Work Practice Costs under Option F (millions 2005$)

	Year 1	**Year 2**	**50-Year Annualized (3 percent)**	**50-Year Annualized (7 percent)**
Public or Commercial Building COFs	$26.1	$10.5	$10.6	$11.8
Target Housing	$464.6	$310.4	$303.9	$328.2
Total	**$490.7**	**$320.9**	**$314.6**	**$340.0**
Source: EPA Calculations.				

Option F Training Costs

Section 4.4 presents the methodology for estimating the number of individuals who will seek training, and section 4.5 presents the estimates of training costs for the other options analyzed. The number of individuals seeking training under Option F is estimated using a similar approach to the estimates for the other options presented in Section 4.4.

Table 4-124 presents the estimated number of individuals trained and the training costs under Option F. There are fewer individuals receiving training annually after the first year under Option F than Option E, because training is required every five years instead of every three years. This accounts for about a 40 percent decrease in the number of individuals seeking training annually compared to Option E.

However, training costs do not decline by 40 percent because the estimates are adjusted to reflect a higher percentage of individuals seeking initial training each year. This is caused due to turnover in the industry – some trained individuals exit the industry each year and are replaced by new entrants. These new entrants must receive 8 hour initial training instead of the 4 hour refresher training that previously trained individuals are eligible for. While the same annual turnover rate is assumed under all options, the aggregate turnover rate will be higher over a five year period compared to a three year period, which affects the mix of initial and refresher training.

Table 4-124: First and Second Year Training Costs under Option F (2005$)		
	Year 1	**Year 2**
Public or Commercial Building COFs		
Number of Initial Renovator Trainings	43,327	7,479
Cost per Initial Renovator Training	$562	$562
Number of Refresher Renovator Trainings	0	1,151
Cost per Refresher Renovator Training	$341	$341
Number of Worker Trainings	50,030	49,825
Cost per Worker Training	$27	$27
Total Training Costs	**$25,700,584**	**$5,940,966**
Target Housing		
Number of Initial Renovator Trainings	192,589	33,245
Cost per Initial Renovator Training	$562	$562
Number of Refresher Renovator Trainings	0	5,115
Cost per Refresher Renovator Training	$341	$341
Number of Worker Trainings	287,857	286,677
Cost per Worker Training	$27	$27
Total Training Costs	**$116,007,157**	**$28,168,186**
Source: EPA Calculations.		

The actual number of events under Option F will be less than under Option E, so fewer renovators may need to become trained under Option F, and actual training costs may be lower under Option F than Option E for that reason. However, the difference in the number of events between Options E and F was not quantified, so the impact of Option F's minor maintenance exception on training costs also was not quantified.

Option F Certification Costs

Section 4.4 presents the methodology for estimating the number certified firms and Section 4.6 presents the estimates of certification costs for the various options. The number of firms certified under Option F is estimated using a similar approach to the estimates for the other options presented in Section 4.4 . The certification costs per-firm presented below are the same as estimated for Option E. The fees used here are assumed values; the actual fees will be set in a future rulemaking.

Table 4-125 presents the estimated number of firms certified and certification costs under Option F. There are fewer firms receiving certification annually after the first year under Option F than Option E, because certification is required every five years instead of every three years. This accounts for about a 40 percent decrease in the number of firms seeking certification.

However, certification costs do not decline by 40 percent because the estimates are adjusted to reflect a higher percentage of firms seeking initial certification each year. This is caused due to turnover in the industry – some certified firms exit the industry each year and are replaced by new entrants. These new entrants must receive initial certification instead of the recertification that previously certified firms are eligible for. While the same annual turnover rate is assumed under all options, the aggregate turnover rate will be higher over a five year period compared to a three year period, which affects the mix of initial certifications and re-certifications.

Table 4-125: First and Second Year Certification Costs under Option F (2005$)		
	Year 1	**Year 2**
Public or Commercial Building COFs		
Number of Initial Firm Certifications	42,670	7,649
Cost per Initial Firm Certifications	$581	$581
Number of Firm Re-Certifications	0	850
Cost per Firm Re-Certification	$492	$492
Number of Non-Certification-Year Firms	0	33,996
Cost per Non-Certification-Year Firm	$152	$152
Enforcement Costs	320,990	320,990
Total Certification Costs	**$25,112,260**	**$10,350,672**
Target Housing		
Number of Initial Firm Certifications	169,051	30,304
Cost per Initial Firm Certifications	$581	$581
Number of Firm Re-Certifications	0	3,367
Cost per Firm Re-Certification	$492	$492
Number of Non-Certification-Year Firms	0	134,686
Cost per Non-Certification-Year Firm	$152	$152
Enforcement Costs	1,064,501	1,064,501
Total Certification Costs	**$99,283,132**	**$40,800,330**
Source: EPA Calculations.		

The actual number of events under Option F will be less than under Option E, so fewer firms may need to become certified under Option F, and actual certification costs may be lower under Option F than estimated above for that reason. However, the difference in the number of events between Options E and F was not quantified, so the impact of Option F's minor maintenance exception on certification costs also was not quantified.

Pre-Renovation Education Costs

The pre-renovation education cost estimates for Option F are summarized below. The estimated pre-renovation education costs are the same for Options E and F because they are based on the estimated number of renovation events, which are the same under both options. Since the actual number of events under Option F will be less than under Option E (due to the difference in the definition of the minor maintenance exception between the two options), the actual pre-renovation education costs under Option F will be lower. However, the impact of Option F's minor maintenance exception on the number of events, and thus on pre-renovation education costs, was not quantified.

Table 4-126: Pre-Renovation Education Costs under Option F (millions 2005$)				
	Year 1	**Year 2**	**50-Year Annualized (3 percent)**	**50-Year Annualized (7 percent)**
Public or Commercial Building COFs	$1.0	$0.2	$0.3	$0.3
Target Housing	$0.4	$0.2	$0.2	$0.2
Total	**$1.4**	**$0.4**	**$0.5**	**$0.5**
Source: EPA Calculations.				

Summary of Option F Costs

Table 4-127 presents the first year, second year, and 50-year annualized costs under Option F. Costs are presented by the type of structure affected and the type of cost incurred.

Table 4-127: Costs of the Renovation, Repair, and Painting Rule under Option F (millions 2005$)				
	Year 1	**Year 2**	**50-Year Annualized (3 percent)**	**50-Year Annualized (7 percent)**
Public or Commercial Building COFs				
Total Work Practice Costs	$26.1	$10.5	$10.6	$11.8
Total Training Costs	$25.7	$5.9	$6.5	$7.5
Total Certification Costs	$25.1	$10.4	$10.5	$11.7
Pre-Renovation Ed. Costs	$1.0	$0.2	$0.3	$0.3
Total Costs	**$77.9**	**$27.0**	**$27.9**	**$31.3**
Target Housing				
Total Work Practice Costs	$464.6	$310.4	$303.9	$328.2
Total Training Costs	$116.0	$28.2	$30.4	$35.1
Total Certification Costs	$99.3	$40.8	$41.5	$46.0
Pre-Renovation Ed. Costs	$0.4	$0.2	$0.2	$0.2
Total Costs	**$680.3**	**$379.6**	**$376.1**	**$409.5**
Total: All Activities				
Total Work Practice Costs	$490.7	$320.9	$314.6	$340.0
Total Training Costs	$141.7	$34.1	$36.9	$42.6
Total Certification Costs	$124.4	$51.2	$52.0	$57.6
Pre-Renovation Ed. Costs	$1.4	$0.4	$0.5	$0.5
Total Costs	**$758.2**	**$406.6**	**$404.0**	**$440.8**
Source: EPA Calculations.				

References:

American School and University (ASU). 2007. "Inside: Class Size." Available at: http://asumag.com/mag/university_inside_class_size/ (Accessed 3/15/2007).

Baker, Kermit. Joint Center for Housing Studies (JCHS) at Harvard University. Personal Communication, August 2005

Buckshot, Kelly; 2006. *Rollin' Rollin' Rollin' Paint is Prime.* Angie's List Magazine. February 2006.

Center for the Child Care Workforce and Human Services Policy Center. 2002. "Estimating the Size and Components of the U.S. Child Care Workforce and Caregiving Population: Key Findings from the Child Care Workforce Estimate (Preliminary Report)," May 2002.

Gilkeya, David; Jacob Hautaluomaa, Taslim Ahmeda, Thomas Keefea, Robert Herrona, Philip Bigelowb. 2003. Construction Work Practices and Conditions Improved After 2-Years' Participation in the HomeSafe Pilot Program. American Industrial Hygiene Association Journal, May/June 2003.

Homestyles.com. 2002. Available at: http://www.store.homestyles.com/homestyles/plans/search. (Accessed 2002).

Hunt, M.O., D.L. Cassens, Ron Zmyslo, and R.L. Leavitt. 2006. *Paint Stripping Trials*. September 19, 2006. http://www.agriculture.purdue.edu/fnr/faculty/hunt/paintstripping.pdf.

Morbidity and Mortality Weekly Report (MMWR). 1997. Update: Blood Lead Levels – United States, 1991-1994. Center for Disease Control and Prevention. 46(07); 141-146.

Morbidity and Mortality Weekly Report (MMWR). 2003. Surveillance for Elevated Blood Lead Levels Among Children – United States, 1997-2001. Center for Disease Control and Prevention. Sep 12.

National Center for Education Statistics (NCES). 2004. "The Status of Public and Private School Library Media Centers in the United States: 1999-2000." http://nces.ed.gov/pubs2004/2004313.pdf. (Downloaded: 3/7/2007).

National Center for Education Statistics (NCES). 2005. "After-School Programs and Activities Survey of the National Household Education Surveys Program (NHES)." http://nces.ed.gov/pubs2006/afterschool/index.asp. (Downloaded 1/3/2007).

National Center for Education Statistics (NCES). 2006a. "Overview of Public Elementary and Secondary Students, Staff, Schools, School Districts, Revenues, and Expenditures: School Year 2004-2005 and Fiscal Year 2004." Available at: http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2007309. (Downloaded 12/22/2006).

National Center for Education Statistics (NCES). 2006b. Common Core of Data Public Elementary/Secondary School Universe Survey Data, 2004-2005." Available at: http://nces.ed.gov/gov/ccd/pubschuniv.asp. (Accessed 12/22/2006).

National Center for Education Statistics (NCES). 2006c. Common Core of Data Local Education Agency (School District) Universe Survey Data. Available at: http://nces/ed/gov/ccd/pubschuniv.asp. (Accessed 12/22/2006).

National Center for Education Statistics (NCES). 2006e. "Characteristics of Private Schools in the United States: Results From the 2003-2004 Private School Universe Survey." (Accessed 12/15/2006).

National Center for Education Statistics (NCES). 2006f. 2003-2004 Private School Universe Survey Data. Received from Stephen Broughman (NCES) December 15, 2006.

National Center for Education Statistics (NCES). 2006g. "Calories In, Calories Out: Food and Exercise in Public Elementary Schools." http://nces.ed.gov/pubs2006/nutrition/index.asp. (Downloaded 3/7/2007)

National Center for Education Statistics (NCES). 2007. "Public School Principals Report on Their School Facilities: Fall 2005." http://nces.ed.gov/pubs2007/2007007.pdf. (Downloaded 3/7/2007).

New Hampshire Department of Education. 2006. "Average Class Size by District in Public Elementary Schools." Available at: http://www.ed.state.nh.us/education/data/ReportsandStatistics/Enrollment/Average%20Class%20Size%20by%20District/Average%20Class%20Size%20by%20District%202005-2006/Average%20Class%20Size%20by%20District%202005-2006.pdf (Accessed 3/15/2007).

New York State Office of the State Comptroller. 2005. "New York City Department of Education Administration of the Early Grade Class Size Reduction Program." 2005-n-3. Available at: http://www.osc.state.ny.us/audits/allaudits/093006/05n3.pdf (Accessed 3/15/2007).

Painting and Decorating Contractors of America . 2003. *What Every Painting and Decorating Contractor Needs to Know About Costing & Estimating, Vol. 2: Rates and Tables*

Personal communication with work group members and other industry experts. 1999.

ProDunkHoops. 2006. "Basketball Court Dimensions." Available at: http://www.produnkhoops.com/guides/court_dimensions.html (Accessed 3/12/2007).

RS Means, 2005, *Means CostWorks Repair & Remodeling Cost Data 2005 CD-ROM*, 7th Edition http://www.rsmeans.com/bookstore/detail.asp?sku=65045

Texas Education Agency. 1999. School Size and Class Size in Texas Public Schools. Available at: http://www.tea.state.tx.us/research/pdfs/prr12.pdf (Accessed 3/15/2007).

U.S. Bureau of Labor Statistics. 2005a. Occupational Employment Statistics Series.

U.S. Bureau of Labor Statistics. 2005b. Consumer Price Index: All urban consumers; other goods and services. Bureau of Labor Statistics, Washington, DC.

U.S. Bureau of Labor Statistics. 2006. "Current Population Survey: Basic Monthly Survey." January 2006.

U.S. Census Bureau. 1990. "H025. Year Structure Built - Universe: Housing units." American Fact Finder. Available at: http://factfinder.census.gov/ (Downloaded 10/26/2005)

U.S. Census Bureau. 1995. Property Owners and Managers Survey (POMS)

U.S. Census Bureau. 1997. *American Housing Survey (AHS)*.

U.S. Census Bureau. 2000c. "H34. Year Structure Built [10] - Universe: Housing Units." American Fact Finder. Available at: http://factfinder.census.gov/ (Downloaded 10/26/2005)

U.S. Census Bureau. 2003. *American Housing Survey (AHS)*.

U.S. Census Bureau. 2000. "Units in Structure, Householder 65 Years and Over, and Householder Below Poverty Level: 2000." *American FactFinder*.

U.S. Census Bureau. 2005d. "Sector 23: Industry Series: Value of Construction for Establishments by Type of Construction: 2002." American Fact Finder. Available at: http://factfinder.census.gov/servlet/EconSectorServlet?caller=dataset&sv_name=*&_SectorId=23&ds_name=EC0200A1&_lang=en&_ts=141735361508 (Downloaded 6/30/2005)

U.S. Census Bureau. 2005f. 2002 Economic Census: Industry Series: Residential Remodelers EC02-23I-236118 (RV). Available at: http://www.census.gov/prod/ec02/ec0223i236118.pdf (Accessed 8/3/2005).

U.S. Census Bureau. 2005g. *American Housing Survey –Overview*. Available at: http://www.census.gov/hhes/www/housing/ahs/overview.html.

U.S. Census Bureau. 2005h. Property Owners and Managers Survey (POMS) – Overview. Available at: http://www.census.gov/hhes/www/housing/poms/overview.html

U.S. Census Bureau. 2006. "American Housing Survey for the U.S. 2005." *Current Housing Reports*.

U.S. Department of Education; Institute of Education Sciences. 2004. "Full-day and Half-day Kindergarten in the United States: Findings from the Early Childhood Longitudinal Study, Kindergarten Class of 1998–99," June 2004; NCES 2004–078.

U.S. Department of Education; Institute of Education Sciences. 2003. " Prekindergarten in U.S. Public Schools: 2000-2001," March 2003; NCES 2003-019.

U.S. Department of Energy (DOE). 2003. Commercial Buildings Energy Consumption Survey (CBECS).

U.S. Department of Housing and Urban Development (HUD). 2001. National Survey of Lead and Allergens in Housing.

U.S. Department of Housing and Urban Development (HUD). 2003. First National Environmental Health Survey of Child Care Centers.

U.S. EPA. 2000a. *Model Renovation Training Course*. EPA 747-B-00-005/6. Available at: http://www.epa.gov/lead/pubs/rrmodel.htm.

U.S. EPA. 2003. Lead-Based Paint Pre-Renovation Information Dissemination - TSCA Sec. 406(b). EPA ICR No. 1669.04; OMB No. 2070-0158.

U.S. EPA. 2005. *Federal Lead Based Paint Program (FLPP) Database.*

U.S. EPA, 2005b. *Disposable Cleaning Cloth (DCC) Lead Clearance Field Study*. July.

U.S. EPA. 2006. Economic Analysis for the Renovation, Repair, and Painting Program Proposed Rule. February 2006.

U.S. EPA. 2007 Economic Analysis for the Supplemental Proposed Rule on Child-Occupied Facilities Under the TSCA Lead Renovation, Repair, and Painting Program. June 2007.

U.S. Office of Management and Budget. 2003. *Circular A-4.*

U.S. Small Business Administration. 2005. “Non-Employer Statistics.” Firm Size Data. http://www.sba.gov/advo/research/data.html. (Downloaded 8/3/2005).

Whitestone Research. The Whitestone Building Maintenance and Repair Cost Reference 2006-2007. 11th Annual Edition. August 2006.

Wilder Research Center. 2005. "Family, Friend and Neighbor Caregivers: Results of the 2004 Minnesota statewide household child care survey." December 2005.

Wilder Research Center. 2001. "Staff recruitment and retention in early childhood care and education and school-age care." April 2001.

4A. Appendix: Detailed Work Practice Cost Tables

The tables in this appendix present the detailed work practices cost estimates by type of events and type of structure. The costs vary across event types and structures based on the sizes of the areas that need to be cleaned and contained. Table 4A-1 and Table 4A-2 describe how these factors vary. The remaining tables present the detailed estimates.

Table 4A-1: Number of Units Required for RRP Interior Activities (2005$)		
Cost Type	**Units**	**Number of Units Required**
Containment		
(1) Sign	Ea.	Two signs are assumed to be required.
(2) Floors (labor): Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	S.F.	Estimated as 110% of the square footage of the work area plus 60 square feet of sheeting for paths (except for small events).
(3) Floors (materials): Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	S.F.	Same as (2).
(4) Walls[d]: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	S.F.	Estimated as the number of doors times 20 square feet (door size), plus 20 square feet (for an extra layer of plastic over the entry door), plus the number of ducts times 1 square foot (duct size).
(5) Tack pad	Per sheet	One tack pad per room affected.
(6) Disposable shoe covers	Per pair	Two for small jobs, none for large jobs.
(7) Roll down polyethylene sheeting	S.F.	(2) plus (4).
(8) Bag polyethylene sheeting	Ea.	(7) divided by 76.2 square feet (the amount of plastic that will fit in a bag).
Cleaning		
(9) HEPA vacuum for work area	Ea.	Estimated as 1.
(10) HEPA vacuum use (floor)	S.F.	Estimated as 110% (125% for kitchens and bathrooms) of the square footage of the work area plus the number of windows times 2/3 of a square foot (the size of a window sill).
(11) HEPA vacuum use (walls)	S.F.	Estimated as the square root of the square footage of the work area times 32 (4 eight foot tall walls).
(12) HEPA vacuum clothes	Hours	Estimated as ten minutes (small events only).
(13) Wet wipe, flat surfaces (cleaning)	S.F.	Estimated as the likelihood of uncarpeted floors multiplied by the square footage of the work area, plus 10% (or 25% for kitchens and bathrooms) of the square footage of the work area multiplied plus the number of windows times 2/3 of a square foot (the size of a window sill).
Verification		
(14) Wet wipe, flat surfaces (verification)	S.F.	Estimated as 31.8 percent (sum of first and second failure rates) multiplied by (13).
(15) Electrostatic cloth sweeper	Ea.	Estimated as 1.
(16) Disposable wet cloth	S.F.	Estimated as 131.8% multiplied by {the square footage of the work area, multiplied by the likelihood of uncarpeted floors plus the number of windows multiplied by 2/3 of a square foot (the size of a window sill)}.
(17) Disposable dry cloth	S.F.	Estimated as 1.8% (second failure rate), multiplied by the square footage of the work area, multiplied by the likelihood of uncarpeted floors.
Abbreviations: S.F. = Square Feet; Ea. = Each Item *Source: RS Means 2005; U.S. Bureau of Labor Statistics 2005b.*		

Table 4A-2: Number of Units Required for RRP Exterior Activities (2005$)		
Cost Type	**Units**	**Number of Units Required**
Containment		
(1) Sign	Ea.	Two signs are assumed to be required.
(2) Ground: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	S.F.	Estimated as the perimeter times 10 feet plus an extra 314 square feet for the corners.
(3) Doors: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	S.F.	Estimated as the number of doors multiplied by 40 square feet, less 20 square feet.
(4) Roll down polyethylene sheeting	S.F.	Estimated as the sum of (2) and (3).

Abbreviations: S.F. = Square Feet; Ea. = Each Item
Source: RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-3: INTERIOR - SF OWNER - KITCHEN EVENT						
Cost Type	Units	Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
		(1)	(2)	(3)	(4)	(5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	236	$29.20	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	236	$17.87	28%	$12.92
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	62	$15.16	100%	$0.00
Tack pad	Ea.	$0.51	1	$0.51	39%	$0.32
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	298	$9.21	92%	$0.73
Bag polyethylene sheeting	Ea.	$2.24	4	$8.75	25%	$6.52
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	201	$9.24	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	405	$18.57	41%	$11.00
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	183	$10.37	67%	$3.44
Wet wipe (verification)	S.F.	$0.06	58	$3.30	0%	$3.30
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	186	$10.13	0%	$10.13
Disposable dry cloth	S.F.	$0.05	3	$0.13	0%	$0.13
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$133**	**63%**	**$49**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-4: INTERIOR - SF OWNER - BATHROOM EVENT						
		Labor and Materials Cost Per Unit[a]	**Number of Units[b]**	**Total Cost Before Baseline Adjustment[c]**	**Baseline Adjustment Factor[d]**	**Total Cost After Baseline Adjustment[e]**
Cost Type	**Units**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	113	$13.95	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	113	$8.54	28%	$6.18
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	62	$15.16	100%	$0.00
Tack pad	Ea.	$0.51	1	$0.51	39%	$0.32
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	174	$5.40	92%	$0.43
Bag polyethylene sheeting	Ea.	$2.24	2	$5.13	25%	$3.82
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	61	$2.78	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	222	$10.17	41%	$6.03
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	55	$3.13	67%	$1.04
Wet wipe (verification)	S.F.	$0.06	18	$0.99	0%	$0.99
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	56	$3.06	0%	$3.06
Disposable dry cloth	S.F.	$0.05	1	$0.04	0%	$0.04
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$70**	**68%**	**$22**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-5: INTERIOR - SF OWNER - SMALL ADDITION OR WALL DISTURBING EVENT						
Cost Type	Units	Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
		(1)	(2)	(3)	(4)	(5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	53	$6.53	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	53	$4.00	28%	$2.89
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	0	$0.00	100%	$0.00
Tack pad	Ea.	$0.51	0	$0.00	39%	$0.00
Pair of disposable shoe covers	Ea.	$0.38	2	$0.77	26%	$0.57
Roll down polyethylene sheeting	S.F.	$0.03	53	$1.63	92%	$0.13
Bag polyethylene sheeting	Ea.	$2.24	1	$1.55	25%	$1.16
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	53	$2.45	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	222	$10.17	41%	$6.03
HEPA vacuum clothes	Ea.	$20.62	0.16666667	$3.44	39%	$2.11
Wet wipe (cleaning)	S.F.	$0.06	29	$1.61	67%	$0.54
Wet wipe (verification)	S.F.	$0.06	9	$0.51	0%	$0.51
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	31	$1.68	0%	$1.68
Disposable dry cloth	S.F.	$0.05	0	$0.02	0%	$0.02
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$35**	**54%**	**$16**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-6: INTERIOR - SF OWNER - MEDIUM ADDITION, WALL DISTURBING, OR WINDOW/DOOR REPLACEMENT EVENT						
Cost Type	Units	Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
		(1)	(2)	(3)	(4)	(5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	236	$29.20	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	236	$17.87	28%	$12.92
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	62	$15.16	100%	$0.00
Tack pad	Ea.	$0.51	1	$0.51	39%	$0.32
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	298	$9.21	92%	$0.73
Bag polyethylene sheeting	Ea.	$2.24	4	$8.75	25%	$6.52
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	177	$8.14	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	405	$18.57	41%	$11.00
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	94	$5.33	67%	$1.77
Wet wipe (verification)	S.F.	$0.06	30	$1.69	0%	$1.69
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	102	$5.52	0%	$5.52
Disposable dry cloth	S.F.	$0.05	1	$0.07	0%	$0.07
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$121**	**66%**	**$41**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-7: INTERIOR - SF OWNER - LARGE ADDITION OR WALL DISTURBING EVENT

Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	289	$35.73	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	289	$21.87	28%	$15.82
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	102	$24.99	100%	$0.00
Tack pad	Ea.	$0.51	2	$1.03	39%	$0.63
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	390	$12.08	92%	$0.95
Bag polyethylene sheeting	Ea.	$2.24	5	$11.47	25%	$8.55
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	231	$10.59	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	462	$21.17	41%	$12.55
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	123	$6.94	67%	$2.30
Wet wipe (verification)	S.F.	$0.06	39	$2.21	0%	$2.21
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	132	$7.20	0%	$7.20
Disposable dry cloth	S.F.	$0.05	2	$0.09	0%	$0.09
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$156**	**68%**	**$51**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-8: INTERIOR - SF OWNER - SMALL WINDOW/DOOR REPLACEMENT EVENT						
Cost Type	**Units**	**Labor and Materials Cost Per Unit[a]** (1)	**Number of Units[b]** (2)	**Total Cost Before Baseline Adjustment[c]** (3)	**Baseline Adjustment Factor[d]** (4)	**Total Cost After Baseline Adjustment[e]** (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	70	$8.61	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	70	$5.27	28%	$3.81
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	0	$0.00	100%	$0.00
Tack pad	Ea.	$0.51	0	$0.00	39%	$0.00
Pair of disposable shoe covers	Ea.	$0.38	2	$0.77	26%	$0.57
Roll down polyethylene sheeting	S.F.	$0.03	70	$2.15	92%	$0.17
Bag polyethylene sheeting	Ea.	$2.24	1	$2.04	25%	$1.52
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	70	$3.22	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	254	$11.67	41%	$6.92
HEPA vacuum clothes	Ea.	$20.62	0.16666667	$3.44	39%	$2.11
Wet wipe (cleaning)	S.F.	$0.06	37	$2.11	67%	$0.70
Wet wipe (verification)	S.F.	$0.06	12	$0.67	0%	$0.67
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	40	$2.19	0%	$2.19
Disposable dry cloth	S.F.	$0.05	1	$0.03	0%	$0.03
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$43**	**56%**	**$19**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-9: INTERIOR - SF OWNER - LARGE WINDOW/DOOR REPLACEMENT EVENT						
Cost Type	Units	Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
		(1)	(2)	(3)	(4)	(5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	764	$94.52	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	764	$57.84	28%	$41.84
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	182	$44.66	100%	$0.00
Tack pad	Ea.	$0.51	2.64287195	$1.36	39%	$0.83
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	946	$29.25	92%	$2.31
Bag polyethylene sheeting	Ea.	$2.24	12	$27.78	25%	$20.72
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	709	$32.54	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	810	$37.14	41%	$22.01
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	377	$21.31	67%	$7.07
Wet wipe (verification)	S.F.	$0.06	120	$6.78	0%	$6.78
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	406	$22.09	0%	$22.09
Disposable dry cloth	S.F.	$0.05	6	$0.28	0%	$0.28
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$376**	**67%**	**$124**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-10: INTERIOR - SF OWNER - SMALL INTERIOR PAINTING EVENT						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	123	$15.27	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	123	$9.35	28%	$6.76
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	22	$5.33	100%	$0.00
Tack pad	Ea.	$0.51	0.46352232	$0.24	39%	$0.15
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	145	$4.49	92%	$0.35
Bag polyethylene sheeting	Ea.	$2.24	2	$4.26	25%	$3.18
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	124	$5.69	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	339	$15.55	41%	$9.22
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	66	$3.72	67%	$1.24
Wet wipe (verification)	S.F.	$0.06	21	$1.18	0%	$1.18
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	71	$3.85	0%	$3.85
Disposable dry cloth	S.F.	$0.05	1	$0.05	0%	$0.05
Prohibited practices alternatives	Ea.	$1.06	1	$1.06	0%	$1.06
Total				**$71**	**61%**	**$27**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-11: INTERIOR - SF OWNER - MEDIUM INTERIOR PAINTING EVENT						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	399	$49.35	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	399	$30.20	28%	$21.85
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	49	$12.06	100%	$0.00
Tack pad	Ea.	$0.51	1.27234037	$0.65	39%	$0.40
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	448	$13.85	92%	$1.10
Bag polyethylene sheeting	Ea.	$2.24	6	$13.16	25%	$9.81
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	340	$15.61	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	562	$25.77	41%	$15.27
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	180	$10.19	67%	$3.38
Wet wipe (verification)	S.F.	$0.06	57	$3.24	0%	$3.24
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	194	$10.55	0%	$10.55
Disposable dry cloth	S.F.	$0.05	3	$0.13	0%	$0.13
Prohibited practices alternatives	Ea.	$1.06	1	$1.06	0%	$1.06
Total				**$187**	**64%**	**$67**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-12: INTERIOR - SF OWNER - LARGE INTERIOR PAINTING EVENT						
Cost Type	Units	Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
		(1)	(2)	(3)	(4)	(5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	614	$76.00	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	614	$46.51	28%	$33.65
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	76	$18.79	100%	$0.00
Tack pad	Ea.	$0.51	2.08115842	$1.07	39%	$0.66
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	691	$21.37	92%	$1.69
Bag polyethylene sheeting	Ea.	$2.24	9	$20.30	25%	$15.13
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	557	$25.55	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	718	$32.96	41%	$19.53
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	295	$16.69	67%	$5.54
Wet wipe (verification)	S.F.	$0.06	94	$5.31	0%	$5.31
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	318	$17.28	0%	$17.28
Disposable dry cloth	S.F.	$0.05	4	$0.22	0%	$0.22
Prohibited practices alternatives	Ea.	$1.06	1	$1.06	0%	$1.06
Total				**$284**	**65%**	**$101**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-13: INTERIOR - SF RENTER - LARGE KITCHEN						
		Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
Cost Type	**Units**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	192	$23.75	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	192	$14.54	28%	$10.51
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	62	$15.16	100%	$0.00
Tack pad	Ea.	$0.51	1	$0.51	39%	$0.32
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	254	$7.85	92%	$0.62
Bag polyethylene sheeting	Ea.	$2.24	3	$7.45	25%	$5.56
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	151	$6.94	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	351	$16.08	41%	$9.53
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	138	$7.80	67%	$2.59
Wet wipe (verification)	S.F.	$0.06	44	$2.48	0%	$2.48
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	140	$7.62	0%	$7.62
Disposable dry cloth	S.F.	$0.05	2	$0.10	0%	$0.10
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$111**	**64%**	**$40**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-14: INTERIOR - SF RENTER - LARGE BATHROOM						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	113	$13.95	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	113	$8.54	28%	$6.18
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	42	$10.24	100%	$0.00
Tack pad	Ea.	$0.51	1	$0.51	39%	$0.32
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	154	$4.78	92%	$0.38
Bag polyethylene sheeting	Ea.	$2.24	2	$4.54	25%	$3.38
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	61	$2.78	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	222	$10.17	41%	$6.03
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	55	$3.13	67%	$1.04
Wet wipe (verification)	S.F.	$0.06	18	$0.99	0%	$0.99
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	56	$3.06	0%	$3.06
Disposable dry cloth	S.F.	$0.05	1	$0.04	0%	$0.04
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$64**	**66%**	**$22**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-15: INTERIOR - SF RENTER - SMALL WALL						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	53	$6.53	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	53	$4.00	28%	$2.89
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	0	$0.00	100%	$0.00
Tack pad	Ea.	$0.51	0	$0.00	39%	$0.00
Pair of disposable shoe covers	Ea.	$0.38	2	$0.77	26%	$0.57
Roll down polyethylene sheeting	S.F.	$0.03	53	$1.63	92%	$0.13
Bag polyethylene sheeting	Ea.	$2.24	1	$1.55	25%	$1.16
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	53	$2.45	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	222	$10.17	41%	$6.03
HEPA vacuum clothes	Ea.	$20.62	0.16666667	$3.44	39%	$2.11
Wet wipe (cleaning)	S.F.	$0.06	29	$1.61	67%	$0.54
Wet wipe (verification)	S.F.	$0.06	9	$0.51	0%	$0.51
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	31	$1.68	0%	$1.68
Disposable dry cloth	S.F.	$0.05	0	$0.02	0%	$0.02
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$35**	**54%**	**$16**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-16: INTERIOR - SF RENTER - MEDIUM WALL						
		Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
Cost Type	**Units**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	192	$23.75	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	192	$14.54	28%	$10.51
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	62	$15.16	100%	$0.00
Tack pad	Ea.	$0.51	1	$0.51	39%	$0.32
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	254	$7.85	92%	$0.62
Bag polyethylene sheeting	Ea.	$2.24	3	$7.45	25%	$5.56
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	133	$6.12	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	351	$16.08	41%	$9.53
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	71	$4.01	67%	$1.33
Wet wipe (verification)	S.F.	$0.06	23	$1.28	0%	$1.28
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	77	$4.17	0%	$4.17
Disposable dry cloth	S.F.	$0.05	1	$0.05	0%	$0.05
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$102**	**67%**	**$34**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-17: INTERIOR - SF RENTER - LARGE WALL						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	245	$30.28	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	245	$18.53	28%	$13.41
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	82	$20.07	100%	$0.00
Tack pad	Ea.	$0.51	2	$1.03	39%	$0.63
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	326	$10.10	92%	$0.80
Bag polyethylene sheeting	Ea.	$2.24	4	$9.59	25%	$7.15
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	187	$8.57	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	415	$19.03	41%	$11.28
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	99	$5.63	67%	$1.87
Wet wipe (verification)	S.F.	$0.06	32	$1.79	0%	$1.79
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	107	$5.84	0%	$5.84
Disposable dry cloth	S.F.	$0.05	1	$0.07	0%	$0.07
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$131**	**67%**	**$43**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-18: INTERIOR - SF RENTER - SMALL WINDOW/DOOR						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	60	$7.45	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	60	$4.56	28%	$3.30
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	0	$0.00	100%	$0.00
Tack pad	Ea.	$0.51	0	$0.00	39%	$0.00
Pair of disposable shoe covers	Ea.	$0.38	2	$0.77	26%	$0.57
Roll down polyethylene sheeting	S.F.	$0.03	60	$1.86	92%	$0.15
Bag polyethylene sheeting	Ea.	$2.24	1	$1.77	25%	$1.32
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	61	$2.79	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	237	$10.86	41%	$6.44
HEPA vacuum clothes	Ea.	$20.62	0.16666667	$3.44	39%	$2.11
Wet wipe (cleaning)	S.F.	$0.06	32	$1.84	67%	$0.61
Wet wipe (verification)	S.F.	$0.06	10	$0.58	0%	$0.58
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	35	$1.91	0%	$1.91
Disposable dry cloth	S.F.	$0.05	0	$0.02	0%	$0.02
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$39**	**55%**	**$17**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-19: INTERIOR - SF RENTER - LARGE WINDOW/DOOR						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	588	$72.74	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	588	$44.52	28%	$32.20
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	182	$44.66	100%	$0.00
Tack pad	Ea.	$0.51	2.19914101	$1.13	39%	$0.69
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	770	$23.80	92%	$1.88
Bag polyethylene sheeting	Ea.	$2.24	10	$22.61	25%	$16.86
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	533	$24.47	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	701	$32.16	41%	$19.06
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	284	$16.06	67%	$5.33
Wet wipe (verification)	S.F.	$0.06	90	$5.11	0%	$5.11
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	306	$16.66	0%	$16.66
Disposable dry cloth	S.F.	$0.05	4	$0.21	0%	$0.21
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$305**	**68%**	**$98**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-20: INTERIOR - SF RENTER - SMALL INTERIOR PAINTING						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	105	$13.05	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	105	$7.98	28%	$5.78
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	22	$5.33	100%	$0.00
Tack pad	Ea.	$0.51	0.43923632	$0.23	39%	$0.14
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	127	$3.93	92%	$0.31
Bag polyethylene sheeting	Ea.	$2.24	2	$3.73	25%	$2.79
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	106	$4.86	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	313	$14.37	41%	$8.52
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	56	$3.18	67%	$1.05
Wet wipe (verification)	S.F.	$0.06	18	$1.01	0%	$1.01
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	60	$3.29	0%	$3.29
Disposable dry cloth	S.F.	$0.05	1	$0.04	0%	$0.04
Prohibited practices alternatives	Ea.	$1.06	1	$1.06		$1.06
Total				**$63**	**61%**	**$24**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-21: INTERIOR - SF RENTER - MEDIUM INTERIOR PAINTING						
Cost Type	Units	Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
		(1)	(2)	(3)	(4)	(5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	315	$38.96	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	315	$23.84	28%	$17.25
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	46	$11.27	100%	$0.00
Tack pad	Ea.	$0.51	1.06181701	$0.55	39%	$0.33
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	361	$11.16	92%	$0.88
Bag polyethylene sheeting	Ea.	$2.24	5	$10.60	25%	$7.90
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	256	$11.74	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	487	$22.35	41%	$13.24
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	135	$7.67	67%	$2.54
Wet wipe (verification)	S.F.	$0.06	43	$2.44	0%	$2.44
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	146	$7.94	0%	$7.94
Disposable dry cloth	S.F.	$0.05	2	$0.10	0%	$0.10
Prohibited practices alternatives	Ea.	$1.06	1	$1.06		$1.06
Total				**$151**	**64%**	**$54**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-22: INTERIOR - SF RENTER - LARGE INTERIOR PAINTING						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	464	$57.45	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	464	$35.16	28%	$25.43
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	70	$17.21	100%	$0.00
Tack pad	Ea.	$0.51	1.6843977	$0.87	39%	$0.53
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	534	$16.53	92%	$1.31
Bag polyethylene sheeting	Ea.	$2.24	7	$15.70	25%	$11.71
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	406	$18.65	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	614	$28.15	41%	$16.68
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	215	$12.19	67%	$4.04
Wet wipe (verification)	S.F.	$0.06	68	$3.88	0%	$3.88
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	232	$12.62	0%	$12.62
Disposable dry cloth	S.F.	$0.05	3	$0.16	0%	$0.16
Prohibited practices alternatives	Ea.	$1.06	1	$1.06		$1.06
Total				**$220**	**65%**	**$78**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-23: INTERIOR - MULTI - LARGE KITCHEN							
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	148	$18.31	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	148	$11.21	28%	$8.11
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	62	$15.16	100%	$0.00
Tack pad	Ea.	$0.51	1	$0.51	39%	$0.32
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	210	$6.48	92%	$0.51
Bag polyethylene sheeting	Ea.	$2.24	3	$6.16	25%	$4.59
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	101	$4.62	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	286	$13.13	41%	$7.78
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	92	$5.19	67%	$1.72
Wet wipe (verification)	S.F.	$0.06	29	$1.65	0%	$1.65
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	93	$5.06	0%	$5.06
Disposable dry cloth	S.F.	$0.05	1	$0.06	0%	$0.06
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$88**	**66%**	**$30**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-24: INTERIOR - MULTI - LARGE BATHROOM						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	113	$13.95	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	113	$8.54	28%	$6.18
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	42	$10.24	100%	$0.00
Tack pad	Ea.	$0.51	1	$0.51	39%	$0.32
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	154	$4.78	92%	$0.38
Bag polyethylene sheeting	Ea.	$2.24	2	$4.54	25%	$3.38
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	61	$2.78	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	222	$10.17	41%	$6.03
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	55	$3.13	67%	$1.04
Wet wipe (verification)	S.F.	$0.06	18	$0.99	0%	$0.99
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	56	$3.06	0%	$3.06
Disposable dry cloth	S.F.	$0.05	1	$0.04	0%	$0.04
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$64**	**66%**	**$22**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-25: INTERIOR - MULTI - SMALL WALL						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	53	$6.53	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	53	$4.00	28%	$2.89
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	0	$0.00	100%	$0.00
Tack pad	Ea.	$0.51	0	$0.00	39%	$0.00
Pair of disposable shoe covers	Ea.	$0.38	2	$0.77	26%	$0.57
Roll down polyethylene sheeting	S.F.	$0.03	53	$1.63	92%	$0.13
Bag polyethylene sheeting	Ea.	$2.24	1	$1.55	25%	$1.16
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	53	$2.45	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	222	$10.17	41%	$6.03
HEPA vacuum clothes	Ea.	$20.62	0.16666667	$3.44	39%	$2.11
Wet wipe (cleaning)	S.F.	$0.06	29	$1.61	67%	$0.54
Wet wipe (verification)	S.F.	$0.06	9	$0.51	0%	$0.51
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	31	$1.68	0%	$1.68
Disposable dry cloth	S.F.	$0.05	0	$0.02	0%	$0.02
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$35**	**54%**	**$16**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-26: INTERIOR - MULTI - MEDIUM WALL						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	148	$18.31	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	148	$11.21	28%	$8.11
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	62	$15.16	100%	$0.00
Tack pad	Ea.	$0.51	1	$0.51	39%	$0.32
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	210	$6.48	92%	$0.51
Bag polyethylene sheeting	Ea.	$2.24	3	$6.16	25%	$4.59
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	89	$4.07	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	286	$13.13	41%	$7.78
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	47	$2.66	67%	$0.88
Wet wipe (verification)	S.F.	$0.06	15	$0.85	0%	$0.85
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	51	$2.76	0%	$2.76
Disposable dry cloth	S.F.	$0.05	1	$0.03	0%	$0.03
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$82**	**68%**	**$26**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-27: INTERIOR - MULTI - LARGE WALL						
Cost Type	**Units**	**Labor and Materials Cost Per Unit[a]** (1)	**Number of Units[b]** (2)	**Total Cost Before Baseline Adjustment[c]** (3)	**Baseline Adjustment Factor[d]** (4)	**Total Cost After Baseline Adjustment[e]** (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	201	$24.84	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	201	$15.20	28%	$11.00
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	82	$20.07	100%	$0.00
Tack pad	Ea.	$0.51	2	$1.03	39%	$0.63
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	282	$8.74	92%	$0.69
Bag polyethylene sheeting	Ea.	$2.24	4	$8.30	25%	$6.19
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	142	$6.52	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	362	$16.61	41%	$9.84
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	76	$4.28	67%	$1.42
Wet wipe (verification)	S.F.	$0.06	24	$1.36	0%	$1.36
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	82	$4.44	0%	$4.44
Disposable dry cloth	S.F.	$0.05	1	$0.06	0%	$0.06
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$112**	**68%**	**$36**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-28: INTERIOR - MULTI - SMALL WINDOW/DOOR						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	49	$6.09	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	49	$3.72	28%	$2.69
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	0	$0.00	100%	$0.00
Tack pad	Ea.	$0.51	0	$0.00	39%	$0.00
Pair of disposable shoe covers	Ea.	$0.38	2	$0.77	26%	$0.57
Roll down polyethylene sheeting	S.F.	$0.03	49	$1.52	92%	$0.12
Bag polyethylene sheeting	Ea.	$2.24	1	$1.45	25%	$1.08
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	50	$2.29	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	214	$9.82	41%	$5.82
HEPA vacuum clothes	Ea.	$20.62	0.16666667	$3.44	39%	$2.11
Wet wipe (cleaning)	S.F.	$0.06	27	$1.51	67%	$0.50
Wet wipe (verification)	S.F.	$0.06	8	$0.48	0%	$0.48
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	29	$1.56	0%	$1.56
Disposable dry cloth	S.F.	$0.05	0	$0.02	0%	$0.02
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$34**	**54%**	**$15**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-29: INTERIOR - MULTI - LARGE WINDOW/DOOR							
		Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
Cost Type	**Units**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	412	$50.97	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	412	$31.19	28%	$22.56
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	182	$44.66	100%	$0.00
Tack pad	Ea.	$0.51	1.58143438	$0.81	39%	$0.50
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	594	$18.36	92%	$1.45
Bag polyethylene sheeting	Ea.	$2.24	8	$17.44	25%	$13.01
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	355	$16.27	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	572	$26.26	41%	$15.56
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	188	$10.66	67%	$3.54
Wet wipe (verification)	S.F.	$0.06	60	$3.39	0%	$3.39
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	203	$11.05	0%	$11.05
Disposable dry cloth	S.F.	$0.05	3	$0.14	0%	$0.14
Prohibited practices alternatives	Ea.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$232**	**69%**	**$72**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-30: INTERIOR - MULTI - SMALL INTERIOR PAINTING						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	93	$11.46	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	93	$7.01	28%	$5.07
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	22	$5.33	100%	$0.00
Tack pad	Ea.	$0.51	0.41625289	$0.21	39%	$0.13
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	114	$3.54	92%	$0.28
Bag polyethylene sheeting	Ea.	$2.24	2	$3.36	25%	$2.50
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	93	$4.26	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	294	$13.47	41%	$7.98
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	49	$2.78	67%	$0.92
Wet wipe (verification)	S.F.	$0.06	16	$0.88	0%	$0.88
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	53	$2.88	0%	$2.88
Disposable dry cloth	S.F.	$0.05	1	$0.04	0%	$0.04
Prohibited practices alternatives	Ea.	$1.06	1	$1.06		$1.06
Total				**$57**	**61%**	**$22**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-31: INTERIOR - MULTI - MEDIUM INTERIOR PAINTING

Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	262	$32.46	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	262	$19.87	28%	$14.37
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	39	$9.61	100%	$0.00
Tack pad	Ea.	$0.51	0.90932872	$0.47	39%	$0.29
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	301	$9.32	92%	$0.74
Bag polyethylene sheeting	Ea.	$2.24	4	$8.86	25%	$6.61
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	203	$9.31	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	434	$19.91	41%	$11.80
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	107	$6.07	67%	$2.02
Wet wipe (verification)	S.F.	$0.06	34	$1.93	0%	$1.93
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	116	$6.28	0%	$6.28
Disposable dry cloth	S.F.	$0.05	2	$0.08	0%	$0.08
Prohibited practices alternatives	Ea.	$1.06	1	$1.06		$1.06
Total				**$126**	**64%**	**$46**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-32: INTERIOR - MULTI - LARGE INTERIOR PAINTING

Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	372	$46.04	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	372	$28.18	28%	$20.38
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	56	$13.89	100%	$0.00
Tack pad	Ea.	$0.51	1.40240455	$0.72	39%	$0.44
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	429	$13.26	92%	$1.05
Bag polyethylene sheeting	Ea.	$2.24	6	$12.59	25%	$9.39
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	313	$14.37	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	539	$24.73	41%	$14.65
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	166	$9.38	67%	$3.11
Wet wipe (verification)	S.F.	$0.06	53	$2.98	0%	$2.98
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	179	$9.71	0%	$9.71
Disposable dry cloth	S.F.	$0.05	2	$0.12	0%	$0.12
Prohibited practices alternatives	Ea.	$1.06	1	$1.06		$1.06
Total				**$178**	**64%**	**$63**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-33: EXTERIOR - SINGLE-FAMILY OWNER - WHOLE EXTERIOR						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	1836	$146.91	89%	$16.32
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	60	$14.75	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	1896	$18.97	53%	$8.98
Prohibited practices alternatives	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Vertical Containment	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$181**	**86%**	**$25**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-34: EXTERIOR - SINGLE-FAMILY OWNER - CONTAINED EXTERIOR (ATTACHED)						
		Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
Cost Type	**Units**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	557	$44.57	89%	$4.95
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	40	$9.83	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	597	$5.97	53%	$2.83
Prohibited practices alternatives	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Vertical Containment	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$61**	**87%**	**$8**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-35: EXTERIOR - SINGLE-FAMILY OWNER - CONTAINED EXTERIOR (DETACHED)						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	914	$73.13	89%	$8.13
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	40	$9.83	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	954	$9.55	53%	$4.52
Prohibited practices alternatives	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Vertical Containment	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$93**	**86%**	**$13**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-36: EXTERIOR - SINGLE-FAMILY OWNER - EXTERIOR PAINTING, 1-WALL						
Cost Type	**Units**	**Labor and Materials Cost Per Unit[a]** (1)	**Number of Units[b]** (2)	**Total Cost Before Baseline Adjustment[c]** (3)	**Baseline Adjustment Factor[d]** (4)	**Total Cost After Baseline Adjustment[e]** (5)
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	459	$36.73	89%	$4.08
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	20	$4.92	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	479	$4.79	53%	$2.27
Prohibited practices alternatives	S.F.	$1.61	1	$1.61	0%	$1.61
Vertical Containment	Ea.	$15.25	1	$0.00	0%	$15.25
Total				**$48**	**52%**	**$23**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-37: EXTERIOR - SINGLE-FAMILY OWNER - EXTERIOR PAINTING, 4-WALLS						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	1836	$146.91	89%	$16.32
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	60	$14.75	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	1896	$18.97	53%	$8.98
Prohibited practices alternatives	S.F.	$1.61	1	$1.61	0%	$1.61
Vertical Containment	Ea.	$62.88	1	$0.00	0%	$62.88
Total				**$182**	**51%**	**$90**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-38: EXTERIOR - SINGLE-FAMILY RENTER - WHOLE EXTERIOR						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	1614	$129.14	89%	$14.35
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	60	$14.75	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	1674	$16.75	53%	$7.93
Prohibited practices alternatives	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Vertical Containment	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$161**	**86%**	**$22**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-39: EXTERIOR - SINGLE-FAMILY RENTER - CONTAINED EXTERIOR (ATTACHED)

Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	557	$44.57	89%	$4.95
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	40	$9.83	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	597	$5.97	53%	$2.83
Prohibited practices alternatives	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Vertical Containment	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$61**	**87%**	**$8**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-40: EXTERIOR - SINGLE-FAMILY RENTER - CONTAINED EXTERIOR (DETACHED)						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	914	$73.13	89%	$8.13
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	40	$9.83	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	954	$9.55	53%	$4.52
Prohibited practices alternatives	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Vertical Containment	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$93**	**86%**	**$13**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-41: EXTERIOR - SINGLE-FAMILY RENTER - EXTERIOR PAINTING, 1-WALL						
		Labor and Materials Cost Per Unit[a]	**Number of Units[b]**	**Total Cost Before Baseline Adjustment[c]**	**Baseline Adjustment Factor[d]**	**Total Cost After Baseline Adjustment[e]**
Cost Type	**Units**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	404	$32.28	89%	$3.59
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	20	$4.92	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	424	$4.24	53%	$2.01
Prohibited practices alternatives	S.F.	$1.61	1	$1.61	0%	$1.61
Vertical Containment	Ea.	$13.04	1	$0.00	0%	$13.04
Total				**$43**	**53%**	**$20**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-42: EXTERIOR - SINGLE-FAMILY RENTER - EXTERIOR PAINTING, 4-WALLS						
Cost Type	**Units**	**Labor and Materials Cost Per Unit[a]** (1)	**Number of Units[b]** (2)	**Total Cost Before Baseline Adjustment[c]** (3)	**Baseline Adjustment Factor[d]** (4)	**Total Cost After Baseline Adjustment[e]** (5)
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	1614	$129.14	89%	$14.35
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	60	$14.75	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	1674	$16.75	53%	$7.93
Prohibited practices alternatives	S.F.	$1.61	1	$1.61	0%	$1.61
Vertical Containment	Ea.	$55.38	1	$0.00	0%	$55.38
Total				**$162**	**51%**	**$79**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-43: EXTERIOR - MULTI-FAMILY - WHOLE EXTERIOR						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	2950	$236.06	89%	$26.23
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	60	$14.75	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	3010	$30.12	53%	$14.26
Prohibited practices alternatives	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Vertical Containment	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$281**	**86%**	**$41**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-44: EXTERIOR - MULTI-FAMILY - CONTAINED EXTERIOR (ATTACHED)						
		Labor and Materials Cost Per Unit[a]	**Number of Units[b]**	**Total Cost Before Baseline Adjustment[c]**	**Baseline Adjustment Factor[d]**	**Total Cost After Baseline Adjustment[e]**
Cost Type	**Units**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	557	$44.57	89%	$4.95
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	40	$9.83	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	597	$5.97	53%	$2.83
Prohibited practices alternatives	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Vertical Containment	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$61**	**87%**	**$8**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-45: EXTERIOR - MULTI-FAMILY - CONTAINED EXTERIOR (DETACHED)						
Cost Type	**Units**	**Labor and Materials Cost Per Unit[a]** (1)	**Number of Units[b]** (2)	**Total Cost Before Baseline Adjustment[c]** (3)	**Baseline Adjustment Factor[d]** (4)	**Total Cost After Baseline Adjustment[e]** (5)
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	914	$73.13	89%	$8.13
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	40	$9.83	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	954	$9.55	53%	$4.52
Prohibited practices alternatives	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Vertical Containment	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$93**	**86%**	**$13**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-46: EXTERIOR - MULTI-FAMILY - EXTERIOR PAINTING, 1-WALL						
Cost Type	**Units**	**Labor and Materials Cost Per Unit[a]** (1)	**Number of Units[b]** (2)	**Total Cost Before Baseline Adjustment[c]** (3)	**Baseline Adjustment Factor[d]** (4)	**Total Cost After Baseline Adjustment[e]** (5)
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	738	$59.01	89%	$6.56
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	20	$4.92	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	758	$7.58	53%	$3.59
Prohibited practices alternatives	S.F.	$1.61	1	$1.61	0%	$1.61
Vertical Containment	Ea.	$32.75	1	$0.00	0%	$32.75
Total				**$73**	**39%**	**$45**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-47: EXTERIOR - MULTI-FAMILY - EXTERIOR PAINTING, 4-WALLS						
		Labor and Materials Cost Per Unit[a]	**Number of Units[b]**	**Total Cost Before Baseline Adjustment[c]**	**Baseline Adjustment Factor[d]**	**Total Cost After Baseline Adjustment[e]**
Cost Type	**Units**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Sign	Ea.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	2950	$236.06	89%	$26.23
Doors: Cover surfaces with polyethylene sheeting	S.F.	$0.25	60	$14.75	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	3010	$30.12	53%	$14.26
Prohibited practices alternatives	S.F.	$1.61	1	$1.61	0%	$1.61
Vertical Containment	Ea.	$124.99	1	$0.00	0%	$124.99
Total				**$283**	**41%**	**$167**

a. See Table 4-36.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-48: INTERIOR - Public or Commercial building COF - Large Wall or Window/Door Replacement Event						
Cost Type	**Units**	**Labor and Materials Cost Per Unit[a]**	**Number of Units[b]**	**Total Cost Before Baseline Adjustment[c]**	**Baseline Adjustment Factor[d]**	**Total Cost After Baseline Adjustment[e]**
		(1)	**(2)**	**(3)**	**(4)**	**(5)**
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	862	$106.67	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	862	$65.28	28%	$47.22
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	96	$23.62	100%	$0.00
Tack pad	Ea.	$0.51	1	$0.51	39%	$0.32
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	958	$29.64	92%	$2.34
Bag polyethylene sheeting	Ea.	$2.24	13	$28.16	25%	$21.00
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	806	$36.98	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	864	$39.65	41%	$23.49
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	559	$31.66	67%	$10.51
Wet wipe (verification)	S.F.	$0.06	153	$8.69	0%	$8.69
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	632	$34.39	0%	$34.39
Disposable dry cloth	S.F.	$0.05	9	$0.44	0%	$0.44
Prohibited practices alternatives	S.F.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$407**	**63%**	**$149**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-49: INTERIOR - Public or Commercial building COF - Small Wall Event

Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	135	$16.70	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	135	$10.22	28%	$7.39
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	1	$0.15	100%	$0.00
Tack pad	Ea.	$0.51	0	$0.00	39%	$0.00
Pair of disposable shoe covers	Ea.	$0.38	2	$0.77	26%	$0.57
Roll down polyethylene sheeting	S.F.	$0.03	136	$4.20	92%	$0.33
Bag polyethylene sheeting	Ea.	$2.24	2	$3.99	25%	$2.97
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	285	$13.05	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	0	$0.00	41%	$0.00
HEPA vacuum clothes	Ea.	$20.62	0.16666667	$3.44	39%	$2.11
Wet wipe (cleaning)	S.F.	$0.06	104	$5.88	67%	$1.95
Wet wipe (verification)	S.F.	$0.06	28	$1.61	0%	$1.61
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	117	$6.38	0%	$6.38
Disposable dry cloth	S.F.	$0.05	2	$0.08	0%	$0.08
Prohibited practices alternatives	S.F.	n.a.	n.a.	n.a.	n.a.	n.a.
Total				**$67**	**65%**	**$24**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-50: INTERIOR - Public or Commercial building COF - Interior Painting Event						
Cost Type	Units	Labor and Materials Cost Per Unit[a] (1)	Number of Units[b] (2)	Total Cost Before Baseline Adjustment[c] (3)	Baseline Adjustment Factor[d] (4)	Total Cost After Baseline Adjustment[e] (5)
Sign	Ea.	$0.11	2	$0.22	45%	$0.12
Floors: Cover surfaces with polyethylene sheeting (Labor)	S.F.	$0.12	862	$106.67	100%	$0.00
Floors: Cover surfaces with polyethylene sheeting (Materials)	S.F.	$0.08	862	$65.28	28%	$47.22
Walls: Cover surfaces with polyethylene sheeting	S.F.	$0.25	96	$23.62	100%	$0.00
Tack pad	Ea.	$0.51	1	$0.51	39%	$0.32
Pair of disposable shoe covers	Ea.	$0.38	0	$0.00	26%	$0.00
Roll down polyethylene sheeting	S.F.	$0.03	958	$29.64	92%	$2.34
Bag polyethylene sheeting	Ea.	$2.24	13	$28.16	25%	$21.00
HEPA vacuum for work area	Ea.	$0.63	1	$0.63	50%	$0.31
HEPA vacuum (floor)	S.F.	$0.05	806	$36.98	100%	$0.00
HEPA vacuum (walls)	S.F.	$0.05	864	$39.65	41%	$23.49
HEPA vacuum clothes	Ea.	$20.62	0	$0.00	39%	$0.00
Wet wipe (cleaning)	S.F.	$0.06	559	$31.66	67%	$10.51
Wet wipe (verification)	S.F.	$0.06	153	$8.69	0%	$8.69
Electrostatic cloth sweeper	Ea.	$0.01	1	$0.01	30%	$0.01
Disposable wet cloth	S.F.	$0.05	632	$34.39	0%	$34.39
Disposable dry cloth	S.F.	$0.05	9	$0.44	0%	$0.44
Prohibited practices alternatives	S.F.	$1.06	1	$1.06	0%	$1.06
Total				**$408**	**63%**	**$150**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-51: Exterior - Public or Commercial building COF - Daycare Center 1-Wall Exterior Painting Event						
Cost Type	Units	Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
		(1)	(2)	(3)	(4)	(5)
Sign	S.F.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	791	$63.28	89%	$7.03
Doors: Cover surfaces with polyethylene sheeting	Ea.	$0.25	60	$14.75	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	851	$8.51	53%	$4.03
Prohibited practices alternatives	S.F.	$1.61	1	$1.61	0%	$1.61
Vertical Containment	Ea.	$6.59	1	$6.59	0%	$6.59
Total				**$88**	**78%**	**$19**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-52: Exterior - Public or Commercial building COF - Daycare Center 4-Wall Exterior Painting Event						
Cost Type	Units	Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
		(1)	(2)	(3)	(4)	(5)
Sign	S.F.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	3163	$253.10	89%	$28.12
Doors: Cover surfaces with polyethylene sheeting	Ea.	$0.25	220	$54.08	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	3383	$33.85	53%	$16.02
Prohibited practices alternatives	S.F.	$1.61	1	$1.61	0%	$1.61
Vertical Containment	Ea.	$29.37	1	$29.37	0%	$29.37
Total				**$343**	**78%**	**$75**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-53: Exterior - Public or Commercial building COF - School 1-Wall Exterior Painting Event						
Cost Type	Units	Labor and Materials Cost Per Unit[a]	Number of Units[b]	Total Cost Before Baseline Adjustment[c]	Baseline Adjustment Factor[d]	Total Cost After Baseline Adjustment[e]
		(1)	(2)	(3)	(4)	(5)
Sign	S.F.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	1322	$105.78	89%	$11.75
Doors: Cover surfaces with polyethylene sheeting	Ea.	$0.25	100	$24.58	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	1422	$14.23	53%	$6.73
Prohibited practices alternatives	S.F.	$1.61	1	$1.61	0%	$1.61
Vertical Containment	Ea.	$13.00	1	$13.00	0%	$13.00
Total				**$146**	**77%**	**$33**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

Table 4A-54: Exterior - Public or Commercial building COF - School 2-Wall Exterior Painting Event						
Cost Type	**Units**	**Labor and Materials Cost Per Unit[a]**	**Number of Units[b]**	**Total Cost Before Baseline Adjustment[c]**	**Baseline Adjustment Factor[d]**	**Total Cost After Baseline Adjustment[e]**
		(1)	**(2)**	**(3)**	**(4)**	**(5)**
Sign	S.F.	$0.11	2	$0.22	47%	$0.12
Ground: Cover surfaces with polyethylene sheeting	S.F.	$0.08	2644	$211.56	89%	$23.51
Doors: Cover surfaces with polyethylene sheeting	Ea.	$0.25	220	$54.08	100%	$0.00
Roll down polyethylene sheeting	S.F.	$0.01	2864	$28.66	53%	$13.56
Prohibited practices alternatives	S.F.	$1.61	1	$1.61	0%	$1.61
Vertical Containment	Ea.	$23.76	1	$23.76	0%	$23.76
Total				**$296**	**79%**	**$63**

a. See Table 4-35.
b. Estimated using EPA (2006) methodology.
c. Product of (1) and (2).
d. See Table 4-51
e. Product of (3) and one minus (2).

Abbreviations: S.F. = Square Feet; Ea. = Each Item

Source: EPA Calculations; HUD 2003; RS Means 2005; U.S. Bureau of Labor Statistics 2005b.

5. Benefits

This chapter presents an analysis of the benefits associated with regulations to be promulgated under TSCA Section 402(c)(3). The proposed work practices, training and certification requirements will reduce lead exposure by increasing the containment and cleanup of dust and debris generated by renovation, repair, and painting (RRP) activities in target housing (TH) and in child-occupied facilities (COF). Additional reductions in lead exposure will be achieved by prohibiting the use of certain paint preparation and removal techniques in jobs that require lead-safe work practices, and by requiring the use of vertical containment in some LRRP jobs. These reductions in exposure will in turn reduce the risks of adverse health and ecological effects in the vicinity of these activities.

However, as discussed later (see results presented in Section 5.7.3), EPA analysis generates certain results that seem to indicate that more stringent control options yield smaller improvements reducing the risks of elevated blood lead levels in children than do less stringent control options. For example, the analysis estimates that using only containment of dust and debris generated during a RRP activity yields higher benefits than using all of the rule's work practices (containment, cleaning, and cleaning verification). This is the opposite of what one might expect and of what is observed in the Dust Study for the 10 experiments that used rule cleaning and containment, since the benefits analysis implies that the combination of rule-style containment with rule-style cleaning and verification would result in more exposure than when such containment is combined with conventional cleaning. This is inconsistent with the Dust Study which shows that the largest decreases were observed in the 10 experiments where the rule's practices of containment, specialized cleaning, and cleaning verification were used. Therefore, the anomalous results are likely to be artifacts of sparse underlying data and modeling assumptions.

EPA summarizes some of the potential causes of these unexpected results (see Section 5.7.4), however at this time EPA is unclear as to precisely why these results are contrary to reasonable expectations. EPA has explored several additional components of the modeling exercise, which might have been leading to unexpected results, but found them not to be the sole cause. For example, EPA has conducted additional Monte Carlo simulations to verify that the model is reasonably stable (see EPA 2008, Appendix E). However, EPA has not investigated all possible data or modeling assumptions that may have led to the anomalous results. For example, the Dust Study was not nationally representative of target housing or COF's. Also, while the Dust Study was intended to assess renovation activities under real-world conditions, these benefits are projected based on analyses that require the assumption that the same house or COF can be renovated identically multiple times to evaluate the performance of the several control options. In sum, because EPA has not determined why the benefits analyses contain anomalous results, EPA has limited confidence in the estimated benefits. EPA does not view the results as being sufficiently robust as to represent the difference in magnitude of the benefits across regulatory alternatives. The estimated benefits for the control options relative to the assumed baseline are also affected by both the limited number of experiments in the Dust Study and the fact that the housing and the COF used in the Dust Study do not represent a statistically valid sample of housing at the national level. In addition, EPA has limited confidence in the quantification of the baseline because of the limited data available to the Agency on the range of practices currently used by contractors.

The chapter is organized around the analytical steps involved in estimating the benefits. These steps are outlined in Figure 5-1. The first section of this chapter presents an overview of these steps, including: -(1) define the exposure scenarios to be evaluated, (2) estimate the IQ changes for each exposure scenario, (3) define the current work practice baseline and estimate the IQ changes currently occurring in LRRP events, (4) estimate the incremental IQ change for each regulatory option relative to the baseline work practices, and (5) estimate the dollar value of the reductions in adverse effects. Sections 5.2 through 5.6 provide the detail on steps one through four. Section 5.7 presents the numerical estimates of the value of the benefits to children.

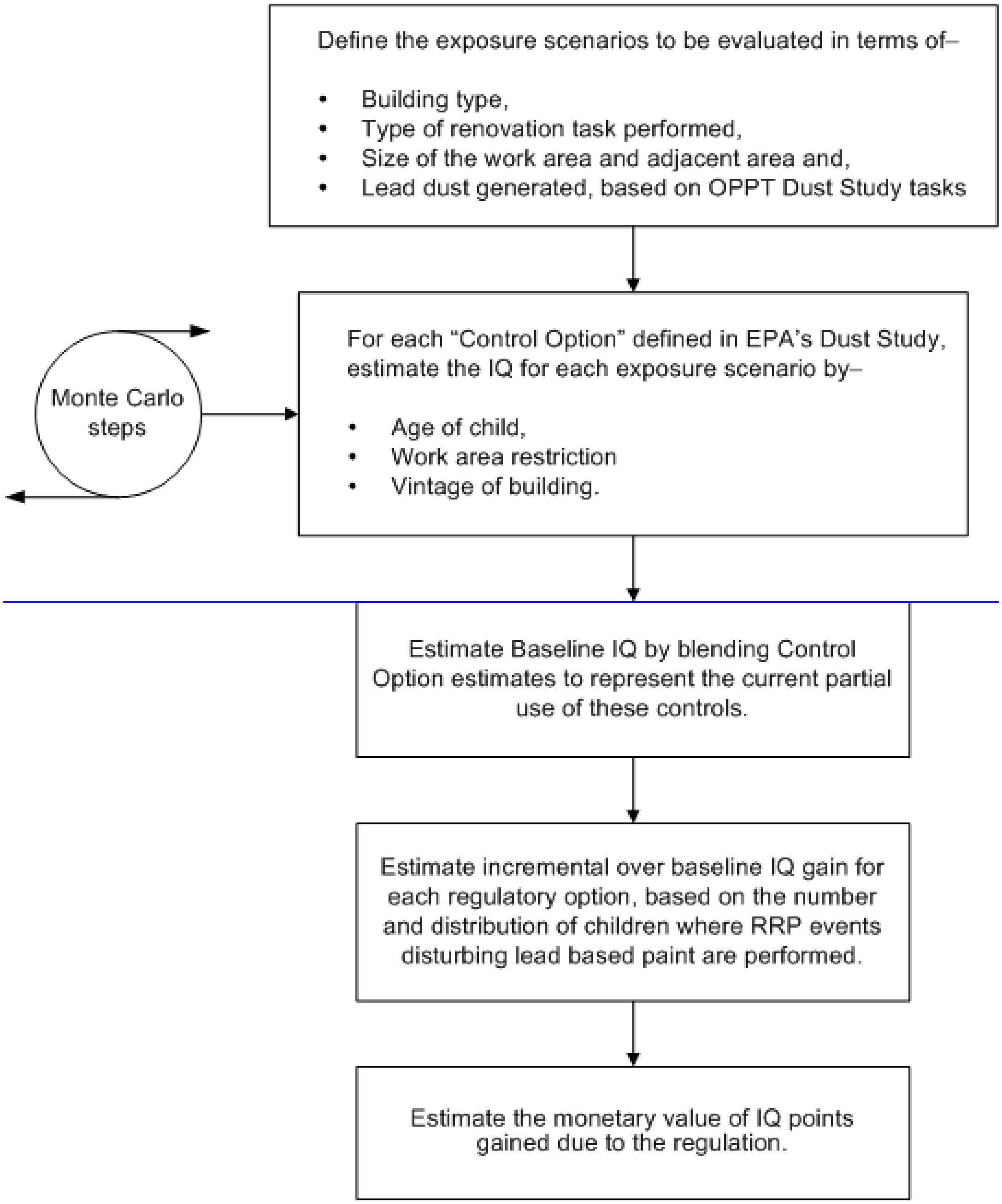
As described more fully in Chapter 4, the regulatory options are defined in terms of:

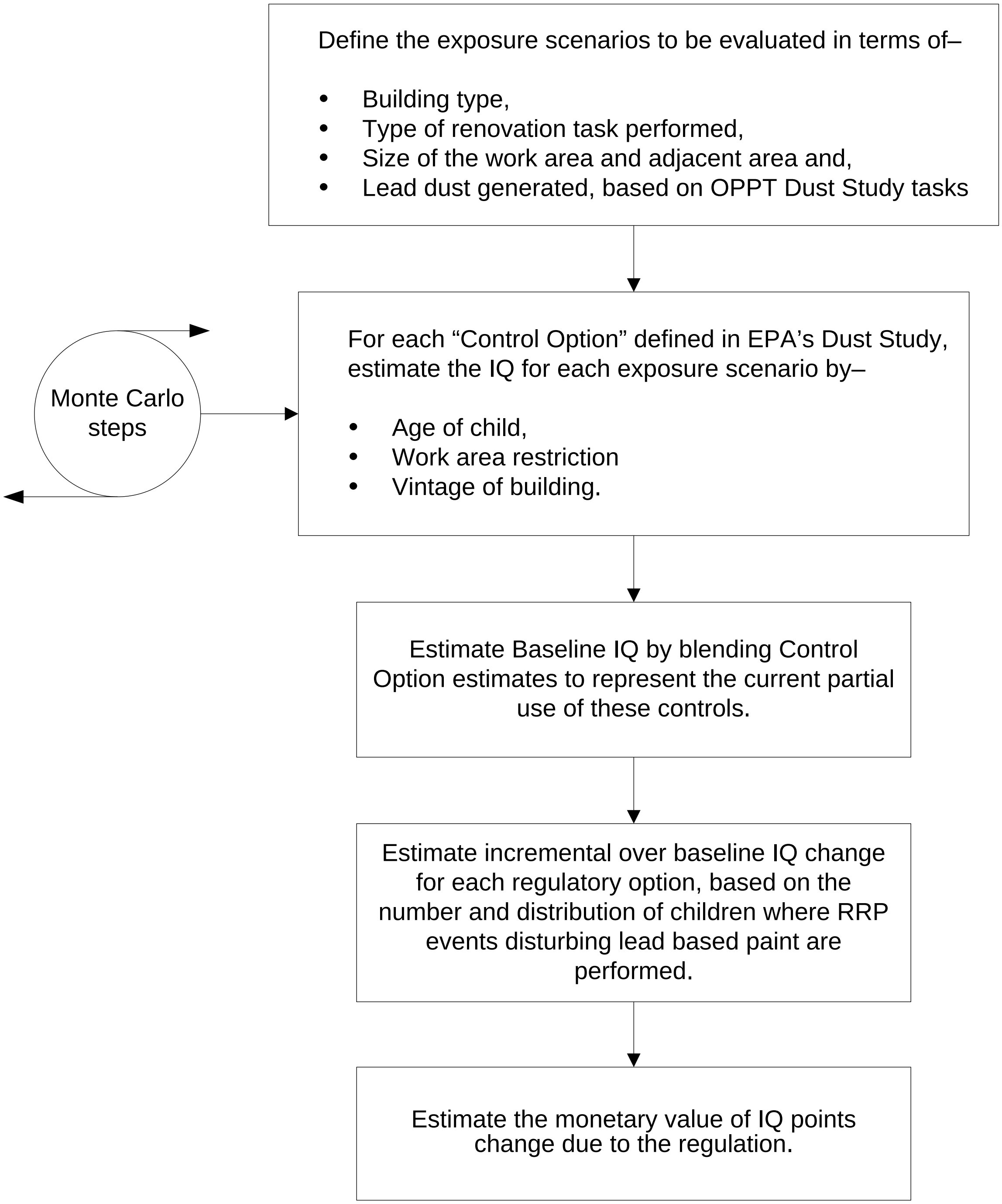
- Their Scope – the particular buildings to which the regulations apply (in terms of year structures were built, whether or not children under the age of 6 or a woman who is or may be pregnant woman are present, and whether the housing units are owner-occupied or rented),
- The Work Practices – the type and extent of containment and clean-up, and whether certain work practices (e.g. high temperature heat guns) are prohibited, and
- Training and Certification requiredrequirements -- extent of training, as well as frequency of training and certification.

The scope of the regulation defines the number of RRP events by type of event, as well as the number of children by age of child that will benefit from the rule. The difference between the anticipated loss of children's IQ points due to lead exposure under the rule (expressed in terms of dollar value) and the "without rule" baseline IQ loss are the quantified benefits of the rule. Because some of the cleaning and containment work practices specified in the regulatory options are already used in some RRP events, the incremental changes in exposure and IQ change attributable to each of the regulatory options are estimated relative to current baseline practices.

FourFive appendices supplement this chapter. They are 5A: Lead-Related Health Effects and Ecological Effects, 5B: Estimating Lead Dust Contamination from Renovation, 5C: Estimating Blood Lead (Pb) Levels Resulting from RRP Events, and 5D: Estimating IQ Effects; 5E: Assumptions about Children's Access to the Work Area.

Figure 5-1: Overview of Analytical Steps




Define the exposure scenarios to be evaluated in terms of–
• Building type,
• Type of renovation task performed,
• Size of the work area and adjacent area and,
• Lead dust generated, based on OPPT Dust Study tasks
Monte Carlo steps
For each "Control Option" defined in EPA's Dust Study, estimate the IQ for each exposure scenario by–
• Age of child,
• Work area restriction
• Vintage of building.
Estimate Baseline IQ by blending Control Option estimates to represent the current partial use of these controls.
Estimate incremental over baseline IQ change for each regulatory option, based on the number and distribution of children where RRP events disturbing lead based paint are performed.
Estimate the monetary value of IQ points change due to the regulation.

5.1 Overview of Approach

A great deal of information on the numerous adverse health effects of lead is available from decades of medical observation and scientific research. Inhaled or ingested lead is distributed throughout the body and is toxic to many organ systems. As a result, its toxicity manifests itself in the form of impacts on several organ systems. A reduction in lead exposure resulting from the rule would lead to a reduction in these adverse health effects and the costs of treating them. Young children are particularly sensitive to lead, which impairs a child's neuropsychological development (~~most commonly~~frequently measured ~~as reduced~~by IQ~~).~~

~~Increased blood-lead levels have also been associated with aberrant behavior~~ change). EPA's Air Quality Criteria for Lead (EPA 2006) provided a thorough review of the available science on lead-related health and ~~an increase~~ecological effects. An excerpt from the Executive Summary is provided in ~~attention deficit hyperactivity (ADHD) in school-age children and a decrease in their growth rate and stature (Needleman 1996, Needleman 2002, Braun 2006, Schwartz 1986, Shukla 1989, Shukla 1992). In addition, more recently a possible association~~Appendix 5A.

Investigating associations between ~~childhood~~ lead exposure and ~~subsequent~~behavior, mood, and social conduct of children has been an emerging area of research. Early studies indicated linkages between lower-level Pb toxicity and behavioral problems (e.g., aggression, attentional problems, and hyperactivity) in children. Blood-lead and tooth-lead levels have been associated with behavioral features of ADHD, including distractibility, poor organization, lacking persistence in completing tasks, and daydreaming, in various cohorts of children with a wide range of Pb exposures. (EPA, 2006, p. 8-31 – 32)

The relationship between lead exposure and delinquent and criminal behavior ~~in adulthood~~also has been ~~observed (Nevin 2007, Reyes 2007).~~
addressed in several investigations. Studies linking attention deficits, aggressive and disruptive behaviors, and poor self-regulation with lead have raised the prospect that early exposure may result in an increased likelihood of engaging in antisocial behaviors in later life. In two prospective cohort studies conducted in Pittsburgh (Needleman et al., 1996) and Cincinnati (Dietrich et al., 2001), elevated lead levels were associated with several measures of behavioral disturbance and delinquent behavior. (EPA 2006 p. 8-32)
These cognitive and behavioral effects, discussed above, are strongly related to ~~their~~ future productivity and expected earnings (Salkever 1995). Both epidemiologic and toxicological studies have shown that environmentally relevant levels of lead affect many different organ systems (EPA 2006). It appears that some of these effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood-lead levels so low as to be essentially without a threshold (EPA 2004).

Epidemiologic studies have consistently demonstrated associations between lead exposure and enhanced risk of deleterious cardiovascular outcomes, including increased blood pressure and increased hypertension (EPA 2006). However, there is sufficient uncertainty about the level of exposure that adults living in target housing or working in COFs will experience that this analysis did not attempt to estimate the level of adverse health effects that would be avoided among adults due to the regulations under consideration. Thus the benefits valuation estimates do not include adult benefits. However, the analysis does present the number of adults who will potentially experience reduced exposures to lead as a result of implementation of the rule. Appendix 5A presents an assessment of the animal toxicology and human epidemiology data available for a range of health effects associated with lead.

The analysis presented in this report focuses on effects on cognitive function in young children (from birth through age five). ~~It~~Neurotoxic effects in children and cardiovascular effects in adults are among

those best substantiated as occurring at blood-lead concentrations as low as 5 to 10 ug/dL (or possibly lower); and these categories of effects are currently clearly of greatest public health concern (EPA 2006, p 8-60). Other newly demonstrated immune and renal system effects among general population groups are also emerging as low-level lead exposure effects of potential public health concern (EPA 2006, p 8-60). Both epidemiologic and toxicologic studies have shown that environmentally relevant levels of lead affect many different organ systems (EPA 2006, p.E-8).
The analysis presented in this report is able to include only a subset of children's health effects due to limitations in understanding and quantifying the dose response relationships for some of the health effects. Even where the dose-response relationships are known, many cases are not included in the estimates because exposure levels cannot be estimated for the relevant groups of potentially affected individuals. For example, IQ losses in children that result from prenatal exposures and IQ losses from exposuredue to lead in breast milk are not included even though it is well known that lead freely crosses the placenta to the fetus during pregnancy and moves from the mother's body into her breast milk during lactationin this analysis (EPA 2006). Pregnant women exposed to lead during renovation activities will readily pass the lead to their developing offspring. This will increase the body burden of lead in newborn and nursing infants, increasing the potential impact on their developing nervous systems and concomitant decrements in IQ function. In addition, exposures of some other potentially affected individuals (for example, neighborsneighbor children of households performing renovations) also have not been estimated in this assessment.

To estimate the benefits of the proposed rulemaking, the quantified adverse health effects associated with exposures to lead from RRP tasks in the baseline (i.e., without RRP regulation) are first calculated; then, health effects associated with exposures are calculated assuming the RRP regulations are in place. Since the rule requires actions intended to reduce contamination, fewer adverse health effects are expected with the rule. This reduction in adverse health effects is the rule's major benefit.
The most commonly used measure of the amount of lead in the body is blood-lead level (PbB), although lead also bioaccumulates in bone, hair, teeth, and other tissues. Published studies relate one or more of these measures, such as blood or bone lead levels, to adverse health effects. Blood lead is generally a biomarker of recent lead exposure. However, it is also affected by chronic exposure (i.e., lead released from bone from previous exposure may result in elevated blood lead levels).

Some studies have examined the question of whether the neurological effects of exposures in early childhood are ameliorated when blood-lead levels decline. The data are mixed on this issue. In a study that treated lead-exposed children with a chelating agent, Ruff (1993) found that children whose blood-lead levels had the greatest decline showed the most improvement in IQcognitive scores. In contrast, Rogan (2001) found that treatment with a chelating agent lowered blood-lead levels in children but did not appear to improve neurological function. Liu (2002) also found that chelation therapy at age 2, while lowering blood-lead levels, did not improve neurological function in children at 5 years of age. While the study did detect a relationship between declining blood-lead and improved neurological function, this association was observed only in the untreated group, leading the authors to speculate that some other factor besides declining lead levels from chelation therapy (such as greater parental involvement), led to the neurological gains. Dietrich (2004) had similar findings in the same cohort of children at 7 years of age. One study cited in ATSDR (1999) showed impaired motor and cognitive function at a current mean level of 2.9 µg/dL, about 20 years after exposure when blood-lead levels were 40-50 µg/dL (Stokes 1998). TheseThe negative impact of lead on IQ and other neurobehavioral outcomes persist in most recent studies suggest that medical interventions aimed at lowering blood-lead levels may not leadfollowing adjustment for numerous confounding factors including social class, quality of caregiving, and parental intelligence. Moreover, these effects appear to dramatic improvements in neurological function. persist into adolescence and young adulthood in the absence of marked reductions in environmental exposure to lead. (EPA 2006, p. 6-76). This further supports the concern that early exposures to lead may lead to irreversible damage and supports the benefits of regulatory interventions to prevent and/or reduce lead exposure.

There are five primary steps in estimating the adverse health effects associated with renovation, repair, and painting projects:

1. Define the exposure scenarios to be evaluated and map RRP activities to OPPT Dust Study activities by building type, exposure duration, type of renovation task, and size of the work area and adjacent area;
2. Estimate IQ change for each exposure scenario by type of building, vintage of the building, age of child, work space access, exposure duration, and control option;
3. Define current work practice baseline, relate baseline work practices to the "control options" in OPPT's Dust Study, and estimate IQ losschange in the baseline;
4. Estimate incremental IQ losschange for each regulatory option and the total IQ gain that would be due to the regulatory option based on the number and distribution of children in target housing (TH) and child occupied facilities (COF) where RRP events disturbing lead based paint is performed; and
5. Assign medical costs, reduced income, or another proxy for willingness-to-pay to avoid the adverse health effects.

Step 1 maps RRP activities into dust study activities and then generates the universe of RRP exposure scenarios for which IQ change will be estimated. Step 2 estimates the child-specific IQ change per each RRP exposure scenario generated in step 1, while taking into account control option, age of the child, workspace access, and vintage of the building. In step 3, current work practice baseline (cleaning and containment) are defined in terms of control options. In step 4, the incremental IQ change values for each regulatory option are scaled up to capture the population of children affected by all RRP events disturbing lead based paint. In step 5, the population based IQ change is multiplied by the value of an IQ point. Methods for implementing these steps are described in detail in Sections 5.2 through 5.6.

5.2 Define Exposure Scenarios and Map RRP Tasks to Dust Study Activities (Step 1)

To generate the exposure scenarios, it was necessary to mapThe choices of RRP activities covered by in these analyses (are based on previously compiled datasets. For residential scenarios Census data –from the 1997 and the 2003 American Housing Survey (AHS) and the 1995 POMS – Property Owners and HUDManagers Survey (POMS) were used to identify the activities. For COFs in public or commercial buildings, EPA used data – the from HUD's 2003 First National Health Survey of Child Care Centers (referred to as CCC) inand Whitestone Research (Whitestone 2006, described in Section 4.3). In order to generate the exposure scenarios, it was necessary to map RRP activities covered in the benefits analysis to the dust study tasks, as defined in the 2007 OPPT *Characterization of Dust Lead Levels after Renovation, Repair, and Painting Activities* (Dust Study) (U.S. EPA 2007)b), referred to as the Dust Study. The Dust Study was designed to measure environmental lead levels after various types of RRP activities were conducted on the interior and exterior of residential housing units and child occupied facilities (EPA

2007b). In the Dust Study, lead loadings were measured for specific work activities (e.g., cutting drywall, planing a door, or replacing a window) rather than for a job as defined by the POMS, AHS, or CCC surveys (e.g., replacing a pipe or renovating a kitchen). Consequently, it was necessary to map the work activities described in the Dust Study to the renovation and remodeling tasks described in the POMS, AHS, and CCC surveys.

The possible sets of exposure scenarios vary by:

- The building type where exposure occurs and the resulting duration of exposure, including:
  - Target Housing[1]
    - where a child-occupant who attends daycare is exposed at home,
    - where a child-occupant who does not attend daycare is exposed at home, and
    - where a daycare child is exposed, and
  - Child-Occupied Facilities in Public or Commercial Buildings
    - daycare centers,
    - schools.
- The type of renovation tasks performed (described below).
- The size of the work area and the adjacent area (described below).

5.2.1 *Target Housing*

To generate the exposure scenarios, it was necessary to map the RRP activities defined based on Census data from the 1997 and the 2003 American Housing Survey (AHS) and the 1995 Property Owners and Managers Survey (POMS) into a set of tasks derived from the OPPT Dust Study experiments – hereafter tasks derived from the OPPT Dust Study experiments will be referred to as Dust Study tasks.

Table 5-1: Map between OPPT Dust Study Task and Census RRP Tasks for Target Housing

shows how the OPPT Dust Study tasks are scaled and mapped to RRP activities reported in Census data for target housing. These relationships are further described below.

[1] The differences between target housing exposure locations are based on the amount of time the child spends in the target housing where the exposure occurs—e.g., a child who lives in the renovated target housing unit and attends daycare is assumed to not be home all day; a child who lives in the renovated target housing unit and does not attend daycare is assumed to be home all day; a child that attends a family daycare in a renovated target housing unit is assumed to be exposed only while attending daycare. Note that the analysis does not consider a scenario where a child gets exposed at daycare and at home.

Table 5-1: Map between OPPT Dust Study Task and Census RRP Tasks for Target Housing	
OPPT Dust Study Task	**Census Task**
Small Cabinet removal	Remodeled bathroom and performed no other remodeling, addition, or wall tasks.
Medium Cabinet removal	Remodeled kitchen and performed no other remodeling, addition, or wall tasks.
Large Cabinet removal	Remodeled bathroom and kitchen and performed no other remodeling, addition, or wall tasks.
Small 1-Cut-Out	Did not remodel kitchen, bathroom; did not add any rooms; performed 1 of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Small 3-Cut-Outs	Did not remodel kitchen, bathroom; did not add any rooms; performed 2 of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Medium 3-Cut-Outs	Did not remodel kitchen, bathroom; did not add any rooms; performed more than 2 of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Small 6-Cut-Outs	Added 1 room and performed 1 of the following tasks: Remodeled Bathroom (AHS TASK ID 71) Remodeled Kitchen (AHS TASK ID 72) Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)

Table 5-1: Map between OPPT Dust Study Task and Census RRP Tasks for Target Housing	
OPPT Dust Study Task	Census Task
Medium 6-Cut-Outs	Added 1 room and performed more than 1 of the following tasks: Remodeled Bathroom (AHS TASK ID 71) Remodeled Kitchen (AHS TASK ID 72) Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Large 6-Cut-Outs	Added 2 or more rooms
Small Cabinet removal/3-Cut-Outs	Remodeled bathroom and performed 1 or 2 of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Medium Cabinet removal/3-Cut-Outs	Remodeled kitchen and performed 1 or 2 of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Large Cabinet removal/3-Cut-Outs	Remodeled kitchen and bathroom and performed 1 of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Small Cabinet removal/6-Cut-Outs	Remodeled bathroom and performed 3 or more of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)

Table 5-1: Map between OPPT Dust Study Task and Census RRP Tasks for Target Housing	
OPPT Dust Study Task	Census Task
Medium Cabinet removal/6-Cut-Outs	Remodeled kitchen and performed 3 or more of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Large Cabinet removal/6-Cut-Outs	Remodeled kitchen and bathroom and performed 2 or more of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Small 6-Cut-Outs	Added 1 room and performed 1 of the following tasks: Remodeled Bathroom (AHS TASK ID 71) Remodeled Kitchen (AHS TASK ID 72) Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Medium 6-Cut-Outs	Added 1 room and performed more than 1 of the following tasks: Remodeled Bathroom (AHS TASK ID 71) Remodeled Kitchen (AHS TASK ID 72) Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Large 6-Cut-Outs	Added 2 or more rooms
Interior Painting – Dry Scraping (equally distributed among small, medium, and large)	38% of Interior Painting (based on phone calls to 9 painters)
Interior Painting – High Temperature Heat Gun (equally distributed among small, medium, and large)	7% of Interior Painting (based on phone calls to 9 painters)
Interior Painting – Low Temperature Heat Gun (equally distributed among small, medium, and large)	20% of Interior Painting (based on phone calls to 9 painters)

Table 5-1: Map between OPPT Dust Study Task and Census RRP Tasks for Target Housing	
OPPT Dust Study Task	**Census Task**
Interior Painting – Power Scraping Door (equally distributed among small, medium, and large)	35% of Interior Painting (based on phone calls to 9 painters)
1 Window/Door Replacement	1/3rd of Window/Door Replacements are assumed to involve 1 window/door
3 Window/Door Replacement	1/3rd of Window/Door Replacements are assumed to involve 3 windows/doors
12 Window/Door Replacement	1/3rd of Window/Door Replacements are assumed to involve 12 windows/doors
Exterior Painting – Dry Scraping (½ Small and ½ Large)	29% of Exterior Painting (based on phone calls to 9 painters)
Exterior Painting – High Temperature Heat Gun (½ Small and ½ Large)	4% of Exterior Painting (based on phone calls to 9 painters)
Exterior Painting – Low Temperature Heat Gun (½ Small and ½ Large)	20% of Exterior Painting (based on phone calls to 9 painters)
Exterior Painting – Power Sanding (½ Small and ½ Large)	44% of Exterior Painting (based on phone calls to 9 painters)
Exterior Painting – Torch (½ Small and ½ Large)	3% of Exterior Painting (based on phone calls to 9 painters)
Replaced Exterior Door	50% of Contained Exterior (and no other RRP tasks)
Needle Gun Exterior Paint Removal	50% of Contained Exterior (and no other RRP tasks)
Replaced Trim	100% of Siding Replacement (and no other Interior RRP task)

In estimating the effects of scenarios where more or less painted surface was disturbed than occurred in an OPPT Dust Study experiment, data from the OOPT Dust Study was extrapolated to these other events. For example, one window was replaced in each OPPT Dust Study window replacement experiment. To extrapolate to a scenario where three windows are replaced, the amount of lead created was assumed to be three times the level in the one window dust study experiment. To derive these level-of-intensity Dust Study tasks, the target housing Census activities (in bold) were mapped to the following groups of Dust Study tasks:

OPPT Dust Study Task	**Size of Work Area**	**Census Task**
Cabinet removal	Small work area	Remodeled bathroom and performed no other remodeling, addition, or wall tasks.
Cabinet removal	Medium work area	Remodeled kitchen and performed no other remodeling, addition, or wall tasks.
Cabinet removal	Large work area	Remodeled bathroom and kitchen and performed no other remodeling, addition, or wall tasks.

OPPT Dust Study Task	Size of Work Area	Census Task
1-Cut-Out	Small work area	Did not remodel kitchen, bathroom; did not add any rooms; performed 1 of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
3-Cut-Outs	Small work area	Did not remodel kitchen, bathroom; did not add any rooms; performed 2 of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
3-Cut-Outs	Medium work area	Did not remodel kitchen, bathroom; did not add any rooms; performed more than 2 of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
6-Cut-Outs	Small work area	Added 1 room and performed 1 of the following tasks: Remodeled Bathroom (AHS TASK ID 71) Remodeled Kitchen (AHS TASK ID 72) Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
6-Cut-Outs	Medium work area	Added 1 room and performed more than 1 of the following tasks: Remodeled Bathroom (AHS TASK ID 71) Remodeled Kitchen (AHS TASK ID 72) Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)

OPPT Dust Study Task	Size of Work Area	Census Task
6-Cut-Outs	Large work area	Added 2 or more rooms
Cabinet removal and 3-Cut-Outs	Small work area	Remodeled bathroom and performed 1 or 2 of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Cabinet removal and 3-Cut-Outs	Medium work area	Remodeled kitchen and performed 1 or 2 of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Cabinet removal and 3-Cut-Outs	Large work area	Remodeled kitchen and bathroom and performed 1 of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Cabinet removal and 6-Cut-Outs	Small work area	Remodeled bathroom and performed 3 or more of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
Cabinet removal and 6-Cut-Outs	Medium work area	Remodeled kitchen and performed 3 or more of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)

OPPT Dust Study Task	Size of Work Area	Census Task
Cabinet removal and 6-Cut-Outs	Large work area	Remodeled kitchen and bathroom and performed 2 or more of the following tasks: Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
6-Cut-Outs	Small work area	Added 1 room and performed 1 of the following tasks: Remodeled Bathroom (AHS TASK ID 71) Remodeled Kitchen (AHS TASK ID 72) Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
6-Cut-Outs	Medium work area	Added 1 room and performed more than 1 of the following tasks: Remodeled Bathroom (AHS TASK ID 71) Remodeled Kitchen (AHS TASK ID 72) Added/Replaced Internal Water Pipes In Home (AHS TASK ID 40) Added/Replaced Plumbing Fixtures In Home (AHS TASK ID 47) Added/Replaced Electrical Wiring To Home (AHS TASK ID 42) Installed Paneling Or Ceiling Tiles (AHS TASK ID 55) Added/Replaced Central Air Conditioning (AHS TASK ID 57) Added/Replaced Built-In Heating Equipment (AHS TASK ID 58) Other Major Improvements or Repairs (AHS TASK ID 64) Added/Replaced Security System In Home (AHS TASK ID 74) HVAC work (POMS)
6-Cut-Outs	Large work area	Added 2 or more rooms
Interior Painting – Dry Scraping	Equally distributed among small, medium, and large	38% of Interior Painting (based on phone calls to 9 painters)
Interior Painting – High Temperature Heat Gun	Equally distributed among small, medium, and large	7% of Interior Painting (based on phone calls to 9 painters)
Interior Painting – Low Temperature Heat Gun	Equally distributed among small, medium, and large	20% of Interior Painting (based on phone calls to 9 painters)

OPPT Dust Study Task	Size of Work Area	Census Task
Interior Painting – Power Scraping Door	Equally distributed among small, medium, and large	35% of Interior Painting (based on phone calls to 9 painters)
1 Window/Door Replacement	Na	1/3rd of Window/Door Replacements are assumed to involve 1 window/door
3 Window/Door Replacement	Na	1/3 rd of Window/Door Replacements are assumed to involve 3 windows/doors
12 Window/Door Replacement	Na	1/3 rd of Window/Door Replacements are assumed to involve 12 windows/doors
Exterior Painting – Dry Scraping	½ Small and ½ Large	29% of Exterior Painting (based on phone calls to 9 painters)
Exterior Painting – High Temperature Heat Gun	½ Small and ½ Large	4% of Exterior Painting (based on phone calls to 9 painters)
Exterior Painting – Low Temperature Heat Gun	½ Small and ½ Large	20% of Exterior Painting (based on phone calls to 9 painters)
Exterior Painting – Power Sanding	½ Small and ½ Large	44% of Exterior Painting (based on phone calls to 9 painters)
Exterior Painting –Torch	½ Small and ½ Large	3% of Exterior Painting (based on phone calls to 9 painters)
Replaced Exterior Door	Na	50% of Contained Exterior (and no other RRP tasks)
Needle Gun Exterior Paint Removal	Na	50% of Contained Exterior (and no other RRP tasks)
Replaced Trim	Na	100% of Siding Replacement (and no other Interior RRP task)

In estimating the effects of scenarios where more or less painted surface was disturbed than occurred in an OPPT Dust Study experiment, data from the OPPT Dust Study was extrapolated to these other events. For example, one window was replaced in each OPPT Dust Study window replacement experiment. To extrapolate to a scenario where three windows are replaced, the amount of lead created was assumed to be three times the level in the one window dust study experiment. To derive these level-of-intensity Dust Study tasks, the target housing Census activities (in bold) were mapped to the following groups of Dust Study tasks:

1. **Interior Remodeling, Additions, and Wall Disturbing (RAW)** Census tasks were mapped to 6 OPPT Dust Study tasks, resulting in 15 single-task scenarios based on the number of work area sizes that are assumed for each task—see below for a description of how work area sizes are determined.

    a. Kitchen (and/or Bathroom) Cabinet Removal; work area sizes: small, medium, or large; → 3 single-task scenarios.

b. Cut-Outs at 1/3 the intensity in the OPPT Dust Study (1-Cut-Out); work area sizes: small; → 1 single-task scenario.

c. Cut-Outs with the same intensity as in the OPPT Dust Study (3-Cut-Outs); work area sizes: small, medium; → 2 single-task scenarios.

d. Cut-Outs with double the intensity of the OPPT Dust Study (6-Cut-Outs); work area sizes: small, medium, large; → 3 single-task scenarios.

e. Cabinet ~~removal~~Removal Combined with Cut-Outs with the same intensity as in the OPPT Dust Study (3-Cut-Outs); work area sizes: small, medium, large; → 3 single-task scenarios.

f. Cabinet ~~removal~~Removal Combined with Cut-Outs with double the intensity of the OPPT Dust Study (6-Cut-Outs); work area sizes: small, medium, large; → 3 single-task scenarios.

2. **Interior Painting (IP)** Census tasks were mapped to 4 OPPT Dust Study tasks, resulting in 12 single-task scenarios based on the number of work area sizes assumed for each task.

   a. Dry Scraping; work area sizes: small, medium, large.

   b. High Temperature Heat Gun; work area sizes: small, medium, large.

   c. Low Temperature Heat Gun; work area sizes: small, medium, large.

   d. Power Scraping; work area sizes: small, medium, large.

3. **Window/Door Replacement (WD)** Census tasks were mapped to 3 OPPT Dust Study tasks, resulting in 3 single-task scenarios.

   a. Window replacement with the same intensity as in the OPPT Dust Study (1 Window); work area size: medium.

   b. Window replacement with 3 times intensity as in the OPPT Dust Study (3 Windows); work area size: medium.

   c. Window replacement with 12 times intensity as in the OPPT Dust Study (12 Windows); work area size: medium [2]

4. **Exterior Painting** Census tasks were mapped to 5 OPPT Dust Study tasks, resulting in 10 single-task scenarios based on the number of work area sizes assumed for each task.

   a. Dry Scraping; work area sizes: small, large.

   b. High Temperature Heat Gun; work area sizes: small, large.

   c. Low Temperature Heat Gun; work area sizes: small, large.

[2] Note that house-wide averages are utilized in the IQ-loss methodology. Therefore, the house-wide average effect from replacing 12 windows in one room or 3 windows per room in 4 rooms (12 windows total) is the same. Therefore, although this OPPT Dust Study task was modeled as replacing 12 windows in 1 room, the data are used to represent replacing 3 windows per room in 4 rooms (12 windows total), since this is what is assumed for estimating costs.

   d. Power Scraping; work area sizes: small, large.

   e. Open Flame Burning; work area sizes: small, large.

5. **Other Exterior** Census tasks were mapped to 8 OPPT Dust Study stand-alone[3] Scenarios, including trim replacement together with large exterior painting tasks.

   a. Trim Replacement, single-task and combined with each of the 5 exterior painting Dust Study Tasks; work area sizes: dust study size, large.

   b. Replace Exterior Door; work area sizes: dust study size.

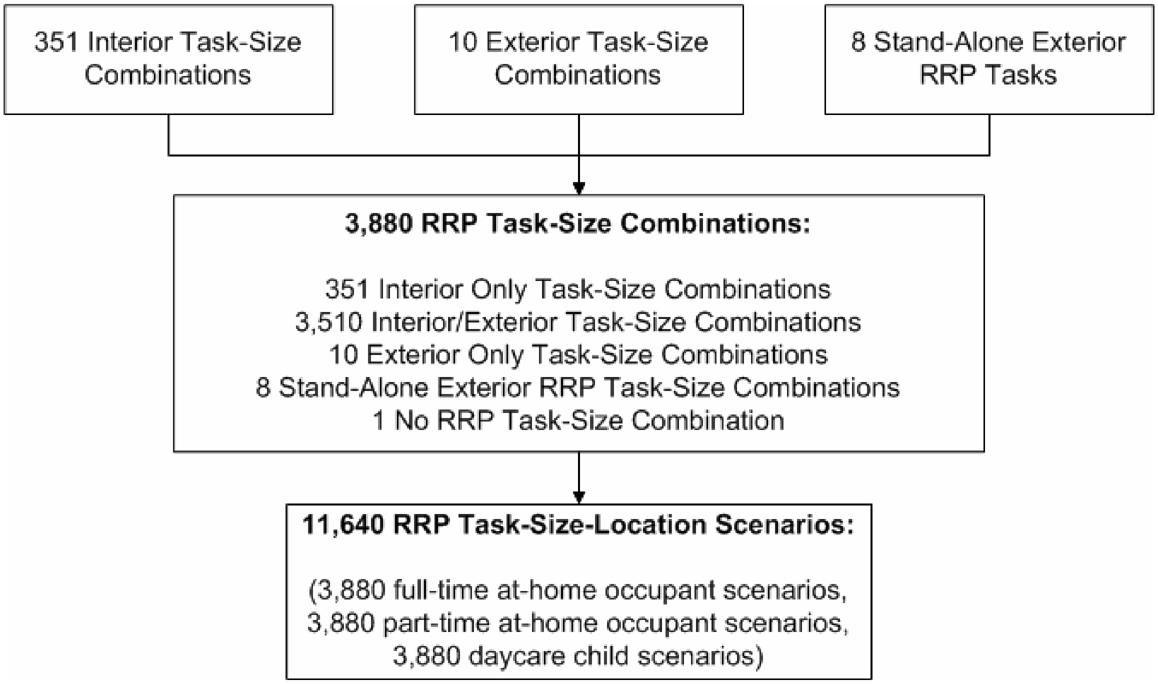
   c. Needle Gun Exterior Paint Removal; work area size: dust study size.

There are 87 possible combinations of the Remodeling, Addition, and Wall Disturbing (RAW) and Interior Painting (IP) tasks (15 RAW-only scenarios, 12 IP-only scenarios, and 15*4 = 60 RAW-IP scenarios).[4] Thus, there are 351 Interior Scenarios (3 WD-only scenarios, 87 RAW/IP-only scenarios, and 87*3 = 261 RAW/IP-WD scenarios. With 351 interior scenarios, 10 exterior painting scenarios and 8 stand-alone exterior scenarios, there are 3,880 scenarios (351 interior-only scenarios, 10 exterior painting-only scenarios, 3,510 combinations of interior and exterior painting scenarios, 8 stand-alone exterior scenarios, and 1 no-RRP scenario) (see Figure 5-2).

[3] A stand-alone scenario is assumed not to occur in combination with other Dust Study tasks. This assumption was made for infrequent Census tasks in order to limit the number of exposure scenarios.

[4] The analysis was constrained so RAW and IP tasks must be like sizes; e.g., there is no scenario with a small RAW and a large IP task.

Figure 5-2: Target Housing RRP Task-Size-Location Scenarios



Work Area Sizes

The costs for most of the containment, cleaning, and verification practices vary with the size of the work area involved. Based on the 2003 AHS, average unit sizes for housing units built before 1978 varied substantially across these categories of housing:

- Single-family owner (2,016 sq. feet),
- Single-family renter (1,471 sq. feet), and
- Multi-family owner & renter (1,135 sq. feet).

For interior events, the average square footage of particular rooms in a single-family owner-occupied home was determined by taking the average square footage of the whole unit from the 1997 AHS (approximately 1,750 sq. feet) and reviewing house plans for homes of similar square footage. The average size of individual rooms was calculated as the average of all rooms of that type from a sample of five house plans.[5] The average square footage of individual rooms in rental single-family units and multi-family units was scaled down from the single-family owner-occupied values in proportion to their relative total square footage.

- For Kitchen or Bathroom Cabinet ~~removal~~Removal and Cut-out activities from the OPPT Dust Study, the three work area sizes (small, medium, and large), are estimated based on the size of a bathroom

[5] Reviewed house plans at http://www.store.homestyles.com/homestyles/plans/search (Homestyles.com 2002).

(3.8% of the housing unit), kitchen (7.4% of the housing unit), or both rooms (11.2% of the housing unit), respectively, as a percentage of the housing unit. [6]

- Window work area sizes are assumed to be the same as a kitchen-sized work area (7.4% of the housing unit).
- For Interior Painting, the large work area size is estimated as being 25% of the total square footage of the housing unit. The square root of the large work area square footage multiplied by 5 yields the small work area size (7% of the housing unit).[7] The medium work area size is the average of the small and the large sizes (16.2% of the housing unit).[8]

To calculate the relevant square footage of an exterior painting event, the perimeters of the typical single-family and multi-family housing unit were estimated. It is assumed that the home is rectangular with a front to side ratio of 2:3 and an average first floor area of 1,390 sq. feet.[9] This assumption leads to a perimeter of 152 feet for a single-family owner-occupied home. The perimeter of a single-family renter unit was estimated to be 130 feet, ~~which assumes~~based on the assumption that ~~the proportion of~~ a single-family renter unit has the same proportion of total square footage to square footage of the first floor ~~of~~ as a single-family owner unit. The perimeter of a multi-family housing structure (which contains several multi-family units) was calculated assuming the first-floor area was three times as large as a single-family unit. This perimeter estimate is 264 feet.

- Exterior painting tasks are assumed to be either along 1 wall or all 4 walls of the building.

---

[6] The bathroom percentage of the unit, 3.8% of the housing unit, is calculated as 3.8% = (48/2,016*4.9%) + (48/1,471*34.2%) + (48/1,135*60.9%). Where 48 square feet is the bathroom size; unit sizes are 2,016, 1,471, and 1,135 square feet, for single-family/owner, single-family/renter, and multi-family units, respectively; and 4.9%, 34.2%, and 60.9%, are the shares of all bathroom events estimated for single-family/owner, single-family/renter, and multi-family units.

The kitchen percentage of the unit, 7.4% of the housing unit, is calculated as 7.4% = (160/2,016*3.5%) + (120/1,471*30.4%) + (80/1,135*66.1%). Where 160, 120, and 80 square feet are the kitchen sizes for single-family/owner, single-family/renter, and multi-family units, respectively; unit sizes are 2,016, 1,471, and 1,135 square feet, for single-family/owner, single-family/renter, and multi-family units, respectively, and 3.5%, 30.4%, and 66.1%, are the shares of all kitchen events estimated for single-family/owner, single-family/renter, and multi-family units.

[7] This represents the area along one wall and five feet out.

[8] The Small Interior Painting size, 7.0% of the housing unit, is calculated as 7.0% = [SQRT(2,016/4)*5/2,016*7.7%] + [SQRT(1,471/4)*5/1,471*35.6%] + [SQRT(1,135/4)*5/1,135*56.7%]. Where the square root of a quarter of the house times 5 is the work area size, SQRT(2,016/4)*5, SQRT(1,471/4)*5, and SQRT(1,135/4)*5 square feet for single-family/owner, single-family/renter, and multi-family units, respectively; unit sizes are 2,016, 1,471, and 1,135, for single-family/owner, single-family/renter, and multi-family units, respectively, and 7.7%, 35.6%, and 56.7%, are the shares of all interior painting events estimated for single-family/owner, single-family/renter, and multi-family units, respectively in the Economic Analysis for the Renovation, Repair, and Painting Program Proposed Rule (EPA 2006b). The large interior painting size is assumed to be 25% of the housing unit, and the medium interior painting size is the midpoint of the small and the large sizes, 16.2% of the housing unit.

[9] Estimated based on information from http://www.dreamhomesource.com (2005) on the average size of the first floor of nine 2,000 square foot two stories homes (1,280 sq. feet). The weighted average of a first floor was calculated using 2003 AHS data which shows that 85% of single-family housing units are two stories high and the remaining 15% of homes are one story (i.e., first floor is 2,016 sq. feet).

- Other exterior work area sizes are assumed to be the same as the OPPT Dust Study experiment size. For example, if one exterior door was replaced in the OPPT Dust Study experiment it was assumed that one exterior door was replaced.

5.2.2 *Public or Commercial Building Child Occupied Facilities (COFs)*

For COFs in public or commercial buildings, EPA used data from HUD's First National Health Survey of Child Care Centers (HUD 2003) and Whitestone Research (see Section 4.3). The survey data were collected in 2001 and were published in 2003. The results include data on 98 daycare centers that are known to have been built before 1978. Table 5-2 shows how the RRP activities in COFs in public or commercial buildings are mapped to OPPT Dust Study tasks. The exposure scenarios differ for schools and daycare centers only in the amount of time a child is assumed to spend in the building.

Table 5-2: Map between OPPT Dust Study Task and Public or Commercial Building COF RRP Task Estimates

OPPT Dust Study Task	HUD/Whitestone Activities
1-Cut-Out	Unplanned maintenance when no other task is performed that year.
3-Cut-Outs	50% of planned wall events when unplanned maintenance does not occur during the year.
6-Cut-Outs	50% of planned wall events when unplanned maintenance does not occur during the year.
4-Cut-Outs	50% of planned wall events when unplanned maintenance occurs during the year.
7-Cut-Outs	50% of planned wall events when unplanned maintenance occurs during the year.
Interior Painting – Dry Scraping (equallyEqually distributed among small, medium, and large)	38% of Interior Painting (based on phone calls to 9 painters)
Interior Painting – High Temperature Heat Gun (equally Equally distributed among small, medium, and large)	7% of Interior Painting (based on phone calls to 9 painters)
Interior Painting – Low Temperature Heat Gun (equally Equally distributed among small, medium, and large)	20% of Interior Painting (based on phone calls to 9 painters)
Interior Painting – Power Scraping Door (equally Equally distributed among small, medium, and large)	35% of Interior Painting (based on phone calls to 9 painters)
1 Window/Door Replacement	50% of Window/Door Replacements
3 Window/Door Replacement	49.7% of Window/Door Replacements
12 Window/Door Replacement	0.3% of Window/Door Replacements
Exterior Painting – Dry Scraping (½ Small and ½ Large)	29% of Exterior Painting (based on phone calls to 9 painters)

Table 5-2: Map between OPPT Dust Study Task and Public or Commercial Building COF RRP Task Estimates	
Exterior Painting – High Temperature Heat Gun (½ Small and ½ Large)	4% of Exterior Painting (based on phone calls to 9 painters)
Exterior Painting – Low Temperature Heat Gun (½ Small and ½ Large)	20% of Exterior Painting (based on phone calls to 9 painters)
Exterior Painting – Power Sanding (½ Small and ½ Large)	44% of Exterior Painting (based on phone calls to 9 painters)
Exterior Painting – Torch (½ Small and ½ Large)	3% of Exterior Painting (based on phone calls to 9 painters)
Needle Gun Exterior Paint Removal	Same Frequency as needle gun exterior paint removal in target housing
Replaced Trim	Same Frequency as TH.

The Public or Commercial Building COF HUD/Whitestone activities (in bold) were mapped to the following groups of Dust Study tasks:

The 19 interior scenarios derived from the HUD/Whitestone activities include the following:

1. **Wall Disturbing (RAW)** tasks (5 single-task scenarios)
    a. Cut-Outs, at 1/3 the intensity in the OPPT Dust Study (1-Cut-Out).
    b. Cut-Outs, with the same intensity as in the OPPT Dust Study (3-Cut-Outs).
    c. Cut-Outs, with double the intensity of the OPPT Dust Study (6-Cut-Outs).
    d. Cut-Outs, at 4/3 the intensity in the OPPT Dust Study (3 Cut-Outs as part of scheduled maintenance and 1 Cut-Out as part of unscheduled maintenance).
    e. Cut-Outs, 7/3 the intensity in the OPPT Dust Study (6 Cut-Outs as part of scheduled maintenance and 1 Cut-Out as part of unscheduled maintenance).
2. **Interior Painting (IP)** tasks (8 single-task scenarios)
    a. Dry Scraping (with and without an unscheduled maintenance Cut-Out).
    b. High Temperature Heat Gun (with and without an unscheduled maintenance Cut-Out).
    c. Low Temperature Heat Gun (with and without an unscheduled maintenance Cut-Out).
    d. Power Scraping (with and without an unscheduled maintenance Cut-Out).
3. **Window/Door Replacement (WD)** tasks (6 single-task scenarios)
    a. Window replacement with the same intensity as in the OPPT Dust Study (1 Window.
    b. Window replacement with 3 times intensity as in the OPPT Dust Study (3 Windows).
    c. Window replacement with 12 times intensity as in the OPPT Dust Study (12 Windows).

The exterior scenarios include the following:

1. **Exterior Painting tasks** (5 OPPT Dust Study activities that result in 15 single-task scenarios)

a. Dry Scraping; work area sizes: small, medium, large.

b. High Temperature Heat Gun; work area sizes: small, medium, large.

c. Low Temperature Heat Gun; work area sizes: small, medium, large.

d. Power Scraping; work area sizes: small, medium, large.

e. Open Flame Burning; work area sizes: small, medium, large.

2. **Other Exterior** tasks (12 stand-alone[10] Scenarios, including trim replacement and exterior door replacement together with large exterior painting activities)

   a. Trim Replacement, single-task and combined with each of the 5 exterior painting Dust Study Tasks; work area sizes: dust study size, large.

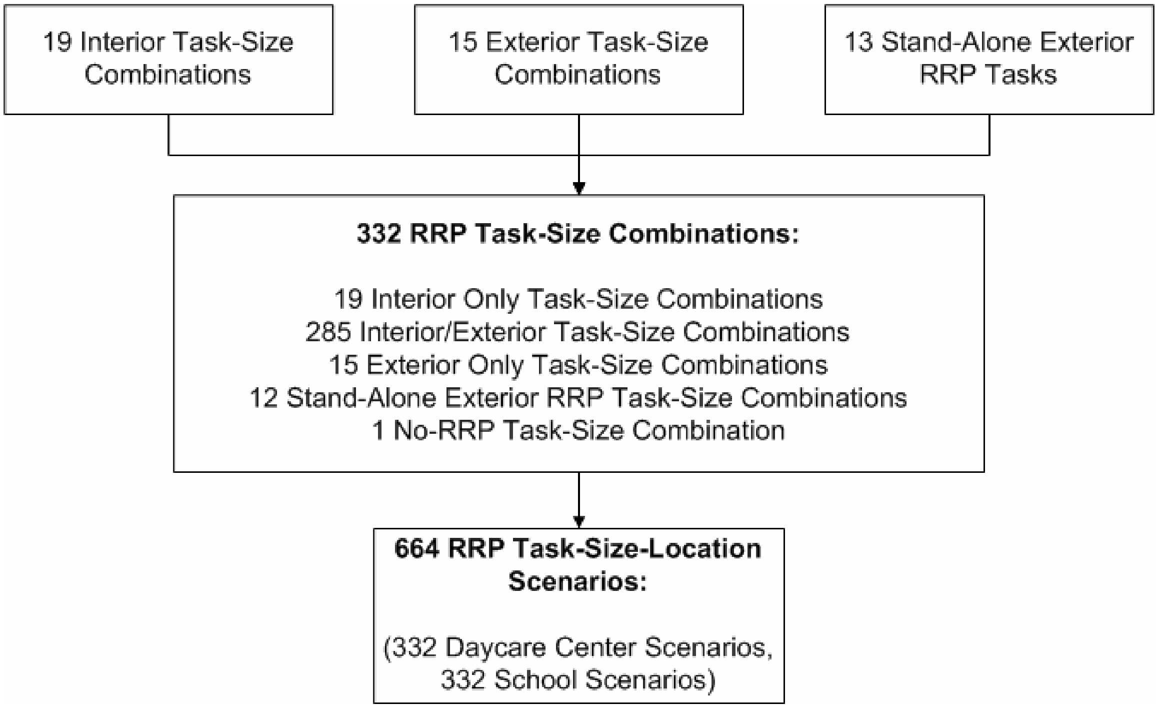
   b. Needle Gun Exterior Paint Removal, single-task and combined with each of the 5 exterior painting Dust Study Tasks; work area sizes: dust study size, large.

The target housing and public and commercial building COF analyses incorporate the same estimates for frequencies with which prohibited practices are used. See Section 5.2.13 for a description of the survey and an explanation of the derivation of these frequencies.

With 19 interior scenarios, 15 exterior painting scenarios, and 12 stand-alone exterior scenarios, there are 332 scenarios (19 interior-only scenarios, 15 exterior painting-only scenarios, 285 (19*15) combinations of interior and exterior painting scenarios, 12 stand-alone exterior scenarios, and 1 no-RRP scenario). Figure 5-3 shows how the 664 public and commercial building exposure scenarios are derived.

Figure 5-3: Public or Commercial Building COF Task-Size-Location Scenarios

[10] A stand-alone scenario is assumed not to occur with other Dust Study tasks. This assumption was made for infrequent Census tasks in order to limit the number of exposure scenarios.


19 Interior Task-Size Combinations
15 Exterior Task-Size Combinations
13 Stand-Alone Exterior RRP Tasks
332 RRP Task-Size Combinations:
19 Interior Only Task-Size Combinations
285 Interior/Exterior Task-Size Combinations
15 Exterior Only Task-Size Combinations
12 Stand-Alone Exterior RRP Task-Size Combinations
1 No-RRP Task-Size Combination
664 RRP Task-Size-Location Scenarios:
(332 Daycare Center Scenarios, 332 School Scenarios)

Work Area Sizes

- Interior work area sizes are all assumed to be the size of a classroom. The average classroom is estimated to be 729 square feet, based on data from the HUD (2003) survey. While the HUD survey was limited to daycare centers, the elementary classrooms sizes are assumed to be similar; note that some of the daycare centers surveyed are located in schools.
- Exterior Painting is assumed to be either along 1, 2, or 4 walls of the building. To calculate the relevant square footage of an exterior painting event, the average perimeters of these buildings were estimated using the average square footage per-floor according to Commercial Buildings Energy Consumption Survey (CBECS) data (DOE 2003). The estimated average square footage of one floor was estimated to be 14,845 for multi-purpose education buildings and 4,871 for stand-alone daycare facilities. It was assumed that the buildings are rectangular with a front to side ratio of 2:3, resulting in a perimeter of 497 feet and 284 feet for multi-purpose education buildings and for stand-alone daycare facilities, respectively.
- Other exterior work area sizes are assumed to be the same as the OPPT Dust Study experiment size

5.2.3 Estimating Lead Levels due to the Use of Prohibited Practices

~~Five~~Six of the regulatory options analyzed in this report (Options A through ~~E~~F) would prohibit the use of certain paint preparation and removal practices in renovations that require the use of lead-safe work practices under the rule.[11] As described above, the OPPT Dust Study results were used to estimate the amount of lead generated by these activities. In estimating the benefits from prohibiting the use of these practices when lead-safe work practices are being used, the following assumptions were made:[12]

- Use of high temperature heat guns would be replaced by use of low-temperature heat gun.
- Use of open flame/torching would be replaced by use of low temperature heat gun.
- Use of power sanding, grind, etc., would be replaced by the same tools with HEPA exhaust controls. The Dust Study did not examine the use of power tools with HEPA exhaust controls, so the analysis uses the Dust Study results for dry scraping instead.

Both the benefit and the cost analyses require an estimate of the frequency with which these various paint preparation and removal techniques are currently used. Table 5-3 indicates the estimated frequencies. These frequencies are based on information provided in telephone calls to 9 painters.[13] The respondents were asked how often they used the following four (4) paint removal techniques on the interior and exterior of pre-1978 buildings:

- Open flame burning or torching of paint;

[11] The practices are open flame burning or torching of paint; using a heat gun above 1,100º F; and power sanding, grinding or abrasive blasting except when done with HEPA exhaust controls.

[12] See Chapter 4 for more discussion of the prohibited practices.

13 Six (6) painting firms and three (3) historic home restoration firms responded to a questionnaire on practices that are prohibited for lead paint abatement. The six painting firms were randomly drawn from the online sales lead provider, Salesgenie.com. The historic home restoration firms were drawn randomly from the Old House Journal's online restoration directory.

- Using a heat gun above 1,100º F;
- Power sanding, grinding or abrasive blasting except when done with HEPA exhaust control; and
- Dry scraping of lead based-paint.

When responding painters could not precisely state what percentage of the time they used a certain work practice they were prompted with never, rarely, sometimes, often or nearly always. These prompted answers were assigned the following values for the percentage of time they are used:

- Never = 1.5%
- Rarely = 16%
- Sometimes = 50%
- Often = 84%
- Nearly always = 99%

Table 5-3 shows the minimum, maximum and average work practice frequencies reported by respondents, where the minimum and maximum values represent the lowest and highest frequencies for individual respondents, and the average represents the typical response across all respondents.

Table 5-3: Summary Statistics for Frequency of Work Practice Use

	Interior Work			Exterior Work		
Prohibited Practice	**Min**	**Max**	**Average**	**Min**	**Max**	**Average**
Open Flame Burning	1.5%	16%	3%	1.5%	16%	3%
Heat Gun > 1100 F	1.5%	16%	5%	1.5%	16%	5%
Power Sanding w/out HEPA	1.5%	99%	40%	1.5%	99%	47%
Dry Scraping	1.5%	99%	43%	1.5%	84%	30%

Based on these responses, it was estimated that interior and exterior painting jobs use various paint removal techniques with the frequencies presented in Table 5-4. Since several respondents indicated that they typically used heat guns at the lower temperatures that would be allowed under the rule, it was assumed that 20 percent of paint removal was performed with low temperature heat guns. The remaining 80 percent of paint removal practices were assumed to occur proportionally to the frequencies in the telephone questionnaire responses, so that the sum of the frequencies for the five paint removal practices is 100 percent.

Table 5-4: Estimated Frequency of Paint Removal Work Practice Use for the Analysis		
Paint Removal Practice Practice	**Interior**	**Exterior**
Heat Gun (Low Temp)	20%	20%
Heat Gun (High Temp)	7%	4%
Open Flame Burning	n.a.	3%
Power Sanding	35%	44%
Dry Scraping	38%	29%
Benefits cannot be estimated for prohibiting interior open flame burning because the Dust Study did not include these activities. As a result, these activities are accounted for as interior high temperature heat gun activities.		

5.2.4 Defining Exposure Scenarios for All Structures

The resulting number of exposure scenarios for target housing and public or commercial building COFs combined is 11,640 + 664 = 12,304, as shown in Figure 5-2 and Figure 5-3.

5.3 Estimate the IQ Change for Each Exposure Scenario by Control Option, Vintage of Building, and Age of Child (Step 2)[14]

IQ change is estimated for each defined exposure scenario described while taking into account various modeling options including:

- Control options[15]:
  - The following four control methods were considered for indoor activities:
    - No plastic, baseline cleaning (Base Control Option);
    - No plastic, verification cleaning (Control Option 1);
    - Rule plastic, baseline cleaning (Control Option 2); and
    - Rule plastic, verification cleaning (Control Option 3, proposed rule requirements).
  - The following three Control Options were considered for outdoor activities:
    - No plastic (Control Option A);
    - With plastic (Control Option B, proposed rule requirements); and
    - Extended plastic (Control Option C).
- Two alternative assumptions about children's access to the workspace during renovations (see Appendix 5E for a detailed description of these assumptions):

[14] The analysis in Step 2 is described in a separate report. See EPA 20072008 "The Approach Used For Estimating Changes in Children's IQ From Lead Dust Generated During Renovation, Repair, and Painting in Residences and Child Occupied Facilities".

[15] See EPA 2007, pp 30 – 32008, section 3.4.2 for more details.

  - Children have access to the workspace before the final renovator cleaning or cleaning verification~~.~~; and
  - Children do not have access to the workspace until after the final renovator cleaning or cleaning verification.
- 6 possible exposure years: ages 0 through 5;
- 4 building vintages: pre-1930, 1930 to 1949, 1950 to 1959, and 1960 to 1978.

IQ change is estimated by: (a) characterizing how media-specific lead concentrations are expected to change over time in response to RRP, (b) using a biokinetic model to estimate the subsequent change in the child's blood lead level as a result of exposure to lead from RRP activities, and (c), converting blood lead levels to IQ changes using regression equations derived from a large ~~studies~~epidemiologic study. Each of these components has associated uncertainties and considerations which are detailed in EPA 2008.

5.3.1 Estimate the amount of lead contamination before, during, and after the renovation project

The first step in characterizing media-specific concentrations is to develop an understanding of how lead concentrations in these media are expected to change over time in response to RRP events and control options. Based on this understanding, the exposure duration can be divided into discrete components that can be characterized separately and then combined to define the concentrations over the course of the exposure (EPA ~~2007~~2008). In this approach, time courses of exposures to the following media were considered; air (ambient and indoor), indoor dust, outdoor soil, diet, and drinking water. Exposures to lead through drinking water and diet were considered to be background exposures and thus were assumed to be unaffected by RRP activities. They were characterized using national-scale default values.

The exposure duration was assumed to be six years, which covers the entire range of children's ages addressed by the RRP rule. This exposure duration was divided into three exposure periods:

1. Pre-renovation,
2. Renovation, and
3. Post-renovation.

The ~~Pre~~pre-renovation exposure period represents the period of exposure before initiation of the RRP activity or activities and thus consists of background contributions only (EPA ~~2007~~2008). The ~~Renovation~~ renovation exposure period, which varies in duration depending on the RRP activity, represents the period of exposure beginning with the initiation of the RRP activity or activities and concluding with the completion of the renovation and any contractor cleaning. The ~~Post~~post-renovation exposure period represents the period of exposure following the renovation and any contractor cleaning and ending when the child reaches six years of age. Each exposure period can be subdivided into phases. Several of the phases are identical across indoor dust, indoor air, and outdoor soil, while others are not identical across all media but occur concurrently with one another. The estimation of lead concentrations during each of these phases (pre-renovation background, renovation and post-renovation for each ~~media are~~ medium is described in greater detail elsewhere (EPA ~~2007~~2008) and are summarized in Appendix 5B.

Figure 5-4: Exposure Periods and Associated Phases for Indoor Dust, Indoor Air, and Outdoor Soil*

Exposure Period	Phase		
	Indoor Dust	Indoor Air	Outdoor Soil
Pre-renovation	Pre-renovation (Background)	Pre-renovation (Background)	Pre-renovation (Background)
Renovation	Renovation (Dust Generating)	Renovation (Dust Generating)	Renovation (Renovation)
	Renovation (After Baseline Cleaning)	Renovation (Settling)	
Post-Renovation	Post-Renovation (Routine Cleaning)	Post-Renovation (Background)	Post-Renovation (Post-Renovation)

*Table adopted from EPA 2007: The Approach Used For Estimating Changes in Children's IQ From Lead Dust Generated During Renovation, Repair, and Painting in Residences and Child Occupied Facilities.

Renovation	Renovation (Dust Generating)	Renovation (Dust Generating)	Renovation (Renovation)
	Renovation (After Renovator Cleaning)	Renovation (Settling)	
		Renovation (Background)	
Post-renovation	Post-renovation (Routine Cleaning)	Post-renovation (Background)	Post-renovation (Post-Renovation)
	Post-renovation (Background)		

*Table taken from EPA 2008: The Approach Used For Estimating Changes in Children's IQ From Lead Dust Generated During Renovation, Repair, and Painting in Residences and Child Occupied Facilities.

RRP Activity Durations Used in Analysis

For each activity, duration values were estimated for the dust generation period and the rest of the renovation period. The single-activity durations are summarized in Table 5-5. The duration for renovation events with combinations of activities was calculated by summing the times for each component activity. Both the dust generation and rest of renovation times were rounded up to the nearest whole number of weeks before using them as inputs to the software tool, because the software tool uses weekly time steps in calculating the exposure inputs to the blood lead model. Smaller time steps would have provided more resolution, but were not feasible due to computer resource constraints. For example, increasing the resolution to daily time steps would have increased the number of calculations and the time required to complete a single simulation by a factor of approximately seven, which would have required about a seven-fold reduction in the number of Monte Carlo iterations (which would significantly decrease the stability of the results).

Table 5-5: Duration of Single-Task RRP Activities			
OPPT Dust Study Activity	**Total Activity Duration (weeks)**	**Dust Generation (weeks)**	**Rest of Renovation (weeks)**
Kitchen Renovations	4.75	1.00	3.75
Three Cutouts	0.10	0.03	0.07
Window Replacement	0.07	0.02	0.05
Dry Scraping	0.17	0.085	0.085
Power Scraping	0.10	0.05	0.05
High Temperature Heat Gun	0.17	0.085	0.085
Low Temperature Heat Gun	0.25	0.125	0.125
Exterior Door Replacement	0.07	0.01	0.06
Trim Replacement	0.40	0.08	0.32
Dry Scraping	0.14	0.07	0.07
Power Scraping	0.10	0.05	0.05
Open Flame Burning	0.15	0.075	0.075
High Temperature Heat Gun	0.25	0.125	0.125
Low Temperature Heat Gun	0.20	0.10	0.10
Needle Gun Ext. Paint Removal	0.20	0.10	0.10

5.3.2 Estimate blood-lead levels from this contamination

Lead concentrations in the activity-influenced exposure media (indoor air, indoor dust, and outdoor soil), and in the background exposure media (ambient air, drinking water, and diet), as well as and lead exposure and intake assumptions, serve as inputs to a biokinetic blood lead model (i.e., the Leggett model) (Figure 5-5).

In the Leggett biokinetic model, the relationship between exposure concentration and lead uptake (absorbed dose) is defined through a compartmental model by a range of factors related to physiological processes and to the chemical and physical properties of the exposure media. These factors include respiratory volume, soil and dust ingestion rates, and gastrointestinal (GI) absorption fractions for diet, water, and soil/dust, which determine how much lead is absorbed from each medium. (See Appendix bC5C and EPA 20072008 for more detail.) The Leggett model is particularly appropriate for this analysis because it can model exposure intakes (and blood-lead output) in time intervals of one day.

Figure 5-5: Flow Chart Illustrating the Approach to Estimating Blood Lead Levels*

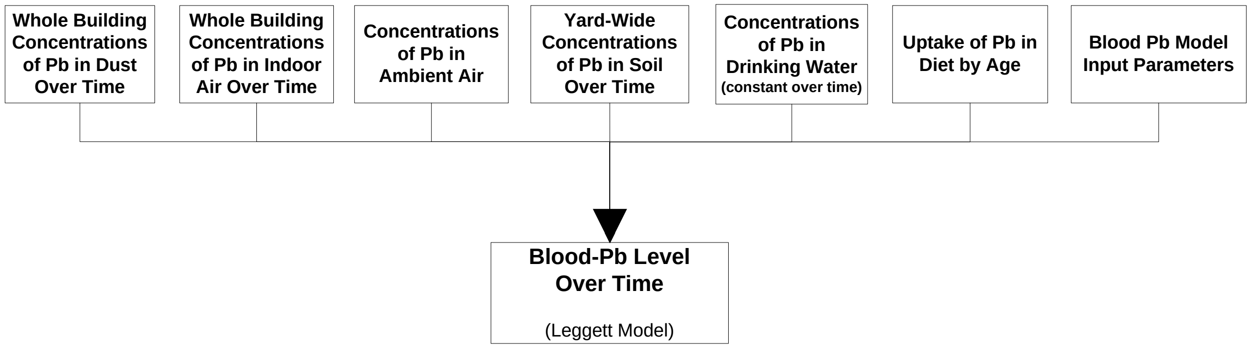


*Figure ~~adopted~~taken from EPA ~~2007~~2008: The Approach Used for Estimating Changes in Children's IQ from Lead Dust Generated During Renovation, Repair, and Painting in Residences and Child Occupied Facilities.

In this approach, blood lead levels for six different hypothetical children are modeled throughout their first six years (from birth until six years of age). Exposure profiles are defined for each child so as to simulate the occurrence of the renovation project at the beginning of a different year of their life (birth, first birthday, second birthday, etc.). (See Appendix 5C and EPA ~~2007~~2008 for more detail on the age-specific exposure profiles.) Prior to the renovation, the children experience background level exposures from all media, and after the renovation the dust and air concentrations are decreased due to routine cleaning and settling. Activity-related lead exposure concentrations vary weekly depending on the activities and year of life being modeled. Ambient air, drinking water, and dietary lead exposures are assigned the same age-specific values in all of the exposure scenarios. Exposure inputs (i.e., dust and soil loading or concentration) were adjusted to reflect the time children spent in target housing or child-occupied facilities each day and over the course of a year. (See Appendix 5C and EPA ~~2007~~2008 for more information on time-weighting of exposure.) The outputs of the models are the estimated ~~time-varying~~ blood lead levels for each of the six hypothetical children from birth until six years of age.

5.3.3 Estimate the ~~loss~~Change in IQ points due to increased blood-lead levels

This assessment estimates the adverse health impact of increased blood-lead levels ~~on cognitive function and, more specifically, IQ values~~as measured by IQ in young children. Appendix 5A includes a review of the recent literature related to the cognitive effects of lead in children. Young children are particularly sensitive to lead, which impairs a child's neuropsychological development (~~most commonly~~frequently measured as ~~reduced~~ IQ~~). Increased blood-lead levels have also been associated with aberrant~~ change). Investigating associations between lead exposure and behavior ~~in school-age~~, mood, and social conduct of children ~~and a decrease in their growth rate and stature.~~ has been an emerging area of research. Early studies indicated linkages between lower-level lead toxicity and behavioral problems (e.g., aggression, attentional problems, and hyperactivity) in children. These cognitive and behavioral effects are strongly related to their future productivity and expected earnings (Salkever 1995; U.S. EPA 2000). EPA believes there is essentially no threshold for adverse health effects of lead in children (U.S. EPA/IRIS 2004). ~~Indeed dose~~Dose-effect curves for lead effects on children's IQs show a non-linear, inverse relationship with the greatest increase in effects occurring at the lowest ~~detectable~~ detected increase in blood-lead levels.

Once the blood lead levels are estimated from the media concentrations, these values are converted to IQ changes using ~~regression~~ equations derived from ~~large studies. The~~ a published, pooled analysis of prospective studies ~~most relevant to the approach outlined in this document are Canfield et al. 2003 and~~ (Lanphear et al. 2005 ~~(USEPA 2006a). These large, well-conducted studies provide~~). This study (which involved 1,333 children) provided both qualitative and quantitative evidence of neurocognitive deficits, measured by IQ, in ~~children~~a subset of children (244) at blood lead levels less than 10 µg/dL. ~~For the current approach, the~~ The Lanphear et al. (2005) models were selected because the population in that study was ~~much larger~~large, included subjects from several countries, from populations with different patterns of lead exposure, and from a wide range of socioeconomic strata. The large~~r~~ number of subjects in the Lanphear et al. study afford~~ed~~ a high~~er~~ degree of precision in identifying and characterizing blood lead-IQ relationships, and allowed the use of ~~more~~ sophisticated statistical models to evaluate the data.

As described more fully in Appendix 5D and Chapter 6 of EPA ~~2007~~2008, a piecewise model was used because ~~peak blood lead levels were likely to be less than 10 µg/dL for the vast majority of children exposed to lead during renovation activities~~in the log linear model, the blood lead-IQ slope increases rapidly at low blood lead levels, and ~~because the relationshipe between shoter-term elevations in blood lead and IQ~~goes to infinity at zero blood lead, which limits its use for predicting lead changes ~~is not well understood,~~ at very low blood lead levels. As a result, the selection of a blood lead-IQ model focused on the piecewise models. The piecewise models that ~~give~~gave greater weight to impacts in this blood lead range were ~~preferred~~chosen because peak blood lead levels are likely to be less than 10 ug/dL for the vast majority of children exposed to lead during renovation activities. Further, while Lanphear et al. (2005) used peak blood ~~Pb~~lead concentrations to determine which segment of a model to apply, for the hypothetical children to whom the approach discussed here is applied, only averages can be used. Because it cannot be known how often a peak is obtained, some proportion of the hypothetical children whose lifetime average blood ~~Pb~~lead levels place their calculations on a lower segment (with steeper slope) would have IQ changes calculated by the corresponding upper segment (shallower slope) based on peak concentrations. Selecting a model with a node, or changing one segment to the other, at a lifetime average blood ~~Pb~~lead concentration of 10 µg/dL rather than at 7.5 µg/dL, is a small protection against applying an incorrectly rapid change (steep slope with increasingly smaller effect as concentrations lower) to the calculation. The following model was therefore used in estimating IQ changes associated with renovation activities.

PbB < 1 IQ *change* = 0

PbB = 1 to 10 *IQ* *change* = *PbB* * -0.88

PbB > 10 *IQ* *change* = -8.75 + (*PbB* - 10) * -0.10

where: *PbB* = Lifetime average of the blood lead level

5.4 Define Current Work Practice Baseline (Cleaning and Containment), Link to the OPPT Dust Study Control Options, and Estimate Baseline IQ ~~Loss~~Change (Step 3)

The baseline against which the regulatory options are compared takes into account current practices. Even without the proposed regulation, renovators already perform some containment and clean-up. Under the LRRP regulation, however, renovators will need to increase their use of these containment and clean-up procedures and add new controls. For example, they will need to add cleaning to those RRP jobs where they already undertake containment, and will need to add containment to jobs to those RRP jobs where they already clean. For some RRP jobs, both cleaning and containment will need to be added, while for other RRP jobs, cleaning and containment already occur, but may or may not follow the work practice requirements of the rule.

The OPPT Dust Study conducted four types of experiments for each type of interior renovation activity: (1) conventional containment and conventional cleaning, (2) conventional containment and rule-style cleaning, (3) rule-style containment and conventional cleaning, and (4) rule-style containment and rule-style cleaning. In order to estimate the baseline levels of lead in dust, soil, and air this analysis estimated the frequency with which current practices fall into these threefour categories based on a telephone survey of nine renovators. Respondents were chosen to represent a range of sizes and geographical distribution.

The questionnaire asked the respondents to indicate which of the following best describes the practices they usually use to contain and clean up debris and dust created during the job:

1. Do not cover floors, doors, and ducts with taped-down plastic sheeting. Do clean-up at the end of the job using a broom or a non-HEPA shop vacuum.

2. Do not cover floors, doors, and ducts with taped-down plastic sheeting. Do clean-up at the end of the job using a HEPA vacuum and also wet mop the floor if it is not carpeted.

3. Do cover floors, doors, and ducts with taped-down plastic sheeting. Do clean-up at the end of the job using a broom or a non-HEPA shop vacuum.

4. Do cover floors, doors, and ducts with taped-down plastic sheeting. Do clean-up at the end of the job using a HEPA vacuum and also wet mop the floor if it is not carpeted.

This provided an indication of how often the containment work practices were used in conjunction with the cleaning work practices. In the following discussion, these combinations are referred to as: Conventional Containment and Cleaning (#1), Conventional Containment and Rule Cleaning (#2), Rule Containment and Conventional Cleaning (#3), and Rule Containment and Rule Cleaning (#4). Of the 9 responses, one contractor selected (#2), six selected (#3), and two selected (#4).

The questionnaire also contained detailed questions on the frequency that the respondent used various specific work practices, such as frequency of two-bucket mopping, and frequency of HEPA vacuuming the floors at the end of a job. These detailed questions examined the practices independently. Note that the questionnaire did not ask respondents about whether the respondents performed cleaning verification, but it is reasonable to assume that contractors currently do not perform the cleaning verification step.[16] The responses to the work practice baseline questions are presented in Table 5-6.

[16] The responses to the detailed questions were also used in the cost estimates.

Table 5-6: Summary of Baseline Work Practice Survey Results

Question	Quest-ion #	Location of Respondents Business											
		Painting Firms				General Contractors					Descriptive Statistics		
		TX	SD	TN	FL	CA	NY	WA	CA	ID	Min	Max	Average
Interior Work													
How often do you post signs warning residents to remain outside the work area?	1	0%	5%	100%	0%	100%	100%	0%	0%	0%	0%	100%	34%
While the work is being performed, how often do you keep all windows and doors within the work area closed, or covered with sheeting?	2	80%	100%	75%	0%	100%	75%	100%	100%	50%	0%	100%	76%
How often do you cover the floor within the work area with taped down sheeting?	3	100%	100%	100%	100%	16%	100%	100%	25%	50%	16%	100%	77%
If > 0%, When you cover the floor with sheeting, do you dispose of the sheeting afterwards or do you reuse the sheeting for other jobs?	4	Reuse	Reuse	Reuse	Reuse	Dispose	Dispose	Reuse	Reuse	Dispose			
If > 0%, When you cover the floor with disposable plastic sheeting how often do you, your crew or your subcontractors mist the sheeting, fold it dirty side inward, and tape it shut to seal or seal in heavy duty plastic bags before removing from the work area?	5	100%	0%	100%	100%	16%	100%	100%	0%	100%	0%	100%	55%
To prevent tracking dust outside the work area, how often do you place a tack-pad outside the work area to catch dust on your shoes?	6	16%	0%	45%	0%	0%	100%	100%	0%	0%	0%	100%	29%
To prevent tracking dust outside the work area, how often do you wear disposable shoe covers?	7	0%	0%	0%	0%	0%	25%	100%	50%	0%	0%	100%	19%
To prevent tracking dust outside the work area, how often do you vacuum your clothes, tools, and other items each time you leave the work area?	8	0%	0%	0%	0%	50%	50%	100%	50%	10%	0%	100%	29%
After completing the job, how often do you vacuum any surfaces in the work area?	9	100%	100%	25%	75%	100%	100%	100%	75%	50%	~~0%~~25%	100%	~~59%~~81%
If >0%, How often was a HEPA vacuum used for vacuuming floors?	10	0%	0%	0%	100%	0%	100%	100%	0%	0%	0%	100%	38%

Table 5-6: Summary of Baseline Work Practice Survey Results

Question	Quest-ion #	Location of Respondents Business											
		Painting Firms				General Contractors					Descriptive Statistics		
		TX	SD	TN	FL	CA	NY	WA	CA	ID	Min	Max	Average
If >0%, How often do you vacuum the walls?	11	0%	0%	0%	0%	100%	100%	0%	75%	0%	0%	100%	31%
After completing the job, how often do you wipe all smooth surfaces with a damp cloth?	12	100%	100%	15%	50%	100%	100%	100%	75%	90%	15%	100%	81%
After completing a job where the floor is not carpeted, how often do you wet mop?	13	100%	50%	10%	0%	16%	100%	0%	75%	100%	0%	100%	41%
If >0%, How often do you use a two-bucket mopping system?	14	0%	100%	100%	0%	0%	100%	0%	16%	0%	0%	100%	35%
After completing a job where the floor is not carpeted, how often do you sweep with an electrostatic cloth sweeper (for example a Swiffer)?	15	0%	60%	0%	0%	16%	0%	0%	0%	0%	0%	60%	8%
(Control Options)*	16	3	3	3	2	3	4	4	3	3	2	4	3
Exterior Work													
(1) How often do you post signs warning residents to remain outside the work area?	1	0%	5%	100%	10%	100%	100%	0%	0%	0%	0%	100%	35%
(2) While the work is being performed, how often do you keep all windows and doors within 20 feet of the work area closed, or covered with sheeting?	2	100%	100%	75%	100%	100%	100%	100%	75%	100%	75%	100%	94%
(3) How often do you cover the ground with sheeting in order to collect falling paint debris?	3	0%	100%	100%	0%	100%	100%	100%	100%	0%	0%	100%	67%

* When performing work in a pre-1978 house, apartment, school, or daycare center that will disturb more than 2 square feet of a painted surface, which of the following best describes the practices you usually use to contain and clean-up debris and dust created during the job:

(1) Do not cover floors, doors, and ducts with taped-down sheeting; do clean-up at the end of the job using a broom or a non-HEPA shop vacuum.

(2) Do not cover floors, doors, and ducts with taped-down sheeting; do clean-up at the end of the job using a HEPA vacuum and also wet mop the floor if it is not carpeted.

(3) Do cover floors, doors, and ducts with taped-down sheeting. Do clean-up at the end of the job using a broom or a non-HEPA shop vacuum.

(4) Do cover floors, doors, and ducts with taped-down sheeting. Do clean-up at the end of the job using a HEPA vacuum and also wet mop the floor if it is not carpeted.

~~A comparison of~~Comparing the contractors' answers to the general question of which of the four choices best described the practices they usually used to their answers to the detailed questions on specific work practices displayed several inconsistencies. For example, the contractor who reported that he usually used conventional containment and rule-style cleaning also reported that he only vacuumed 75 percent of the time and he never mopped. Three of the six contractors who reported usually using rule-style containment and conventional style cleaning also reported using taped-down plastic sheeting no more than 50 percent of the time; four out of six reported reusing the sheeting rather than disposing of it; four reported always carefully misting and folding the sheeting before disposal (when plastic was used), and two reported that they did not mist and carefully fold the sheeting before disposal. Of the two contractors who reported using rule-style cleaning and rule-~~-~~style containment, the answers from one contractor were consistent with this, while the other contractor reported that he did not mop floors or vacuum walls and reused his plastic sheeting.

With the inconsistencies in the responses of the contractors, it seemed unreasonable to characterize the baseline practices of contractors based solely on the usual cleaning and containment practices they reported~~ that they usually used~~. Thus, for the benefit estimations, each respondent's answer to the question of which of the four choices best describes his usual current containment and clean-up practices was adjusted by his response to ~~certain of~~ the detailed questions. These adjustments were undertaken to reflect the fact that, in many instances, current work practices incorporate some but not all of the work practices to be required by the LRRP Rule. (For example, using plastic containment but reusing the plastic sheeting; vacuuming at the end of the job but not using a HEPA vacuum; or mopping at the end of the job but using one-bucket mopping.) In other words, even where renovators are performing cleaning and containment, current baseline work practices capture only some of the benefits of the rule requirements.

Basically the adjustments entailed the following two steps. Each respondent was assigned to one or more control options based on his answers. For example, if the respondent said that he covered surfaces with plastic and disposed of the plastic after use, but he did not mist and fold the plastic as required by the LRRP regulations, then this was given 75 percent credit and was modeled in the benefits estimation as having 75 percent of events in the Rule Containment Control Option and 25 percent in the Conventional Containment Control Option. After the nine respondents were assigned to Control Option categories, the percentage of jobs in each category was estimated. These percentages were normalized so that they would sum to 100 percent. Details on how these percentage adjustments were developed and used to weight the benefits from three containment and cleaning practices: plastic use, vacuum use, and mopping practices as described below.

Step 1: Determine percentage adjustments

The responses indicated that many contractors currently only partially implemented the work practices required by the rule. Thus the first step was to assign to each combination of work practices the percentage of the IQ benefits that combination would provide. For example, if a contractor reported that he usually used conventional cleaning along with plastic containment, and he disposed of the plastic at the end of the job but did not mist and carefully fold the plastic when disposing of it, this is represented as achieving "rule containment and conventional cleaning" 75% of the time and "conventional containment and conventional cleaning" 25% of the time (see

Table 5-7: Percent Adjustment for Type of Baseline Interior Plastic Use*

). Likewise, if a contractor reported that he usually vacuumed at the end of a job, that he vacuumed both floors and walls but did not use a HEPA vacuum, then this is represented as achieving the rule vacuuming 25% of the time (see Table 5-8).

- The decision matrices below (

• Table 5-7: Percent Adjustment for Type of Baseline Interior Plastic Use*

- through Table 5-9) show the percentage adjustments to the IQ benefits for plastic use, vacuuming use, and mopping practices.
- Table 5-10 through Table 5-12 show the number of respondents in each category.

Table 5-7: Percent ~~IQ Benefits~~ Adjustment for Type of Baseline Interior Plastic Use*

	Mist and Fold Carefully	Do Not Mist or Fold Carefully
Dispose of Plastic	100%	75%
Reuse Plastic	50%	0%

* Note that most of the respondents did not provide information on exterior plastic use. Thus any use of exterior plastic that is estimated for the baseline is assumed to result in the full IQ protection of following the rule's practices for exterior containment.

Table 5-8: Percent ~~Benefits~~ Adjustment for Type of Baseline Vacuuming at End of Job

	Vacuum and Use HEPA on Walls	Vacuum but do Not Use HEPA on Walls	No Vacuuming on Walls ~~(No HEPA)~~
Use HEPA on Floors	100%		75%
No HEPA on Floors		25%	0%

As shown in Table 5-11 below, there were no respondents that reported the combination of activities in the two gray shaded cells: HEPA vacuuming of walls but non-HEPA vacuuming of floors, and HEPA vacuuming of floors but vacuuming walls with a non-HEPA vacuum.

Table 5-9: Percent ~~Benefits~~ Adjustment for Type of Baseline Mopping Practices

Use Two-Bucket Mopping	100%
Use One-Bucket mopping	50%

Table 5-10: Respondent Locations – Baseline Interior Plastic Use

	Mist and Fold Carefully	Do Not Mist or Fold

		Carefully
Dispose of Plastic	3 respondents	
Reuse Plastic	2 respondents	4 respondents
There were no respondents that reported the combination of activities in the gray shaded cell: Dispose of plastic but do not mist and fold carefully when disposing.		

Table 5-11: Respondent Locations – Baseline Vacuum Uses			
	Vacuum and Use HEPA on Walls	**Vacuum but do Not Use HEPA on Walls**	**No Vacuuming on Walls (No HEPA)**
Use HEPA on Floors	1 respondent		2 respondents
No HEPA on Floors		2 respondents	4 respondents
There were no respondents that reported the combination of activities in the two gray shaded cells: HEPA vacuuming of walls but non-HEPA vacuuming of floors, and HEPA vacuuming of floors but vacuuming walls with a non-HEPA vacuum.			

Table 5-12: Respondent Locations – Baseline Mopping Practices	
Use Two-Bucket Mopping	3 respondents
Use One-Bucket mopping	6 respondents

Step 2: Adjust the calculations for the work practice benefit percentages

- If the respondent said they usually practiced rule containment and conventional cleaning (#3 in the list above), the percentage of the time they do this is estimated as the product of the "misting the sheeting" percentage and the percentage adjustment for plastic use.
- If the respondent said they practiced conventional containment and rule cleaning (#2 in the list above), the percentage of the time they do this is estimated as the average of:

  ((overall vacuuming percentage * percentage adjustment for vacuum use),

  (wet mopping of non-carpeted floors percentage * percentage adjustment for mopping practices))
- If the respondent said they practiced rule containment methods and rule cleaning (#4 in the list above), the percentage of the time they do this is estimated as the average of:

  ("misting the sheeting" percentage * percentage adjustment for plastic use),

  (overall vacuuming percentage * percentage adjustment for vacuum use), and

  (wet mopping of non-carpeted floors percentage * percentage adjustment for mopping practices))
- No respondent said they usually used conventional containment and conventional cleaning.

5.4.1 *Resulting Estimates of Cleaning and Containment in the Baseline*

Figure 5-6 presents the responses to the baseline work practice questionnaire that were used to assign the percentage of events assumed to be performed using the cleaning and containment practices in each of the four interior control options in the OPPT dust study (~~Battelle 2007~~EPA 2007b). As described above, respondents reported which of these four interior control options best matched the practices they *usually* used~~, and how~~. How often they used these practices (rather than using conventional practices) was estimated based ~~on how often they responded~~ their responses to ~~the~~ related questions in the questionnaire. Figure 5-7 shows how the results for interior cleaning and containment practices presented in Figure 5-6 are adjusted for compliance and combined with the compliance-adjusted exterior containment questionnaire responses in order to obtain the percentages of renovations that are assumed to occur in the eight OPPT dust study (~~Battelle 2007~~EPA 2007b) control option categories (four interior control options multiplied by two exterior control options).

The compliance adjustment is calculated assuming a rate of 75 percent compliance with the rule. It is assumed that the renovators who will not comply with the rule use conventional practices in the baseline. Thus, since it is estimated that 63 percent of renovators use conventional interior practices in the baseline, 38 percent (63 percent minus 25 percent) of renovators will comply with the rule, and would have otherwise used conventional interior practices in the baseline scenario. It follows that 50 percent (38 percent divided by 75 percent) of those complying with the rule would have otherwise used conventional interior practices in the baseline. Likewise, 21 percent (16 percent divided by 75 percent) who comply with the rule would have otherwise used rule-style interior practices (excluding verification) in the baseline (See Figure 5-7).

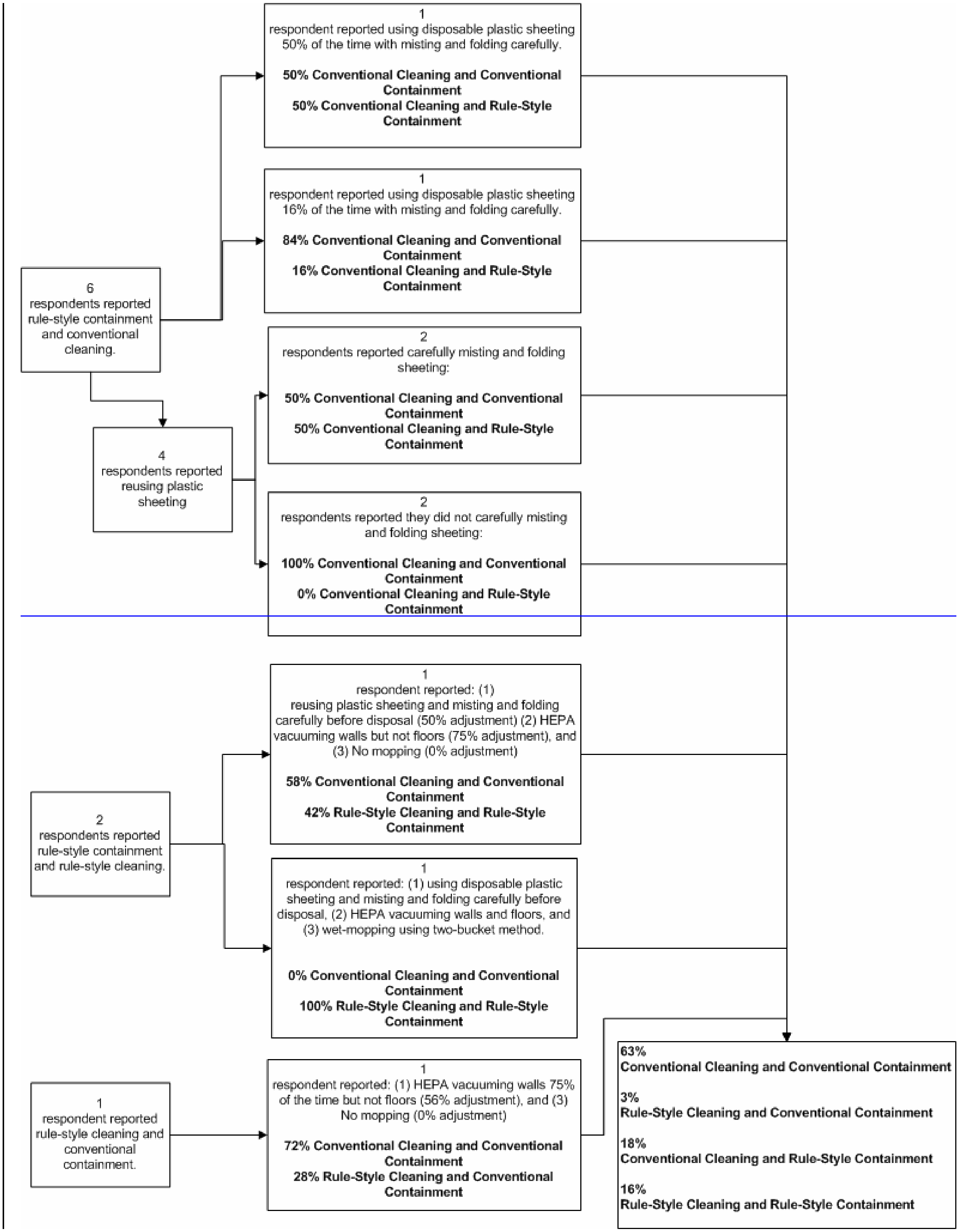
The effect of these baseline adjustments can be seen by comparing the benefits estimated using this baseline to the benefits ~~that would be~~ estimated ~~if it were assumed~~assuming that all renovators used conventional containment and conventional cleaning. Using Option E as an example, the annualized benefits (using a 3 percent discount rate) are $~~2,342~~1,670 million.[17] If the analysis had assumed that everyone used conventional containment and cleaning, then the benefits of Option E would be estimated at $~~2,850~~3,602 million. The difference between these two estimates ($~~508~~1,932 million = $~~2,850~~3,602 million – $~~2,342~~1,670 million) is the value of the current baseline work practices. In other words, approximately ~~18~~54 percent of the total benefits of Option E are already captured in current baseline work practices.

[17] See ~~Table 5-15~~

Table 5-16: Total Annualized Mean 50-Year Benefits of IQ Points Gained using Alternative Discount Rates of 3% and 7% ($ Millions)

for this result and Section 5-7 for a full presentation of the benefit estimates

Figure 5-6: Estimating the Baseline Levels of Interior Conventional and Rule-Style Cleaning and Containment



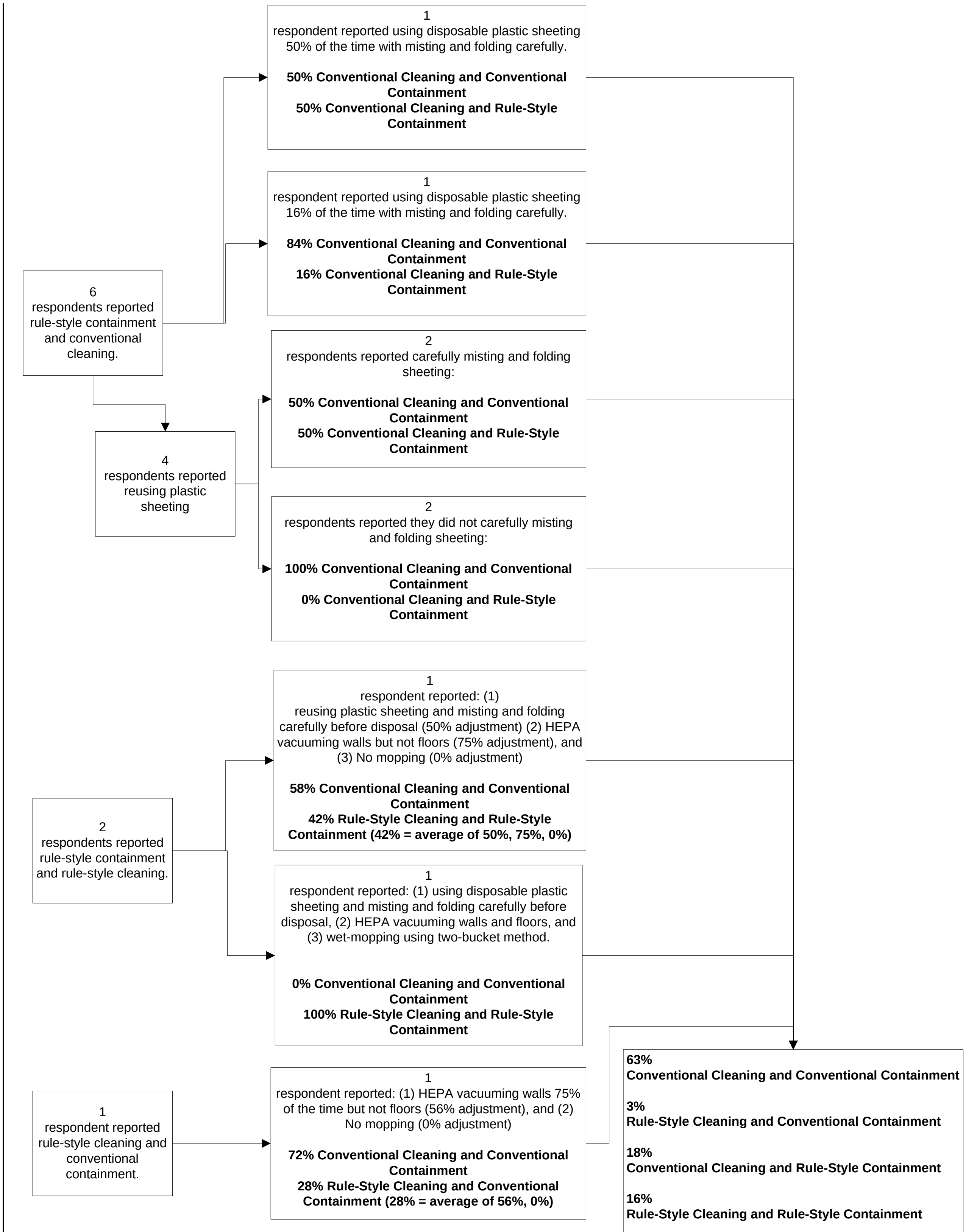


Figure 5-7: Estimating the Baseline Levels of Interior and Exterior Conventional and Rule-Style Cleaning and Containment

Interior	**Exterior**
63% **Conventional Cleaning and Conventional Containment** **3%** **Rule-Style Cleaning and Conventional Containment** **18%** **Conventional Cleaning and Rule-Style Containment** **16%** **Rule-Style Cleaning and Rule-Style Containment**	**67%** **Use Exterior Plastic Containment** **33%** **Do Not Use Exterior Plastic Containment**
After Compliance Adjustment **(Assume 25% not in compliance use conventional practices in the baseline):** **50%** **Conventional Cleaning and Conventional Containment** **4%** **Rule-Style Cleaning and Conventional Containment** **25%** **Conventional Cleaning and Rule-Style Containment** **21%** **Rule-Style Cleaning and Rule-Style Containment**	**After Compliance Adjustment** **(Assume 25% not in compliance use conventional practices in the baseline):** **89%** **Use Exterior Plastic Containment** **11%** **Do Not Use Exterior Plastic Containment**

Assumed Baseline Control Options (After 75% Compliance Adjustment)
(Assume 25% not in compliance use conventional practices in the baseline):

5.6%
Interior: Conventional Cleaning and Conventional Containment. Exterior: Conventional Containment

0.5%
Interior: Rule-Style Cleaning and Conventional Containment. Exterior: Conventional Containment

2.7%
Interior: Conventional Cleaning and Rule-Style Containment. Exterior: Conventional Containment

2.3%
Interior: Rule-Style Cleaning and Rule-Style Containment. Exterior: Conventional Containment

44.7%
Interior: Conventional Cleaning and Conventional Containment. Exterior: Rule-Style Containment

3.7%
Interior: Rule-Style Cleaning and Conventional Containment. Exterior: Rule-Style Containment

21.9%
Interior: Conventional Cleaning and Rule-Style Containment. Exterior: Rule-Style Containment

18.7%
Interior: Rule-Style Cleaning and Rule-Style Containment. Exterior: Rule-Style Containment

5.5 Estimate the Incremental IQ ~~Loss~~Change for Each Regulatory Option Based on the Number and Distribution of Children and RRP Events Disturbing Lead Based Paint (Step 4)

Steps 1 and 2 provide child specific estimates of IQ ~~loss~~change per each defined exposure scenario. Step 3 defines current baseline work practices. In step 4, the individual incremental IQ ~~loss~~change values for each regulatory option (e.g., IQ ~~loss~~change under the rule[18] – IQ ~~loss~~change under baseline practices) are scaled up to capture the population of children affected by all RRP events disturbing lead based paint. For RRP events in target housing, EPA used data from the AHS (1997 and 2003) and POMS (1995), which provide information on the number of households in which renovation and repair tasks of various types were carried out during the prior two years. For child occupied facilities in public or commercial buildings, EPA used data from HUD's First National Health Survey of Child Care Centers (HUD 2003). The survey data was collected in 2001 and was published in 2003; it includes data on 98 daycare centers that are known to have been built before 1978. This methodology and data were also used to extrapolate to kindergartens. In addition, data from Whitestone Research was used to estimate the types and frequency of RRP work for COFs in public or commercial buildings (including both elementary schools and childcare centers). For a more detailed description of the approach used to estimate the number of RRP events see Chapter 4.

The basic steps for estimating the number of events and children in target housing are:

1. Estimate the number of events and the number of individuals affected using housing unit level Census data.
2. Estimate the likelihood that an event will be affected by the rule (does the event disturb paint or LBP).
3. Combine the results of the above two steps to estimate:
    a. annual number of renovations where paint is disturbed,
    b. annual number of target housing units where LBP is disturbed,
    c. number and age distribution of children in target housing where LBP is disturbed.

The basic steps for estimating the number of events and children in COFs in public or commercial buildings are:

1. Estimate the number of COFs in public or commercial buildings (buildings and classrooms),
2. Estimate the frequency of performing an RRP event,
3. Estimate the likelihood that an event will be affected by the rule (does the event disturb paint or LBP).
4. Combine the results of the above three steps to estimate:
    a. annual number of centers and classrooms where painted surfaces are disturbed,
    b. annual number of centers and classrooms where *LBP* is disturbed,
    c. number and age distribution of children in public and commercial buildings where LBP is disturbed.

[18] Assuming 75% compliance with the rule.

5.6 Assign Medical Costs, Reduced Income or Other Proxy for Willingness to Pay to Avoid the Adverse Health Effects (Step 5)

In the following analysis, standard values from the economic literature are used for the benefits valuation. In lieu of willingness to pay, reduced income is used as an estimate of the cost of chronic conditions.

The estimated value of an IQ point is $12,953 (2005 dollars), which is derived from coefficients provided by Salkever (1995). The IQ value is modeled as the present value of a loss in expected lifetime earnings due to a one point IQ drop.[19] The present value is calculated assuming that, while most people start working at age 18, average income in the early adult years is reduced because some are still in school. In addition, the present value assumes a retirement age of 67 years old, due to the revisions of the Social Security law that are incrementally increasing the retirement age such that it will be at age 67 by the time today's children are retiring. Further, the analysis assumes that children would be affected by lead at 3 years of age, the median of the range when children are most susceptible to lead hazards. As a result, the value of an IQ point is only discounted back to age 3. Limiting the valuation estimation to reduced income underestimates the value of children's neurological benefits. Additional measures of the impact on IQ are: additional education costs for special and remedial education, and medical costs to treat very high levels of lead. This analysis does not generate the information needed to estimate the number of such cases, so these measures are not included in the valuation of children's benefits.

5.7 Results

This analysis estimates the benefits of ~~six~~seven LRRP regulatory options in terms of IQ deficits in children. Option P is the option that was previously analyzed in the economic ~~analysis~~ analyses of the 2006 proposed rule and the 2007 supplemental proposal. Option P is reanalyzed here using the benefit models and assumptions developed for this report. Options A through ~~E~~ F include additional requirements that are not part of Option P, and differ from each other in terms of the universe of the structures they affect in each year (rule scope and phasing in of coverage). The regulated universe under Option P is the same as under Option B. Unlike Option B, however, Option P does not prohibit the use of any paint removal techniques.

Options differ in terms of the age of structures covered by the option in each year, and in terms of whether all units or only rental units are covered by the option. Specifically, Options P, A, and B are limited to pre-1960 structures during Year 1 of the regulation and their scope is expanded to structures built between 1960 and 1978 in Year 2. Options C and D are limited to pre-1960 structures in both Year 1 and Year 2. Finally, ~~Option E includes~~ Options E and F include pre-1978 structures in both Year 1 and Year 2. Differences between Options E and F include the definition of the minor maintenance exemption and the length of time that the firm certification and renovator training are valid. The minor maintenance exception is defined as 6 ft^2 or less per room for interiors or 20 ft^2 or less for exteriors, excluding renovations involving prohibited activities, demolition or window replacement. This different definition in Option F impacts the number of renovation events required to use lead-safe work practices. However, the difference between the number of events under options E and F could not be estimated because sufficient data were not available. In addition, firm certification and renovator training under Option F are valid for 5 years (instead of 3 years under the other options). This analysis does not estimate any

[19] Present value of earnings calculated at a 3 percent discount rate.

differences in benefits between options E and F that are attributable to the difference between the options in the length of time that training, certification, and accreditation are valid. Thus, the estimated benefits under option E and option F are the same, even though the benefits would be expected to be larger under option E because it covers more jobs.

Within the scope categories described above, Options A and C include all target housing units and all COFs. Within the vintage categories specified above, Options P, B, D, E, and E F include all rental housing units, all owner-occupied target housing units where a child under the age of 6 resides, and all COFs.

As shown in the tables and discussion below, regardless of which option is considered, the estimated benefits are substantial. In addition, a number of benefit categories have been excluded from the estimated benefits. Among the categories of benefits excluded fromthat are not specifically evaluated in this analysis, and that are described more fully in Appendix 5A, are:

- IQ losschange in children resulting from prenatal and breast milk exposure;
- Other children's health and developmental effects for which the science is less certain and for which there wereare not adequate data to develop a dose- response curve,s and thus a benefits estimate. These outcomes include attention deficits, reduced ability to inhibit inappropriate responding; impulsivity, distractibility, criminalbenefit estimates. Investigating associations between Pb exposure and behavior, reactivity to the environment,mood, and social behavior, and auditory function. Recentconduct of children has been an emerging area of research suggest that IQ loss is most strongly associated with concurrent blood lead levels and that this relationship is stronger in older. Early studies indicated linkages between lower-level Pb toxicity and behavioral problems (e.g., aggression, attentional problems, and hyperactivity) in children;
- Benefits that accrue to adults, including avoided cases of increased blood pressure and hypertension, coronary heart disease (CHD), stroke, and death; and
- Adverse effects on plants and animals.

In addition, the incremental difference between willingness-to-pay to avoid children's IQ loss due to exposure to lead dust, and the income loss resulting from the IQ loss is not included in the valuation of benefits. (The calculated benefits estimates are based on lost income instead of willingness-to-pay values.)

5.7.1 Benefits under Each Regulatory Option

The first measure of the benefits for each of the regulatory options consists of the number of events affected by the rule and the resulting number of people protected by the rule, . Included in this number are both the number of children under the age of six (for whom benefits are quantified and monetized) and the number of individuals age six and greater (who will experience benefits but for whom these benefits have not been quantified or monetized in this analysis). These are presented in Table 5-13. The estimated number of people protected, as shown in Table 5-13, reflect the following adjustments: 1) the proportion of regulated RRP events during one year period where lead-based paint is present and 2) an assumption of 75 percent compliance with the rule.

Table 5-13: Annual Number of RRP Events; Number of Individuals Protected under each of the Regulatory Options								
	Number of Events (thousands)				Number of Individuals Protected by the Rule (thousands)*			
					Children under the Age of 6		Individuals Age 6 and Older	
Option	First Year	First Year with LSWP	Second Year	Second Year with LSWP	First Year	Second Year	First Year	Second Year
P	6,149	4,931	11,268	4,396	1,~~549~~161	1,~~857~~393	~~6,100~~4,575	~~7,108~~5,331
A	10,022	8,094	18,608	7,396	1,~~549~~161	1,~~857~~393	~~12,022~~9,016	~~14,178~~10,633
B	6,149	4,931	11,268	4,396	1,~~549~~161	1,~~857~~393	~~6,100~~4,575	~~7,108~~5,331
C	10,022	8,094	9,981	5,707	1,~~549~~161	1,~~542~~157	~~12,022~~9,016	~~11,973~~8,980
D	6,149	4,931	6,123	3,409	1,~~549~~161	1,~~542~~157	~~6,100~~4,575	~~6,075~~4,556
E	11,~~314~~413	8,~~364~~437	11,~~268~~366	4,~~396~~435	1,~~865~~398	1,~~857~~393	~~7,239~~5,430	~~7,210~~5,407

~~* Assumes a 75% compliance rate.~~

~~Note: The overall number of events represents the number of RRP events that incur costs as a result of the rule (even if it is only the cost of a test kit to determine that that lead-based paint will not be disturbed in the renovation). The number of events with lead-safe work practices (LSWP) represents the number of events that use the rule's work practices. The number of events increases from the first year to the second year for Options P, A, and B due to the increase in the scope of the rule in the second year (slightly offset by the demolition rate). The number decreases for Option C, D, and E due to the reduction in the number of buildings encompassed by each option over time due to demolitions. The percentage of events with lead-safe work practices decreases from the first year to the second due to improvements in the false positive rate of the test kits.~~

~~In the first year, five out of six of the options protect the same number of children under the age of six -- approximately 1.5 million children -- while Option E covers more children. Options A and C protect the same number of children as Options P, B and D even though Options A and C cover more RRP events. This is because all five of these options cover owner-occupied housing units built before 1960 where a child under the age of six resides plus all pre-1960 rental housing and COFs. Options A and C, however, also cover RRP events in owner-occupied housing built before 1960 where there are no children under the age of six. This can be seen in the number of individuals age six and older protected, which is larger for Options A and C than for Options P, B and D.~~

~~Option E protects considerably more children under the age of six in the first year – approximately 1.9 million in total – because it covers all owner-occupied units built before 1978 where a child under the age of six resides plus all pre-1978 rental housing and COFs. In the second year of the rule, coverage is variously extended under Options P, A and B. As a result, from the second year and into the future, Options P, A and B provide the same level of protection to children as Option E – approximately 1.9 million cases of exposure avoided in children under the age of six. Options C and D continue to result in the lower number of avoided exposures – approximately 1.5 million cases in children.~~

In the second year and into the future, Option A offers the widest protection to persons age six and older – approximately 14.2 million cases of avoided exposure – followed by Option C with approximately 12.0 million avoided exposures in persons age six and older. Options P and B protect somewhat fewer persons age 6 and older than are protected by Option E -- approximately 7.1 million as opposed to approximately 7.2 million. Option D provides protection for only 6.1 million persons age six and older.

The second benefits metric presents the number of IQ points gained as a result of the rule. Table 5-13 presents these benefits, in thousands of IQ points gained, for each of the regulatory options. Option E provides the greatest total benefit relative to the other options during the first year and is one of three options providing the greatest IQ benefits in the second year of the rule. In year one, Option E results in a 22 percent increase in the number of IQ points gained compared to Options A through D, and a 40 percent increase compared to Option P. During the second year of the rule, the total number of IQ points gained under options P, A, and B increases as the scope of the regulated universe expands under those options. In year two, Option E results in a 29 percent more IQ points gained compared to Option P, and 22 percent more compared to Options C and D. Options A and B result in the same number of IQ points gained as under Option E.

Table 5-13: Total Number of IQ Points Gained (in thousands) by Option, Building Type and Year								
F**	11,413	8,437	11,366	4,435	1,398	1.393	5,430	5,407

* Assumes a 75% compliance rate.

Note: The overall number of events represents the number of RRP events that incur costs as a result of the rule (even if it is only the cost of a test kit to determine that that lead-based paint will not be disturbed in the renovation). The number of events with lead-safe work practices (LSWP) represents the number of events that use the rule's work practices. The number of events increases from the first year to the second year for Options P, A, and B due to the increase in the scope of the rule in the second year (slightly offset by the demolition rate). The number decreases for Option C, D, and E due to the reduction in the number of buildings encompassed by each option over time due to demolitions. The percentage of events with lead-safe work practices decreases from the first year to the second due to improvements in the false positive rate of the test kits.

** The number of events under F will be somewhat less than E, but it was not possible to estimate this number and therefore the numbers for Option E are used.

In the first year, five out of seven of the options protect the same number of children under the age of six – approximately 1.2 million children – while Options E and F cover more children. Options A and C protect the same number of children as Options P, B and D even though Options A and C cover more

RRP events. This is because all five of these options cover owner-occupied housing units built before 1960 where a child under the age of six resides plus all pre-1960 rental housing and COFs. Options A and C, however, also cover RRP events in owner-occupied housing built before 1960 where there are no children under the age of six. This can be seen in the number of individuals protected who are age six and older, which is larger for Options A and C than for Options P, B and D.

Options E and F protect considerably more children under the age of six in the first year – approximately 1.4 million in total – because they cover all owner-occupied units built before 1978 where a child under the age of six resides plus all pre-1978 rental housing and COFs. In the second year of the rule, coverage is extended under Options P, A and B. As a result, from the second year and into the future, Options P, A and B provide the same level of protection to children as Options E and F – affecting 1.4 million children under the age of six annually. Options C and D continue to result in the lower number of children affected – approximately 1.2 million children.

In the second year and into the future, Option A offers the widest protection to persons age six and older – approximately 10.6 million children affected – followed by Option C with approximately 9.0 million affected persons age six and older. Options P and B protect somewhat fewer persons age 6 and older than are protected by Options E and F – approximately 5.3 million as opposed to approximately 5.4 million. Option D provides protection for 4.6 million and 4.9 million persons age six and older, respectively. The second benefits metric is the number of IQ points gained as a result of the rule. Table 5-14 presents these benefits, in thousands of IQ points gained, for each of the regulatory options. Options E and F provide the greatest total benefit relative to the other options during the first year and are among the options providing the greatest IQ benefits in the second year of the rule. In year one, Options E and F result in a 28 percent increase in the number of IQ points gained compared to Options A through D, and a 66 percent increase compared to Option P. During the second year of the rule, the total number of IQ points gained under options P, A, and B increases as the scope of the regulated universe expands under those options. In year two, Options E and F result in 41 percent more IQ points gained compared to Option P, and 28 percent more compared to Options C and D. Options A and B result in the same number of IQ points gained as under Options E and F by year 2.

Table 5-14: Total Number of IQ Points Gained (in thousands) by Option, Building Type and Year

	Target Housing		COFs in Public and Commercial Buildings		Total	
Option	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
P	~~110~~48	~~128~~58	~~3~~4	~~6~~5	~~114~~52	~~134~~63
A	~~146~~103	~~184~~129	~~2~~4	5	~~148~~108	~~188~~134
B	~~146~~103	~~184~~129	~~2~~4	5	~~148~~108	~~188~~134
C	~~146~~103	~~146~~103	~~2~~4	~~2~~4	~~148~~108	~~148~~107
D	~~146~~103	~~146~~103	~~2~~4	~~2~~4	~~148~~108	~~148~~107
E	~~184~~129	~~184~~129	5	5	~~189~~135	~~188~~134
F	129	129	5	5	135	134

Table 5-15 presents the total monetized benefits of each option by building type and year. Overall, target housing represents between 95 and 99 percent of the total benefit for the first and second year of the rule. As with IQ points gained, ~~Option~~ Options E ~~results~~and F result in the greatest total benefit for both years.

Options P, A, and B all result in an increase in benefits in the second year of the rule due to an increase in the number of buildings covered by each option. The slight reduction in the total benefits for Options C, D, ~~and~~ E, and F can be attributed to demolition of buildings since each option covers the same building types in both the first and second year of the rule.

~~Table 5-14: Total Dollar Value of IQ Points Gained by Option, Building Types and Year ($ Millions)~~

Table 5-15: Total Dollar Value of IQ Points Gained by Option, Building Types and Year ($ Millions)						
	Target Housing		COFs in Public and Commercial Buildings		Total	
Option	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
P	$~~1,430~~618	$~~1,607~~751	$~~45~~53	$~~72~~64	$~~1,474~~670	$~~1,680~~815
A	$1,~~893~~339	~~$2,310~~$1,669	$~~26~~57	$~~59~~71	$1,~~919~~396	~~$2,369~~$1,740
B	$1,~~893~~339	~~$2,310~~$1,669	$~~26~~57	$~~59~~71	$1,~~919~~396	~~$2,369~~$1,740
C	$1,~~893~~339	$1,~~830~~334	$~~26~~57	$~~25~~56	$1,~~919~~396	$1,~~855~~390
D	$1,~~893~~339	$1,~~830~~334	$~~26~~57	$~~25~~56	$1,~~919~~396	$1,~~855~~390
E	~~$2,389~~$1,676	~~$2,310~~$1,669	$~~61~~71	$~~59~~71	~~$2,451~~$1,747	~~$2,369~~$1,740
F	$1,676	$1,669	$71	$71	$1,747	$1,740

Table 5-16: Total Annualized Mean 50-Year Benefits of IQ Points Gained using Alternative Discount Rates of 3% and 7% ($ Millions)

shows the annualized mean 50 year benefits ~~of avoided exposures~~ at 3% and 7% discount rates by building type for each option. When using a 3 percent discount rate, the mean total benefits range from about $~~1.65~~ 0.78 billion to $~~2.34~~1.67 billion annually across the options, with the greatest benefit occurring in ~~Option~~Options E and F. Using a 7 percent discount rate, all the mean annualized values are slightly higher than they are when a 3 percent discount rate is used.

~~Table 5-15: Total Annualized Mean 50-Year Benefits of IQ Points Gained using Alternative Discount Rates of 3% and 7% ($ Millions)~~						
Table 5-16: Total Annualized Mean 50-Year Benefits of IQ Points Gained using Alternative Discount Rates of 3% and 7% ($ Millions)						
	Target Housing		COFs in Public and Commercial Buildings		Total	
Option	3%	7%	3%	7%	3%	7%
P	$~~1,580~~715	$~~1,674~~757	$~~70~~61	$~~74~~64	$~~1,650~~776	$~~1,748~~821
A	~~$2,264~~$1,589	~~$2,395~~$1,681	$~~57~~68	$~~60~~71	~~$2,322~~$1,657	~~$2,455~~$1,752
B	~~$2,264~~$1,589	~~$2,395~~$1,681	$~~57~~68	$~~60~~71	~~$2,322~~$1,657	~~$2,455~~$1,752
C	$1,~~809~~280	$1,~~926~~363	$~~25~~54	$~~27~~58	$1,~~834~~334	$1,~~952~~420
D	$1,~~809~~280	$1,~~926~~363	$~~25~~54	$~~27~~58	$1,~~834~~334	$1,~~952~~420
E	~~$2,284~~$1,6	~~$2,431~~$1,7	$~~59~~68	$~~63~~72	~~$2,342~~$1,6	~~$2,493~~$1,7

	02	05			70	78
F	$1,602	$1,705	$68	$72	$1,670	$1,778

One factor that varies among the regulatory options presented above is the scope of the option (i.e. whether the rule covers buildings built before 1960 or built before 1978). Because of differences in the number of buildings, the total number of children in the buildings, and the likelihood that the buildings contain lead-based paint, benefits may not be evenly distributed across all vintage categories in the option. Table 5-17 presents the number of IQ points gained by vintage of the building and by regulatory option. The number of IQ points gained reflects the number of housing units and COFs in each vintage category, whether that vintage category is covered by the regulatory option in that year, and whether or not certain work practices are prohibited by the regulation.

Table 5-16: Total Number of IQ Points Gained (in thousands) By Option and Building Vintage

Table 5-17: Total Number of IQ Points Gained (in thousands) By Option and Building Vintage

Option	Vintage							
	Pre-1930		**1930-1949**		**1950-1959**		**1960-1978**	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
P	~~90~~21	~~89~~21	~~16~~17	~~16~~17	~~8~~14	~~8~~14	0	~~20~~11
A	~~108~~43	~~107~~43	~~27~~33	~~27~~33	~~13~~31	~~13~~31	0	~~41~~27
B	~~108~~43	~~107~~43	~~27~~33	~~27~~33	~~13~~31	~~13~~31	0	~~41~~27
C	~~108~~43	~~107~~43	~~27~~33	~~27~~33	~~13~~31	~~13~~31	0	0
D	~~108~~43	~~107~~43	~~27~~33	~~27~~33	~~13~~31	~~13~~31	0	0
E	~~108~~43	~~107~~43	~~27~~33	~~27~~33	~~13~~31	~~13~~31	~~41~~27	~~41~~27
F	43	43	33	33	31	31	27	27

Table 5-18: Total Dollar Value of IQ Points Gained By Option and Building Vintage ($ Millions)

presents the monetized value of the IQ points gained by vintage of the building and by regulatory option. As with the number of IQ points gained, the monetized value reflects the number of housing units and COFs in each vintage category, whether that vintage category is covered by the regulatory option in that year, and whether or not certain work practices are prohibited by the regulation.

~~**Table 5-17: Total Dollar Value of IQ Points Gained By Option and Building Vintage ($ Millions)**~~

Table 5-18: Total Dollar Value of IQ Points Gained By Option and Building Vintage ($ Millions)

Option	Vintage							
	Pre-1930		**1930-1949**		**1950-1959**		**1960-1978**	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
P	$~~1,161~~274	$~~1,122~~273	$~~204~~220	$~~198~~219	$~~109~~176	$~~105~~175	$0	$~~254~~147
A	$~~1,398~~563	$~~1,352~~561	$~~354~~428	$~~342~~427	$~~167~~404	$~~161~~403	$0	$~~514~~350
B	$~~1,398~~563	$~~1,352~~561	$~~354~~428	$~~342~~427	$~~167~~404	$~~161~~403	$0	$~~514~~350
C	$~~1,398~~563	$~~1,352~~561	$~~354~~428	$~~342~~427	$~~167~~404	$~~161~~403	$0	$0
D	$~~1,398~~563	$~~1,352~~561	$~~354~~428	$~~342~~427	$~~167~~404	$~~161~~403	$0	$0
E	$~~1,398~~563	$~~1,352~~561	$~~354~~428	$~~342~~427	$~~167~~404	$~~161~~403	$~~531~~351	$~~514~~350
F	$563	$561	$428	$427	$404	$403	$351	$350

Table 5-19 presents the 50-year annualized monetized value of the IQ points gained by vintage of the building and by regulatory option. As with the number of IQ points gained, the monetized value reflects the number of children occupying housing units and COFs in each vintage category, whether that vintage category is covered by the regulatory option in that year, and whether or not certain work practices are prohibited by the regulation.

Table 5-19: 50-Year Annualized Dollar Value of IQ Points Gained By Option and Building Vintage ($ Millions)					
	Vintage				
Option	**Pre-1930**	**1930-1949**	**1950-1959**	**1960-1978**	**All Vintages**
Annualized using 3 Percent Discount Rate					
P	$262	$210	$168	$135	$776
A	$538	$410	$387	$322	$1,657
B	$538	$410	$387	$322	$1,657
C	$538	$410	$387	$0	$1,334
D	$538	$410	$387	$0	$1,334
E	$538	$410	$387	$336	$1,670
F	$566	$417	$416	$355	$1,670
Annualized using 7 Percent Discount Rate					
P	$279	$224	$179	$139	$821
A	$573	$436	$412	$332	$1,752
B	$573	$436	$412	$332	$1,752
C	$573	$436	$412	$0	$1,420
D	$573	$436	$412	$0	$1,420
E	$573	$436	$412	$357	$1,778
F	$602	$444	$442	$378	$1,866

Structures built before 1960 where children under the age of six are present (both COFs and residences of children under the age of six) are covered by all the options. Thus for each of the three vintage categories that comprise structures built before 1960, Options A through EF have the same number of IQ points gained. Option P has fewer IQ points gained in each vintage category because Option P does not include the prohibition on certain paint preparation activities, a prohibition included in Options A through EF.

5.7.2 *While the vast majority of total IQ points gained are found in the pre-1930 vintage category, the major difference between Option E and the other options is the additional children covered in the first year by Option E. In year 1, Option E benefits deliver an additional $531 million*Uncertainty Analysis

As discussed in benefits the document entitled "The Approach Used for Estimating Changes in Children's IQ from its coverage of buildings built between 1960 and 1978Lead Dust Generated during Renovation, Repair, and Painting in Residences and Child-Occupied Facilities " (EPA 2008, referred to as the Approach document) the selection of blood lead models is a critical element because it provides the link between the exposure media concentrations and the measures of IQ change. The Leggett model (Leggett 1993) was used since it is capable of modeling the impacts of very short-term lead exposures (even acute, one-time exposures), typical of renovation activities. Quantifying the uncertainty associated with model selection is problematic, and therefore the uncertainties associated with the Leggett model were evaluated in several ways. One way resembles a sensitivity analysis by focusing on a parameter in model structure. The selection of the red blood cell (RBC) saturation concentration, a required input to the Leggett model, is complicated as it appears to depend on the level and duration of exposure, and there is potential variation from one person to another (Leggett 1993). The default RBC saturation concentration in the Leggett (1993) model is 350 µg/dL RBC. However, data do exist that support the use of a value of 140 µg/dL RBC (Leggett 1993). To evaluate the sensitivity of the EPA 2008 approach to this range of saturation concentrations, blood lead concentrations were estimated separately using saturation concentrations of 350 µg/dL and 140 µg/dL RBC for three exposure scenarios: background exposures; the single activity scenario; and the multiple activities scenario. The change in IQ was then estimated for the single activity and multiple activities examples (see Appendix I of EPA 2008). A higher saturation concentration results in higher blood lead concentrations, and the differences between the results using different saturation concentrations are greatest for scenarios with the highest exposures (older vintages, more RRP activities). The most substantial differences were found in the multiple RRP activities example for the mean pre-1930 vintage results.

Model uncertainty can be evaluated by comparing blood lead estimates from several models with similar inputs and durations of exposure. Previous comparisons have shown that, under chronic exposure conditions, the blood lead estimates obtained with the Leggett model are approximately 2 to 3 times those obtained with the IEUBK model (Pounds and Leggett 1998). As discussed in Section 5.5 of EPA 2008, estimates of the background blood lead averaged over 0 to 6 years were obtained with the Leggett and IEUBK models, and were consistent with previous comparisons. (Pounds and Leggett consider "The disadvantages of the model for applications to Pb as a chemical toxicant generally stem from the facts that *a*) the model was designed primarily for use in radiation protection, where the starting point is often an intake level rather than environmental concentration, and *b*) the computer code was not originally intended for dissemination to the public." They also regard "For applications to Pb as a chemical toxicant, an important disadvantage of the ICRP model is that Pb input is defined in micrograms per day to the gastrointestinal tract and to the respiratory tract. Thus, the user must convert the Pb concentrations in food, air, soil, dust, paint, or other media to the amount of Pb ingested or inhaled per day. This conversion requires both effort and judgment." As noted in section 4.8 of EPA 2008, this conversion is a necessary step in the several blood lead models, including the IEUBK model.) However, since the IEUBK model is not appropriate for use in modeling short-term exposures, it was not possible to compare the blood lead estimates of the two models with short-term acute exposures typical of RRP activities. Thus, only limited conclusions about model uncertainty can be made from this comparison. Pounds and Leggett (1998) also note "The ICRP model has other disadvantages and differences from the integrated exposure uptake biokinetic (IEUBK) and O'Flaherty [another biokinetic] models." One of these is that "It does not incorporate a statistical treatment to estimate population values"; section 5.3 of EPA 2008 describes how that approach achieves estimates using the Leggett model together with a GSD. Pounds and Leggett go on to write "It should be noted that the omission of an error estimate for population values is not necessarily a disadvantage. Use of general U.S. population-based statistics to generate error estimates for a subpopulation (that may have very different patterns of Pb exposure and biokinetics) may provide an inappropriate estimate for the subpopulation." This is pertinent to the uncertainties described in the next paragraphs.

Model uncertainty can also be evaluated by comparing background blood lead estimates from several models with measured human data. One source of human data is CDC's NHANES data. Comparison of the NHANES data with the background blood lead estimates is problematic for many reasons, as discussed in Section 5.5 of EPA 2008. A comparison of the NHANES III, Phase 2 vintage-specific data (USEPA 1998) with the median blood lead estimates for a hypothetical child from the IEUBK model shows that the median estimates from the IEUBK model are slightly higher than the NHANES geometric means for houses of older vintages (pre-1946) and slightly lower for houses of more recent vintages. A comparison of the NHANES III data with the median blood lead estimates for a hypothetical child using the Leggett model shows that the median estimates from the Leggett model are in the high-end of the NHANES data, and are approximately 2 to 3 times the geometric mean. The NHANES III, Phase 2, data are from 1991 to 1994. Data from more recent surveys show that mean blood lead estimates have dropped, but it was not possible to obtain more recent NHANES data by vintage. Thus, the extent to which the comparison above has changed is unknown.

Based on these analyses, it is possible that the Leggett model may have an upward bias ranging from 5-25% of actual levels (based on the RBC saturation results) to 2-3 times actual levels. In order to allow the benefits analysis to consider a lower bound in its quantified analyses, the two renovation examples presented in EPA 2008, were re-analyzed using the original blood lead levels presented in EPA 2008 and blood lead levels that were divided by a factor of three. The resulting background blood lead levels and associated IQ changes are presented below in Table 5-20 and Table 5-25, respectively. The resulting blood lead levels and IQ changes for the single activity example are presented in Table 5-21 and Table 5-22 and, respectively; the resulting blood lead levels and IQ changes for the multiple activity example are presented in Table 5-23 and Table 5-24, respectively. The largest impact on IQ change was observed in the single activity example, for houses of the newer vintages (1960-1978) (see Table 5-30). This was expected because the blood lead levels in EPA 2008 were less than 10 ug/dl, and therefore already in the steeper segment of the piecewise linear IQ model. For each housing vintage category, the average of the mean percent changes in IQ resulting from dividing the blood lead levels by three for the two examples was used for the purposes of providing a lower bound for use in the benefits analysis. This lower bound was calculated as the average of the mean IQ changes across the two examples, two child access assumptions, and the four control options. For example, the average percent change for the Pre-1930 vintage, 27 percent, was calculated as the average of mean IQ changes shown in the shaded cells of Table 5-26 through Table 5-29. The percent changes in IQ used to calculate the lower bounds for each vintage category are shown in Table 5-30.

Table 5-20: Blood Lead Levels, Background Exposure

RRP Model Configuration	5th Percentile Blood Lead Levels				Median Blood Lead Levels				Mean Blood Lead Levels				95th Percentile Blood Lead Levels			
	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978
EPA (2008) Value	3.11	2.82	2.23	2.17	12.99	9.50	6.37	5.74	20.32	14.71	9.08	7.76	63.35	45.41	25.99	20.75
With Blood Lead Level/3	1.04	<1.00	<1.00	<1.00	4.33	3.17	2.12	1.91	6.77	4.90	3.03	2.59	21.12	15.14	8.66	6.92
Absolute Difference	2.07	>1.82	>1.23	>1.17	8.66	6.34	4.25	3.83	13.55	9.81	6.05	5.18	42.23	30.27	17.33	13.84

* Child-specific exposure settings: Child spends 100 percent of the time in the residence.

Table 5-21: Blood Lead Levels, Single Activity Example, Child Allowed in Work Area

RRP Model Configuration	5th Percentile Blood Lead Levels				Median Blood Lead Levels				Mean Blood Lead Levels				95th Percentile Blood Lead Levels			
	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978
Base Control Option																
EPA (2008) Value	4.16	3.62	3.00	2.73	18.23	12.11	9.13	7.54	24.93	17.41	12.07	9.94	69.41	50.15	31.73	25.71
With Blood Lead Level/3	1.39	1.21	<1.00	<1.00	6.08	4.04	3.04	2.51	8.31	5.80	4.02	3.31	23.14	16.72	10.58	8.57
Absolute Difference	2.78	2.42	>2.00	>1.73	12.15	8.07	6.09	5.03	16.62	11.61	8.04	6.63	46.27	33.44	21.16	17.14
Control Option 1																
EPA (2008) Value	4.36	3.81	3.15	2.89	21.56	13.79	10.71	8.54	28.29	19.43	14.14	11.33	75.66	55.17	37.46	29.87
With Blood Lead Level/3	1.45	1.27	1.05	<1.00	7.19	4.60	3.57	2.85	9.43	6.48	4.71	3.78	25.22	18.39	12.49	9.96
Absolute Difference	2.90	2.54	2.10	>1.89	14.37	9.19	7.14	5.69	18.86	12.95	9.43	7.55	50.44	36.78	24.98	19.91
Control Option 2																
EPA (2008) Value	4.17	3.60	2.97	2.70	17.80	11.90	8.91	7.41	24.47	17.14	11.77	9.74	68.42	49.39	30.90	25.12
With Blood Lead Level/3	1.39	1.20	<1.00	<1.00	5.93	3.97	2.97	2.47	8.16	5.71	3.92	3.25	22.81	16.46	10.30	8.37
Absolute Difference	2.78	2.40	>1.97	>1.70	11.87	7.94	5.94	4.94	16.32	11.43	7.85	6.49	45.62	32.93	20.60	16.74
Control Option 3																
EPA (2008) Value	4.03	3.47	2.86	2.61	16.83	11.41	8.49	7.12	23.73	16.71	11.40	9.48	68.04	48.90	30.49	24.83
With Blood Lead Level/3	1.34	1.16	<1.00	<1.00	5.61	3.80	2.83	2.37	7.91	5.57	3.80	3.16	22.68	16.30	10.16	8.28
Absolute Difference	2.69	2.31	>1.86	>1.61	11.22	7.61	5.66	4.75	15.82	11.14	7.60	6.32	45.36	32.60	20.33	16.56

* Child-specific exposure settings: Child spends 100 percent of the time in the residence; RRP activity occurs in the child's second year of life (1 to 2 years old).

Table 5-22: Blood Lead Levels, Single Activity Example, Child Not Allowed in Work Area																
RRP Model Configuration	5th Percentile Blood Lead Levels				Median Blood Lead Levels				Mean Blood Lead Levels				95th Percentile Blood Lead Levels			
	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978
Base Control Option																
EPA (2008) Value	3.78	3.29	2.70	2.48	15.63	10.83	7.87	6.69	22.61	16.07	10.69	8.96	66.05	47.52	28.91	23.64
With Blood Lead Level/3	1.26	1.10	<1.00	<1.00	5.21	3.61	2.62	2.23	7.54	5.36	3.56	2.99	22.02	15.84	9.64	7.88
Absolute Difference	2.52	2.19	>1.70	>1.48	10.42	7.22	5.25	4.46	15.07	10.71	7.13	5.97	44.03	31.68	19.27	15.76
Control Option 1																
EPA (2008) Value	4.23	3.74	3.08	2.83	21.28	13.60	10.55	8.42	27.98	19.21	13.95	11.19	74.95	54.71	36.98	29.58
With Blood Lead Level/3	1.41	1.25	1.03	<1.00	7.09	4.53	3.52	2.81	9.33	6.40	4.65	3.73	24.98	18.24	12.33	9.86
Absolute Difference	2.82	2.50	2.05	>1.83	14.19	9.07	7.03	5.61	18.65	12.81	9.30	7.46	49.97	36.47	24.66	19.72
Control Option 2																
EPA (2008) Value	3.77	3.27	2.68	2.47	15.36	10.67	7.74	6.61	22.27	15.84	10.46	8.79	65.20	46.93	28.13	22.99
With Blood Lead Level/3	1.26	1.09	<1.00	<1.00	5.12	3.56	2.58	2.20	7.42	5.28	3.49	2.93	21.73	15.64	9.38	7.66
Absolute Difference	2.51	2.18	>1.68	>1.47	10.24	7.11	5.16	4.41	14.85	10.56	6.97	5.86	43.47	31.28	18.75	15.33
Control Option 3																
EPA (2008) Value	3.91	3.39	2.79	2.56	16.43	11.19	8.30	6.98	23.27	16.42	11.15	9.30	67.01	48.15	29.81	24.44
With Blood Lead Level/3	1.30	1.13	<1.00	<1.00	5.48	3.73	2.77	2.33	7.76	5.47	3.72	3.10	22.34	16.05	9.94	8.15
Absolute Difference	2.61	2.26	>1.79	>1.56	10.95	7.46	5.53	4.65	15.52	10.95	7.43	6.20	44.67	32.10	19.87	16.29

* Child-specific exposure settings: Child spends 100 percent of the time in the residence; RRP activity occurs in the child's second year of life (1 to 2 years old).

Table 5-23: Blood Lead Levels, Multiple Activities Example, Child Allowed in Work Area

RRP Model Configuration	5th Percentile Blood Lead Levels				Median Blood Lead Levels				Mean Blood Lead Levels				95th Percentile Blood Lead Levels			
	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978
Base Control Option																
EPA (2008) Value	7.77	5.18	4.61	3.85	36.25	22.63	18.37	13.10	44.17	29.96	23.21	17.07	107.87	79.91	58.68	44.06
With Blood Lead Level/3	2.59	1.73	1.54	1.28	12.08	7.54	6.12	4.37	14.72	9.99	7.74	5.69	35.96	26.64	19.56	14.69
Absolute Difference	5.18	3.45	3.07	2.57	24.17	15.08	12.25	8.73	29.45	19.97	15.47	11.38	71.91	53.27	39.12	29.38
Control Option 1																
EPA (2008) Value	8.00	5.32	4.73	3.93	38.12	23.79	19.47	13.76	46.24	31.44	24.57	17.96	112.22	83.78	62.14	46.52
With Blood Lead Level/3	2.67	1.77	1.58	1.31	12.71	7.93	6.49	4.59	15.41	10.48	8.19	5.99	37.41	27.93	20.71	15.51
Absolute Difference	5.34	3.54	3.15	2.62	25.41	15.86	12.98	9.17	30.83	20.96	16.38	11.97	74.81	55.85	41.42	31.01
Control Option 2																
EPA (2008) Value	7.73	5.13	4.56	3.80	34.93	21.85	17.57	12.64	42.56	28.88	22.17	16.42	103.62	76.70	55.88	42.19
With Blood Lead Level/3	2.58	1.71	1.52	1.27	11.64	7.28	5.86	4.21	14.19	9.63	7.39	5.47	34.54	25.57	18.63	14.06
Absolute Difference	5.15	3.42	3.04	2.54	23.29	14.57	11.71	8.43	28.37	19.25	14.78	10.95	69.08	51.13	37.26	28.13
Control Option 3																
EPA (2008) Value	7.29	4.97	4.37	3.64	31.58	19.85	15.75	11.61	39.26	26.68	20.20	15.19	98.03	72.29	51.68	39.36
With Blood Lead Level/3	2.43	1.66	1.46	1.21	10.53	6.62	5.25	3.87	13.09	8.89	6.73	5.06	32.68	24.10	17.23	13.12
Absolute Difference	4.86	3.31	2.91	2.43	21.05	13.23	10.50	7.74	26.17	17.79	13.47	10.13	65.36	48.19	34.45	26.24

* Child-specific exposure settings: Child spends 100 percent of the time in the residence; RRP activity occurs in the child's second year of life (1 to 2 years old).

Table 5-24: Blood Lead Levels, Multiple Activities Example, Child Not Allowed in Work Area

RRP Model Configuration	5th Percentile Blood Lead Levels				Median Blood Lead Levels				Mean Blood Lead Levels				95th Percentile Blood Lead Levels			
	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978
Base Control Option																
EPA (2008) Value	5.92	4.46	3.83	3.33	29.74	18.64	14.86	10.98	36.93	25.18	19.19	14.55	93.00	68.71	49.70	38.35
With Blood Lead Level/3	1.97	1.49	1.28	1.11	9.91	6.21	4.95	3.66	12.31	8.39	6.40	4.85	31.00	22.90	16.57	12.78
Absolute Difference	3.95	2.97	2.55	2.22	19.83	12.43	9.91	7.32	24.62	16.79	12.80	9.70	62.00	45.80	33.13	25.56
Control Option 1																
EPA (2008) Value	6.65	4.77	4.17	3.58	35.55	22.07	18.08	12.80	43.24	29.40	22.95	16.86	105.90	79.13	58.57	44.24
With Blood Lead Level/3	2.22	1.59	1.39	1.19	11.85	7.36	6.03	4.27	14.41	9.80	7.65	5.62	35.30	26.38	19.52	14.75
Absolute Difference	4.43	3.18	2.78	2.39	23.70	14.71	12.05	8.54	28.82	19.60	15.30	11.24	70.60	52.75	39.05	29.49
Control Option 2																
EPA (2008) Value	5.79	4.36	3.74	3.25	27.12	17.05	13.46	10.15	34.04	23.18	17.39	13.36	86.76	63.50	44.85	34.94
With Blood Lead Level/3	1.93	1.45	1.25	1.08	9.04	5.68	4.49	3.38	11.35	7.73	5.80	4.45	28.92	21.17	14.95	11.65
Absolute Difference	3.86	2.91	2.49	2.17	18.08	11.37	8.97	6.76	22.69	15.45	11.59	8.91	57.84	42.33	29.90	23.30
Control Option 3																
EPA (2008) Value	5.98	4.41	3.82	3.29	28.11	17.71	14.04	10.51	35.03	23.89	18.08	13.83	88.46	64.99	46.53	36.14
With Blood Lead Level/3	1.99	1.47	1.27	1.10	9.37	5.90	4.68	3.50	11.68	7.96	6.03	4.61	29.49	21.66	15.51	12.05
Absolute Difference	3.99	2.94	2.55	2.20	18.74	11.81	9.36	7.01	23.35	15.93	12.05	9.22	58.98	43.33	31.02	24.09

* Child-specific exposure settings: Child spends 100 percent of the time in the residence; RRP activity occurs in the child's second year of life (1 to 2 years old).

Table 5-25: IQ Change, Background Exposure

RRP Model Configuration	5th Percentile Blood Lead Levels				Median Blood Lead Levels				Mean Blood Lead Levels				95th Percentile Blood Lead Levels			
	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978
EPA (2008) Value	-2.72	-2.47	-1.95	-1.90	-9.06	-8.32	-5.58	-5.03	-9.82	-9.24	-7.95	-6.79	-14.30	-12.43	-10.41	-9.87
With Blood Lead Level/3	-0.91	-*	-*	-*	-3.79	-2.77	-1.86	-1.68	-5.93	-4.29	-2.65	-2.26	-9.91	-9.28	-7.58	-6.05
Absolute Difference	1.81	-*	-*	-*	5.27	5.54	3.72	3.35	3.90	4.95	5.30	4.53	4.39	3.15	2.83	3.82
Percent Change	67	-*	-*	-*	58	67	67	67	40	54	67	67	31	25	27	39

* IQ change is not defined because blood lead levels were below the range (<1 µg/dL) where the IQ change equation (Lanphear et al., 2005) was considered applicable. In this case, the absolute difference between the Approach and blood lead values cannot be calculated, since the lower bound of IQ change cannot be determined.
Child-specific exposure settings: Child spends 100 percent of the time in the residence.

Table 5-26: IQ Change, Single Activity Example, Child Allowed in Work Area

RRP Model Configuration	5th Percentile Blood Lead Levels				Median Blood Lead Levels				Mean Blood Lead Levels				95th Percentile Blood Lead Levels			
	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978
Base Control Option																
EPA (2008) Value	-3.64	-3.17	-2.62	-2.39	-9.61	-8.97	-7.99	-6.60	-10.30	-9.52	-8.96	-8.70	-14.93	-12.93	-11.01	-10.38
With Blood Lead Level/3	-1.21	-1.06	-*	-*	-5.32	-3.53	-2.66	-2.20	-7.27	-5.08	-3.52	-2.90	-10.12	-9.45	-8.81	-7.50
Absolute Difference	2.43	2.11	-*	-*	4.29	5.44	5.33	4.40	3.03	4.44	5.45	5.80	4.81	3.48	2.20	2.89
Percent Change	67	67	-*	-*	45	61	67	67	29	47	61	67	32	27	20	28
Control Option 1																
EPA (2008) Value	-3.81	-3.34	-2.76	-2.52	-9.95	-9.14	-8.82	-7.47	-10.65	-9.73	-9.18	-8.89	-15.58	-13.45	-11.61	-10.82
With Blood Lead Level/3	-1.27	-1.11	-0.92	-*	-6.29	-4.02	-3.12	-2.49	-8.25	-5.67	-4.13	-3.30	-10.33	-9.62	-9.01	-8.71
Absolute Difference	2.54	2.23	1.84	-*	3.66	5.12	5.70	4.98	2.40	4.06	5.06	5.58	5.25	3.83	2.60	2.10
Percent Change	67	67	67	-*	37	56	65	67	23	42	55	63	34	28	22	19
Control Option 2																
EPA (2008) Value	-3.65	-3.15	-2.60	-2.36	-9.56	-8.95	-7.80	-6.48	-10.26	-9.49	-8.93	-8.52	-14.83	-12.85	-10.92	-10.32
With Blood Lead Level/3	-1.22	-1.05	-*	-*	-5.19	-3.47	-2.60	-2.16	-7.14	-5.00	-3.43	-2.84	-10.08	-9.42	-8.78	-7.33
Absolute Difference	2.44	2.10	-*	-*	4.37	5.48	5.20	4.32	3.12	4.49	5.50	5.68	4.74	3.42	2.14	3.00
Percent Change	67	67	-*	-*	46	61	67	67	30	47	62	67	32	27	20	29
Control Option 3																
EPA (2008) Value	-3.52	-3.03	-2.51	-2.29	-9.46	-8.90	-7.43	-6.23	-10.18	-9.45	-8.90	-8.29	-14.79	-12.80	-10.88	-10.29
With Blood Lead Level/3	-1.17	-1.01	-*	-*	-4.91	-3.33	-2.48	-2.08	-6.92	-4.87	-3.32	-2.76	-10.07	-9.41	-8.77	-7.24
Absolute Difference	2.35	2.02	-*	-*	4.55	5.57	4.95	4.15	3.26	4.57	5.57	5.53	4.72	3.39	2.11	3.05
Percent Change	67	67	-*	-*	48	63	67	67	32	48	63	67	32	26	19	30

* IQ change is not defined because blood lead levels were below the range (<1 µg/dL) where the IQ change equation (Lanphear et al., 2005) was considered applicable. In this case, the absolute difference between the Approach and blood lead values cannot be calculated, since the lower bound of IQ change cannot be determined.
Child-specific exposure settings: Child spends 100 percent of the time in the residence; RRP activity occurs in the child's second year of life (1 to 2 years old).

Table 5-27: IQ Change, Single Activity Example, Child Not Allowed in Work Area																
RRP Model Configuration	5th Percentile Blood Lead Levels				Median Blood Lead Levels				Mean Blood Lead Levels				95th Percentile Blood Lead Levels			
	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978
Base Control Option																
EPA (2008) Value	-3.30	-2.88	-2.36	-2.17	-9.34	-8.84	-6.89	-5.85	-10.06	-9.38	-8.82	-7.84	-14.58	-12.65	-10.72	-10.17
With Blood Lead Level/3	-1.10	-0.96	-*	-*	-4.56	-3.16	-2.30	-1.95	-6.59	-4.69	-3.12	-2.61	-10.00	-9.36	-8.43	-6.90
Absolute Difference	2.20	1.92	-*	-*	4.78	5.68	4.59	3.90	3.47	4.69	5.70	5.22	4.58	3.29	2.29	3.27
Percent Change	67	67	-*	-*	51	64	67	67	34	50	65	67	31	26	21	32
Control Option 1																
EPA (2008) Value	-3.70	-3.28	-2.70	-2.48	-9.92	-9.12	-8.81	-7.37	-10.62	-9.71	-9.16	-8.87	-15.50	-13.40	-11.56	-10.79
With Blood Lead Level/3	-1.23	-1.09	-0.90	-*	-6.21	-3.97	-3.08	-2.46	-8.16	-5.60	-4.07	-3.26	-10.31	-9.61	-8.99	-8.63
Absolute Difference	2.47	2.18	1.80	-*	3.72	5.16	5.73	4.91	2.46	4.10	5.09	5.61	5.20	3.79	2.56	2.16
Percent Change	67	67	67	-*	37	57	65	67	23	42	56	63	34	28	22	20
Control Option 2																
EPA (2008) Value	-3.30	-2.86	-2.35	-2.16	-9.31	-8.82	-6.77	-5.78	-10.03	-9.36	-8.80	-7.69	-14.49	-12.59	-10.64	-10.10
With Blood Lead Level/3	-1.10	-0.95	-*	-*	-4.48	-3.11	-2.26	-1.93	-6.50	-4.62	-3.05	-2.56	-9.97	-9.34	-8.20	-6.71
Absolute Difference	2.20	1.91	-*	-*	4.83	5.71	4.51	3.85	3.53	4.74	5.75	5.13	4.52	3.25	2.43	3.39
Percent Change	67	67	-*	-*	52	65	67	67	35	51	65	67	31	26	23	34
Control Option 3																
EPA (2008) Value	-3.42	-2.97	-2.44	-2.24	-9.42	-8.87	-7.26	-6.11	-10.13	-9.42	-8.87	-8.14	-14.68	-12.72	-10.81	-10.25
With Blood Lead Level/3	-1.14	-0.99	-*	-*	-4.79	-3.26	-2.42	-2.04	-6.79	-4.79	-3.25	-2.71	-10.03	-9.38	-8.69	-7.13
Absolute Difference	2.28	1.98	-*	-*	4.63	5.61	4.84	4.07	3.34	4.63	5.62	5.43	4.65	3.34	2.12	3.12
Percent Change	67	67	-*	-*	49	63	67	67	33	49	63	67	32	26	20	30

* IQ change is not defined because blood lead levels were below the range (<1 µg/dL) where the IQ change equation (Lanphear et al., 2005) was considered applicable. In this case, the absolute difference between the Approach and blood lead values cannot be calculated, since the lower bound of IQ change cannot be determined.
Child-specific exposure settings: Child spends 100 percent of the time in the residence; RRP activity occurs in the child's second year of life (1 to 2 years old).

Table 5-28: IQ Change, Multiple Activities Example, Child Allowed in Work Area

RRP Model Configuration	5th Percentile Blood Lead Levels				Median Blood Lead Levels				Mean Blood Lead Levels				95th Percentile Blood Lead Levels			
	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978
Base Control Option																
EPA (2008) Value	-6.80	-4.53	-4.04	-3.37	-11.48	-10.06	-9.62	-9.07	-12.30	-10.83	-10.12	-9.49	-18.93	-16.02	-13.81	-12.29
With Blood Lead Level/3	-2.27	-1.51	-1.35	-1.12	-8.97	-6.60	-5.36	-3.82	-9.24	-8.74	-6.77	-4.98	-11.45	-10.48	-9.74	-9.24
Absolute Difference	4.53	3.02	2.69	2.25	2.51	3.46	4.26	5.25	3.06	2.09	3.35	4.51	7.48	5.54	4.07	3.06
Percent Change	67	67	67	67	22	34	44	58	25	19	33	48	40	35	29	25
Control Option 1																
EPA (2008) Value	-7.00	-4.65	-4.14	-3.44	-11.67	-10.18	-9.73	-9.14	-12.52	-10.98	-10.27	-9.58	-19.38	-16.42	-14.17	-12.55
With Blood Lead Level/3	-2.33	-1.55	-1.38	-1.15	-9.03	-6.94	-5.68	-4.01	-9.31	-8.80	-7.17	-5.24	-11.60	-10.61	-9.86	-9.32
Absolute Difference	4.67	3.10	2.76	2.30	2.64	3.25	4.06	5.13	3.21	2.18	3.10	4.34	7.78	5.81	4.31	3.23
Percent Change	67	67	67	67	23	32	42	56	26	20	30	45	40	35	30	26
Control Option 2																
EPA (2008) Value	-6.77	-4.49	-3.99	-3.33	-11.34	-9.98	-9.54	-9.03	-12.14	-10.71	-10.02	-9.42	-18.49	-15.69	-13.52	-12.10
With Blood Lead Level/3	-2.26	-1.50	-1.33	-1.11	-8.92	-6.37	-5.12	-3.69	-9.19	-8.42	-6.46	-4.79	-11.30	-10.37	-9.65	-9.17
Absolute Difference	4.51	2.99	2.66	2.22	2.42	3.61	4.41	5.34	2.95	2.29	3.55	4.63	7.18	5.32	3.87	2.93
Percent Change	67	67	67	67	21	36	46	59	24	21	35	49	39	34	29	24
Control Option 3																
EPA (2008) Value	-6.38	-4.35	-3.83	-3.19	-10.99	-9.77	-9.35	-8.92	-11.79	-10.49	-9.81	-9.29	-17.91	-15.23	-13.08	-11.80
With Blood Lead Level/3	-2.13	-1.45	-1.28	-1.06	-8.80	-5.79	-4.59	-3.38	-9.07	-7.78	-5.89	-4.43	-11.11	-10.22	-9.50	-9.07
Absolute Difference	4.25	2.90	2.55	2.12	2.19	3.99	4.75	5.53	2.72	2.70	3.92	4.86	6.80	5.01	3.58	2.73
Percent Change	67	67	67	67	20	41	51	62	23	26	40	52	38	33	27	23

* Child-specific exposure settings: Child spends 100 percent of the time in the residence; RRP activity occurs in the child's second year of life (1 to 2 years old).

Table 5-29: IQ Change, Multiple Activities Example, Child Not Allowed in Work Area																
RRP Model Configuration	5th Percentile Blood Lead Levels				Median Blood Lead Levels				Mean Blood Lead Levels				95th Percentile Blood Lead Levels			
	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978	Pre-1930	1930 to 1949	1950 to 1959	1960 to 1978
Base Control Option																
EPA (2008) Value	-5.18	-3.90	-3.35	-2.92	-10.80	-9.65	-9.26	-8.85	-11.55	-10.33	-9.71	-9.22	-17.38	-14.86	-12.88	-11.70
With Blood Lead Level/3	-1.73	-1.30	-1.12	-0.97	-8.67	-5.44	-4.33	-3.20	-8.99	-7.35	-5.60	-4.25	-10.93	-10.09	-9.43	-9.04
Absolute Difference	3.45	2.60	2.23	1.94	2.13	4.21	4.92	5.65	2.56	2.98	4.11	4.98	6.45	4.76	3.45	2.66
Percent Change	67	67	67	67	20	44	53	64	22	29	42	54	37	32	27	23
Control Option 1																
EPA (2008) Value	-5.82	-4.18	-3.65	-3.14	-11.41	-10.01	-9.59	-9.04	-12.21	-10.77	-10.10	-9.46	-18.72	-15.94	-13.80	-12.31
With Blood Lead Level/3	-1.94	-1.39	-1.22	-1.05	-8.94	-6.44	-5.27	-3.73	-9.21	-8.57	-6.69	-4.92	-11.38	-10.45	-9.74	-9.24
Absolute Difference	3.88	2.79	2.43	2.09	2.46	3.57	4.32	5.31	3.00	2.19	3.40	4.55	7.34	5.49	4.06	3.07
Percent Change	67	67	67	67	22	36	45	59	25	20	34	48	39	34	29	25
Control Option 2																
EPA (2008) Value	-5.06	-3.82	-3.27	-2.84	-10.53	-9.48	-9.11	-8.77	-11.25	-10.12	-9.52	-9.10	-16.73	-14.31	-12.37	-11.34
With Blood Lead Level/3	-1.69	-1.27	-1.09	-0.95	-7.91	-4.97	-3.93	-2.96	-8.89	-6.76	-5.07	-3.90	-10.72	-9.91	-9.26	-8.92
Absolute Difference	3.38	2.54	2.18	1.90	2.62	4.51	5.18	5.81	2.36	3.36	4.45	5.20	6.02	4.40	3.11	2.42
Percent Change	67	67	67	67	25	48	57	66	21	33	47	57	36	31	25	21
Control Option 3																
EPA (2008) Value	-5.23	-3.86	-3.34	-2.88	-10.63	-9.55	-9.17	-8.80	-11.35	-10.19	-9.59	-9.15	-16.91	-14.47	-12.55	-11.47
With Blood Lead Level/3	-1.74	-1.29	-1.11	-0.96	-8.20	-5.17	-4.09	-3.07	-8.92	-6.97	-5.27	-4.03	-10.78	-9.96	-9.32	-8.96
Absolute Difference	3.49	2.57	2.23	1.92	2.44	4.39	5.08	5.74	2.43	3.23	4.32	5.11	6.13	4.51	3.23	2.51
Percent Change	67	67	67	67	23	46	55	65	21	32	45	56	36	31	26	22
* Child-specific exposure settings: Child spends 100 percent of the time in the residence; RRP activity occurs in the child's second year of life (1 to 2 years old).																

Table 5-30: Average Percent Change in IQ for Uncertainty Analysis Lower Bound	
Vintage Category	**Average Percent Change in IQ**
Pre-1930	27%
1930 to 1949	36%
1950 to 1959	50%
1960 to 1978	58%

The percentages in Table 5-30 are multiplied by the values in Table 5-17 to generate the lower bound results presented in Table 5-31.

Table 5-31: Uncertainty Range for Total Number of IQ Points Gained (in thousands) By Option and Building Vintage

	Vintage									
Option	**Pre-1930**		**1930-1949**		**1950-1959**		**1960-1978**		**All Vintages**	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
P	6 - 21	6 - 21	6 - 17	6 - 17	7 - 14	7 - 14	0 - 0	7 - 11	19 - 52	25 - 63
A	12 - 43	12 - 43	12 - 33	12 - 33	16 - 31	15 - 31	0 - 0	16 - 27	39 - 108	55 - 134
B	12 - 43	12 - 43	12 - 33	12 - 33	16 - 31	15 - 31	0 - 0	16 - 27	39 - 108	55 - 134
C	12 - 43	12 - 43	12 - 33	12 - 33	16 - 31	15 - 31	0 - 0	0 - 0	39 - 108	39 - 107
D	12 - 43	12 - 43	12 - 33	12 - 33	16 - 31	15 - 31	0 - 0	0 - 0	39 - 108	39 - 107
E	12 - 43	12 - 43	12 - 33	12 - 33	16 - 31	15 - 31	16 - 27	16 - 27	55 - 135	55 - 134
F	12 - 43	12 - 43	12 - 33	12 - 33	16 - 31	15 - 31	16 - 27	16 - 27	55 - 135	55 - 134

The percentages in Table 5-30 are multiplied by the values in Table 5-19 to generate the lower bound results presented in Table 5-32.

Chapter 7 contains several sensitivity analyses that address some of the uncertainties in this analysis by considering the impacts of alternative assumptions. One of the alternatives considers adjusting lead levels from renovations to account for potential differences in lead levels in paint across vintages. Adjusting the lead loadings from air, dust and soil resulting from renovations to account for vintage-specific levels of lead in paint results in a 14 percent reduction in total benefits. See Section 7.1 for more details.

Table 5-32: Uncertainty Range for Annualized Dollar Value of IQ Points Gained By Option and Building Vintage ($ Millions)					
	Vintage				
Option	Pre-1930	1930-1949	1950-1959	1960-1978	All Vintages
Annualized using 3 Percent Discount Rate					
P	$70 - $262	$76 - $210	$84 - $168	$79 - $135	$309 - $776
A	$144 - $538	$148 - $410	$193 - $387	$188 - $322	$673 - $1,657
B	$144 - $538	$148 - $410	$193 - $387	$188 - $322	$673 - $1,657
C	$144 - $538	$148 - $410	$193 - $387	$0 - $0	$485 - $1,334
D	$144 - $538	$148 - $410	$193 - $387	$0 - $0	$485 - $1,334
E	$144 - $538	$148 - $410	$193 - $387	$196 - $336	$681 - $1,670
F	$144 - $538	$148 - $410	$193 - $387	$196 - $336	$681 - $1,670
Annualized using 7 Percent Discount Rate					
P	$75 - $279	$81 - $224	$89 - $179	$82 - $139	$326 - $821
A	$153 - $573	$157 - $436	$205 - $412	$194 - $332	$710 - $1,752
B	$153 - $573	$157 - $436	$205 - $412	$194 - $332	$710 - $1,752
C	$153 - $573	$157 - $436	$205 - $412	$0 - $0	$516 - $1,420
D	$153 - $573	$157 - $436	$205 - $412	$0 - $0	$516 - $1,420
E	$153 - $573	$157 - $436	$205 - $412	$209 - $357	$725 - $1,778
F	$153 - $573	$157 - $436	$205 - $412	$209 - $357	$762 - $1,866

5.7.3 *Impact of Alternative Work Practice Requirements on Benefits*

Another set of factors to consider in terms of regulatory options are the work practices required by the rule. For purposes of estimating costs and benefits, these alternatives were defined in terms of the control options developed based on the OPPT Dust Study results. As shown in

Table 5-16: Total Annualized Mean 50-Year Benefits of IQ Points Gained using Alternative Discount Rates of 3% and 7% ($ Millions)

and repeated in Table 5-33, Option E is estimated to provide annualized benefits of approximately $2.3between $0.7 billion and $1.7 billion (annualized using a 3 percent discount rate). Other possible control options would require some but not all of the work practices included under the rule. Table 5-33 also presents the estimated benefits for several variants of Option E. One such option would be to require the use of rule containment but not rule cleaning nor cleaning verification (designated Option E1 in Table 5-33). This would provide nearly the same level of estimated benefits as Option E.). The estimated benefits under option E1 are larger than the benefits under option E. This is the opposite of what one might expect, since it implies that rule-style cleaning and verification would result in more exposure compared to conventional cleaning when rule-style containment is also performed. Limiting the requirements to rule cleaning without rule containment and without cleaning verification, however, would result in much lower benefits. As shown in Table 5-18, annualized benefits under Option E2 would be reduced by just over 50 percent to approximately $1.1 billion (annualized using a 3 percent discount rate). Adding cleaning verification towithout containment (Option E2), or rule cleaningcleaning only (Option E3) increases the total annualized benefit to approximately $1.3 billion, but there is still a decrease in), results in lower benefits of about 43 percent when compared to the full Option E, which also requires the use of rule containment.

. While it is expected that benefits under Option E are higher compared to Options E2 and E3, it is unexpected that benefits are higher under Option E3 compared to Option E2. As discussed more fully in Section 5.7.4, this apparent increase in benefits is likely an artifact of the underlying data and modeling.]

Option E4 estimates the benefits if Option E did not include a prohibition on the use of certain paint preparation and removal practices (e.g. use of open flame burning, torching or high temperature heat guns; and power sanding, grinding or abrasive blasting without a HEPA exhaust control) for renovations requiring lead-safe work practices under the rule. Without this prohibition, annualized benefits under Option E would be reduced by just under 30 percent (to approximately $1.7about 50 percent (to between $0.3 and $0.8 billion).

~~**Table 5-18: Total Quantified Benefits (Due to IQ Loss) of Avoided Exposures by Alternative E Options, Building Types and Year ($ Millions).**~~

Table 5-33: Total Quantified Benefits (Due to IQ Loss) by Alternative E Options, Building Types and Year ($ Millions).

Option	Target Housing Y1	Target Housing Y2	Target Housing Annualized 3%	Target Housing Annualized 7%	COFs in Public and Commercial Buildings Y1	COFs Y2	COFs Annualized 3%	COFs Annualized 7%	Total Y1	Total Y2	Total Annualized 3%	Total Annualized 7%
~~E – Preferred Option~~	~~$2,389~~	~~$2,310~~	~~$2,284~~	~~$2,431~~	~~$61~~	~~$59~~	~~$59~~	~~$63~~	~~$2,451~~	~~$2,369~~	~~$2,342~~	~~$2,493~~
E – Preferred Option Lower bound/	$682	$679	$652	$693	$31	$31	$29	$31	$712	$709	$681	$725
Upper Bound	$1,676	$1,669	$1,602	$1,705	$71	$71	$68	$72	$1,747	$1,740	$1,670	$1,778
~~E1 – Containment Only (No Cleaning or Cleaning Verification)~~	~~$2,413~~	~~$2,333~~	~~$2,307~~	~~$2,455~~	~~$11~~	~~$11~~	~~$11~~	~~$12~~	~~$2,425~~	~~$2,344~~	~~$2,318~~	~~$2,467~~
~~E2 – Cleaning Only (No Containment or Cleaning Verification)~~	~~$1,155~~	~~$1,117~~	~~$1,104~~	~~$1,175~~	~~$25~~	~~$24~~	~~$24~~	~~$25~~	~~$1,180~~	~~$1,141~~	~~$1,128~~	~~$1,201~~
~~E3 – Cleaning Plus Verification Only (No Containment)~~	~~$1,331~~	~~$1,287~~	~~$1,272~~	~~$1,354~~	~~$69~~	~~$66~~	~~$66~~	~~$70~~	~~$1,399~~	~~$1,353~~	~~$1,337~~	~~$1,423~~
~~E4 – No Prohibition on Any Paint Removal Practices (Same Rule Containment, Rule Cleaning, and Cleaning Verification as Option E)~~	~~$1,662~~	~~$1,607~~	~~$1,589~~	~~$1,691~~	~~$75~~	~~$72~~	~~$71~~	~~$76~~	~~$1,737~~	~~$1,680~~	~~$1,660~~	~~$1,767~~
E1 – Containment Only Lower bound/	$891	$887	$851	$906	$9	$9	$9	$9	$900	$896	$860	$915
Upper Bound (No Cleaning or Cleaning Verification)	$2,162	$2,153	$2,067	$2,200	$20	$20	$19	$20	$2,182	$2,173	$2,086	$2,220
E2 – Cleaning Plus Lower bound/	$130	$130	$124	$132	$31	$31	$29	$31	$161	$160	$154	$164
Upper Bound Verification Only (No Containment)	$327	$325	$312	$332	$72	$71	$68	$73	$398	$396	$380	$405

E3 – Cleaning Only Lower bound/ Upper Bound (No Containment or Cleaning Verification)	$359	$358	$343	$365	$13	$13	$13	$14	$372	$371	$356	$379
	$875	$872	$837	$891	$31	$31	$30	$32	$907	$903	$867	$922
E4 – No Prohibition Lower bound/ Upper Bound on Any Paint Removal Practices (Same Rule Containment, Rule Cleaning, and Cleaning Verification as Option E)	$299	$298	$286	$305	$27	$27	$26	$28	$327	$325	$312	$332
	$754	$751	$720	$767	$64	$64	$61	$65	$818	$815	$782	$832
Note: Options E1, E2 and E3 include the same prohibition on certain paint preparation and removal practices that Option E contains												

5.7.4 *Anomalies in the Benefits Analysis*

As discussed in the previous section (see results presented in Section 5.7.3), the analysis generates certain results that seem to indicate that more stringent control options yield smaller improvements in IQ change (and thus smaller benefits) than do less stringent control options. For example, the analysis estimates that using only containment yields higher benefits than using all of the rule's work practices (containment, cleaning, and cleaning verification). This is the opposite of what one might expect, since it implies that the combination of rule-style containment with rule-style cleaning and verification would result in more exposure than when such containment is combined with conventional cleaning. It seems highly unlikely that more careful cleaning will actually increase exposure and, therefore, this result is likely an artifact of the underlying data and modeling.

This section summarizes some of the potential causes of these unexpected results. The benefits analysis is based on three main components: the Dust Study, the blood lead-IQ modeling, and the benefits estimation. The contribution of each component to the unexpected results is described below.

Dust Study

EPA conducted a field study (Characterization of Dust Lead Levels after Renovation, Repair, and Painting Activities) (the "Dust Study") to characterize dust lead levels resulting from various renovation, repair, and painting activities. In the Dust Study, 60 interior experiments (48 at housing units and 12 at a child-occupied facility) and 15 different exterior renovation activities were performed at 15 target housing units and a child-occupied facility.

There are several reasons that lead levels reported in the Dust Study might contribute to anomalies in the benefits analysis. The Dust Study included a limited number of samples. These samples were used to create distributions of dust lead loadings for use in the blood lead-IQ modeling. The distributions developed from these small sample sizes have significant uncertainty and many of the resulting distributions are quite wide. Also, the Dust Study was a field study, not a laboratory study. It was intended to provide a real-world analysis of renovation activities, and thus, it was not possible to control all the variables one would wish to control in the study. Different renovations for a given task were similar but not identical, and were conducted under different conditions. In some cases different control options for a given renovation task were conducted in different houses which had different lead levels in the paint. Similarly, different renovators performed different experiments. These factors can also lead to situations in which a stricter control option in one house can generate higher dust lead levels than a less strict control option in another house.

Despite these limitations in the use of the Dust Study in estimating benefits, EPA is confident in the validity of the Dust Study. EPA requested a peer review of the Dust Study from the Clean Air Science Advisory Committee (CASAC) Lead Review Panel. According to the peer review report, the CASAC Panel found "that the [Dust Study] was reasonably well-designed, considering the complexity of the problem, and that the report provided information not available from any other source. The study indicated that the rule cleaning procedures reduced the residual lead remaining after a renovation more than did the baseline cleaning procedures. Another positive aspect of the Dust Study was that it described deviations from the protocol when they occurred." The CASAC Panel also contended that the limited data from residential housing units and child-occupied facilities included in the Dust Study, most likely do not represent a statistically valid sample of housing at the national level. They noted that there are aspects of the study that would underestimate the levels of lead loadings while other aspects of the study would overestimate the loadings. EPA agrees that the Dust Study is not nationally representative of all housing. A major purpose of the Dust Study was to assess the proposed work practices. A statistically valid sample of housing at the national level was not feasible and was not needed to assess the rule's work practices.

Blood Lead-IQ Modeling

The methodology for the blood lead-IQ modeling can contribute to unexpected results in the benefits estimates. The model uses a set sequence of random numbers to determine how sampling from the input distributions will be performed. The same sequence is used for each scenario and across options within a scenario (e.g., workspace restriction) to facilitate comparison across scenarios and different options. However, the random numbers are not the same for each control option evaluated for a given scenario. The only differences between control options are the activity-related inputs (which are derived from the Dust Study). As described earlier, the activity data for a particular activity were not typically collected from a single location for all control options, which prevents directly linking activity data across control options. As a result, there was no value in fixing the seed for the random numbers used across control options because the activity data for the control options are independent. It is important to note that the comparison between two control options often can compare two different sets of non-activity-related inputs (routine cleaning efficiency, background indoor dust loadings, etc.) and these differences in inputs could contribute to unexpected results. For example, a more stringent control option could have a higher background indoor dust loading than does a less stringent control option. The impact of this uncertainty is mitigated by the large number of Monte Carlo iterations performed, but clearly still has an impact in some cases. Similarly, when evaluating the results for cleaning verification (i.e., comparing scenarios "with rule cleaning" to those "with rule cleaning and verification cleaning"), unexpected results can occur. The model uses different random numbers for the "with rule cleaning" and "with rule cleaning and verification cleaning" control option for the different Monte Carlo iterations. Because the Monte Carlo tool does not achieve 100 percent stability in the percentile estimates, differences in the selected random numbers sometimes resulted in unexpected results. If the percentiles remained constant across iterations, this issue would not arise.

Benefits Analysis

The IQ modeling generates estimates of IQ change for each renovation job or combination of jobs, given the control option and other factors (age of child, workspace access assumptions, etc.). The benefits analysis then compares the results of the regulatory control option(s) to the control options used in the baseline, and estimates the resulting change in IQ points under each scenario. The benefits analysis then aggregates these scenarios by weighting the results according to the estimated number of children exposed in a given scenario, and assigning a dollar value to monetize the aggregate loss in IQ points. The steps in the benefits analysis affect the magnitude of results for each control option, but do not affect the underlying relationships between control options, which are based on the blood lead-IQ modeling and the Dust Study, in turn. Still, the modeling in the benefits analysis can influence the unexpected results. For example, the benefits analysis is based on the mean IQ change from the blood lead-IQ modeling, because the mean represents the expected value of the estimated IQ change distributions (that is, colloquially, the average or typical value). However, the mean IQ changes are more influenced by the tails of the distribution and issues of stability than are other measurements. Therefore, the choice of the mean IQ change as a metric could be influencing the unexpected results.

Conclusion

The economic analysis combines three different components (the Dust Study, the blood lead-IQ modeling, and the benefits analysis) to estimate benefits. The Agency is confident that every individual element is of appropriate quality for its intended purpose. These elements were intended to examine the rule as a whole, and cannot necessarily be reliably disaggregated to generate estimates at finer levels of detail (for example, for individual work practices). EPA is confident that, when taken as a whole, the rule generates substantial benefits.

Appendix 5A: Lead-Related Health Effects and Ecological Effects

Lead exposure can cause many adverse health and ecological effects. The quantitative benefits estimates in Chapter 5 are based only on the value of reduced lifetime earnings due to IQ loss from exposures to children under the age of six. This appendix supplements the benefits chapter by providing a broader, qualitative discussion of lead-related effects (including adult effects and ecological effects that are not included in the quantitative benefits estimates), based on EPA's Air Quality Criteria for Lead.

The information provided in this Appendix is an excerpt from the Executive Summary of the document Air Quality Criteria for Lead (United States Environmental Protection Agency, October 2006, EPA/600/R-5/144aF, this document is available at http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=158823). Specifically, the information provided in this Appendix is directly from the following sections of the Executive Summary:

E.4 Health Effects Associated with Lead Exposure

E.5 Human Population Groups at Special Risk and Potential Public Health Impacts

E.6 Environmental Effects of Lead

Background

The purpose of the 2006 Lead Air Quality Criteria document (AQCD) is to critically assess the latest scientific information on lead. The final version of the revised Lead AQCD mainly assesses pertinent literature published or accepted for publication through December 2005.

The First External Review Draft (dated December 2005) of the revised Lead AQCD underwent public comment and was reviewed by the Clean Air Scientific Advisory Committee (CASAC) at a public meeting held in Durham, NC on February 28-March 1, 2006. The public comments and CASAC recommendations received were taken into account in making appropriate revisions and incorporating them into a Second External Review Draft (dated May, 2006) which was released for further public comment and CASAC review at a public meeting held June 28-29, 2006. In addition, still further revised drafts of the Integrative Synthesis chapter and the Executive Summary were then issued and discussed during an August 15, 2006 CASAC teleconference call. Public comments and CASAC advice received on these latter materials, as well as Second External Review Draft materials, were taken into account in making and incorporating further revisions into this final version of the Lead AQCD.

Health Effects Associated With Lead Exposure

Both epidemiologic and toxicological studies have shown that environmentally relevant levels of lead affect many different organ systems. Research completed since the 1986 AQCD/Addendum and 1990 Supplement indicates that lead effects occur at blood-lead levels even lower than those previously reported for many endpoints. Remarkable progress has been made since the mid-1980s in understanding the lead effects on health. Recent studies have focused on details of the associations, including the shapes of concentration-response relationships, especially at levels well within the range of general population exposures, and on those biological and/or socio-environmental factors that either increase or decrease an individual's risk. Key findings and conclusions regarding important outcomes of newly available toxicological and epidemiologic studies of lead health effects are highlighted below.

Neurotoxic Effects of Lead Exposure

1. Neurobehavioral effects of lead-exposure early in development (during fetal, neonatal, and later postnatal periods) in young infants and children (≤7 years old) have been observed with remarkable consistency across numerous studies involving varying study designs, different developmental assessment protocols, and diverse populations. Negative lead impacts on neurocognitive ability and other neurobehavioral outcomes are robust in most recent studies even after adjustment for numerous potentially confounding factors (including quality of care giving, parental intelligence, and socioeconomic status). These effects generally appear to persist into adolescence and young adulthood.
2. The overall weight of the available evidence provides clear substantiation of neurocognitive decrements being associated in young children with blood-lead concentrations in the range of 5-10 μg/dL, and possibly somewhat lower. Some newly available analyses appear to show lead effects on the intellectual attainment of preschool and school age children at population mean concurrent blood-lead levels ranging down to as low as 2 to 8 μg/dL. A decline of 6.2 points in full scale IQ for an increase in concurrent blood lead levels from 1 to 10 μg/dL has been estimated, based on a pooled analysis of results derived from seven well-conducted prospective epidemiologic studies.
3. In the limited literature examining the effects of environmental lead exposure on adults, mixed evidence exists regarding associations between lead and neurocognitive performance. No associations were observed between cognitive performance and blood lead levels; however, significant associations were observed in relation to bone lead concentrations, suggesting that long-term cumulative lead exposure may contribute to neurocognitive deficits in adults.
4. Animal toxicology data indicate that developmental ~~Pb~~ lead exposures creating steady-state blood-lead concentrations of ~10 μg/dL result in behavioral impairments that persist into adulthood in rats and monkeys. No evident threshold has yet been found; and lead-induced deficits, for the most part, have been found to be very persistent, even with various chelation treatments. However, experimental studies indicate that environmental enrichment during development can partially mitigate the effects of lead on cognitive function. In rats, neurobehavioral deficits that persisted well into adulthood were observed with prenatal, preweaning, and postweaning lead exposure. In monkeys, such neurobehavioral deficits were observed both with in utero-only exposure and with early postnatal-only exposure when peak blood-lead levels did not exceed 15 μg/dL and steady-state levels were ~11 μg/dL.
5. Learning impairment has been observed in animal studies at blood levels as low as 10 μg/dL, with higher level learning showing greater impairment than simple learning tasks. The mechanisms associated with these deficits include: response preservation; insensitivity to

changes in reinforcement density or contingencies; deficits in attention; reduced ability to inhibit inappropriate responding; impulsivity; and distractibility.

6. Lead affects reactivity to the environment and social behavior in both rodents and nonhuman primates at blood lead levels of 15 to 40 μg/dL. Rodent studies also show that lead exposure potentiates the effects of stress in females.
7. Auditory function has also been shown to be impaired at blood lead levels of 33 μg/dL, while visual functions are affected at 19 μg/dL.
8. Neurotoxicological studies in animals clearly demonstrated that lead mimics calcium and affects neurotransmission and synaptic plasticity.
9. Epidemiologic studies have identified genetic polymorphisms of two genes that may alter susceptibility to the neurodevelopmental consequences of lead exposure in children. Variant alleles of the ALAD gene are associated with differences in absorption, retention, and toxicokinetics of lead. Polymorphisms of the vitamin D receptor gene have been shown to affect the rate of resorption and excretion of lead over time. These studies are only suggestive, and parallel animal studies have not been completed.

Cardiovascular Effects of Lead

10. Epidemiologic studies have consistently demonstrated associations between lead exposure and enhanced risk of deleterious cardiovascular outcomes, including increased blood pressure and incidence of hypertension. A meta-analysis of numerous studies estimates that a doubling of blood-lead level (e.g., from 5 to 10 μg/dL) is associated with ~1.0 mm Hg increase in systolic blood pressure and ~0.6 mm Hg increase in diastolic pressure. Studies have also found that cumulative past lead exposure (e.g., bone lead) may be as important, if not more, than present lead exposure in assessing cardiovascular effects. The evidence for an association of lead with cardiovascular morbidity and mortality is limited but supportive.
11. Experimental toxicology studies have confirmed lead effects on cardiovascular functions. Most have shown that exposures creating blood-lead levels of ~20 to 30 μg/dL for long periods result in arterial hypertension that persists long after cessation of lead exposure in genetically normal animals. One study reported blood pressure increases at blood-lead levels as low as 2 μg/dL in rats. A number of in vivo and in vitro studies provide compelling evidence for the role of oxidative stress in the pathogenesis of lead-induced hypertension. However, experimental investigations of cardiovascular effects of lead in animals are unclear as to why low, but not high, levels of lead exposure cause hypertension in experimental animals.

Renal Effects of Lead

12. In the general population, both circulating and cumulative lead was found to be associated with longitudinal decline in renal function. Effects on creatine clearance have been reported in human adult hypertensives to be associated with general population mean blood-lead levels of only 4.2 μg/dL. The public health significance of such effects is not clear, however, in view of more serious signs of kidney dysfunction being seen in occupationally exposed workers only at much higher blood-lead levels (>30-40 μg/dL).

13. Experimental studies using laboratory animals demonstrated that the initial accumulation of absorbed lead occurs primarily in the kidneys. This takes place mainly through glomerular filtration and subsequent reabsorption, and, to a small extent, through direct absorption from the blood. Both low dose lead-treated animals and high dose lead-treated animals showed a "hyperfiltration" phenomenon during the first 3 months of lead exposure. Investigations into biochemical alterations in lead-induced renal toxicity suggested a role for oxidative stress and involvement of NO, with a significant increase in nitrotyrosine and substantial fall in urinary excretion of NOx.

14. Iron deficiency increases intestinal absorption of lead and the lead content of soft tissues and bone. Aluminum decreases kidney lead content and serum creatinine in lead-intoxicated animals. Age also has an effect on lead retention. There is higher lead retention at a very young age and lower bone and kidney lead at old age, attributed in part to increased bone resorption and decreased bone accretion and, also, kidney lead.

Effects of Lead on the Immune System

15. Findings from recent epidemiologic studies suggest that lead exposure may be associated with effects on cellular and humoral immunity. These include changes in serum immunoglobulin levels. Studies of biomarkers of humoral immunity in children have consistently found significant associations between increasing blood-lead concentrations and serum IgE levels at blood-lead levels <10 μg/dL.

16. Toxicologic studies have shown that lead targets immune cells, causing suppression of delayed type hypersensitivity response, elevation of IgE, and modulation of macrophages into a hyper-inflammatory phenotype. These types of changes can cause increased risk of atopy, asthma, and some forms of autoimmunity and reduced resistance to some infectious diseases. Lead exposure of embryos resulting in blood-lead levels <10 μg/dL can produce persistent later-life immunotoxicity.

Effects of Lead on Heme Synthesis

17. Lead exposure has been associated with disruption of heme synthesis in both children and adults. A 10% probability of anemia (hematocrit <35%) is estimated to be associated with a blood-lead level of ~20 μg/dL at age 1 year. Increases in blood lead concentration of about 20-30 μg/dL are sufficient to halve erythrocyte ALAD activity and sufficiently inhibit ferrochelatase to double erythrocyte protoporphyrin levels.

18. Toxicological studies demonstrated that lead intoxication interferes with red blood cell (RBC) survival and alters RBC mobility. Hematological parameters, such as mean corpuscular volume, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration, are also significantly decreased upon exposure to lead. These effects are due to internalization of lead by RBC. The transport of lead across the RBC membrane is energy-independent and carrier-mediated; and the uptake of lead appears to be mediated by an anion exchanger through a vanadate-sensitive pathway.

19. Erythrocyte ALAD activity ratio (ratio of activated/non activated enzyme activity) has been shown to be a sensitive, dose-responsive measure of lead exposure, regardless of the mode of

administration of lead. Competitive enzyme kinetic analyses in RBCs from both humans and Cynomolgus monkeys indicated similar inhibition profiles by lead.

Effects of Lead on Bones and Teeth

20. Experimental studies in animals demonstrate that lead substitutes for calcium and is readily taken up and stored in the bone and teeth of animals, potentially allowing bone cell function to be compromised both directly and indirectly by exposure. Relatively short-term exposure of mature animals to lead does not result in significant growth suppression. However, chronic lead exposure during times of inadequate nutrition has been shown to adversely influence bone growth, including decreased bone density, decreased trabecular bone, and growth plates.
21. Exposure of developing animals to lead during gestation and the immediate postnatal period has clearly been shown to significantly depress early bone growth in a dose-dependent fashion, though this effect is not manifest below a certain threshold.
22. Systemically, lead has been shown to disrupt mineralization of bone during growth, to alter calcium binding proteins, and to increase calcium and phosphorus concentration in the blood stream, in addition to potentially altering bone cell differentiation and function by altering plasma levels of growth hormone and calciotropic hormones such as vitamin D3 [1,25-(OH2)D3.
23. Periods of extensive bone remodeling, such as occur during weight loss, advanced age, altered metabolic state, and pregnancy and lactation are all associated with mobilization of lead stores from bone of animals.
24. Numerous epidemiologic studies and, separately, animal studies (both post-eruptive lead exposure and pre- and perinatal lead exposure studies) suggest that lead is a caries-promoting element. However, whether lead incorporation into the enamel surface compromises the integrity and resistance of the surface to dissolution, and ultimately increases risk of dental decay, is unclear.
25. Increased risk of dental caries has been associated with lead exposure in children and adults. Lead effects on caries were observed in populations whose mean blood-lead levels were less than 10 μg/dL.

Reproductive and Developmental Effects of Lead

26. Epidemiologic evidence suggests small associations between lead exposure and male reproductive outcomes, including perturbed semen quality and increased time to pregnancy. There are no adequate epidemiologic data to evaluate associations between lead exposure and female fertility. Most studies have yielded no associations, or weak associations, of lead exposure with thyroid hormone status and male reproductive endocrine status in highly exposed occupational populations.
27. New ~~toxicologic~~toxicological studies support earlier conclusions, presented in the 1986 Lead AQCD, that (a) lead can produce both temporary and persisting effects on male and female reproductive function and development and (b) lead disrupts endocrine function at multiple points along the hypothalamic-pituitary-gonadal axis. Although there is evidence for a common mode of action, consistent effects on circulating testosterone levels are not always

observed in lead-exposed animals. Inconsistencies in reports of circulating testosterone levels complicate derivation of a dose-response relationship for this endpoint.

28. Lead-induced testicular damage (ultrastructural changes in testes of monkeys at blood-lead >35 to 40 µg/dL) and altered female sex hormone release, imprinting during early development, and altered female fertility all suggest ~~Pb~~lead -induced reproductive effects. However, lead exposure does not generally produce total sterility. Pre- and postnatal exposure to lead has been demonstrated to result in fetal mortality and produce a variety of sublethal effects in the offspring. Many of the lead-induced sublethal developmental effects occur at maternal blood-lead levels that do not result in clinical (overt) toxicity in the mothers. Teratogenic effects resulting from lead exposure reported in a few studies appear to be confounded by maternal toxicity.

Lead Effects on Other Organ Systems

29. Lead impacts the hypothalamic-pituitary-adrenal axis, elevating corticosterone levels and altering stress responsivity. This may be a potential mechanism contributing to lead-induced hypertension, with further possible roles in the etiology of diabetes, obesity and other disorders.
30. Studies of hepatic enzyme levels in serum suggest that liver injury may be present in lead workers; however, associations specifically with lead exposures are not evident. Children exposed to relatively high levels of lead (blood lead >30 µg/dL) exhibit depressed levels of circulating 1,25-dihydroxy vitamin D (1,25-OH-D). However, associations between serum vitamin D status and blood lead were not evident in a study of calcium-replete children who had average lifetime blood-lead concentrations <25 µg/dL.
31. Field studies that evaluated hepatic enzyme levels in serum suggest that liver injury may be present in lead workers; however, associations specifically with lead exposures have not been well established.
32. Simultaneous induction of the activities of phase II drug metabolizing enzymes and decreased phase I enzymes with a single exposure to lead nitrate in rat liver suggest that lead is capable of causing biochemical phenotype similar to hepatic nodules.
33. Newer studies examined the induction of GST-P at both transcriptional and translational levels using in vitro systems and indicated a role for lead-nitrate and lead-acetate in the induction process.
34. Lead-induced alterations in cholesterol metabolism appear to be mediated by the induction of several enzymes related to cholesterol metabolism and the decrease of 7 α-hydroxylase, a cholesterol-catabolizing enzyme. This regulation of cholesterol homeostasis is modulated by changes in cytokine expression and related signaling.
35. Newer experimental evidence suggests that lead-induced alterations in liver heme metabolism involve perturbations in ALAD activity, porphyrin metabolism, alterations in Transferrin gene expression, and associated changes in iron metabolism.
36. Gastrointestinal (GI) absorption of lead is influenced by a variety of factors, including chemical and physical forms of the element in ingested media, age at intake, and various nutritional factors. The degeneration of intestinal mucosal epithelium leading to potential

malabsorption and alterations in the jejunal ultrastructure (possibly associated with distortion of glycocalyx layer) have been reported in the intestine of lead-exposed rats.

37. Nutritional studies that varied lead, Ca, and vitamin D levels in the diet have demonstrated competition of lead with Ca absorption. Supplementation with vitamin D has been reported to enhance intestinal absorption of Ca and lead. Physiological amounts of vitamin D, when administered to vitamin D-deficient rats, resulted in elevated lead and Ca levels. In the case of severe Ca deficiency, lead ingestion results in a marked decrease in serum 1,25 hydroxy vitamin D.

Genotoxic and Carcinogenic Effects of Lead

38. Epidemiologic studies of highly exposed occupational populations suggest a relationship between lead and cancers of the lung and the stomach; however the evidence is limited by the presence of various potential confounders, including metal co-exposures (e.g., to arsenic, cadmium), smoking, and dietary habits. The 2003 NTP and 2004 IARC reviews concluded that lead and lead compounds were probable carcinogens, based on limited evidence in humans and sufficient evidence in animals. Similarly, lead and lead compounds would likely be classified as likely to be carcinogenic to humans according to the new 2005 EPA Cancer Assessment Guidelines for Carcinogen Risk Assessment, based on animal data even though the human data are inadequate.

39. Studies of genotoxicity consistently find associations of lead exposure with DNA damage and micronuclei formation; however, the associations with the more established indicator of cancer risk, chromosomal aberrations, are inconsistent.

40. Lead is an animal carcinogen and extends our understanding of mechanisms involved to include a role for metallothionein. Specifically, the recent data show that metallothionein may participate in lead inclusion bodies and, thus, serves to prevent or reduce lead-induced tumorigenesis.

41. In vitro cell culture studies that evaluated the potential for lead to transform rodent cells are inconsistent, and careful study of a time course of exposure is necessary to determine whether lead actually induces transformation in cultured rodent cells. There is increased evidence suggesting that lead may be co-carcinogenic or promotes the carcinogenicity of other compounds. Cell culture studies do support a possible epigenetic mechanism or co-mutagenic effects.

Lead-Binding Proteins

42. Proteins depending upon sulfur-containing side chains for maintaining conformity or activity are vulnerable to inactivation by lead, due to its strong sulfur-binding affinity.

43. The enzyme, ALAD, a 280 kDa protein, is inducible and is the major lead-binding protein within the erythrocyte.

44. The lead-binding protein in rat kidney has been identified as a cleavage product of α-2-microglobulin. The low molecular weight lead-binding proteins in human kidney have been identified as thymosin β 4 (molecular weight 5 kDa) and acyl-CoA binding protein (molecular weight 9 kDa). In human brain, lead-binding proteins include thymosin β4 and an unidentified protein of 23 kDa.

45. Animal toxicology studies with metallothionein-null mice demonstrated a possible role for metallothionein as a renal lead-binding protein.

Human Population Groups At Special Risk And Potential Public Health Impacts

46. Children, in general and especially low SES (often including larger proportions of African-American and Hispanic) children, have been well-documented as being at increased risk for lead exposure and lead-induced adverse health effects. This is due to several factors, including enhanced exposure to lead via ingestion of soil-lead and/or dust-lead due to normal hand-to-mouth activity and/or pica.
47. Even children with low lead exposure levels (having blood lead of 5-10 µg/dL or, possibly, somewhat lower) are at notable risk, due to apparent non-linear dose-response relationships between blood lead and neurodevelopmental outcomes. It is hypothesized that initial neurodevelopmental lesions occurring at blood-lead levels <10 µg/dL may disrupt different developmental processes in the nervous system than more severe high level exposures.
48. Adults with idiosyncratic exposures to lead through occupations, hobbies, make-up use, glazed pottery, native medicines, and other sources are at risk for lead toxicity. Certain ethnic and racial groups are known to have cultural practices that involve ingestion of lead-containing substances, e.g., ingestion of foods or beverages stored in lead-glazed pottery or imported canned food from countries that allow lead-soldered cans.
49. Cumulative past lead exposure, measured by bone lead, may be a better predictor of cardiovascular effects than current blood-lead levels. African-Americans are known to have substantially higher baseline blood pressure than other ethnic groups, so lead's impact on an already higher baseline could indicate a greater susceptibility to lead for this group.
50. Effects on adults of low-level lead exposures also include some renal effects (i.e., altered creatinine clearance) at blood-lead levels <5 ug/dL. Lead exposure combined with other risk factors, such as diabetes, hypertension, or chronic renal insufficiency may result in clinically relevant effects in individuals with two or more other risk factors.
51. At least two genetic polymorphisms, of the ALAD and the vitamin D receptor gene, have been suggested to play a role in susceptibility to lead. In one study, African-American children were found to have a higher incidence of being homozygous for alleles of the vitamin D receptor gene thought to contribute to greater lead blood levels. This work is preliminary and further studies will be necessary to determine implications of genetic differences that may make certain populations more susceptible to lead exposure.
52. What was considered "low" for lead exposure levels in the 1980s is an order of magnitude higher than the current mean level in the U.S. population, and current average blood-lead levels in U.S. populations remain perhaps as much as two orders of magnitude above preindustrial "natural" levels in humans. There is no level of lead exposure that has yet been identified, with confidence, as being clearly not being associated with possible risk of deleterious health effects. Some recent studies of lead neurotoxicity in infants have observed effects at population average blood-lead levels of only 1 or 2 µg/dL; and some cardiovascular, renal, and immune outcomes have been reported at blood-lead levels below 5 µg/dL.

53. Public health interventions have resulted in declines, over the last 25 years, of more than 90% in the mean blood-lead level within all age and gender subgroups of the U.S. population, substantially decreasing the numbers of individuals at likely risk for lead-induced toxicities. Nevertheless, estimates of the magnitude of potential public health impacts of lead exposure can be substantial for the U.S. population. For example, in estimating the effect of lead exposure on intelligence, it was projected that the fraction of individuals with an IQ >120 would decrease from ~9% with no lead exposure to less than 3% at a blood-lead level of 10 µg/dL. Also, the fraction of individuals with an IQ >130 points was estimated as being likely to decrease from 2.25% to 0.5% with a blood-lead level change from 0 to 10 µg/dL. In addition, an estimate of hypertension-related risk for serious cardiovascular events (coronary disease, stroke, peripheral artery disease, cardiac failure) indicates that a decrease in blood lead from 10 to 5 µg/dL could result in an annual decrease of 27 events per 100,000 women and 39 events per 100,000 men.

Environmental Effects Of Lead

Terrestrial Ecosystems

Methodologies Used in Terrestrial Ecosystem Research

54. Electron probe microanalysis (EPMA) techniques provide the greatest information on metal speciation. Other techniques, such as EXAFS (extended X-ray absorption fine structure) and EXANES (extended X-ray absorption near edge spectroscopy), show great promise and will be important in solving key mechanistic questions.
55. In situ methodologies have been developed to lower soil-lead relative bioavailability. These amendments typically fall within the categories of phosphate, biosolid, and Al/Fe/Mn-oxide amendments. Some of the drawbacks to soil amendment include phosphate toxicity to plants and increased arsenic mobility at high soil phosphate concentrations. The use of iron (III) phosphate seems to mitigate arsenic mobility, however increased concentrations of phosphate and iron limit their application when drinking water quality is a concern.

Distribution of Atmospherically Delivered Lead in Terrestrial Ecosystems

56. Total lead deposition during the 20th century has been estimated at 1 to 3 g Pb m^{-2}, depending on elevation and proximity to urban areas. Total contemporary loadings to terrestrial ecosystems are ~1 to 2 mg m^{-2} $year^{-1}$. This is a relatively small annual flux of lead compared to the reservoir of ~0.5 to 4 g m^{-2} of gasoline additive-derived lead already deposited in surface soils over much of the United States.
57. Dry deposition can account for 10% to >90% of total lead deposition. Because Clean Air Act Legislation has preferentially reduced lead associated with fine particles, relative contributions of dry deposition have changed in the last few decades.
58. Although inputs of lead to ecosystems are currently low, lead export from watersheds via groundwater and streams is substantially lower than inputs. Therefore, even at current input levels, watersheds are accumulating anthropogenic lead.
59. Species of lead delivered to terrestrial ecosystems can be inferred by emission source. For example, lead species emitted from automobile exhaust are dominated by particulate lead

halides and double salts with ammonium halides (e.g., PbBrCl, $PbBrCl_2NH_4Cl$), while lead emitted from smelters is dominated by lead-sulfur species. Halides from automobile exhaust break down rapidly in the atmosphere, via redox reactions in the presence of atmospheric acids. Lead phases in the atmosphere, and presumably the compounds delivered to the surface of the earth (i.e., to vegetation and soils), are suspected to be in the form of PbSO4, PbS, and PbO.

60. The importance of humic and fulvic acids and hydrous Mn- and Fe-oxides for scavenging lead in soils was discussed in some detail in the 1986 Lead AQCD. The importance of these lead binding substrates is reinforced by studies reported in the more contemporary literature.
61. The amount of lead that has leached into mineral soil appears to be on the order of 20 to 50% of the total anthropogenic lead deposition.
62. The vertical distribution and mobility of atmospheric lead in soils was poorly documented prior to 1986. Techniques using radiogenic lead isotopes have been developed to differentiate between gasoline-derived lead and natural, geogenic (native) lead. These techniques provide more accurate determinations of the depth-distribution and potential migration velocities for atmospherically delivered lead in soils.
63. Selective chemical extractions have been used extensively over the past 20 years to quantify amounts of a particular metal phase in soil or sediment rather than total metal concentration. However, some problems persist with the selective extraction technique: (a) extractions are rarely specific to a single phase; and (b) in addition to the nonselectivity of reagents, significant metal redistribution has been found to occur during sequential chemical extractions. Thus, although chemical extractions provide some useful information on metal phases in soil or sediment, the results should be treated as “operationally defined,” e.g., “H_2O_2-liberated Pb” rather than “organic Pb.”
64. Soil solution dissolved organic matter content and pH typically have very strong positive and negative correlations, respectively, with the concentration of dissolved lead species.

Effects of Lead on Natural Terrestrial Ecosystems

65. Atmospheric lead pollution has resulted in the accumulation of lead in terrestrial ecosystems throughout the world. In the United States, anthropogenically-derived lead represents a significant fraction of the total lead burden in soils, even in sites remote from smelters and other industrial plants. However, few significant effects of lead pollution have been observed at sites that are not near point sources of lead.
66. Evidence from precipitation collection and sediment analyses indicates that atmospheric deposition of lead has declined dramatically (>95%) at sites unaffected by point sources of lead, and there is little evidence that lead accumulated in soils at these sites represents a threat to ground water or surface water supplies.
67. The effects of lead and other chemical emissions on terrestrial ecosystems near smelters and other industrial sites decrease downwind from the lead source. Several studies using the soil burden as an indicator have shown that much of the contamination occurs within a radius of 20 to 50 km around the emission source. Elevated metal concentrations around smelters have been found to persist despite significant reductions in emissions. The concentrations of lead in soils, vegetation, and fauna at these sites can be two to three orders of magnitude higher

than in reference areas. Assessing the risks specifically associated with lead is difficult, because these sites also experience elevated concentrations of other metals and because of effects related to SO2 emissions. The confounding effect of other pollutants makes the assessment of lead-specific exposure-response relationships impossible at the whole ecosystem level.

68. In the most extreme cases, near smelter sites, the death of vegetation causes a near-complete collapse of the detrital food web, creating a terrestrial ecosystem in which energy and nutrient flows are minimal.

69. More commonly, stress in soil microorganisms and detritivores can cause reductions in the rate of decomposition of detrital organic matter. Although there is little evidence of significant bioaccumulation of lead in natural terrestrial ecosystems, reductions in microbial and detritivorous populations can affect the success of their predators. Thus, at present, industrial point sources represent the greatest lead-related threat to the maintenance of sustainable, healthy, diverse, and high-functioning terrestrial ecosystems in the United States.

Terrestrial Species Response/Mode of Action

70. Plants take up lead via their foliage and through their root systems. Surface deposition of lead onto plants may represent a significant contribution to the total lead in and on the plant, as has been observed for plants near smelters and along roadsides.

71. There are two possible mechanisms (symplastic or apoplastic) by which lead may enter the root of a plant. The symplastic route is through the cell membranes of root hairs; this is the mechanism of uptake for water and nutrients. The apoplastic route is an extracellular route between epidermal cells into the intercellular spaces of the root cortex. The symplastic route is considered the primary mechanism of lead uptake in plants.

72. Recent work supports previous conclusions that the form of metal tested, and its speciation in soil, influence uptake and toxicity to plants and invertebrates. The oxide form of lead is less toxic than the chloride or acetate forms, which are less toxic that the nitrate form of lead. However, these results must be interpreted with caution, as the counter ion (e.g., the nitrate ion) may also be contributing to the observed toxicity.

73. Lead may be detoxified in plants by deposition in root cell walls, and this may be influenced by calcium concentrations. Other hypotheses put forward recently include the presence of sulfur ligands and the sequestration of lead in old leaves as detoxification mechanisms. Lead detoxification has not been studied extensively in invertebrates. Glutathione detoxification enzymes were measured in two species of spider. Lead may be stored in waste nodules in earthworms or as pyromorphite in the nematode.

74. Lead effects on heme synthesis (as measured primarily by ALAD activity and protoporphyrin concentration) were documented in the 1986 Lead AQCD and continue to be studied. However, researchers caution that changes in ALAD and other enzyme parameters are not always related to adverse effects, but may simply indicate exposure. Other effects on plasma enzymes, which may damage other organs, have been reported. Lead also may cause lipid peroxidation, which may be alleviated by vitamin E, although lead poisoning may still result. Changes in fatty acid production have been reported, which may influence immune response and bone formation.

75. Insectivorous mammals may be more exposed to lead than herbivores, and higher trophic-level consumers may be less exposed than lower trophic-level organisms. Nutritionally deficient diets (including low calcium) cause increased uptake of lead and greater toxicity in birds.

76. Interactions of lead with other metals are inconsistent, depending on the endpoint measured, the tissue analyzed, the animal species, and the metal combination.

Exposure/Response of Terrestrial Species

77. Recent critical advancements reported in the current Lead AQCD in understanding toxicity levels relies heavily on the work completed by a multi-stakeholder group, consisting of federal, state, consulting, industry, and academic participants, led by the EPA to develop Ecological Soil Screening Levels (Eco-SSLs).

78. Eco-SSLs are concentrations of contaminants in soils that would result in little or no measurable effect on ecological receptors. The Eco-SSLs are intentionally conservative in order to provide confidence that contaminants that could present an unacceptable risk are not screened out early in the evaluation process. That is, at or below these levels, adverse effects are considered unlikely. Due to conservative modeling assumptions (e.g., metal exists in most toxic form or highly bioavailable form, high food ingestion rate, high soil ingestion rate) that are common to screening processes, several Eco-SSLs are derived below the average background soil concentration for a particular contaminant.

79. The Eco-SSLs for terrestrial plants, birds, mammals, and soil invertebrates are 120, 11, 56, and 1700 mg Pb/kg soil, respectively.

Aquatic Ecosystems

Methodologies Used in Aquatic Ecosystem Research

80. Many of the terrestrial methods can also be applied to suspended solids and sediments collected from aquatic ecosystems. Just as in the terrestrial environment, the speciation of lead and other trace metals in natural freshwaters and seawater plays a crucial role in determining their reactivity, mobility, bioavailability, and toxicity. Many of the same speciation techniques employed for the speciation of lead in terrestrial ecosystems are applicable in aquatic ecosystems.

81. There is now a better understanding of the potential effects of sampling, sample handling, and sample preparation on aqueous-phase metal speciation. Thus, a need has arisen for dynamic analytical techniques that are able to capture a metal's speciation, in-situ and in real time.

82. With few exceptions, ambient water quality criteria (AWQC) are derived based on data from aquatic toxicity studies conducted in the laboratory. In general, both acute (short term) and chronic (long term) AWQCs are developed. Depending on the species, the toxicity studies considered for developing acute criteria range in length from 48 to 96 hours.

83. Acceptable chronic toxicity studies should encompass the full life cycle of the test organism, although for fish, early life stage or partial life cycle toxicity studies are considered acceptable. Acceptable endpoints include reproduction, growth and development, and survival, with the effect levels expressed as the chronic value.

84. The biotic ligand model (BLM), which considers the binding of free metal ion to the site of toxic action and competition between metal species and other ions, has been developed to predict the toxicity of several metals under a variety of water quality conditions. However, there are limitations to this tool in deriving AWQC because, currently, limited work has been conducted in developing chronic BLMs (for any metals, let alone lead) and the acute BLMs to date do not account for dietary metal exposures.

Distribution of Lead in Aquatic Ecosystems

85. Atmospheric lead is delivered to aquatic ecosystems primarily through deposition (wet and/or dry) or through erosional transport of soil particles.

86. A significant portion of lead in the aquatic environment exists in the undissolved form (i.e., bound to suspended particulate matter). The ratio of lead in suspended solids to lead in filtrate varies from 4:1 in rural streams to 27:1 in urban streams.

87. The oxidation potential of lead is high in slightly acidic solutions, and Pb^{2+} binds with high affinity to sulfur-, oxygen-, and nitrogen-containing ligands. Therefore, speciation of lead in the aquatic environment is controlled by many factors (e.g., pH, redox, dissolved organic carbon, sulfides). The primary form of lead in aquatic environments is divalent (Pb^{2+}), while Pb^{4+} exists only under extreme oxidizing conditions. Labile forms of lead (e.g., Pb^{2+}, $PbOH^{+}$, $PbCO_3$) are a significant portion of the lead inputs to aquatic systems from atmospheric washout. Lead is typically present in acidic aquatic environments as $PbSO_4$, PbCl4, ionic Pb, cationic forms of lead-hydroxide, and ordinary lead-hydroxide ($Pb(OH)_2$). In alkaline waters, common species of lead include anionic forms of lead-carbonate ($Pb(CO_3)$) and $Pb(OH)_2$.

88. Lead concentrations in lakes and oceans were generally found to be much lower than those measured in the lotic waters assessed by NAWQA. In open waters of the North Atlantic the decline of lead concentrations has been associated with the phasing out of leaded gasoline in North America and Western Europe. However, in estuarine systems, it appears that similar declines following the phase-out of leaded gasoline are not necessarily as rapid.

89. Based on a synthesis of NAWQA data from the United States, lead concentrations in surface waters, sediments, and fish tissues (whole body) respectively range from: 0.04 to 30 µg/L (mean = 0.66, median = 0.50, 95th %tile = 1.1); 0.5 to 12,000 mg/kg (mean = 120, median = 28, 95th %tile = 200); and 0.08 to 23 mg/kg (mean = 1.03, median = 0.59, 95th %tile = 3.24).

Effects of Lead on Natural Aquatic Ecosystems

90. Lead exposure may adversely affect organisms at different levels of organization, i.e., individual organisms, populations, communities, or ecosystems. Generally, however, there is insufficient information available for single materials in controlled studies to permit evaluation of specific impacts on higher levels of organization (beyond the individual organism). Potential effects at the population level or higher are, of necessity, extrapolated from individual level studies. Available population, community, or ecosystem level studies are typically conducted at sites that have been contaminated or adversely affected by multiple stressors (several chemicals alone or combined with physical or biological stressors). Therefore, the best-documented links between lead and effects on the environment are with effects on individual organisms.

91. Natural systems frequently contain multiple metals, making it difficult to attribute observed adverse effects to single metals. For example, macro invertebrate communities have been widely studied with respect to metals contamination and community composition and species richness. In these studies, multiple metals were evaluated and correlations between observed community level effects were ascertained. The results often indicate a correlation between the presence of one or more metals (or total metals) and the negative effects observed. While, correlation may imply a relationship between two variables, it does not imply causation of effects.

92. In simulated microcosms or natural systems, environmental exposure to lead in water and sediment has been shown to affect energy flow and nutrient cycling and benthic community structure.

93. In field studies, lead contamination has been shown to significantly alter the aquatic environment through bioaccumulation and alterations of community structure and function.

94. Exposure to lead in laboratory studies and simulated ecosystems may alter species competitive behaviors, predator-prey interactions, and contaminant avoidance behaviors. Alteration of these interactions may have negative effects on species abundance and community structure.

95. In natural aquatic ecosystems, lead is often found coexisting with other metals and other stressors. Thus, understanding the effects of lead in natural systems is challenging given that observed effects may be due to cumulative toxicity from multiple stressors.

Aquatic Species Response/Mode of Action

96. Recent research has suggested that due to the low solubility of lead in water, dietary lead (i.e., lead adsorbed to sediment, particulate matter, and food) may contribute substantially to exposure and toxicity in aquatic biota.

97. Generally speaking, aquatic organisms exhibit three lead accumulation strategies: (1) accumulation of significant lead concentrations with a low rate of loss, (2) excretion of lead roughly in balance with availability of metal in the environment, and (3) weak net accumulation due to very low metal uptake rate and no significant excretion.

98. Protists and plants produce intracellular polypeptides that form complexes with lead. Macrophytes and wetland plants that thrive in lead-contaminated regions have developed translocation strategies for tolerance and detoxification.

99. Like aquatic plants and protists, aquatic animals detoxify lead by preventing it from being metabolically available, though their mechanisms for doing so vary. Invertebrates use lysosomal-vacuolar systems to sequester and process lead within glandular cells. They also accumulate lead as deposits on and within skeletal tissue, and some can efficiently excrete lead. Fish scales and mucous chelate lead in the water column, and potentially reduce visceral exposure.

100. Numerous studies have reported the effects of lead exposure on blood chemistry in aquatic biota. Plasma cholesterol, blood serum protein, albumin, and globulin concentrations were identified as bioindicators of lead stress in fish.

101. Nutrients affect lead toxicity in aquatic organisms. Some nutrients seem capable of reducing toxicity. Exposure to lead has not been shown to reduce nutrient uptake ability, though it has been demonstrated that lead exposure may lead to increased production and loss of organic material (e.g., mucus and other complex organic ligands).

102. Avoidance responses are actions performed to evade a perceived threat. Some aquatic organisms have been shown to be quite adept at avoiding lead in aquatic systems, while others seem incapable of detecting its presence.

103. The two most commonly reported lead-element interactions are between lead and calcium and between lead and zinc. Both calcium and zinc are essential elements in organisms and the interaction of lead with these ions can lead to adverse effects both by increased lead uptake and by a decrease in Ca and Zn required for normal metabolic functions.

Exposure/Response of Aquatic Species

104. The 1986 Lead AQCD reviewed data in the context of sublethal effects of lead exposure. The document focused on describing the types and ranges of lead exposures in ecosystems likely to adversely impact domestic animals. As such, the 1986 AQCD did not provide a comprehensive analysis of the effects of lead to most aquatic primary producers, consumers, and decomposers.

105. Waterborne lead is highly toxic to aquatic organisms, with toxicity varying with the species and life stage tested, duration of exposure, form of lead tested, and water quality characteristics.

106. Among the species tested, aquatic invertebrates, such as amphipods and water fleas, were the most sensitive to the effects of lead, with adverse effects being reported at concentrations as low as 0.45 μg/L (range: 0.45 to 8000 μg/L).

107. Freshwater fish demonstrated adverse effects at concentrations ranging from 10 to >5400 μg/L, depending generally upon water quality parameters.

108. Amphibians tend to be relatively lead tolerant; however, they may exhibit decreased enzyme activity (e.g., ALAD reduction) and changes in behavior (e.g., hypoxia response behavior).

Critical Loads for Lead in Terrestrial and Aquatic Ecosystems

109. Critical loads are defined as threshold deposition rates of air pollutants that current knowledge indicates will not cause long-term adverse effects to ecosystem structure and function. A critical load is related to an ecosystem's sensitivity to anthropogenic inputs of a specific chemical.

110. The critical loads approach for sensitive ecosystems from acidification has been in use throughout Europe for about 20 years. Its application to lead and other heavy metals in Europe is more recent. European critical load values for lead have been developed but are highly specific to the bedrock geology, soil types, vegetation, and historical deposition trends in each European country. To date, the critical loads framework has not been used for

regulatory purposes in the United States for any chemical. Considerable research is necessary before critical load estimates can be formulated for ecosystems extant in the United States.

111. Speciation strongly influences the toxicity of lead in soil and water and partitioning between dissolved and solid phases determines the concentration of lead in soil drainage water, but it has not been taken into account in most of the critical load calculations for lead performed to date.

112. Runoff of lead from soil may be the major source of lead into aquatic systems. However, little attempt has been made to include this source into critical load calculations for aquatic systems due to the complexity of including this source in the critical load models.

In summary, due to the deposition of lead from past practices (e.g., leaded gasoline, ore smelting) and the long residence time of lead in many aquatic and terrestrial ecosystems, a legacy of environmental lead burden exists, over which is superimposed much lower contemporary lead loadings. The potential for ecological effects of the combined legacy and contemporary lead burden to occur is a function of the bioavailability or bioaccessibility of the lead, which, in turn, is highly dependent upon numerous site factors (e.g., soil organic carbon content, pH, water hardness). Moreover, while the more localized ecosystem impacts observed around smelters are often striking, these perturbations cannot be attributed solely to lead. Many other stressors (e.g., other heavy metals, oxides of sulfur and nitrogen) can also act singly or in concert with lead to cause such notable environmental impacts.

Appendix 5B: Estimating Lead Dust Contamination from Renovation

The analyses discussed below are described in more detail in EPA 20072008 "The Approach Used For Estimating Changes in Children's IQ From Lead Dust Generated During Renovation, Repair, and Painting in Residences and Child Occupied Facilities."

5B.1 Estimate Lead Dust Contamination Prior to Renovation

A child's exposure to lead over the first six years of life consists of exposure to both lead released as a result of RRP activities and background lead concentrations. Therefore, background levels of lead in indoor air, indoor dust, and outdoor soil represent an important component of total lead exposure for children. It is necessary to characterize these background levels for accurate estimation of blood lead levels and to allow for the determination of the portion of the blood lead levels attributable to RRP activities under different Controlcontrol options (EPA 20072008).

5B.1.1 Ambient and Indoor Air

Background ambient air lead concentrations are taken from the 2005 annual average total suspended particulate (TSP) monitoring data for lead contained in EPA's Air Quality Systems (AQS) database (USEPA 2006bEPA 2006c). The range of concentrations in this database is quite large, with a 5th percentile concentration of 0.002 microgram per cubic meter (µg/m^3) and a 95th percentile concentration of 0.37 µg/m^3. Based on these data, the median concentration (0.025 µg/m^3) was selected as the background exposure concentration. This value is likely biased high because lead monitors are often located in areas with nearby lead emission sources.

No representative background indoor air concentration data were located for this approach. As a result, it was assumed that these concentrations would equal the background ambient air lead concentration (0.025 µg/m^3). It is unclear whether this assumption would tend to positively or negatively bias blood lead level results since no comparative indoor air concentration data were found. The assumption is a recognized limitation of this approach (EPA 20072008).

5B.1.2 Indoor Dust

The HUD (2002) lead dust loading data used in this approach were limited to houses containing lead paint (LBP), were processed into four building vintages (Prepre-1930, 1930 to 1949, 1950 to 1959, and 1960 to 1978), and were weighted accordingly. The values are weighted to reflect the HUD sampling stages so that the national averages calculated from the data are representative of the U.S. housing stock, excluding houses that do not contain childrenweights. From these data, a geometric mean (GM) and geometric standard deviation (GSD) were calculated for each vintage. In developing these values, appropriately accounting for non-detect values is important. The approaches used to account for non-detect values in background and activity-related data also introduce uncertainty in the estimated distributions. The particular approach used for non-detects in the HUD 2002 data used to develop background indoor dust lead loadings and outdoor soil concentrations involved first developing house-average values and then processing these averages to develop the distributions of loadings and concentrations. This approach was selected because it reduces the bias that results when more samples are taken in one house than another (i.e., when houses with more samples would have more influence) and reduces the contribution of within-house variability. Another source of uncertainty in the approach used to address non-detects is that houses with one or more dust lead loading value below detection limits are included in the calculation at levels corresponding to the highest detection limit reported for that housing unit. The more recent vintages had fewer observations from which to estimate the floor dust background distributions, and therefore these estimates are more uncertain than estimated distributions for the older housing vintages. A detailed description of how values below the detection limit were handled statistically is described elsewhere (EPA 2007).2008). Separate GMs and GSDs were calculated using this approach for indoor dust lead loadings on floors, window sills, and window troughs, and these values were combined to create composite GMs and GSDs as described in EPA 2008. The resulting composite GMs were used in deterministic simulations, while the distributions defined by the corresponding pairs of composite GMs and GSDs were used for probabilistic modeling. The values for background lead loadings for indoor dust are shown for residences and in Table 5B-1. EPA 2008 also describes how the CCC (HUD 2003) data were used to develop numbers for COFs in Table 5B-1 and Table 5B-2, respectively (EPA 2007); these background lead loadings in floor dust are shown in Table 5B-2.

Table 5B--1: Background Lead Loadings in Floor Dust for Residences by Building Vintage.

Building Vintage	Background Indoor Dust Lead Loadings (µg/ft2)	
	GM	GSD
Pre-1930	18.29	29.71
1930 to 1949	5.65	27.74
1950 to 1959	3.57	22.37
1960 to 1978	1.20	22.71

Table 5B Building Vintage	Background Indoor Dust Loading: Floor (µg/ft^2)		Background Indoor Dust Loading: Sill (µg/ft^2)		Background Indoor Dust Loading: Trough (µg/ft^2)		Background Indoor Dust Loading: Overall (µg/ft^2)	
	GM	GSD	GM	GSD	GM	GSD	GM	GSD
Pre-1930	1.09	8.16	67.67	7.71	930.39	9.27	1.13	8.59
1930 to 1949	1.69	5.83	21.15	12.46	331.61	7.89	1.72	6.15
1950 to 1959	0.44	6.26	18.20	8.38	247.89	9.68	0.47	6.89
1960 to 1978	0.34	3.35	8.09	11.17	214.46	7.20	0.36	3.80

Table 5B-2. Background PbLead Loadings in Floor Dust for COFs by Building Vintage

Building Vintage	Background Indoor Dust Lead Loadings (µg/ft²)	
	GM	GSD
Pre-1930	2.11	1.09
1930 to 1949	1.42	2.79
1950 to 1959	2.01	2.11
1960 to 1978	0.31	9.05

5B.1.3 Outdoor Soil

The HUD (2002) lead outdoor soil concentration data used in this approach were limited to houses containing LBP, were processed into four building vintages (Pre-1930, 1930 to 1949, 1950 to 1959, and 1960 to 1978), and were weighted accordingly (EPA 20072008). These data were used to identifycalculate vintage-specific GMs and GSDs for background soil concentrations. In As with the indoor values, in developing these values, appropriately accounting for non-detect values is important and described elsewhere (EPA 20072008). The GMs were used in deterministic simulations, while the corresponding GMs and GSDs were used for probabilistic modeling. The vintage-specific background soil concentrations are shown in
Table 5B-3.

Table 5B--3. Background Soil Lead Concentrations by Building Vintage

Building Vintage	Background Outdoor Soil Lead Concentrations (µg/g)	
	GM	GSD
Pre 1930	223.19354.41	4.933.97
1930 to 1949	110.47172.39	4.1744
1950 to 1959	64.2185.38	4.423.97
1960 to 1978	15.0574.12	4.2315

5B.1.4 Drinking Water

For purposes of this approach, it is assumed that drinking water exposures are not impacted by RRP activities, and all of the exposed children are assumed to receive the same age-specific exposures. While there is a rather large amount of data in the literature, in many cases the measurements represent "first-draw" samples, non-random ("priority") samples, or come from communities where lead levels were known to be elevated. After reviewing the literature, the average drinking water concentration exposure was estimated to be 4.61 µg/L,. This estimate is based on data from two recent studies of residential water concentrations in U.S. and Canadian homes and apartments (Moir et al. 1996, Clayton et al. 1999). The range of values seen in these studies (0.84 to 16 µg/L) was considered to be representative of randomly sampled residential water in houses constructed since lead pipe and solder were banned for residential use. The selected value is close to a default value (4.0 µg/L) recommended for use with the IEUBK blood lead model when evaluating the blood lead impacts of soil contamination (USEPA 1994). Much higher values have been encountered in homes with lead piping and/or very corrosive water.

5B.1.5 Diet

It is expected that young children will be exposed to lead in the foods they consume but that these exposures will not be impacted by RRP activities. In this approach, all exposed children are assumed to receive the age-specific estimates of dietary lead intake developed by EPA's Office of Solid Waste and Emergency Response (USEPA 2006c2006d). EPA developed these estimates by analyzing food consumption data from the NHANES III survey conducted by the National Center for Health Statistics, and food residue data from the U.S. Food and Drug Administration's (FDA) Total Dietary Study. The daily intake values published by EPA and summarized in Table 5B-4 are considerably lower than those developed using the same methodology in the 1980s and 1990s. Lead concentrations in food have decreased dramatically since the prohibition of lead solder in food containers in 1982.

Table 5B-4. Summary of Non-Water Dietary Lead Intake Estimates [a]

Age (months)	Updated Dietary Lead Intake Estimate (µg/day)
0 to 11	3.16
12 to 23	2.60
24 to 35	2.87
36 to 47	2.74
48 to 59	2.61
60 to 71	2.74
72 to 84	2.99

[a] Data derived from USEPA ~~2006b~~2006d.

5.B.2 Lead levels during and after renovation ~~(Step 2—Continued)~~

In order to create a full picture of lead exposure for a child, it is necessary to examine lead levels generated during RRP activities. A RRP event can consist of a single activity (e.g., replacing a window) or a series of activities (e.g., renovating a kitchen and replacing several windows). The goal of this section is to describe the methods used in this approach to build the activity-related inputs.

The OPPT Dust Study (~~Battelle 2007~~EPA 2007b) provides the data used to determine the activity-related lead levels. Two other data sources were also considered for the analysis: U.S. EPA's *Lead Exposure Associated with Renovation and Remodeling Activities: Environmental Field Sampling Study* (hereafter referred to as "EFSS") (USEPA 1997) and the National Association of Home Builders's *Lead-Safe Work Practices Survey Project Report* (hereafter referred to "NAHB LSWP") (NAHB 2006). The OPPT Dust Study was selected over these studies because it provides the combinations of activities and control options that were necessary to analyze the RRP rule. Additional detail on the reasons the other studies were not chosen is provided elsewhere (EPA ~~2007~~2008).

5B.2.1 Indoor Air

The Renovation exposure period represents the period of exposure beginning with the initiation of the RRP activity or activities and concluding with the completion of the renovation and any contractor cleaning. There are three phases of the Renovation period for indoor air concentrations: the Dust Generating phase, the Settling phase, and the Background phase. The Dust Generating phase represents the portion of the renovation where RRP activities are creating leaded dust (e.g., during demolition). The Settling phase represents the period of time following completion of the Dust Generating activities during which the dust in air settles onto the floor. The Background phase represents the period of time from the end of the Settling phase until the end of the Renovation period. For each of these phases, two different Work Area restriction assumptions were evaluated: child allowed in Work Area at any time during renovation, and child not allowed in Work Area from initiation of renovation until the end of all renovation phases. For each option, a separate, complete set of outputs (i.e., IQ change estimates) was generated.

There are four steps involved in estimating air concentrations for this exposure period: (1) calculate whole building RRP activity-related concentrations during the Dust Generating phase; (2) combine activity concentrations to calculate whole building concentrations for the Dust Generating phase; (3) estimate the Settling of dust in air during the Settling phase; and (4) calculate concentrations for background phase. The details of these steps are described elsewhere (EPA 20072008).

The Post-renovation period represents the time beginning at the conclusion of the Renovation period and continuing until the end of the exposure duration. This period consists entirely of background contributions only.

5B.2.2 Indoor Dust (During Renovation)

There are two phases of the Renovation period for indoor dust concentrations: the Dust Generating phase and the After BaselineRenovator Cleaning phase. The Dust Generating phase represents the portion of the renovation where RRP activities are creating leaded dust (e.g., during demolition). The After BaselineRenovator Cleaning phase represents the remainder of the Renovation period and takes into account some basic cleaning after completion of the Dust Generating activities. The approaches used to estimate indoor dust concentrations for these phases are identical; however, different loadings values are used to represent the different phases. The approach for estimating indoor dust concentrations for the Renovation period consists of four steps: (1) convert wipe sample indoor dust loadings to vacuum sample indoor dust loadings; (2) calculate whole building RRP activity-related vacuum indoor dust loadings; (3) calculate whole building total vacuum indoor dust loadings (including background); and (4) convert whole building total vacuum indoor dust loadings to whole building indoor dust concentrations. For each of these phases, two different Work Area restriction assumptions were evaluated: child allowed in Work Area at any time during renovation, and child not allowed in Work Area from initiation of renovation until the end of all renovation phases. For each option, a separate, complete set of outputs (i.e., IQ change estimates) was generated.

These steps are described below.

Step A: Convert wipe sample indoor dust loadings to vacuum sample indoor dust loadings

In this step, the activity-related lead loadings and background indoor dust loading values, are converted from indoor dust wipe samples to indoor dust Blue Nozzle (BN) vacuum samples. This step is required because the regression equations developed to convert from indoor dust loadings to indoor dust concentrations require that loadings be provided in terms of BN vacuum samples. This conversion is performed for activity-related loadings using the following equation for uncarpeted floors based on "Conversion Equations for Use in Section 403 Rulemaking" (USEPA 1997):

$$DLOAD_{BN,LOC,PH,CO,ACT} = 0.185*(DLOAD_{W,LOC,PH,CO,ACT})^{0.931} \quad \textbf{(Equation 5 - 1)}$$

where:

$DLOAD_{BN,LOC,PH,CO,ACT}$	=	Indoor dust Pb BN sampling loading in location *LOC* during phase *PH*, with Control Option *CO*, and Activity *ACT*, in µg/m^2
$DLOAD_{W,LOC,PH,CO,ACT}$	=	Indoor dust Pb wipe sampling loading in location *LOC* during phase *PH*, with Control Option *CO*, and Activity *ACT*, in µg/m^2

No equation is provided for converting loadings from carpet, so it was assumed this equation could be applied to both carpets and hard surfaces. This is recognized as a limitation of the approach.

Likewise, this conversion is performed for background loadings. Again, no equation is provided for converting loadings from carpet, so it was assumed this equation could be applied to both carpets and hard surfaces. This is recognized as a limitation of the approach. The conversion of lead loadings to concentrations introduces sizable uncertainty into the modeled dust concentrations. This conversion is being used for both carpeted and hard-floor surfaces, when the wipe samples only apply to hard floors. Although this regression introduces uncertainty, conversion remains a necessary step, because the blood lead models are configured to accept lead concentrations and not lead loadings. This regression represents the best known relationship available. The impact of this uncertainty of IQ change estimates is likely substantial, but whether it biases the estimates high or low is unclear. A detailed description of the conversion is described elsewhere (EPA 2008).

Step B: Calculate Whole Building Activity Loadings

The indoor dust loadings were developed for three different locations in the building: Workspace, Adjacent Room, and Rest of the building. These location-specific loadings were combined into a single whole house loading for each activity in target housing. For COFs, activity concentrations are calculated separately by location in building. This distinction between location-specific (for COFs) and whole house average (for target housing) is based on the assumption that children between the ages of 0 and 6 years of age are likely to spend most of their time in a single room of a COF. As a result, exposures were modeled for two different situations, one for a situation in which children spend their time in a room where an RRP activity is taking place and another where the children spend their time in a room adjacent to the room undergoing the RRP activity. For residences, concentrations are estimated separately for the work area and the rest of the building; however, based on the assumption that children have equal access to the entire house, whole-house average concentrations are used for estimating exposures.

Step C: Calculate Whole Building Loadings

The indoor dust lead loadings were developed for two different locations in the building: Work Area and Rest of Building. For target housing, the activity-specific lead loadings for these two locations were combined into a whole house lead loading for each activity, based on the assumption that children have access to the entire house at some point in time. There are separate estimates of whole house lead loadings under two scenarios, depending on whether a child is assumed to have access to the Work Area both during and after the renovation, or only to have access to the Work Area after the renovation. The estimates in the benefits analysis are constructed out of combinations of the 100% or 0% child access results from EPA 2008. See Appendix 5E for a detailed description of the child access assumptions.

For COFs in public or commercial buildings (such as schools and day care centers), the assumption was made that children between the ages of 0 and 6 years of age are likely to spend most of their time in a single classroom. Thus, the loadings are calculated separately for the classroom where the renovation takes place and other adjacent classrooms, and no COF-wide average loading is calculated. The benefits estimates are based solely on the exposures of children in the classroom where a renovation is taking place, and do not include any exposures of children in adjacent classrooms. Also, the benefits estimates for COFs in public or commercial building are limited to the scenario where children do not have access to Work Area during the renovation.

For renovations with exterior tasks, the contribution to interior dust lead loadings (through tracking soil into the interior) was estimated for the entire house.

Step C: Calculate Tracking of Outdoor Soil into Building

The tracking of lead in outdoor soil into the indoor environment was assumed to occur during both phases of the Renovation period (Dust Generating and Rest of Renovation) and the Post-renovation period. The background lead loading values used to represent the Pre-renovation period are assumed to include tracking, thus no tracking was added during that period. If no outdoor renovation activities were conducted in a given scenario, tracking was not estimated because outdoor soil concentrations will be equal to background. Further detail is discussed elsewhere (EPA 2008).

Step D: Calculate Whole Building Loadings

After calculating whole building average loadings for each activity, the next step is to sum the loadings across all RRP activities and then add the background loadings. This total loading represents the contributions from all activities as well as the contributions from background. Note that for scenarios with only one RRP activity, this step consists of simply summing the whole building loadings for that activity and the background loadings.

Step DE: Convert Loadings to Concentrations

The final step required to calculate indoor dust concentrations for both phases of the Renovation period is to convert the whole building total indoor dust loadings to indoor dust concentrations. For buildings of known vintage, the BN sample whole building total loading values are converted to indoor dust concentrations using the appropriate housing vintage-specific regression equation, which is summarized below:

$$DCONC_{PH,CO,VIN} = e^{(Intercept_{VIN} + Slope_{VIN^*}(\ln(DLOAD_{BN,PH,CO,VIN})))} \quad \textbf{(Equation 5 - 2)}$$

where:

$DCONC_{PH,CO,VIN}$	=	Total whole building average indoor dust concentration during phase *PH*, with Control Option *CO*, and building vintage *VIN*, in µg/g
$DLOAD_{BN,PH,CO,VIN}$	=	Total whole building average indoor dust Pb BN sampling loadings during phase *PH*, with Control Option *CO*, and building vintage *VIN*, in µg/m^2

5B.2.3 Indoor Dust (Post-renovation)

The Post-renovation exposure period represents the period of exposure beginning with the completion of the renovation and any contractor cleaning and ending with the end of the time period for which exposures are being characterized. There are two phases of the Post-renovation period for indoor dust concentrations: the Routine Cleaning phase and the Background phase. The Routine Cleaning phase represents the period of time between the completion of the renovation and the time at which indoor dust concentrations return to background levels, and this phase accounts for the decrease in indoor dust concentrations that occurs due to routine cleaning of the building. The Background phase represents only contributions from background sources of indoor dust. The approach for estimating concentrations during the Post-renovation (Background) phase is identical to the approach used for the Pre-renovation period. The approach for estimating indoor dust concentrations for the Routine Cleaning phase consists of two steps: (1) calculating the change in indoor dust loadings based on routine cleaning; and (2) converting the resulting indoor dust loadings to indoor dust concentrations. These steps are described below.

Indoor dust lead loadings in the Routine Cleaning phase are a function of the loadings at the completion of the renovation and the frequency and efficiency of routine cleaning. Unlike previous phases which used a single loading to represent the entire phase, a time series of loadings is developed for this phase to account for the decrease in dust loadings that occurs over time with repeated routine cleanings. Cleaning efficiency is an important part of the cleaning process and is described in greater detail elsewhere (EPA 20072008).

The final step required to calculate indoor dust concentrations for the routine cleaning phase is to convert the time series of whole building total indoor dust loadings to a time series of indoor dust concentrations. For buildings of known vintage, the blue nozzle (BN) sample whole building total loading values are converted to indoor dust concentrations using the vintage-specific regression equation described elsewhere (EPA 20072008).

5B.2.4 Outdoor Soil (During Renovation)

Outdoor soil concentrations during the Renovation exposure period are estimated based on the lead loading associated with the activity-Control Option combination, the size of the yard, the size of the areas impacted by the activity, and the background concentration. For each of the phases, two different Work Area restriction assumptions were evaluated: child allowed in Work Area at any time during renovation, and child not allowed in Work Area from initiation of renovation until the end of all renovation phases. For each option, a separate, complete set of outputs (i.e., IQ change estimates) was generated. There are two steps involved in calculating outdoor soil concentrations during the Renovation exposure period: (1) calculating soil concentrations in the different regions of the yard; and (2) calculating whole yard average concentrations.

Concentrations are estimated for three sections of the yard; dripline (roughly adjacent to house or building); nearby area (adjacent to dripline); and remainder of yard. The concentration in the remainder of the yard is assumed to be equivalent to the background soil concentration. The concentrations in the dripline and nearby areas are calculated based on the estimated loadings from the activity or activities in the two areas and assumed soil characteristics. The whole yard soil concentration is calculated as an area-weighted average of the concentrations in the dripline, nearby area, and remainder of yard (EPA 20072008).

5B.2.5 Outdoor Soil (Post Renovation)

Two outdoor control options are considered. InFor the No Plastic Control Option, it is assumed that no groundcover is spread under the work to prevent debris or dust from landing on the ground. For the With Plastic Control Option, ground cover is used and removed at the end of the job. In the For the No Plastic Control Option, it is assumed that there is assumptions are no cleanup and there is no degradation of lead in outdoor soil. Therefore; therefore, the Post-renovation exposure period lead concentrations are identical to the Renovation period concentrations. -For the With Plastic and With Extended Plastic Control Options, outdoor soil lead concentrations for all Control Options during the Post-renovation exposure period are estimated using the same approach used for the Renovation period, with the Post-renovation exposure period lead loadings used instead of the Renovation period loadings. (EPA 2007).2008)

Appendix 5C: Estimating Blood Lead Levels Resulting from RRP Events

The analyses discussed below are described in more detail in Section 5 of EPA ~~2007~~2008 "The Approach Used for Estimating Changes in Children's IQ from Lead Dust Generated During Renovation, Repair, and Painting in Residences and Child Occupied Facilities".

5C.1 Introduction

Lead concentrations in the exposure media, as well as lead exposure and intake assumptions, serve as inputs into the International Commission for Radiation Protection (ICRP) model (hereafter referred to as the Leggett model). In this approach, blood lead levels for six different hypothetical children are modeled throughout their first six years (from birth until six years of age). Exposure profiles are defined for each child so as to simulate the occurrence of the renovation project at the beginning of a different year of their life (birth, first birthday, second birthday, etc.). Prior to the renovation, the children experience background level exposures from all media, and after the renovation the dust and air concentrations are decreased due to routine cleaning and settling. Activity-related lead exposure concentrations vary weekly depending on the activities and year being modeled. Ambient air, drinking water, and dietary lead exposures are assigned the same age-specific values in all of the exposure scenarios.

It is recognized that some portion of lead in the Background exposure media may derive from RRP-activity-related sources, for example, if the exposed child consumes homegrown vegetables grown in lead-contaminated garden soil. However, this proportion is likely to be small for most of the exposure scenarios considered in this analysis.

5C.1.1 Selected Model -- Leggett Model

Three models were considered for use in the approach: the Integrated Exposure Uptake Biokinetic (IEUBK) Model for Children (hereafter referred to as the IEUBK model), the International Commission for Radiation Protection (ICRP) model (hereafter referred to as the Leggett model), and an empirical model developed by Lanphear et al. (1998). The Leggett and IEUBK models are two well-documented, widely-used, and well-tested and calibrated biokinetic models (see Section 4.4 of ~~USEPA,~~EPA 2006a). The Lanphear et al. (1998) model uses an empirical regression-based approach for predicting average blood ~~Pb~~lead levels on the basis of environmental concentrations and other variables. The Lanphear model was not applied in this approach because there is nothing in the development of the empirical model that predicts how it would respond to episodic peak exposures.

The IEUBK model estimates long-term (annual average) blood ~~Pb~~lead levels and was not originally developed to model episodic peak exposures and subsequent reductions in exposure levels, as expected from RRP activities. Short-term dust, air, and soil ~~Pb~~lead concentrations must be averaged over longer periods when used as inputs to the IEUBK model. In contrast, the Leggett model was developed to model exposure through time and can adequately capture the relatively short-lived exposures introduced by renovation activities. In addition, it is capable of predicting changes in blood ~~Pb~~lead levels for exposed individuals over their entire lifespan (birth to 90 years old). The compartmental structure of the Leggett model was patterned after similar models developed by the ICRP to model the age-specific biokinetics of calcium-like radionuclides (Leggett, 1993). Although the approach presented in this document could have been adapted to use either the Leggett or IEUBK blood Pblead model, the Leggett model was selected due to its ability to capture short-term variations in exposure conditions that are expected with renovation activities.

In the biokinetic component of the Leggett model, the movement of absorbed Pblead (from ingestion and inhalation) through various body "compartments" is simulated. The model is "biokinetic," rather than "pharmacokinetic," because transfers between compartments are controlled by firstfirst order transfer coefficients (equivalent to first-order rate constants), rather than being perfusion-controlled. The values for the transfer rates were estimated using a range of values from adult human radioactive tracer studies, autopsy data from adults and children, and data from animal studies related to the absorption, deposition, and excretion of Pb and chemically similar elements (Leggett, 1993). Leggett developed estimates of biokinetic parameters for six age categories: newborn (0 to 100 days), 1 year, 5 years, 10 years, 15 years, and 25 years and older, with ageage specific transfer parameters for children estimated by interpolation between the nearest values. Transfer factors for children were adjusted to take into account the more rapid bone turnover (calcium/Pb addition and resorption) in children compared with adults.

The Leggett model does not accept exposure concentrations directly. Instead, it accepts total inhalation and ingestion intakes (administered doses) as inputs. Thus, the exposure concentration time series are converted to intakes using intake parameter inputs, as described below.

5C.1.2 Derivation of Blood Lead Estimation Inputs

In order to obtain estimates of blood lead, both the time series of the media inputs (air, indoor dust, outdoor soil, diet, and drinking water) and the "exposure factor" values that govern intake and absorption processes must be specified.

Time Series of Media Concentrations: Exposure to Renovation Activity at Different Ages

Indoor dust, air (ambient and indoor), outdoor soil, and water concentrations and dietary lead intakes are the necessary exposure concentration inputs for the blood lead models. . Indoor dust, outdoor soil, and air concentrations were estimated for each exposure period and phase of the renovation activities. , as discussed in Chapter 3 of EPA 2008. For the indoor single activity and multiple activities examples presented below, the outdoor soil lead concentration was always assumed to remain at background levels throughout the life of each theoretical child. In addition, the drinking, as no outdoor activities occurred in these scenarios. If outdoor activities are included in a scenario, outdoor soil lead concentration will also vary according to the activity. Drinking water and dietary concentrations were set at age-specific background levels in all the scenarios (see discussion below). There are a number of model inputs that govern how the exposure concentrations are converted to absorbed lead dose (uptake) estimates. These variables represent the physiological and behavioral characteristics of the exposed population and the chemical and physical properties of the exposure media that govern exposure and absorption by inhalation and ingestion and are presented elsewhere (in EPA 20072008).

In order to determine the range of blood lead levels associated with the range of exposure model parameters, the Monte Carlo time series estimates of indoor dust, air, and soil concentrations were used as inputs to the blood lead models. -For each week of the exposure model, the 5th percentile, 20th percentile, median, mean80th percentile, and 95th percentile indoor dust and outdoor soil lead concentrations were calculated from the 20,000 Monte Carlo iterations. An additional probabilistic step was performed to account for inter-individual differences in uptake characteristics and other variants. To do so, each blood lead percentile was assumed to represent a geometric mean of a blood lead distribution (EPA 2008). A lognormal distribution was then created by assuming a geometric standard deviation (SD) of 1.6, sampling 20,000 times based on a lognormal distribution from 0 to 1, as described in Appendix E of EPA 2008. Each blood lead percentile was used to represent the midpoint of a specified range of probabilities (for example, the 5th percentile blood lead is sampled when a value of 0 to 0.1 is generated, 20th percentile blood lead is sampled when a value of 0.1 to 0.3 is generated, and so on). These 20,000 values were then used to generate the 5th, 50th, and 95th percentiles of the distribution, as well as the arithmetic mean. These blood Pb percentiles were used to calculate estimated IQ change. Media concentration values were adjusted for the percentilefraction of time the child spends in the home and the fraction of time spent elsewhere using overall background concentrations, as described in Section 4.1 of EPA 2008. For the examples presented here, it was assumed that the child spends 100 percent of the time in the residence. Each percentile's dust, soil, and air values became a separate weekly time series for indoor dust concentrations, and was were run separately using the same air, outdoor soil,independently from other percentiles, with fixed weekly water, and dietary lead inputs. for all percentiles

Indoor air and indoor dust lead concentrations were estimated in weekly increments. Each scenario involved estimating blood lead concentration profiles for a child associated with the specified series of weekly exposure concentration estimates corresponding to the Renovation (Dust Generating), Renovation (After Baseline Cleaning), Post-renovation (Routine Cleaning), and Post-renovation (Background) phases. Depending on the activities and scenarios being evaluated, dust exposures could remain elevated above background for many weeks.

It was expected that these complex exposure scenarios would have different impacts on estimated blood lead levels, depending on the age of the child when renovation occurs. In order to explore how the blood lead levels change when the RRP activity occurs in a different year of a child's life, six different hypothetical children were modeled for each exposure period, as shown in

Figure 5C **1**. Child 1 experiences the renovation beginning at birth. The remaining weeks after the renovation follow the weekly Post-renovation concentrations from the indoor dust and indoor air exposure modeling. Child 2 experiences Pre-renovation (Background) levels during the first year of life and the renovation occurs at the beginning of the second year of life, with the remaining weeks after renovation following the Post-renovation concentrations, and so on for Child 3, Child 4, Child 5, and Child 6.

Figure 5C 1: Definition of Modeled Hypothetical Children and the Time in Their Life When They Experience the RRP Activity

Time ↓		Child 1	Child 2	Child 3	Child 4	Child 5	Child 6
	Age 0 to 1 (Year 1)	Renovation Occurs	Pre-renovation	Pre-renovation	Pre-renovation	Pre-renovation	Pre-renovation
	Age 1 to 2 (Year 2)	Post-renovation	Renovation Occurs	Pre-renovation	Pre-renovation	Pre-renovation	Pre-renovation
	Age 2 to 3 (Year 3)	Post-renovation	Post-renovation	Renovation Occurs	Pre-renovation	Pre-renovation	Pre-renovation
	Age 3 to 4 (Year 4)	Post-renovation	Post-renovation	Post-renovation	Renovation Occurs	Pre-renovation	Pre-renovation
	Age 4 to 5 (Year 5)	Post-renovation	Post-renovation	Post-renovation	Post-renovation	Renovation Occurs	Pre-renovation
	Age 5 to 6 (Year 6)	Post-renovation	Post-renovation	Post-renovation	Post-renovation	Post-renovation	Renovation Occurs

*Figure taken from EPA 2008: The Approach Used for Estimating Changes in Children's IQ from Lead Dust Generated During Renovation, Repair, and Painting in Residences and Child Occupied Facilities.

As noted above, the exposure concentrations and lead intake from background pathways (i.e., those assumed to not to be impacted by renovation – drinking water and non-water diet) were also parameter inputs to the blood lead model. Drinking water concentrations were assigned a single, constant value for all ages. In addition to drinking water, it is expected that young children will be exposed to lead in the foods they consume.

Exposure factor adjustments by age and care type

Exposure inputs into the Leggett model are adjusted to reflect the time children spend in non-parental care and at home. The adjustments take into account the number of hours per week and months per year children spend in a non-parental care setting. Hours per week in non-parental care can be further modified by accounting for awake versus sleeping hours—including naps taken at daycare. Number of months children spend in non-parental care may be a function of vacation, holidays, and illness, which causes the child to be absent from care.

The data used to estimate the adjustment factors were derived primarily from variables in the database of the National Household Education Surveys Program of 2005, which had an Early Childhood Education/Program Participation (ECPP) component[20 21]. The data include percentiles for number of hours per week and months per year children spend in non-parental care arrangements by age of child and type of arrangement. These percentiles were then combined with awake hours per day to provide exposure adjustment factors.

[20] 2005 NHES Early Childhood Program Participation Survey (NCES 2006-075). U.S. Department of Education. Washington, DC: National Center for Education Statistics.

[21] The survey does not include children in kindergarten and therefore estimates for 5 year olds in center based care in a public/private school setting are used as a surrogate for children in Kindergarten.

The survey included six age categories (<1 to 5) and three types of non-parental care:

1. Relative care: provided by a relative other than the child's parents.
2. Non-relative care: provided by babysitters, nannies, and family day care providers.
3. Center-based care: provided by day care centers, nursery schools, pre-kindergartens, and other types of early childhood education programs such as Head Start.

The survey also included estimates for the number of hours per week by arrangement type (relative, non-relative, center), location (own home, other home, center, public preschool, etc), and child's age at the time of the survey. These variables were combined to estimate four sets of adjustment factors corresponding to the following:

1. Center based care outside of school settings (COF's) (center care excluding centers located in public/private K-12 schools)
2. Center based care at school settings (COFs-school) (center care only located in public/private K-12 schools)
3. Target Housing Child Occupied Facilities (TH-COFs) (or relative and non-relative care combined)
4. Care in any of the previous settings (used to adjust for time not at home)

Survey variables for hours per week were filtered to identify only those children who had regular weekly care totaling at least 6 hours. The data were further restricted to exclude cases where the care was located in the child's own home. The data were then stratified by age of the child at the time of the survey and type of non-parental care. Hours per week were adjusted by assuming that children aged 1-4 took naps for 25 percent of their time at day care (or 2 hours for every 8 hours at care). It was assumed that children older than 4 did not nap.

The annual duration of care in months is a more difficult variable to estimate as the topic is not directly addressed by the NCES survey but must be derived from related questions such as age care first began and age at the time of the survey. In addition, children may have multiple arrangements within a care type. In light of these variations, the childcare arrangement in which the child spent the greatest number of months was used to estimate duration of care. Thus, if a child had two relative arrangements, one that he had been in for 11 months and one that he had been in for 4 months, the value for that child used to estimate the percentiles would be 11 months. To calculate mean length of time in care, age (in months) when the arrangement began was subtracted from age at the time of the survey.

For TH-COFs (i.e., relative and non-relative care) older children (>=2) had a difference of at least 12 months between the time care began and their age at the survey. This is interpreted to mean that on average these children are in a non-parental care arrangement throughout the year (i.e., 12 months or 52 weeks) and therefore these values were set to 12 months. A similar approach was used for center-based care in school settings but a threshold of 9 months, or the academic calendar, was used instead of 12 months. The NCES survey does not address such factors such as vacation and holidays, which may impact months per year in care. To reflect the likely variation in amount of time children are out of care for vacation, holidays, and illness; a distribution of 1 week (5^{th} percentile), 2 weeks (arithmetic mean/median), and 4 weeks (95^{th} percentile) was used. These are assumed values, and are not reported in the NCES survey. As with any assumptions, there are uncertainties regarding this assumption. The impact of the assumed values on estimated IQ change is not known, but is expected to be small.[22]

Since dust ingestion is only likely to occur during waking hours, the average hours awake per week is used as the denominator in the adjustment equation. Awake hours per day were calculated as the difference between 24 hours and a distribution of the number of hours children sleep[23]. Hours awake per week were the product of awake hours per day and seven days/week.

An example calculation for 1-year-olds-old children in COFs outside of schools is shown below.

- Mean number of hours per week 1-year-olds-old children spend in COF (25.9 hrs).
- Number of months a 1-year--old child attends COF (10.3 months).
- Mean number of hours per week 1-year-olds are-old children spend awake (82.6 hrs).
- Total number of months per year (12 months).

$$\frac{25.9 \text{ hours/week} * 10.3 \text{ months/year}}{82.6 \text{ hours/week} * 12 \text{ months/year}} = 0.269$$

In this example, RRP floor loadings are adjusted by 0.269 to estimate the lead load to which the child is exposed. Age specific exposure adjustment factors for each care type are shown below (Table **5C-1** to Table 5C-4). The benefits analysis is based on the mean adjustment factors.

[22] The NCES survey data already accounts for some time that children spend out of care. For example, according to the NCES data, a 1-year old child in a COF outside of schools spends an average of 10.8 months of a year in care, not accounting for vacation, holidays, and illnesses. Assuming 2 weeks (0.5 months) per year for vacations, holidays, and illnesses reduces this to 10.3 months per year in care. And children typically only spend only part of each day and part of each week in a COF. Increasing the assumed value for time out of care for vacations, holidays, and illnesses would have a less than proportional effect on estimated exposures. For instance, doubling the assumed value would not result in halving the estimated exposure. As explained elsewhere in this section, the mean exposure adjustment factor for a 1-year old child in a COF outside of schools is 0.269. Doubling the assumed mean time for time out of care due to vacations, holidays, and illnesses from 2 weeks to 4 weeks would decrease the adjustment factor from 0.269 to 0.256, a 5% decrease.

[23] Source: Child specific exposure factors handbook. SeptemberSpecific Exposure Factors Handbook (EPA 2002, Interim Report. EPA-600-P-00-002B).

Age specific minutes spent sleeping per 24 hr day

Age	5th Percentile	Mean	Median	95th Percentile
1 to 4	540	732.36	720	930
5 to 11	480	625.06	630	780

Table 5C--1: Age Specific Adjustment Factors for Center Based Care Outside of Schools (COFs)

Age	5th Percentile	Mean	Median	95th Percentile
0	0.000	0.069	0.074	0.208
1	0.008	0.269	0.313	0.327
2	0.000	0.264	0.273	0.327
3	0.011	0.223	0.188	0.295
4	0.020	0.207	0.171	0.295
5	0.013	0.210	0.162	0.368

Table 5C--2 Age Specific Adjustment Factors for Center Based Care at Schools (COFs-School)

Age	5th Percentile	Mean	Median	95th Percentile
0	0.000	0.058	0.045	0.107
1	0.016	0.168	0.091	0.238
2	0.000	0.188	0.169	0.238
3	0.015	0.142	0.067	0.190
4	0.015	0.149	0.097	0.205
5	0.018	0.159	0.150	0.238

Table 5C--3 Age Specific Adjustment Factors for careCare in TH-COFs outsideOutside the homeHome

Age	5th Percentile	Mean	Median	95th Percentile
0	0.000	0.063	0.060	0.238
1	0.006	0.264	0.274	0.327
2	0.000	0.246	0.214	0.327
3	0.023	0.242	0.214	0.354
4	0.017	0.221	0.188	0.295
5	0.018	0.256	0.203	0.409

`

Table 5C--4. Age Specific Adjustment Factors for All Non-Parental Care outsideOutside the homeHome

Age	5th Percentile	Mean	Median	95th Percentile
0	1.000	0.910	0.911	0.722
1	0.980	0.638	0.589	0.563
2	1.000	0.642	0.601	0.563
3	0.973	0.662	0.658	0.563
4	0.969	0.680	0.681	0.563
5	0.979	0.735	0.757	0.591

NOTE: These values are calculated as (1-non parental care factor) and are intended to be used to estimate the amount of time children are at home.

Research indicates that for children in kindergarten through 2nd grade about 20% have non-parental care arrangements before school and 48% have a non-parental care arrangement after school.[24] The likelihood of after school arrangements does not appear to differ substantially among age groupings (i.e., 54% of 6-8 graders have non-parental arrangements after school). This is important because the average number of hours spent in these settings is presented in the aggregate for kindergarten through 8th grade, i.e., data are not reported for kindergartners alone. Overall, children who were in before-school arrangements spent an average of 4.7 hours per week in this setting (i.e., about 1 hour/day). Children who were in after-school arrangements spent an average of 9.0 hours per week in this setting (i.e., about 2 hours/day).

The COF analysis does not take into account RRP activities that may occur in before and after-school care arrangements for kindergarteners. This occurs primarily because of the expected complexity of adding this new configuration to the analysis and in part the limited data on kindergarteners. This could lead to underestimates of benefits attributed to COFs. For example, kindergarteners who attend half-day programs may spend an equal or greater amount of time in before- and after-school arrangements. However, there has been a long-term trend from half day to full day kindergartens (NCES 2004b). Thus, any underestimate of benefits that occurs as a result of not accounting for before- and after-school programs in children attending half-day programs could diminish with time.

[24] U.S. Department of Education, National Center for Education Statistics. *Before- and After-School Care, Programs, and Activities of Children in Kindergarten Through Eighth Grade: 2001,* NCES 2004-008, by Brian Kleiner, Mary Jo Nolin, and Chris Chapman. Project Officer: Chris Chapman. Washington, DC: 2004.

~~Appendix 5D~~: Estimating IQ ~~effects~~
Appendix 5DChanges

The analyses discussed below are described in more detail in Section 6 of EPA ~~2007~~2008 "The Approach Used for Estimating Changes in Children's IQ from Lead Dust Generated During Renovation, Repair, and Painting in Residences and Child Occupied Facilities."

~~Once~~

Figure 5D-1: Flowchart Illustrating the Estimation of IQ Changes from Blood Lead Levels

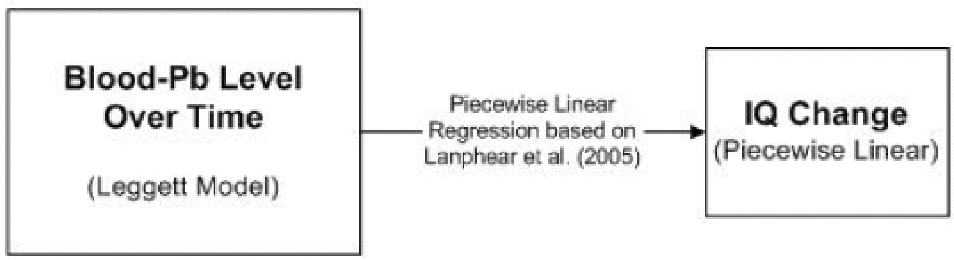


*Figure taken from EPA 2008: The Approach Used for Estimating Changes in Children's IQ from Lead Dust Generated During Renovation, Repair, and Painting in Residences and Child Occupied Facilities.

As can be seen in Figure 5D1, once the blood ~~Pb~~lead levels are estimated from the media concentrations, the lifetime average blood ~~Pb~~lead estimates generated from the Leggett model were used to calculate estimated IQ changes using regression equations. Two such sets of regression equations are presented in Lanphear et al. (2005) and Canfield et al. (2003). For this approach, the Lanphear et al. (2005) models were selected because the population in that study was much larger and represented several countries, various patterns of ~~Pb~~lead exposure, and a wide range of socioeconomic conditions. The larger number of subjects in the Lanphear et al. (2005) study afforded a higher degree of precision in identifying and characterizing blood ~~Pb~~lead-IQ relationships, and enabled more sophisticated statistical models to be used for evaluating the data (see Section 5D.1). See Section 6.2 ~~o~~of EPA ~~2007~~2008 for a presentation of the estimated IQ changes for the single and multiple renovation, repair, and painting (RRP) activity examples using the Lanphear et al. (2005) piecewise linear model.

5D.1 Selected Model (Lanphear et al. 2005)

Lanphear et al. (2005) derived regression relationships between several blood ~~Pb~~lead metrics (e.g., lifetime and concurrent) and IQ test results based on linear, cubic spline, log-linear, and piecewise linear equations. For the blood ~~Pb~~lead metric, this approach uses the lifetime average blood ~~Pb~~lead level because it more fully accounts for the renovation activity exposures of children in all six age groups. The alternative, using the concurrent level, would require calculating averages near the ages when IQ was measured for the test subjects in Lanphear et al. (2005). This would involve calculating an average for ages 5 or 6 years, which would result in smaller blood ~~Pb~~lead levels for those children who experience the renovation earlier than that and whose blood ~~Pb~~lead levels have nearly reached background by age 6.

Lanphear et al. (2005) developed several different models relating blood ~~Pb~~lead metrics to IQ, which predict a wide range of IQ changes for given blood ~~Pb~~lead levels. First, they developed log-linear models relating IQ changes to all blood ~~Pb~~lead metrics they examined – peak (highest measured), concurrent (blood ~~Pb~~lead measured closest to the IQ test), lifetime average, and early childhood (average from age 6 months to 24 months). In these models, the relationships between IQ change and blood ~~Pb~~lead are curved, with steeper slopes at low blood ~~Pb~~lead levels. Lanphear et al. (2005) also fit piecewise models (consisting of separate linear fits for different blood ~~Pb~~lead concentration ranges) to several of the blood ~~Pb~~lead metrics. The piecewise model developed for the concurrent blood ~~Pb~~lead metric was presented in the Lanphear et al. (2005) paper. The U.S. EPA ~~(USEPA Activity-related Communication 2007)~~ also obtained the relevant piecewise models for lifetime average blood ~~Pb~~lead concentrations based on the same data set (EPA 2007a).

The Lanphear et al. (2005) study included a relatively high proportion of children with low blood ~~Pb~~lead levels. For example, approximately 18 percent of the children had blood ~~Pb~~lead levels below 10 µg/dL and about eight percent had blood ~~Pb~~lead levels that never exceeded 7.5 µg/dL. The statistical model with the strongest relationship between blood ~~Pb~~lead and IQ levels in the Lanphear et al. (2005) data set is the log-linear model. In this model, the blood ~~Pb~~lead -IQ slope increases rapidly at low blood ~~Pb~~lead levels, and goes to infinity at zero blood ~~Pb~~lead, which limits its use for predicting IQ changes at very low blood ~~Pb~~lead levels. As a result, the selection of a blood ~~Pb~~lead-IQ model for this approach focused on the piecewise models. The four piecewise linear models considered are presented in Table 6-1.

IQ Models 1 and 2 each have two separate slopes, one for children with a peak blood ~~Pb~~lead above 10 µg/dL and another for those with a peak blood ~~Pb~~lead below 10 µg/dL. These models only differ based on the blood ~~Pb~~lead metric to which they apply – IQ Model 1 is applied to concurrent blood ~~Pb~~lead levels and IQ Model 2 is applied to lifetime average blood ~~Pb~~lead levels. Similarly, IQ Models 3 and 4 have slopes for children above and below 7.5 µg/dL~~, with~~. IQ Model 3 is applicable to concurrent blood ~~Pb~~lead levels and IQ Model 4 is applicable to lifetime average blood ~~Pb~~lead levels. As can be seen from Table 6-1 and noted in Lanphear et al. (2005), the various models predict very different IQ changes, particularly in the low-blood ~~Pb~~lead range. IQ Models 1 and 2 predict IQ changes much closer to those predicted with the log-linear model.

Table ~~6-1.~~5C-5. Piecewise Linear Slopes Estimated by Lanphear et al. (2005) and USEPA Activity related Communication (2007)

Blood Pb-IQ Model	Slope	Applicable Blood Pb Metric
IQ Model 1	-0.80*PbB, for peak PbB < 10	Concurrent PbB
	-0.13*PbB, for peak PbB ≥ 10	
IQ Model 2	-0.88*PbB, for peak PbB < 10	Lifetime Average PbB
	-0.10*PbB, for peak PbB ≥ 10	
IQ Model 3	-2.94*PbB, for peak PbB < 7.5	Concurrent PbB
	-0.16*PbB, for peak PbB ≥ 7.5	
IQ Model 4	-3.13*PbB, for peak PbB < 7.5	Lifetime Average PbB

	-0.13*PbB, for peak PbB ≥ 7.5	

Because peak blood ~~Pb~~lead levels were likely to be less than 10 µg/dL for the vast majority of children exposed to ~~Pb~~lead during renovation activities, and because the relationship between shorter-term elevations in blood ~~Pb~~lead and IQ changes is not well understood, the piecewise models that gave greater weight to impacts in this blood ~~Pb~~lead range were preferred. Further, while Lanphear et al. (2005) used peak blood ~~Pb~~lead concentrations to determine which segment of a model to apply, for the hypothetical children to whom the approach discussed here is applied, only averages can be used. Because it cannot be known how often a peak is obtained, some proportion of the hypothetical children whose lifetime average blood ~~Pb~~lead levels place their calculations on a lower segment (with steeper slope) would have IQ changes calculated by the corresponding upper segment (shallower slope) based on peak concentrations. Selecting a model with a node, or changing one segment to the other, at a lifetime average blood ~~Pb~~lead concentration of 10 µg/dL rather than at 7.5 µg/dL, is a small protection against applying an incorrectly rapid change (steep slope with increasingly smaller effect as concentrations lower) to the calculation.

Hence, IQ Model 2 (as shown below) was selected for use in estimating IQ changes associated with renovation activities.

PbB < 1   *IQ change* = 0

PbB = 1 to 10   *IQ change* = PbB * -0.88

PbB > 10   *IQ change* = -8.75 + (PbB - 10) * -0.10

where:

PbB = Lifetime average of the blood ~~Pb~~lead level

As shown in the above equations, no IQ changes are predicted for blood ~~Pb~~lead concentrations less than 1.0 µg/dL. This assumption was made in recognition of the lack of data in this blood ~~Pb~~lead range in the Lanphear et al. (2005) study cohorts. The assumption has little impact on the IQ changes in this analysis because the geometric mean (GM) blood ~~Pb~~lead levels associated with typical "background" (water and diet) ~~Pb~~lead exposures exceed 1.0 µg/dL across the age range being analyzed.

Appendix 5E: Assumptions About Children's Access to the Work Area

Table 5E-1 summarizes how the primary estimate in the Economic Analysis combines different results from the Approach for interior RRP events. Columns 1 through 5 represent the estimates and assumptions specific to the Economic Analysis, and columns 6 through 9 represent the Approach assumptions and Dust Study data that are assigned to each row. In the baseline, 46% of events are estimated to use rule-style containment, which corresponds to row 1 in the table. In the primary estimate, of the remaining 54% of events that are uncontained, the child is assumed not to access the work area in 50% of them (27% of the total number of events), as shown in column 5, row 2 in the table. The child is assumed to access the work area in the other 50% of the uncontained events (also 27% of the total events), as shown in column 5, row 3 in the table. So a child accesses the work area in 27% of the events (column 5, row 3), and does not access the work area in 73% of events (column 5, row 1 + row 2) in the primary estimate.

The situation is similar, but slightly more complicated, for events with exterior components. Table 5E-2 summarizes the primary estimate for events with exterior components. Columns #1 through #8 represent the estimates and assumptions specific to the economic analysis, and columns 1 through 5 are the same as in Table 5E-1. Columns 9 and 10 represent the Approach assumptions and Dust Study data that are assigned to each row. For simplification purposes, the same 27% access and 73% no-access assumption used for interior events is also used in the primary estimate for events with exterior components. However, the analysis reflects the share of exterior events using rule-style containment. In the baseline, 89% of exterior events are estimated to use rule-style containment, and 11% are estimated not to use containment. Thus, for events with exterior components, each row corresponding to Table 5E-1 can be split into two parts, 89% of which use exterior containment and 11% of which do not. This is shown in Table 5E-2, column 6. Column 5 and column 6 are multiplied to generate the percent of exterior jobs in each category, as shown in column 8 of Table 5E-2 .

For events with exterior components, the primary estimate still assumes that the child does not access the work area in 73% of RRP events. (This is the sum of rows 1 through 4 for column 5 in Table 5E-2.) The child still accesses the work area in 27% of all RRP events (row 5, column 5).

With and Without Child Access

The estimates in the Economic Analysis are constructed out of the 100% or 0% child access results from the Approach. The 50% assumption in the Economic Analysis does not represent the area of the house that the child has access to, or the amount of time the child spends in the work area. Instead, it represents the share of RRP events without rule-style containment in which the child accesses the work area. Looking at Table 5E-1, the 50% assumption in the primary estimate of the Economic Analysis does not refer to the column 6 values. It represents the distribution of the column 4 values across rows 2 and 3.

Table 5E-1: Summary of Analysis of Child Access to the Work Area in the Baseline - Interior Events

Row	(1) Rule-Style Containment	(2) Percent of All RRP Events	(3) Child Access to the Work Area	(4) Percent of Uncontained RRP Events	(5) Percent of All RRP Events - Primary Estimate in Econ Analysis	(6) Child Access in the Approach*	(7) Child Spends Time in	(8) Average Whole-House Loadings**	(9) Renovation Loadings †
1	Rule-Style Containment	46%	Child does not access the work area during renovation	---	46%	0%	Rest of house only - no work area access	Rest of house only - no work area loadings	Control Options with rule containment (C.O. 2 & 3)
2	Uncontained	54%	Child does not access the work area during renovation	50%	27%	0%	Rest of house only - no work area access	Rest of house only - no work area loadings	Control Options without containment (Base Control & C.O. 1)
3			Child accesses the work area during renovation	50%	27%	100%	Entire house - including work area	Weighted average of work area and rest of house, weighted by % of house represented by the work area	Control Options without containment (Base Control & C.O. 1)

* A child with 0% access means that the child does not access the work area during the renovation. A child with 100% access means that a child accesses 100% of the house (including the work area) during the renovation. It does not mean that the child spends 100% of the time in the work area during the renovation.

** "Rest of house" loadings are based on observation room loadings from the Dust Study.

† Loadings based on activity-specific Dust Study data (specific to window replacements, painting, etc.) for the following control options:
Base Control = No plastic sheeting, baseline cleaning;
Control Option 1 = No plastic sheeting, rule cleaning;
Control Option 2 = Plastic sheeting, baseline cleaning; and
Control Option 3 = Plastic sheeting, rule cleaning.

Table 5E-2: Summary of Analysis for Child Access in the Work Area in the Baseline – Events with Exterior Components

Row	(1) Rule-Style Interior Containment	(2) Percent of All RRP Events	(3) Child Access to the Work Area	(4) Percent of Uncontained RRP Events	(5) Percent of All RRP Events	(6) Baseline Percent of Exterior Events with Rule-Style Containment	(7) Exterior Plastic Status	(8) Percent of All RRP Events – Primary Estimate in Econ Anal*	(9) Average Whole-Yard Soil Concentration	(10) Exterior Renovation Loadings**
1	Rule-Style Containment	46%	Child does not access the work area during renovation	---	46%	89%	Exterior Plastic = Yes	41%	Rest of yard (=background)	Control Option B
2						11%	Exterior Plastic = No	5%	Rest of yard (=background)	Control Option A
3	Uncontained	54%	Child does not access the work area during renovation	50%	27%	89%	Exterior Plastic = Yes	24%	Rest of yard (=background)	Control Option B
4						11%	Exterior Plastic = No	3%	Rest of yard (=background)	Control Option A
5			Child accesses the work area during renovation	50%	27%	89%	Exterior Plastic = Yes	24%	Weighted average of work area, nearby area, and rest of yard	Control Option B
6						11%	Exterior Plastic = No	3%	Weighted average of work area, nearby area, and rest of yard	Control Option A

* Column 8 = column 5 x column 6

** Control Option A = No plastic sheeting;

Control Option B = Plastic sheeting.

The amount of time spent indoors vs. outdoors is not addressed explicitly in the calculations. Instead, the analysis uses ingestion rate data that estimates outdoor soil ingestion and indoor dust ingestion, in combination with estimated outdoor soil and indoor dust concentrations, to estimate exposures (i.e., time spent indoors/outdoors is accounted for implicitly in the ingestion rate data). An explanation of how the outdoor soil and indoor dust concentrations are calculated for each phase and type of job is provided below.

INTERIOR ONLY JOBS

- Pre-Renovation
  - Outdoor soil = background
  - Indoor dust = background
  - No difference between "access/no access"
- Renovation
  - Outdoor soil = background
  - Indoor dust = activity-specific, renovation loadings
    - Child with "access" = area-weighted average of "work area" indoor dust and "rest of house" indoor dust
    - Child with "no access" = "rest of house" indoor dust
- Post-Renovation
  - Outdoor soil = background
  - Indoor dust = activity-specific, post renovation loadings
    - Estimated based on area-weighted average of activity-specific "work area" indoor dust and activity-specific "rest of house" indoor dust
  - No differences between "access/no access"

EXTERIOR ONLY JOBS

- Pre-Renovation
  - Outdoor soil = background
  - Indoor dust = background
  - No difference between "access/no access"
- Renovation
  - Outdoor soil = activity-specific, renovation concentrations
    - Child with "access" = area-weighted average of activity-specific "work area" outdoor soil, activity-specific "nearby area" outdoor soil, and "rest of yard" outdoor soil (which is set to background outdoor soil)[25]

[25] For exterior jobs, "work area" levels were calculated from Dust Study data collected on the rule plastic, and

    - Child with "no access" = area-weighted average of activity-specific "nearby area" outdoor soil and "rest of yard" outdoor soil (which is set to background outdoor soil)
  - Indoor dust
    - Estimated based on background indoor dust and lead dust tracked in from outside (which is a function of activity-specific outdoor soil concentration)
- Post-Renovation
  - Outdoor soil = activity-specific, post-renovation concentrations
    - Estimated as area-weighted average of activity-specific "work area" outdoor soil, activity-specific "adjacent area" outdoor soil, and "rest of yard" outdoor soil (which is set to background outdoor soil)
  - Indoor dust = activity-specific, post-renovation loadings
    - Estimated based on background indoor dust and lead dust tracked in from outside (which is a function of activity-specific, post-renovation outdoor soil concentration)
  - No differences between "access/no access"

INTERIOR + EXTERIOR JOBS

- Pre-Renovation
  - Outdoor soil = background
  - Indoor dust = background
  - No difference between "access/no access"
- Renovation
  - Outdoor soil = activity-specific, renovation concentrations
    - Child with "access" = area-weighted average of activity-specific "work area" outdoor soil, activity-specific "nearby area" outdoor soil, and "rest of yard" outdoor soil (which is set to background outdoor soil)
    - Child with "no access" = area-weighted average of activity-specific "nearby area" outdoor soil and "rest of yard" outdoor soil (which is set to background outdoor soil)
  - Indoor dust = activity-specific, renovation loadings
    - Child with "access" = area-weighted average of "work area" indoor dust and "rest of house" indoor dust
    - Child with "no access" = "rest of house" indoor dust
  - All indoor dust loading estimates include contribution from tracking of lead dust from

"nearby area" levels were calculated using Dust Study data collected near rule plastic (but beyond the rule plastic).

outside, which is added to the area-weighted average

- Post-Renovation
    - Outdoor soil = activity-specific, post-renovation concentrations
        - Estimated as area-weighted average of activity-specific “work area” outdoor soil, activity-specific “adjacent area” outdoor soil, and “rest of yard” outdoor soil (which is set to background outdoor soil)
    - Indoor dust = activity-specific, post-renovation loadings
        - Area-weighted average of “work area” indoor dust and “rest of house” indoor dust, plus contribution from tracking of lead dust from outside
    - No differences between “access/no access”

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for lead. U.S. Department of Health and Human Services, Public Health Service. http://www.atsdr.cdc.gov/toxprofiles/tp13.html

Battelle. 2007. Draft Final Report on Characterization of Dust Lead Levels after Renovation, Repair, and Painting Activities. Prepared by Battelle (Columbus, OH) for the Office of Pollution Prevention and Toxics (Washington, D.C.). January 23 2007.

Braun, Joe, Robert S. Kahn, Tanya Froehlich, Peggy Auinger and Bruce P. Lanphear, 2006. Exposures to Environmental Toxicants and Attention Deficit Hyperactivity Disorder in US Children. Ehp Environmental Health Perspectives, doi:10.1289/ehp.9478 (available at http://dx.doi.org/) Online 19 September.

Canfield, R. L., et al. 2003. Intellectual Impairment in Children with Blood Lead Concentrations below 10μg per Deciliter. New England Journal of Medicine, 348(16): 1517-1526.

Centers for Disease Control and Prevention (CDC). National Center for Health Statistics (NCHS). National Health and Nutrition Examination Survey Data. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 1994, http://www.cdc.gov/nchs/about/major/nhanes/nh3data.htm

Clayton, C.A.; Pellizzari, E.D.; Whitmore, R.W.; Perritt, R.L.; and Quackenboss, J.J. 1999. National human exposure assessment survey (NHEXAS): distributions and associations of lead, arsenic, and volatile organic compounds in EPA Region 5. *J. Exposure Anal. Environ. Epidemiol*. 9: 381-392.

Dietrich, K. M., et al. 2004. Effect of Chelation Therapy on the Neuropsychology and Behavioral Development of Lead-Exposed Children After School Entry. Pediatrics, 114(1): 19-26.

Lanphear, B. P., et al. 1998a. Environmental Exposures to Lead and Urban Children's Blood Lead Levels. Environmental Research, Section A, 76: 120-130.

Lanphear, B. P., et al. 2005. Low-Level Environmental Lead Exposure and Children's Intellectual Function: An International Pooled Analysis. Environmental Health Perspectives, 113(7): 894-899.

Leggett, R.W. 1993. An Age-Specific Kinetic Model of Lead Metabolism in Humans. Environmental Health Perspectives. 101: 598-616.

Liu, X., et al. 2002. Do Children with Falling Blood Lead Levels Have Improved Cognition? Pediatrics, 110(4): 787-791.

Moir, C.M.; Freedman, B.; and McCurdy, R. 1996. Metal mobilization from water-distribution systems of buildings serviced by lead-pipe mains. *Canadian Water Resources Journal.* 21: 45-52.

Mulligan, G.M., Brimhall, D., and West, J. (2005). *Child Care and Early Education Arrangements of Infants,Toddlers, and Preschoolers: 2001* (NCES 2006-039). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

NAHB. 2006. Lead-Safe Work Practices Survey Project Report. Prepared by Atrium Environmental Health and Safety Services (Reston, VA) for the National Association of Home Builders. November.

Needleman, H. L.; Riess, J. A.; Tobin, M. J.; Biesecker, G. E.; Greenhouse, J. B. (1996) Bone Pb levels and delinquent behavior. JAMA J. Am. Med. Assoc. 275: 363-369.

Needleman, H. L.; McFarland, C.; Ness, R. B.; Fienberg, S. E.; Tobin, M. J. (2002) Bone Pb levels in adjudicated delinquents. A case control study. Neurotoxicol. Teratol. 24: 711-717.

Nevin, Rick, 2007. Understanding international crime trends: The legacy of preschool lead exposure, Environmental Research 104 (2007) 315–336.

Pounds, J.G.; and Leggett, J. 1998. The ICRP Age-Specific Biokinetic Model for Lead: Validations, Empirical Comparisons, and Explorations. *Environmental Health Perspectives.* 106 (S6): 1505-1511.

Reyes, Jessica Wolpaw, 2007. Environmental Policy as Social Policy? The Impact of Childhood Lead Exposure on Crime, The B.E. Journal of Economic Analysis & Policy, Volume 7, Issue 1, Article 51.

Rogan, W. J., et al. 2001. The effect of chelation therapy with succimer on neuropsychological development in children exposed to lead. New England Journal of Medicine, 344(19): 1421-1426.

Ruff, H. A., et al. 1993. Declining blood lead levels and cognitive changes in moderately lead-poisoned children. The Journal of the American Medical Association, 269(13): 1641-1646.

Salkever, D. S. 1995. Updated estimates of earnings benefits from reduced exposure of children to environmental lead. Environmental Research, 70(1): 1-6.

Schwartz, J.; Angle, C.; Pitcher, H. (1986) Relationship between childhood blood lead and stature. Pediatrics 77: 281-288.

Schwartz, J. 1994. Low-level lead exposure and children's IQ: a meta-analysis and search for a threshold. Environmental Research, 65(1): 42-55.

Shukla, R.; Bornschein, R. L.; Dietrich, K. N.; Buncher, C. R.; Berger, O.G.; Hammond, P. B.; Succop, P. A. (1989). Fetal and infant lead exposure: effects on growth in stature. Pediatrics 84: 604-612.

Shukla R, Dietrick KN, Bornschein RL, Berger O, Hammond PB (1992). Lead exposure and growth in the early preschool child: a follow-up report from the Cincinnati Lead Study. Pediatrics, 88(5): 886-92.

Stokes, L., et al. 1998. Neurotoxicity in young adults 20 years after childhood exposure to lead: the Bunker Hill experience. Occupational Environmental Medicine, 55: 507-516.

U.S. Census Bureau. 1995. Property Owners and Managers Survey (POMS). http://www.census.gov/hhes/www/housing/poms/poms.html

U.S. Census Bureau. 1997 and 2003. American Housing Survey (AHS). http://www.census.gov/hhes/www/housing/ahs/ahs.html

U.S. Department of Education, 2004a. National Center for Education Statistics. *Before- and After-School Care, Programs, and Activities of Children in Kindergarten Through Eighth Grade: 2001*, NCES 2004-008. Washington, DC: 2004.

U.S. Department of Education. 2004b. National Center for Educaton Statistics. The Condition of Education in 2004. Indicator 3. Trends in Full- and Half-Day Kindergarten. (NCES 2004-077). Washington, DC. http://nces.ed.gov/programs/coe/2004/pdf/03_2004.pdf

U.S. Department of Education. 2005. National Center for Education Statistics Early Childhood Program Participation Survey (NCES 2006-075). Washington, DC.

U.S. Department of Energy (DOE). 2003. Commercial Buildings Energy Consumption Survey (CBECS).

U.S. Department of Housing and Urban Development (HUD). 2000. National Survey of Lead and Allergens in Housing. http://www.hud.gov/offices/lead/techstudies/survey.cfm#natsurvey

U.S. Department of Housing and Urban Development (HUD). 2002. National Survey of Lead and Allergens in Housing: Final Report, Revision 6. Office of Lead Hazard Control. October 31. Available at: http://www.hud.gov/offices/lead/techstudies/survey.cfm#natsurvey.

U.S. Department of Housing and Urban Development (HUD). 2003. First National Environmental Health Survey of Child Care Centers.

U.S. Environmental Protection Agency (~~U.S.~~ EPA). 1986. Air Quality Criteria for Lead, Volumes 1-4 and Supplement. Research Triangle Park, N.C., EPA 600/8-83-028AF. http://cfpub.epa.gov/ncea/cfm/nceapublication.cfm?ActType=PublicationTopics&detype=DOCUMENT&subject=LEAD&subjtype=TITLE&excCol=Archive

U.S. Environmental Protection Agency (U.S. EPA). 1994. Technical Support Document: Parameters and Equations Used in the Integrated Exposure Uptake Biokinetic Model for Lead in Children (v.099d). Office of Solid Waste. EPA 540/R-94/040.

U.S. Environmental Protection Agency (EPA). 1997a. Lead Exposure Associated with Renovation and Remodeling Activities: Environmental Field Sampling Study (EFSS). Office of Pollution Prevention and Toxics. EPA 747-R-96-007, May 1997. http://www.epa.gov/lead/pubs/r96-007.pdf

U.S. Environmental Protection Agency (EPA). 1998. Hazard Standard Risk Analysis –TSCA Section 403. Risk Analysis to Support Standards for Lead in Paint, Dust, and Soil. Office of Pollution, Prevention, and Toxics. EPA 747-R-97-006.

U.S. Environmental Protection Agency (EPA). 2000a. Hazard Standard Risk Analysis Supplement – TSCA Section 403. Risk Analysis to Support Standards for Lead in Paint, Dust, and Soil, Supplemental Report, Volume 1. Office of Pollution Prevention and Toxics. EPA 747-R-00-004. December 2000. http://www.epa.gov/lead/403risksupp.htm

U.S. Environmental Protection Agency (USEPA). 2002b.EPA). 2002. Children-Specific Exposure Factors Handbook Interim Draft. National Center for Environmental Assessment, Office of Research and Development. EPA-600-P-00-002B.

U.S. Environmental Protection Agency (U.S. EPA). 2004. IRIS Database for Risk Assessment. Office of Research and Development, National Center for Environmental Assessment. Updated July 8, 2004. http://www.epa.gov/iriswebp/iris/index.html

U.S. Environmental Protection Agency (U.S. EPA). 2005. Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children, Windows® version (IEUBKwin v1.0 build 262) (September, 2005) 32-bit version. http://www.epa.gov/superfund/programs/lead/products.htmhttp://www.epa.gov/superfund/health/contaminants/lead/products.htm

U.S. Environmental Protection Agency (EPA). 2006. Air Quality Criteria for Lead (Final). EPA/600/R-5/144aF. Office of Research and Development. October. http://cfpub2.epa.gov/ncea/cfm/recordisplay.cfm?deid=32647158823

U.S. Environmental Protection Agency (EPA). 2006b. Economic Analysis for the Renovation, Repair, and Painting Program Proposed Rule. Office of Pollution Prevention and Toxics. February 2006.

U.S. Environmental Protection Agency (USEPA). 2006b.EPA). 2006c. Air Quality System (AQS) Database.Available at: http://www.epa.gov/ttn/airs/airsaqs/aqsweb/aqswebwarning.htm.

U.S. Environmental Protection Agency, 2007. The Approach Used for Estimating Changes in Children's IQ from Lead Dust Generated During Renovation, Repair, and Painting in Residences and Child Occupied Facilities. November 15, 2007. (EPA). 2006d. Specific estimates of dietary lead intake developed by EPA's Office of Solid Waste and Emergency Response. Available at: http://www.epa.gov/superfund/lead/ieubkfaq.htm#FDA.

U.S. Environmental Protection Agency (USEPA) Activity-Related Communication. 2007.EPA) . 2007a. Email Correspondence between Elizabeth Margosches of USEPA and Richard Hornung of Cincinnati Children's Hospital Medical Center. Title of email: re: coefficients of a piecewise linear model. July 20, 2007.

U.S. Environmental Protection Agency (EPA). 2007b. Revised Final Report on Characterization of Dust Lead Levels after Renovation, Repair, and Painting Activities. Prepared by Battelle (Columbus, OH) for the Office of Pollution Prevention and Toxics (Washington, D.C.). November 13, 2007.

U.S. Environmental Protection Agency (EPA), 2008. The Approach Used for Estimating Changes in Children's IQ from Lead Dust Generated During Renovation, Repair, and Painting in Residences and Child Occupied Facilities. Office of Pollution Prevention and Toxics. 2008.

Whitestone Research. The Whitestone Building Maintenance and Repair Cost Reference 2006-2007. 11th Annual Edition. August 2006.

Wirt, J., Choy, S., Rooney, P., Provasnik, S., Sen, A., and Tobin, R. (2004). The Condition of Education 2004 (NCES 2004-077). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

6. Comparison of Benefits to Costs

This chapter evaluates the various regulatory options under consideration in terms of their net benefits (i.e. benefits minus costs). The benefits associated with each option are estimated based on the number and value of IQ points that would be gained due to reductions in exposure to lead dust from RRP projects that disturb lead-based paint. In reviewing the net benefits, it is important to remember that these estimates only partially account for the benefits of the rule; some important groups of benefits are excluded from monetization. Among the categories of benefits excluded from this analysis are:

- IQ loss in children resulting from prenatal and breast milk exposure;
- Other children's health and developmental effects for which the science is less certain and for which there are not adequate data to develop ~~a~~ dose-~~-~~ response curve~~,~~s and thus ~~a benefits estimate. These outcomes include attention deficits, reduced ability to inhibit inappropriate responding; impulsivity, distractibility, criminal~~ benefit estimates. Investigating associations between lead exposure and behavior, ~~reactivity to the environment,~~ mood, and social ~~behavior, and auditory function.~~conduct of children has been an emerging area of research. Early studies indicated linkages between lower-level lead toxicity and behavioral problems (e.g., aggression, attentional problems, and hyperactivity) in children. Recent research suggest that IQ loss is most strongly associated with concurrent blood lead levels~~ and that this relationship is stronger in older children~~;
- Benefits that may accrue to adults, including avoided cases of increased blood pressure and hypertension~~, coronary heart disease (CHD), stroke, and death~~; and
- Adverse effects on plants and animals.

In addition, the incremental difference between willingness-to-pay to avoid children's IQ loss due to exposure to lead dust, and the income loss resulting from the IQ loss is not included in the valuation of benefits. ~~(~~The calculated benefits estimates are based on lost income instead of willingness-to-pay values.~~)~~

~~Six~~Seven regulatory options are analyzed in this report. ~~Five of them (Options A through E)~~These options differ from ~~each~~ one another in terms of which housing units and child occupied facilities (COFs) are covered by the rule. Specifically, ~~they differ~~the regulated universe differs in terms of:

- When the buildings were built (i.e. pre-1960 or pre-1978),
- Whether all owner occupied housing units are covered or only owner occupied units where a child under the age of six resides (rental units and COFs are covered under all options), and
- Whether the coverage is the same in all years or phased in over the first two years.

~~Options A though E are compared to~~ The options also differ in terms of the definition of the minor maintenance exception, how frequently a firm must be re-certified and renovators must be re-trained, and whether or not certain paint removal practices are prohibited.

Option P, the option that was previously analyzed in the economic analysis of the 2006 proposed rule and the 2007 supplemental proposal~~. Option P~~, is reanalyzed here using the cost and benefit models and assumptions developed for this report. The regulated universe under Option P is the same as under Option B. Option P, however, does not ~~account for the cost of using vertical containment when needed during certain exterior jobs to ensure that dust and debris from the renovation does not migrate to adjacent~~

~~properties. Nor does Option P include a prohibition on~~prohibit the use of any paint removal techniques. Option F (the Final Rule) covers the same housing units and COFs as Option E, but has a different definition of minor maintenance exception and provides for 5-year certification and training periods as opposed to 3-year periods. The ~~six~~seven options are described in Table 6-1.

Table 6-1: Options Included in Economic Analysis

Option	Scope: First Year	Scope: Second Year	Minor Maintenance Exception**	Digital Trainee Photos	Previously Trained Individuals	Exterior Containment	Prohibited Practices‡
Option P – *Proposed Rule Option*	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*	<2 ft² per component for interiors, <20 ft² for exteriors.	No	Certification given to those with previous relevant training.	Cover the ground a sufficient distance to collect falling paint debris.†	None
Option A	All pre-1960 target housing and COFs.*	All target housing and COFs.	<2 ft² per room for interiors, <20 ft² for exteriors.	Yes	Certification given to those with previous training only if they complete a refresher course.	Cover the ground a sufficient distance to collect falling paint debris, with a minimum of 10 feet required. Ground covering would be supplemented with vertical containment where necessary.	Open-flame burning or torching of LBP; using machines that remove LBP through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are used with HEPA exhaust control; and operating a heat gun on LBP at 1100° F or higher.
Option B	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*					
Option C	All pre-1960 target housing and COFs.*						
Option D	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**						
Option E – *Preferred Option for Final Rule*	All rental target housing and COFs, and owner-occupied target housing *where a child under the age of six or a woman who is or may be pregnant resides.*						

* Plus all target housing units built before 1978 where a child with an increased blood-lead level resides, where an increased blood-lead level is defined as greater than or equal to 10 µg/dL or a State or local government level of concern, if lower.
** Not analyzed due to limitations with the data on the incidence of renovation, repair, and painting events.
† The use of vertical containment was implicit in the proposed rule, but was not included in the economic analysis of the proposal.
‡ Practices are prohibited for renovations requiring lead-safe work practices under the rule.

~~The costs for these six options are estimated in Chapter 4 and summarized in Table 6-2. In terms of first year costs, regulatory Options A through E display a wide range of costs and all are more expensive than Option P. Option E (which covers all rental housing and COFs built before 1978, plus all pre-1978 owner-occupied housing where a child under the age of six or a woman who is or may be pregnant resides) has the highest first year cost, at $758 million. This is followed closely by Options A and C with a first year cost of $696 million. In terms of annualized costs, however, Option E is not the most expensive option – at $423 million (3% discount rate) it has the third highest costs. Options A and C have higher annualized costs.~~

~~Generally, it would be expected that costs would drop between the first and second years because improved test kits are assumed to be available for use by the second year. These improved test kits will reduce the number of instances where lead-safe work practices need to be used under the rule by reducing the number of false positive identifications for lead paint subject to the regulation. Consistent with this expectation, costs are lower in the second year for Options C, D, and E. For Options A and B, costs increase between the first and second years because the effect of the improved test kits is overridden by a change in the scope of these options which expands coverage from a pre-1960 universe to a pre-1978 universe.~~

~~Table 6-2: Comparison of Options – Cost per Individual Protected~~[a] Option		Scope: First Year	Scope: Second Year	Minor Maintenance Exception**	Certification & Training Periods	Previously Trained Individuals	Exterior Containment	Prohibited Practices	Digital Trainee Photos
Proposed Rule	P	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*	≤ 2 ft^2 per component	Firm certification and renovator training periods are 3 years each	Certification given to those with previous relevant training.	Cover the ground a sufficient distance to collect falling paint debris. †	None	No
Final Rule Options	A	All pre-1960 target housing and COFs.*	All target housing and COFs.	≤ 2 ft^2 per room for interiors, ≤ 20 ft^2 for exteriors.		Certification given to those with previous training only if they complete a refresher course.	Cover the ground a sufficient distance to collect falling paint debris, with a minimum of 10 feet required.	Yes ‡	Yes
	B	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 *where a child under the age of six resides.**	All rental target housing and COFs and owner-occupied target housing *where a child under the age of six resides.*						
	C	All pre-1960 target housing and COFs.*							
	D	All rental target housing and COFs built before 1960, and owner-occupied target housing built before 1960 where a child under the age of six resides.*							
	E	All rental target housing and COFs, and owner-occupied target housing *where a child under the age of 6 or a pregnant woman resides.*							
	F **Final Rule**	All rental target housing and COFs, and owner-occupied target housing *where a child under the age of 6 or a pregnant woman resides.*		≤ 6 ft^2 per room for interiors, ≤ 20 ft^2 for exteriors.	Firm certification and renovator training periods are 5 years each				

* Plus all target housing units built before 1978 where a child with an increased blood-lead level resides.

** Not analyzed due to limitations with the data on the incidence of renovation, repair, and painting events. The minor maintenance exception is only available for renovations that do not use prohibited or restricted practices, and that do not involve window replacement or demolition of painted surfaces areas.

† The use of vertical containment was implicit in the proposed rule, but was not included in the economic analysis of the proposal.

‡ Practices prohibited or restricted for renovations requiring lead-safe work practices under the rule or qualifying for the minor maintenance exception: Open-flame burning or torching of LBP; operating a heat gun on LBP at 1100° F or higher; and using machines that remove LBP through high speed operation such as sanding, grinding, power planing, needle gun, abrasive blasting, or sandblasting, unless such machines are used with HEPA exhaust control.

	Annual Cost (millions 2005$)	Annual Number of At-Risk Children Protected[b] (thousands 2005$)	Annual Cost per At-Risk Child Protected

The costs for these seven options are estimated in Chapter 4 and summarized in Table 6-2. In terms of first year costs, regulatory Options A through F display a wide range of costs and all are more expensive than Option P. Option E (which covers all rental housing and COFs built before 1978, plus all pre-1978 owner-occupied housing where a child under the age of six or a pregnant woman resides) has the highest first year cost, at $758 million. Option F has the same first year cost, followed closely by Options A and C with a first year cost of $696 million. In terms of annualized costs, Option F – at $404 million (3% discount rate) has only the third highest costs. Options A, B, C and E have higher annualized costs.

Table 6-2: Comparison of Options – Cost per Individual Protected[a]

	Annual Cost (millions 2005$)			Annual Number of At-Risk Children Protected[b] (thousands)			Annual Cost per At-Risk Child Protected		
	Year 1	**Year 2**	**Annual-ized**	**Year 1**	**Year 2[c]**	**Annual Average**	**Year 1**	**Year 2**	**Annual-ized**
	3 Percent Discount Rate								
Option P	$358	$41242 4	$343	1,54916 1	1,85739 3	1,683262	$231 308	$222 305	$20427 2
Option A	$696	$79181 5	$681	1,54916 1	1,85739 3	1,683262	$449 600	$426 585	$40553 9
Option B	$427	$47949 3	$409	1,54916 1	1,85739 3	1,683262	$276 368	$258 354	$24332 4
Option C	$696	$45146 5	$455	1,54916 1	1,54215 7	1,403052	$449 600	$292 402	$32443 2
Option D	$42642 7	$27027 9	$273	1,54916 1	1,54215 7	1,403052	$275 368	$175 241	$19526 0
Option E	$758	$41442 7	$423	1,86539 8	1,85739 3	1,689267	$406 542	$223 306	$250 334
Option F	$758	$407	$404	1,398	1,393	1,267	$542	$292	$319
	7 Percent Discount Rate								
Option P	$358	$41242 4	$367	1,54916 1	1,85739 3	1,683262	$231 308	$222 305	$21829 1
Option A	$696	$79181 5	$727	1,54916 1	1,85739 3	1,683262	$449 600	$426 585	$43257 6
Option B	$427	$47949 3	$437	1,54916 1	1,85739 3	1,683262	$276 368	$258 354	$26034 7
Option C	$696	$45146 5	$491	1,54916 1	1,54215 7	1,403052	$449 600	$292 402	$35046 7
Option D	$42642 7	$27027 9	$295	1,54916 1	1,54215 7	1,403052	$275 368	$175 241	$21028 1
Option E	$758	$41442 7	$460	1,86539 8	1,85739 3	1,689267	$406 542	$223 306	$272 363
Option F	$758	$407	$441	1,398	1,393	1,267	$542	$292	$348

[a] Assuming 75% compliance with the regulations.
[b] Number of at-risk children is estimated as the number of children exposed to LRRP ages 0 – 5 years. Double-counting may occur in cases where a child may be present for both an RRP at home and at the child's COF in a given year.
[c] The reduction in the number of children protected under Options C through E from Year 1 to Year 2 is proportional to the reduction in the stock of pre-1978 target housing and COFs,.

Because not all buildings built before 1978 have lead-based paint, the number of renovation events that need to use lead safe work practices is a subset of the total number of events covered by the rule. Currently available test kits for detecting whether lead-based paint is present have a high false positive rate (estimated to average 63 percent), resulting in the frequent use of lead safe work practices when they are not necessary, i.e., when lead-based paint is not present. EPA expects that improved test kits (with a false positive rate of 10 percent) will be commercially available by September 2010, but this analysis does not assume that the improved test kits will be in use until the second year that all of the rule's requirements are in effect. Thus, the number of events with lead safe work practices is estimated to decrease from the first year to the second year because of the adoption of the improved test kits. As a result, costs decline between the first and second years for several of the options. Costs are lower in the second year for Options C, D, E and F. For Options P, A and B, costs increase between the first and second years because the effect of the improved test kits is overridden by the change in the scope of these options which expands coverage from a pre-1960 universe in Year 1 to a pre-1978 universe in Year 2.

6.1 Benefits in Terms of Number of Children Protected

One measure of the impact of each option is the number of children protected by the regulation. Protected children are those living in target housing units covered by the rule or attending a regulated COF for at least the minimum amount of time per year as specified in the rule, where the following two conditions are met: RRP events take place and lead-based paint is both present and disturbed. The measures of costs and benefits estimated in this analysis address the incremental improvement in protection above the baseline conditions.

Options A through D, as well as Option P, ~~all~~ protect the same number of children in the first year (i.e. all children under the age of six in buildings built before 1960). ~~Option~~ Options E ~~covers~~ and F cover an additional ~~316~~238 thousand children in the first year because it covers children under the age of six in pre-1978 buildings, not just those in pre-1960 buildings. In the second year and beyond, Options P, A, and B, expand the coverage to the regulation to include pre-1978 buildings and thus protect the same number of children under the age of six as ~~Option~~ Options E and F. Options C and D maintain coverage of pre-1960 buildings. From the second year forward, all options cover a progressively smaller number of buildings due to demolitions of pre-1978 units. In terms of annual average number of children protected, ~~Option~~ Options E ~~protects~~ and F protect the most, with Options P, A, and B close behind. ~~Option~~Options E ~~has~~and F have the highest average number of children protected because ~~it protects~~they protect more children than the other options in the first year.

In the right-most set of columns in Table 6-2, the options are compared in terms of cost- per-~~child exposure avoided~~ at-risk child protected. By this measure, Option D appears to be the most cost effective and Option A the least. The cost per child protected for Option ~~E~~F falls ~~in~~below the middle of the range at $~~250~~318 per child (annualized cost using a 3 percent discount rate). While this is an informative measure, it does not tell the entire story. For example, Option D does not cover buildings constructed between 1960 and 1978, thus leaving over ~~300~~215,00 children unprotected each year. It is also ~~interesting~~informative to compare Options P and B, which cover the same universe in both the first and future years. Option P has a lower cost-per-child than Option B. However, Option P does not restrict or prohibit certain work practices that generate large amounts of lead dust or fumes, so is less protective than Option B. Third, Options A and C cover all owner-occupied housing units whether or not ~~a~~ there are children under the age of six. These options are more costly per child protected because they are ~~also providing~~including a larger universe of housing units where adults are receiving protection ~~to adults even if~~but no ~~child is present~~additional children.

6.2 Net Benefits

Another way to compare the efficiency of the options is to examine their net benefits. Based on the subset of benefits that have been monetized, Table 6-3 and Table 6-4 display net benefit calculations for the first year of the rule and the annualized value of the rule, respectively. As discussed in Chapter 5 (section 5.7.2), for each regulatory option there is a broad range of benefit estimates reflecting alternative assumptions about the relationship between lead exposure and blood-lead levels. Consequently, there is also a range of net benefits estimates for each regulatory option analyzed.

In terms of first~~-~~-year net benefits (Table 6-3), ~~Option P has the lowest net benefits ($1.1 billion), while Option ~~Options E ~~has~~and F have the largest ~~net ~~benefits~~ ($1.7 billion). The other options fall in between at $1.2 billion (~~, followed by Options A~~ and C) and $1.5 billion (Options~~, B, C and D~~). Thus while~~. Option ~~E~~P has the ~~highest first year costs, the ~~smallest benefits~~ gained more than offset~~. Because the costs do not vary in a simple manner with the ~~costs, resulting in the highest ~~benefits, net benefit levels do not directly correspond to benefit levels. Four options are relatively close in terms of first-year net benefits~~ among all~~. They are Options B and D (with net benefits in the range of $80 to $969 million) and Options E and F (with net benefits in the ~~options considered. ~~range of -$46 to $989 million). Options A and C have much lower net benefits (range from -$189 to $700 million).

Table 6-3: Comparison of Options -- First Year Net Benefits			
	First Year Cost[a] (millions 2005$)	Children's IQ Benefits – First Year[b] (millions 2005$)	Net Benefits[c] – Children's IQ Only (millions 2005$)
Option P	$358	~~$1,474~~$241 - $670	~~$1,116~~-$118 - $312
Option A	$696	$507 - $1,~~919~~396	~~$1,223~~-$189 - $700
Option B	$427	$507 - $1,~~919~~396	~~$1,492~~$80 - $969
Option C	$696	$507 - $1,~~919~~396	~~$1,223~~-$189 - $700
Option D	$427	$507 - $1,~~919~~396	~~$1,492~~$80 - $969
Option E	$758	~~$2,451~~$712 - $1,747	~~$1,693~~-$46 - $989
Option F	$758	$712 - $1,747	-$46 - $989

[a] Developed in Chapter 4.
[b] Developed in Chapter 5
[c] Difference between sum of benefits and costs.

~~Similar results are found when comparing~~Comparing options on the basis of annualized net benefits (Table 6-4~~). Option P continues to have the smallest net benefits and Option E has the largest net benefits. This result holds regardless of whether the annualization is done with a 3 percent or a 7 percent discount rate. Using annualized values, Options B and E are very similar in terms of costs, benefits, and net benefits. Option E, however, has somewhat larger net benefits and protects slightly more children than Option B as a result of the broader scope of Option E in the first year.~~

) produces slightly different conclusions. First, only Option P and A have net benefits ranges where the lower bound is below zero. In annualized terms, Options E and F clearly provide the largest net benefits (in the range of $258 to $1,266 million using 3 percent, and in the range of $265 to $1,337 million using 7 percent). Options B and D follow close behind. Option C, which had a net benefit lower bound less than zero for the first year, has an annualized net benefit lower bound above zero.

Table 6-4: Comparison of Options -- Annualized Costs and Net Benefits			
	Annualized Cost[a] (millions 2005$)	**Children's IQ Benefits – Annualized[b] (millions 2005$)**	**Net Benefits[c] – Children's IQ Only (millions 2005$)**
Annualized using 3 Percent Discount Rate			
Option P	$343	~~$1,650~~ $309 - $776	~~$1,307~~ -$34 - $433
Option A	$681	~~$2,322~~ $673 - $1,657	~~$1,641~~ -$8 - $976
Option B	$409	~~$2,322~~ $673 - $1,657	$264 - $1,~~913~~ 247
Option C	$455	$485 - $1,~~834~~ 334	~~$1,379~~ $30 - $879
Option D	$273	$485 - $1,~~834~~ 334	$211 - $1,~~561~~ 061
Option E	$423	~~**$2,342**~~ $681 - $1,670	$258 - $1,~~**920**~~ 248
Option F	$404	$681 - $1,670	$277 - $1,266
Annualized using 7 Percent Discount Rate			
Option P	$367	~~$1,748~~ $326 - $821	~~$1,381~~ -$41 - $454
Option A	$727	~~$2,455~~ $710 - $1,752	-$17 - $1,~~728~~ 025
Option B	$437	~~$2,455~~ $710 - $1,752	$2~~,018~~ 72 - $1,315
Option C	$491	$516 - $1,~~952~~ 420	~~$1,461~~ $24 - $929
Option D	$295	$516 - $1,~~952~~ 420	$220 - $1,~~657~~ 125
Option E	$460	~~**$2,493**~~ $725 - $1,778	$2~~**,033**~~ 65 - $1,318
~~[a] Developed in Chapter 4~~ ~~[b] Developed in Chapter~~ ~~[c] Difference between sum of benefits and costs~~			
Option F	$441	$725 - $1,778	$284 - $1,337

[a] Developed in Chapter 4
[b] Developed in Chapter 5
[c] Difference between sum of benefits and costs

Additional understanding of the impact of the regulations is gained from examining how the net benefits vary across types of buildings. As shown in Table 6-5, using Option ~~E~~F as an example, RRP in target housing provides the vast majority of the net benefits~~; however~~. While much smaller, the net benefits for public and commercial building COFs are also positive.

Table 6-5: Annualized Net Benefits by Building Type – Option E F			
	Annualized Cost[a] (millions 2005$)	**Children's IQ Benefits – Annualized[b] (millions 2005$)**	**Net Benefits[c] – Children's IQ Only (millions 2005$)**
Annualized using 3 Percent Discount Rate			
Target Housing (rental, owner-occupied and COFs in residences)	$391376	$2,284$652 - $1,602	$275 - $1,893226
Public or Commercial Building COFs (Schools and daycare centers)	$3128	$5929 - $68	$271 - $40
Total	**$423404**	$2,342$681 - $1,670	$277 - $1,920266
Annualized using 7 Percent Discount Rate			
Target Housing (rental, owner-occupied and COFs in residences)	$425410	$2,431$693 - $1705	$2,00684 - $1296
Public or Commercial Building COFs (Schools and daycare centers)	$3531	$6331 - $72	$280 - $41
Total	**$460441**	$2,493$725 - $1778	$2,03384 - $1337
[a] Developed in Chapter 4 [b] Developed in Chapter 5 [c] Difference between sum of benefits and costs. May not sum to totals due to rounding.			

6.3 Comparison of Option Alternatives in Terms of Net Benefits

One of the major differences between the option previously analyzed (Option P) and Options A through EF is that Options A through EF restrict or prohibit certain work practices.[1] The effect of these restrictions on costs and benefits are shown in Table 6-6, using Option E as an example. The first row presents the costs, benefits and net benefits that would occur under Option E if Option E did not prohibit these work practices. The second row presents the increased costs and benefits associated with these restrictions. While these additional requirements increase the costs slightly, the resulting increase in benefits is much greater and the net benefit of these additional requirements is strongly positive. In other words, they increase the totalprohibiting these paint removal practices increases net benefits by between $350 million and $1 billion.

[1] In renovations requiring lead-safe work practices under the rule, Options A though E prohibit open flame burning or torching LBP; operating a heat gun at 1100° F or higher; and machine sanding, grinding, abrasive blasting, or sandblasting LBP, except when done with HEPA exhaust control.

Table 6-6: Annualized Net Benefits – Prohibited Practice Ban -- Option E			
	Annualized Cost[a] (millions 2005$)	Children's IQ Benefits – Annualized[b] (millions 2005$)	Net Benefits[c] – Children's IQ Only (millions 2005$)
Annualized using 3 Percent Discount Rate			
Modified Option E, excluding any prohibition on paint removal practices	$419	$1,660$312 - $782	$1,241 $106 - $363
Incremental impact of prohibiting certain paint removal practices	$4	$682369 - $888	$678365 - $885
Total after prohibiting certain paint removal practices	$423	$2,342$681 - $1,670	$258 - $1,920248
Annualized using 7 Percent Discount Rate			
Modified Option E, excluding any prohibition on paint removal practices	$456	$1,767$332 - $832	$1,311 $123 - $376
Incremental impact of prohibiting certain paint removal practices	$4	$726392 - $946	$722388 - $942
Total after prohibiting certain paint removal practices	$460	$2,493$725 - $1778	$2,03365 - $1318
Prohibits the following paint removal practices in renovations requiring lead-safe work practices under the rule: open flame or torching of paint, using a heat gun above 1100° F, and power sanding, grinding, or abrasive blasting except when done using HEPA exhaust control. [a] Developed in Chapter 4 [b] Developed in Chapter 5 [c] Difference between sum of benefits and costs			

Other possible combinations of control options were also analyzed. As discussed in Chapters 4 and 5, each of these alternative control options would require some but not all of the work practices included under Options A through EF. For example, the regulation might require the use of rule containment, but not rule cleaning and cleaning verification. Alternatively, it might require rule cleaning, but not rule containment. Table 6-7 presents several alternative versions of Option E and compares their net benefits to the Preferred Option E (Option E as presented in Table 6-2 through Table 6-4). Each of the alternative versions of Option E presented in Table 6-7 would ban the prohibited practices. The alternatives differ as follows:

- Option E – requires rule containment, rule cleaning, and cleaning verification;
- Option E1 – requires rule containment, but not rule cleaning or cleaning verification;
- Option E2 – requires rule cleaning and cleaning verification, but not rule containment; and
- Option E3 – requires rule cleaning, but not cleaning verification or rule containment; and
- Option E3 – requires rule cleaning and cleaning verification but not rule containment.

As shown in Table 6-7, the net benefits for banning prohibited practices and requiring containment, but not requiring cleaning or cleaning verification are slightly higher than the net benefits from the preferred version of Option E. This is becauseWhile the savingsdecline in costs are greater thanis expected, the lostincrease in benefits; the preferred Option E provides greater total is unexpected. As discussed more fully in Chapter 5, this apparent increase in benefits is likely an artifact of the underlying data and modeling. The other two alternative versions (those that rely on cleaning as opposed to containment), have much smaller benefits and thus smaller net benefits than ~~the preferred version of~~ Option E.

Table 6-7: Annualized Net Benefits – Variations of Option E			
Option	Annualized Cost[a] (millions 2005$)	Children's IQ Benefits – Annualized[b] (millions 2005$)	Net Benefits[c] – Children's IQ Only (millions 2005$)
Annualized using 3 Percent Discount Rate			
Option E – Rule Containment, Rule Cleaning, Cleaning Verification	$423	~~$2,342~~$681 - $1,670	$258 - $1,~~920~~248
Option E1 – Rule Containment Only	$364	$860 - $2,~~318~~086	$496 - $1,~~954~~722
Option E2 – Rule Cleaning and Cleaning Verification Only	$~~349~~372	$1~~,128~~54 - $380	~~$779~~-$219 - $8
Option E3 – Rule Cleaning ~~and Cleaning Verification~~ Only	$~~372~~349	~~$1,337~~$356 - $867	$~~965~~7 - $517
Annualized using 7 Percent Discount Rate			
Option E – Rule Containment, Rule Cleaning, Cleaning Verification	$~~460~~423	~~$2,493~~$681 - $1,670	$2~~,033~~58 - $1,248
Option E1 – Rule Containment Only	$~~396~~364	$860 - $2,~~467~~086	~~$2,071~~$496 - $1,722
Option E2 – Rule Cleaning and Cleaning Verification Only	$~~380~~372	$1~~,201~~54 - $380	~~$821~~-$219 - $8
Option E3 – Rule Cleaning ~~and Cleaning Verification~~ Only	$~~405~~349	~~$1,423~~$356 - $867	~~$1,018~~$7 - $517

Option E and the variations described above prohibit the following practices for renovations requiring lead-safe work practices under the rule: open flame or torching of paint, using a heat gun above 1100° F, and power sanding, grinding, or abrasive blasting except when done using HEPA exhaust control.
[a] Developed in Chapter 4
[b] Developed in Chapter 5
[c] Difference between sum of benefits and costs

6.4 Summary

~~Six~~Seven regulatory options are considered throughout this report. Option P is the previously analyzed option from the proposed rule, with ~~cost~~costs and ~~benefit~~ benefits re-estimated here using the cost and benefit models and assumptions developed for this report.[2] As summarized in Table 6-1, Options A through ~~E all~~ F differ from Option P in several ways; most notably they prohibit certain work practices. Options A through ~~E~~ F differ among themselves, however, in terms of the number and age of buildings covered by the rule in each year (i.e. the scope of the regulation)~~.~~

~~In addition to alternative definitions of scope~~, the definition of minor maintenance exceptions, and the frequency with which re-certification and re-training must occur.

[2] See Chapters 4 and 5 for details on these assumptions and models.

The analysis also examined the effect of not prohibiting certain paint preparation and removal practices, and the effect of requiring either containment or cleaning but not both. The inclusion of prohibited practices in the regulation substantially increases the net benefits. Requiring rule cleaning but not rule containment would greatly reduce net benefits, while requiring. Requiring rule containment but not rule cleaning wouldappears to increase estimated net benefits slightly (because the cost saving is slightly greater than the loss in benefits). Total benefits, however, would decrease under a regulation that required containment, but did not require cleaningthis is an illogical and cleaning verification.unexpected result occurring for the reasons discussed in Chapter 5.

By nearly every measure, Option E is the preferred choice. While Option E is the most expensive in the first year, it also covers the most children and provides the largest benefits and net benefits in the first year. In terms of annualized values (which are more representative of the long-term, overall impact of the regulation), Option E has the greatest net benefit at an annualized cost that is about half-way between the most expensive and the least expensive option.Options E and F consistently rank among the highest under all the benefit and net benefit measures presented in this chapter. While Options E and F have the highest first year cost, their 50-year annualized costs fall well within the middle of the range of costs and they provide the greatest annualized benefits. Even though Options E and F rank very similarly for several of the measures, Option F provides higher annualized net benefits than Option E.[3] The majority of these net benefits are coming from RRP events in target housing – but RRP events in public and commercial buildingbuildings with COFs also provide substantial positive net benefits.

[3] Option F (the Final Rule) covers the same housing units and COFs as Option E, but has a different definition of minor maintenance exception and provides for 5-year certification and training periods as opposed to a 3-year period. This difference in definitions reduces the number of renovation events required to use lead-safe work practices under Option F. However, the difference between the number of events under options E and F, and the related difference in costs and benefits, could not be estimated because sufficient data were not available. Since both costs and benefits would be lower under Option F as compared to Option E, the impact on net benefits is unknown.

7. Sensitivity Analysis

To address some of the uncertainties in this analysis, this section considers the impacts of several alternative assumptions on the cost estimates presented in Chapter 4 and the benefit estimates presented in Chapter 5.~~[1]~~ ~~Five~~ Six alternative estimates are presented in this sensitivity analysis. The first considers adjusting lead levels from renovations to account for potential differences in lead levels in paint across vintages. The second examines alternative assumptions about work area sizes. The third and fourth examine alternative assumptions about work practices in the baseline. ~~Finally, the~~ The fifth alternative considers the sensitivity of the estimates to an alternative assumed mix of paint removal techniques. Finally, the sixth considers alternative assumptions about children's access to the work area before final cleanup in the baseline.

7.1 Vintage-Adjusted Lead Levels

As described in Chapter 5, this analysis estimated lead levels in air and dust ~~data~~ from the 2007 EPA Office of Pollution Prevention and Toxics (OPPT) Dust Study (EPA 2007b). Most of the structures that were studied were built prior to the 1930s. There is evidence that the lead levels in paint have varied over time. By using these data to estimate loadings from RRP events in all ages of buildings, without any adjustment, the primary estimate does not reflect changes over time in lead levels in paint. This sensitivity adjusts the OPPT Dust Study lead loadings to account for differences in the lead levels in paint by age of building (vintage) for both target housing and public or commercial building COFs. This analysis examines four vintages: buildings built before 1930, buildings built from 1930 to 1949, those built from 1950 to 1959, and those built from 1960 to 1978.

Table 7-1 presents the vintage adjustment factors utilized for this sensitivity analysis. These were calculated using data from the National Survey of Lead and Allergens in Housing (HUD 2001). The geometric mean level of lead in paint was calculated for the four vintages of housing for interior and exterior components separately. The component population weights provided by HUD (2001) were utilized in the calculation. Lead levels in air, dust, and soil resulting from renovations in the OPPT Dust Study were adjusted by the factors presented in the right-hand column of Table 7-1 to account for potential differences in lead levels in paint across building vintages.

~~[1] The primary cost estimate and the alternative estimates presented in this chapter do not include the additional cost of covering owner-occupied target housing where a woman who is or may be pregnant resides. Including such housing in the scope of the regulation is estimated to increase the cost of the primary estimate by 1%.~~

Note that the distribution of the concentrations of lead in paint for painted surfaces with lead concentrations above 1.0 mg/cm^2 does not affect the rule's costs, since the rule applies to all cases where the concentration of lead in paint exceeds 1.0 mg/cm^2.

Table 7-1: Vintage Adjustment Factors

Year	Component Type	Sample Size[a]	Population of Components (thousands)[b]	Geometric Mean [a]Lead in Paint (mg/cm^2) [c]	Vintage Adjustment Factor[d]
Pre-1930	Exterior	349	39,879	6.07	100%
1930-1949	Exterior	146	16,901	3.77	62%
1950-1959	Exterior	182	19,267	2.53	42%
1960-1978	Exterior	111	12,937	3.31	55%
Pre-1930	Interior	843	269,755	6.30	100%
1930-1949	Interior	263	77,341	3.33	53%
1950-1959	Interior	201	54,187	3.14	50%
1960-1978	Interior	129	29,117	3.67	58%

[a] The sample size is the number of components tested in the HUD survey.

[b] The population of components is the estimated number of components that exist nationwide.

[c] Geometric mean of XRF measurements (mg/cm^2) exceeding 1.0 mg/cm^2.

[d] The vintage adjustment factor is calculated as the ratio between the geometric mean concentration of lead in paint for a given vintage and the geometric mean for the Pre-1930 vintage. For example, the exterior vintage adjustment factor for the 1930-1949 vintage is calculated as 3.77/6.07.

Source: Calculated from National Survey of Lead and Allergens I Housing (HUD 2001)

7.1.1 Benefits Sensitivity: Vintage-Adjusted Lead Levels

Adjusting the lead loadings from air, dust and soil resulting from renovations to account for vintage-specific levels of lead in paint results in a ~~seven~~14 percent reduction in total benefits. ~~This change is driven by the approximately 20 percent reductions in the benefits associated with structures built between 1930 – 1949 and 1960 – 1978. The majority~~Table 7-1shows that for the adjusted vintages, adjustment factor is largest for the 1950-1960 vintage and smallest for the 1960-1978 vintage. The results in Table 7-2 are consistent with this result, since the 1950-1960 vintage shows the steepest decline in benefits and the 1960-1978 vintage shows the smallest decline in benefits. Note that a substantial share of the benefits are associated with pre-1930 housing units, which are not affected by the vintage adjustment. ~~The differences between the primary and alternative estimates for pre-1930 structures only reflect differences in the random draws associated with the probabilistic components of the benefits model. The differences between the primary and alternative estimates for the newer vintages reflect the vintage adjustment.~~

Table 7-2: Alternative Benefits Estimate: Vintage-Adjusted Air, Dust and Soil Levels (Annualized, 3 percent discount rate, millions 2005$)			
Description	**Primary Estimate**	**Alternative Estimate**	**Percent Change**
All Vintages	**~~$2,342~~$1,670,211**	**~~$2,178~~$1,438,181**	**-~~7%~~14%**
Pre-1930	~~$1,398~~$538,153	~~$1,390~~$538,153	~~-1%~~**0%**
1930 – 1949	$~~354~~409,534	$~~287~~322,415	-~~19%~~**21%**
1950 – 1959	$~~167~~386,651	$~~174~~288,672	~~4%~~**-25%**
1960 – 1978	$~~531~~335,873	$~~428~~288,941	-~~20%~~**14%**

7.2 Work Area Sizes

The data sources utilized in this analysis to characterize renovation, repair, and painting activities do not include specific information about the size of the areas affected by the work. In some cases the work area size can be reasonable inferred; for example, the average work area size of a kitchen renovation is the size of an average kitchen. In other cases, such as when "replaced electrical wiring" was reported, the appropriate work area size is less obvious. Since there is uncertainty surrounding the work area sizes utilized in this analysis, the sensitivity of the costs and benefits to the work area size is evaluated here. Section 4.2 and Tables 4-7 through 4-11 in Chapter 4 describe the work area sizes used in the primary estimate. In this sensitivity analysis the costs and benefits are estimated assuming work area sizes that are 50 percent larger and 50 percent smaller than the primary estimate's work area sizes.

7.2.1 Cost Sensitivity: Size of Work Area

Table 7-3 presents alternative cost estimates assuming smaller and larger work area sizes compared to the primary estimate. A 50 percent change in the work area size results in less than a 10 percent change in the total annualized costs. The magnitude of the change in total cost is smaller than the corresponding change in the work area size because not all costs are affected by a change in the work area size.

Table 7-3: Alternative Cost Estimate: Larger and Smaller Work Area Sizes (Annualized, 3 percent discount rate, millions 2005$)		
Description	**Estimate**	**Percent Change**
Primary Estimate	$~~419~~ 404	
50% Larger Work Area	$~~455~~ 440	~~8%~~9%
50% Smaller Work Area	$~~381~~ 366	-9%

7.2.2 Benefit Sensitivity: Size of Work Area

Table 7-4 presents alternative benefit estimates assuming smaller and larger work area sizes compared to the primary estimate. A 50 percent change in the work area size results in ~~about~~less than a ~~5~~2 percent change in the total annualized benefits, indicating that the benefits estimates are not particularly sensitive to assumptions about work area size. Estimated benefits increase under both alternatives (larger work area size and smaller work area size). This is not the expected result, and is likely to be an artifact of sparse underlying data and modeling assumptions. See Section 5.7.4 for a discussion of the potential causes for unexpected results in the benefits analysis.

Table 7-4: Alternative Benefits Estimate: Larger and Smaller Work Area Sizes (Annualized, 3 percent discount rate, millions 2005$)		
Description	**Estimate**	**Percent Change**
Primary Estimate	~~$2,799~~ $3,093	
50% Larger Work Area	~~$2,951~~ $3,138	1.5%
50% Smaller Work Area	~~$2,633~~ $3,108	~~-6%~~0.5%
Note that estimates were calculated using a deterministic version of the benefits model rather than the probabilistic model. The deterministic version of the model was used because it requires less time and resources to calculate results. There is no reason to believe that the deterministic and the probabilistic models would differ in their sensitivity to work area size.		

7.2.3 Net Benefit Sensitivity: Size of Work Area

Table 7-5 presents alternative ~~benefits~~net benefit estimates assuming smaller and larger work area sizes compared to the primary estimate. A 50 percent change in the work area size results in ~~about~~less than a ~~5~~2 percent change in the total annualized net benefits, indicating that the net benefits estimates are not overly sensitive to assumptions about work area size.

Table 7-5: Alternative Net Benefits Estimate: Larger and Smaller Work Area Sizes (Annualized, 3 percent discount rate, millions 2005$)		
Description	**Estimate**	**Percent Change**
Primary Estimate	$2,~~380~~ 689	
50% Larger Work Area	$2,~~496~~ 698	~~5%~~0.3%
50% Smaller Work Area	$2,~~251~~ 742	~~-5%~~2.0%
Note that estimates were calculated using a deterministic version of the benefits model rather than the probabilistic model. The deterministic version of the model was used because it requires less time and resources to calculate results. There is no reason to believe that the deterministic and the probabilistic models would differ in their sensitivity to work area size.		

7.3 Baseline Work Practice Use

The assumptions about the use of ~~baseline~~ rule-required work practices ~~that are consistent with rule requirements~~ in the baseline are based on a questionnaire that was administered to nine contractors. Since these data are not based on a statistically valid survey, there is considerable uncertainty associated with these assumptions. Thus, the sensitivity of the cost and benefit estimates to these assumptions is considered here.

7.3.1 Cost Sensitivity: Baseline Level Use of Required Work Practices

This section examines the sensitivity of total annualized rule costs ~~assuming~~ to the assumption that work practices required by the rule are used in the baseline with 50 percent greater frequency or 50 percent lower frequency than in the primary estimate. Table 7-6 presents the primary and alternative assumptions about how often the required work practices are used in the baseline. Higher baseline usage of required work practices results in lower incremental costs of the rule because it implies that contractors must make fewer changes to their current work practices to comply with the rule. Likewise, lower baseline usage of required work practices results in higher incremental costs of the rule. Assuming lower baseline usage of required work practices has a larger impact on costs because there are no constraints on a 50% reduction in the use of work practices, whereas there are constraints preventing the increased use of some of the work practices. Some of these practices are used 100%, or nearly 100%, of the time under the primary baseline estimate. Therefore, there is very little room for increased usage of these particular practices. Thus, as can be seen in Table 7-7, costs are more sensitive to lower baseline usage of required practices than to higher baseline usage.

Table 7-6: Percentage of Required Work Practices Used in the Baseline				
	Work Practice	**Primary Estimate**	**50% More Baseline Work Practice Use**	**50% Less Baseline Work Practice Use**
Interior	Sign	45%	68%	23%
	Floors: Cover surfaces with polyethylene sheeting (labor)	100%	100%	51%
	Floors: Cover surfaces with polyethylene sheeting (materials)	28%	42%	14%
	Walls: Cover surfaces with polyethylene sheeting	100%	100%	50%
	Tack pad	39%	58%	19%
	Pair of disposable shoe covers	26%	39%	13%
	Roll down polyethylene sheeting	92%	100%	46%
	Bag polyethylene sheeting	25%	38%	13%
	HEPA vacuum for work area (the actual vacuum)	50%	75%	25%
	vacuum use (floors)	100%	100%	54%
	vacuum use (walls)	41%	61%	20%
	HEPA vacuum clothes	39%	58%	19%
	Wet wipe, flat surfaces	67%	100%	33%
	Wet wipe, flat surfaces (verification)	0%	0%	0%
	Electrostatic cloth sweeper	30%	44%	15%
	Disposable wet cloth	0%	0%	0%
	Disposable dry cloth	0%	0%	0%
Exterior	Sign	47%	70%	23%
	Ground: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	89%	100%	44%
	Doors: Cover surfaces with polyethylene sheeting, each layer, 6 mil, incl. glue & tape	100%	100%	63%
	Roll down polyethylene sheeting[e]	53%	79%	26%

~~a. The compliance-adjusted work practice factor inflates the unadjusted value by incorporating an assumed 75% non-compliance rate and cannot be greater than 100%.~~

Note: The percentage of required work practices assumed to be employed in the baseline incorporates an assumed 75% non-compliance rate. When assuming that the rate of baseline compliance increases by 50% for this sensitivity analysis, the baseline percentage is constrained to be no greater than 100%.

Table 7-7: Alternative Cost Estimate: Baseline Level Use of Required Work Practices (Annualized, 3 percent discount rate, millions 2005$)		
Description	**Estimate**	**Percent Change**
Primary Estimate	$~~419~~ 404	
50% Higher Baseline Work Practice Use	$~~369~~ 354	-12%

50% Lower Baseline Work Practice Use	$~~592~~ 583	~~41%~~44%

7.3.2 Benefit Sensitivity: Baseline Level Use of Required Work Practices

This section examines the sensitivity of total annualized rule benefits assuming rule-style containment and rule-style cleaning practices are used in the baseline with 50 percent greater frequency or 50 percent lower frequency than in the primary estimate. Higher baseline usage of required work practices results in lower incremental benefits of the rule because it implies that contractors are already using more of the work practices that lower exposures to lead in dust, air, and soil. Likewise, lower baseline usage of required work practices results in higher incremental benefits of the rule.

Table 7-8 presents the alternative assumptions regarding the use of baseline work practices. The percentage of events where interior rule-style cleaning and containment and/or exterior plastic sheeting are used (last row in Table 7-8) is increased or decreased by 50 percent. The frequency of events in the remaining seven categories is then adjusted proportionally in the opposite direction. For example, when the use of rule-style cleaning, rule-style containment, and exterior plastic is increased by 50% (from 18.7% in the primary estimate to 28%), the value for conventional cleaning, conventional containment, and no exterior plastic *decreases* from 5.6% to 4.9%.

Table 7-8: Baseline Level Use of Required Work Practices				
Interior Controls	**Exterior Controls**	**Percentage of Baseline Events**		
		Primary	**50% More Rule-Style**	**50% Less Rule-Style**
Conventional Cleaning and Conventional Containment	No Exterior Plastic Sheeting	5.6%	4.9%	6.2%
Rule-Style Cleaning and Conventional Containment	No Exterior Plastic Sheeting	0.5%	0.4%	0.5%
Conventional Cleaning and Rule-Style Containment	No Exterior Plastic Sheeting	2.7%	2.4%	3.0%
Rule-Style Cleaning and Rule-Style Containment	No Exterior Plastic Sheeting	2.3%	2.1%	2.6%
Conventional Cleaning and Conventional Containment	Exterior Plastic Sheeting	44.7%	39.5%	49.8%
Rule-Style Cleaning and Conventional Containment	Exterior Plastic Sheeting	3.7%	3.3%	4.1%
Conventional Cleaning and Rule-Style Containment	Exterior Plastic Sheeting	21.9%	19.4%	24.4%
Rule-Style Cleaning and Rule-Style Containment	**Exterior Plastic Sheeting**	**18.7%**	**28.0%**	**9.3%**

Table 7-9 shows that a 50 change in the number of events where rule-style cleaning and rule style containment are used in the baseline changes the total annualized benefits by about ~~8~~7 percent.

Table 7-9: Alternative Benefits Estimate: Baseline Level Use of Required Work Practices (Annualized, 3 percent discount rate, millions 2005$)		
Description	**Estimate**	**Percent Change**
Primary Estimate	~~$2,342~~ $1,670	
50% Higher Baseline Work Practice Use	~~$2,163~~ $1,558	~~-8%~~7%

50% Lower Baseline Work Practice Use	~~$2,522~~ $1,782	~~8%~~7%

7.3.3 Net Benefits Sensitivity: Baseline Level Use of Required Work Practices

Table 7-10 illustrates that an increase in the assumed baseline usage of required work practices lowers benefits more than costs, but the difference is relatively small. A decrease in the assumed baseline level use of required work practices increases benefits and costs by about the same amount.

Table 7-10: Alternative Net Benefits Estimate: Baseline Level Use of Required Work Practices (Annualized, 3 percent discount rate, millions 2005$)

Description	Estimate	Percent Change
Primary Estimate	$1,~~923~~ 266	
50% Higher Baseline Work Practice Use	$1,~~794~~ 205	~~-7%~~5%
50% Lower Baseline Work Practice Use	$1,~~930~~ 198	~~0%~~ -5%

7.4 Baseline Benefits Cleaning and Containment Assumptions

The assumptions about the use of cleaning and containment work practices in the baseline are based on a questionnaire that was administered to nine contractors. Since these data are not based on a statistically valid survey there is considerable uncertainty associated with these assumptions. Thus, the sensitivity of the costs and benefits estimates to these assumptions is considered here.

The OPPT Dust Study conducted four types of experiments for each type of interior renovation activity: (1) conventional containment and conventional cleaning, (2) conventional containment and rule-style cleaning, (3) rule-style containment and conventional cleaning, and (4) rule-style containment and rule-style cleaning. In order to estimate the baseline levels of lead in dust, soil, and air after renovation events, this analysis estimated the frequency with which contractors practices fall into these four categories. These grouping were based on nine responses to the following question:

When performing work in a pre-1978 house, apartment, school, or daycare center that will disturb more than 2 square feet of a painted surface, which of the following best describes the practices you usually use to contain and clean-up debris and dust created during the job:

1. *You do not cover floors, doors, and ducts with taped-down sheeting. You do clean-up at the end of the job using a broom or a non-HEPA shop vacuum.*
2. *You do not cover floors, doors, and ducts with taped-down sheeting. You clean-up at the end of the job using a HEPA vacuum and you also wet mop the floor if it is not carpeted.*
3. *You cover floors, doors, and ducts with taped-down sheeting. You clean-up at the end of the job using a broom or a non-HEPA shop vacuum.*
4. *You cover floors, doors, and ducts with taped-down sheeting. You clean-up at the end of the job using a HEPA vacuum and you also wet mop the floor if it is not carpeted.*

Of the nine responses, one contractor selected (2), six selected (3), and two selected (4). However, when these responses were compared with the contractors' responses to related questions several inconsistencies were found. For example, the contractor who reported that he usually used conventional containment and rule-style cleaning also reported that he only vacuumed 75 percent of the time and he never mopped. Three of the six contractors who reported usually using rule-style containment and conventional style cleaning also reported using taped-down plastic sheeting no more than 50 percent of the time; four out of six reported reusing the sheeting rather than disposing of it; four reported always carefully misting and folding the sheeting before disposal (when plastic was used), and two reported that they did not mist and carefully fold the sheeting before disposal. Of the two contractors that reported using rule-style cleaning and rule style containment, the answers from one contractor were consistent with this, while the other contractor reported that he did not mop or vacuum walls and reused his plastic sheeting.

The inconsistencies in the responses of the contractors made it seem unreasonable to characterize the baseline practices of contractors based on the cleaning and containment practices they reported that they *usually* used. So the assumptions about the baseline-level work practice use were developed based on the response to this question and other related questions as described in Chapter 5. Since there is considerable uncertainty surrounding these assumptions and estimates, this section examines the sensitivity of the benefits to these assumptions. To accomplish this, an alternative scenario is evaluated where it is assumed that contractors *always* used the cleaning and containment practices they reported that they *usually* used. For the reasons described above, contractors do not appear to *always* use these practices; nevertheless, considering the estimates associated with this alternative assumption demonstrates the sensitivity of the benefits estimates to these estimates and assumptions. Table 7-11 presents the primary estimate for the baseline benefits cleaning and containment practices as well as the alternative estimate where it is assumed that contractors *always* use the cleaning and containment practices they reported *usually* using;.

Table 7-11: Baseline Level Use of Required Work Practices: alternative estimate assuming contractors *always* use the cleaning and containment practices they reported *usually* using

Interior Controls	Exterior Controls	Percentage of Baseline Events	
		Primary Estimate	Alternative Estimate
Conventional Cleaning and Conventional Containment	No Exterior Plastic Sheeting	5.6%	0.0%
Rule-Style Cleaning and Conventional Containment	No Exterior Plastic Sheeting	0.5%	1.2%
Conventional Cleaning and Rule-Style Containment	No Exterior Plastic Sheeting	2.7%	7.4%
Rule-Style Cleaning and Rule-Style Containment	No Exterior Plastic Sheeting	2.3%	2.5%
Conventional Cleaning and Conventional Containment	Exterior Plastic Sheeting	44.7%	0.0%
Rule-Style Cleaning and Conventional Containment	Exterior Plastic Sheeting	3.7%	9.9%
Conventional Cleaning and Rule-Style Containment	Exterior Plastic Sheeting	21.9%	59.3%
Rule-Style Cleaning and Rule-Style Containment	Exterior Plastic Sheeting	18.7%	19.8%

Table 7-12 shows that the benefits are sensitive to the assumptions that affect the estimated number of contractors using rule-style cleaning and/or rule-style containment in the baseline. However, net benefits are still positive even under the extreme assumption that contractors *always* use the practices they reported *usually* using.

Table 7-12: Alternative Benefits Estimate: Assume Contractors *Always* use Practices they Reported *Usually* Using (Annualized, 3 percent discount rate, millions 2005$)				
Description	**Benefits**		**Net Benefits**	
	Estimate	**Percent Change**	**Estimate**	**Percent Change**
Primary Estimate	~~$2,342~~ $1,670		~~-~~$1,~~923~~266	
Always Use Usual Practices in Baseline	$~~765~~ 489	-~~67%~~71%	$~~346~~86	- ~~82%~~93%

7.5 Frequency of Using Paint Removal Techniques

The assumptions about the frequency of the use of various paint removal techniques in the baseline are based on a questionnaire that was administered to nine contractors. Table 7-13 presents the frequencies of the various paint removal techniques estimated in this analysis (See Section 4.3.5 of Chapter 4 for a detailed description of this table and the underlying data).

Table 7-13: Summary Statistics for Frequency of Paint Removal Work Practice Use		
Paint Removal Practice Practice	**Interior**	**Exterior**
Heat Gun (Low Temp)	20%	20%
Heat Gun (High Temp)	7%	4%
Open Flame Burning	n.a.	3%
Power Sanding	35%	44%
Dry Scraping	38%	29%
Benefits cannot be estimated for prohibiting interior open flame burning because the Dust Study did not include these activities. As a result, these activities are accounted for as interior high temperature heat gun activities.		

Since these data are not based on a statistically valid survey there is considerable uncertainty surrounding the frequency with which various paint removal techniques are used. This frequency affects the estimated cost of prohibiting certain paint removal practices.[2] To assess the sensitivity of the costs and benefits to these estimates, this analysis presents ~~the~~ a series of cost and benefit estimates ~~under the assumption~~; each assumes that ~~each~~one of the paint removal ~~technique~~ techniques is always used for paint removal. These alternative estimates provide the upper and lower bound of the cost and benefit estimates for allowing the frequency of paint removal techniques to vary while holding other variables constant.

7.5.1 Cost Sensitivity: Frequency of Using Paint Removal Techniques

[2] The rule prohibits the following paint removal practices in renovations requiring lead-safe work practices under the rule: open flame or torching of paint, using a heat gun above 1100° F, and power sanding, grinding, or abrasive blasting except when done using HEPA exhaust control.

Table 7-14 shows that the costs of the rule (including a prohibition on the use of certain paint removal practices) are not sensitive to the assumed mix of paint removal techniques; no mix of paint removal techniques would result in more than a ~~6~~7 percent increase in costs or a 1 percent decrease in costs. This results from the relatively low cost of the alternatives to prohibited practices.

Table 7-14: Alternative Cost Estimate: Frequency of Using Paint Removal Techniques (Annualized, 3 percent discount rate, millions 2005$)		
Description	**Estimate**	**Percent Change**
Primary Estimate	$~~419~~ 404	
100% Dry Scraping	$~~415~~ 400	~~-1%~~0.9%
100% Low Temperature Heat Gun	$~~415~~ 400	~~-1%~~0.9%
100% High Temperature Heat Gun	$~~445~~ 431	6.6%
100% High Temperature Heat Gun Indoors and Open Flame Outdoors	$~~445~~ 431	6.6%
100% Power Sanding/Scraping	$~~419~~ 404	-0.1%

7.5.2 Benefit Sensitivity: Frequency of Using Paint Removal Techniques

Table 7-15 shows that the benefits are sensitive to the assumed mix of paint removal techniques. Increasing the percentage of painting events where dry scraping or low temperature heat guns are used to prepare painting surfaces results in lower benefits and increasing the percentage of painting events where high temperature heat guns, open flame, and power sanding/scraping are used would increase benefits.

Table 7-15: Alternative Benefits Estimate: Frequency of Using Paint Removal Techniques (Annualized, 3 percent discount rate, millions 2005$)		
Description	**Estimate**	**Percent Change**
Primary Estimate	~~$2,342~~ $1,670	
100% Dry Scraping	$~~1,076~~ 562	-~~54%~~66%
100% Low Temperature Heat Gun	$~~878~~ 493	-~~62%~~70%
100% High Temperature Heat Gun	~~$3,002~~ $2,203	~~28%~~32%
100% High Temperature Heat Gun Indoors and Open Flame Outdoors	~~$3,090~~ $2,452	~~32%~~47%
100% Power Sanding/Scraping	~~$4,323~~ $3,239	~~85%~~94%

7.5.3 Net Benefits Sensitivity: Frequency of Using Paint Removal Techniques

Table 7-16 shows that the net benefits are sensitive to the assumed mix of paint removal techniques, since benefits are sensitive to this mix but costs are not.

Table 7-16: Alternative Net Benefits Estimate: Frequency of Using Paint Removal Techniques (Annualized, 3 percent discount rate, millions 2005$)		
Description	**Estimate**	**Percent Change**
Primary Estimate	$1,~~923~~ 266	
100% Dry Scraping	$~~661~~ 162	-~~66%~~87%
100% Low Temperature Heat Gun	$~~463~~ 93	-~~76%~~93%
100% High Temperature Heat Gun	~~$2,556~~ $1,773	~~33%~~40%
100% High Temperature Heat Gun Indoors and Open Flame Outdoors	$2,~~644~~ 022	~~37%~~60%
100% Power Sanding/Scraping	~~$3,904~~ $2,835	~~103%~~124%

7.6 Child Access to Work Area

Under the work practice standards required by the rule, renovation firms must post signs clearly defining the work area and warning occupants and other persons not involved in renovation activities to remain outside of the work area. These signs must be posted before beginning the renovation and must remain in place and readable until the renovation and post-renovation cleaning verification have been completed. In addition, work area access would only be possible through an air-locked opening in two-layers of plastic sheeting.

Under conventional containment practices, however, children may have easy access to the work area before final cleanup is completed. Data were not available to estimate how often children access RRP work areas before the final cleanup is performed, so under the primary estimate it is assumed that children have access to the work area 50 percent of the time that rule-style containment is not used in the baseline. The sensitivity of the benefits estimates to these assumptions is considered here. Under the first alternative it is assumed that children never have access to the work area in the baseline. Under the second alternative it is assumed that children have access to the work area 100 percent of the time that rule-style containment is not used in the baseline.

The text below and Table 7-17 ~~shows that the benefit estimates are sensitive to the~~ through Table 7-20 describe these assumptions ~~about children's access~~ in more detail.

Table 7-17 summarizes how the primary estimate combines different results calculated using the methodology from EPA 2008 for interior RRP events. Columns 1 through 5 represent the estimates and assumptions specific to the Economic Analysis, and columns 6 through 9 represent the assumptions from EPA 2008 that are assigned to each row. In the baseline, 46 percent of events are estimated to use rule-style containment, which corresponds to row 1 in Table 7-17. In the primary estimate, of the remaining 54% of events that are uncontained, the child is assumed not to access the work area~~. However, net benefits are still substantial even under the extreme assumption children never~~ in 50% of them (27% of the total number of events), as shown in column 5, row 2 in Table 7-17. The child is assumed to access the work area ~~before final cleanup in the baseline.~~in the other 50% of the uncontained events (also 27% of the total events), as shown in column 5, row 3 in Table 7-17. So a child accesses the work area in 27% of the events (column 5, row 3), and does not access the work area in 73% of events (column 5, row 1 + row 2) in the primary estimate.

Table 7-18 summarizes the sensitivity analysis for interior events. The primary estimate section of Table 7-18 (rows 1 through 3) is unchanged from Table 7-17. In the 0% work area access sensitivity analysis section of Table 7-18, 46% of interior RRP events are still assumed to use rule-style containment (row 4). It is assumed that there are no uncontained events where the child has access to the work area in this sensitivity analysis (row 6, column 4). Thus, in 100% of uncontained events the child does not have access to the work area (row 5, column 4), which means that 54% of all events are assumed to be uncontained without child access to the work area (row 5, column 5). Therefore, in the 0% sensitivity analysis for interior events, no child accesses the work area (row 6, column 5).

In the 100% work area access sensitivity analysis section of Table 7-18, 46% of interior RRP events are still assumed to use rule-style containment (row 7). 100% of uncontained events are assumed to be in row 9, column 4. Thus, in the 100% sensitivity analysis, 54% of events are assumed to allow access to the work area (row 9, column 5).

The situation is similar, but slightly more complicated, for events with exterior components. Table 7-19 summarizes the primary estimate for events with exterior components. Columns #1 through #8 represent the estimates and assumptions specific to the economic analysis, and columns 1 through 5 are the same as in Table 7-17. Columns 9 and 10 represent the assumptions from EPA 2008 that are assigned to each row. For simplification purposes, the same 27% access and 73% no-access assumption used for interior events is also used in the primary estimate for events with exterior components. However, the analysis reflects the share of exterior events using rule-style containment. In the baseline, 89% of exterior events are estimated to use rule-style containment, and 11% are estimated not to use containment. Thus, for events with exterior components, each row corresponding to Table 7-17 can be split into two parts, 89% of which use exterior containment and 11% of which do not. This is shown in Table 3, column 6. Column 5 and column 6 are multiplied to generate the percent of exterior jobs in each category, as shown in column 8 of Table 7-19.

For events with exterior components, the primary estimate still assumes that the child does not access the work area in 73% of RRP events. (This is the sum of rows 1 through 4 for column 5 in Table 7-19.) The child still accesses the work area in 27% of all RRP events (row 5, column 5).

Table 7-20 summarizes the sensitivity analysis for events with exterior components. The primary estimate section (rows 1 through 6) is the same as in Table 7-19. In the 0% work area access sensitivity analysis, 46% of RRP events with exterior events are in rows 7 and 8, where the child does not access the work area. In the remaining 54% of RRP events, the child accesses the work area in 0% of them. Thus, rows 11 and 12 have 0% in columns 5 and 8. Of the remaining 54% of events (where the child also does not access the work area), 48% of these events are in row 9, column 8 and 6% are in row 10, column 8. In the 0% sensitivity analysis, no children are assumed to access the work area.

Similarly, in the 100% work area access sensitivity analysis in Table 7-20 , 46% of RRP events with exterior components are in rows 13 and 14, where the child does not access the work area. In the remaining 54% of RRP events, the child accesses the work area in 100% of them. Thus, rows 15 and 16 have 0% in column 8. All 100% of the 54% of events where the child accesses the work area are in columns 5 and 8 in rows 17 and 18. Following the same 89% to 11% distribution, 48% of these events are in row 17 and 6% are in row 18. Since the 100% refers to the percent of children with access only in uncontained events, this sensitivity analysis results in children having access to the work area in 54% of all events (row 17, column 5).

Table 7-17: ~~Alternative Benefits Estimate: Percentage~~Summary of ~~Children with~~Analysis of Child Access to the Work Area ~~(Annualized, 3 percent discount rate, millions 2005$)~~in the Baseline - Interior Events

<table>
<tr><th>Row</th><th>(1)
Rule-Style Containment</th><th>(2)
Percent of All RRP Events</th><th>(3)
Child Access to the Work Area</th><th>(4)
Percent of Uncontained RRP Events</th><th>(5)
Percent of All RRP Events - Primary Estimate in Econ Analysis</th><th>(6)
Child Access in the Approach*</th><th>(7)
Child Spends Time in</th><th>(8)
Average Whole-House Loadings**</th><th>(9)
Renovation Loadings †</th></tr>
<tr><td>1</td><td>Rule-Style Containment</td><td>46%</td><td>Child does not access the work area during renovation</td><td>---</td><td>46%</td><td>0%</td><td>Rest of house only - no work area access</td><td>Rest of house only - no work area loadings</td><td>Control Options with rule containment (C.O. 2 & 3)</td></tr>
<tr><td>2</td><td rowspan="2">Uncontained</td><td rowspan="2">54%</td><td>Child does not access the work area during renovation</td><td>50%</td><td>27%</td><td>0%</td><td>Rest of house only - no work area access</td><td>Rest of house only - no work area loadings</td><td>Control Options without containment (Base Control & C.O. 1)</td></tr>
<tr><td>3</td><td>Child accesses the work area during renovation</td><td>50%</td><td>27%</td><td>100%</td><td>Entire house - including work area</td><td>Weighted average of work area and rest of house, weighted by % of house represented by the work area</td><td>Control Options without containment (Base Control & C.O. 1)</td></tr>
</table>

* A child with 0% access means that the child does not access the work area during the renovation. A child with 100% access means that a child accesses 100% of the house (including the work area) during the renovation. It does not mean that the child spends 100% of the time in the work area during the renovation.

** "Rest of house" loadings are based on observation room loadings from the Dust Study.

† Loadings based on activity-specific Dust Study data (specific to window replacements, painting, etc.) for the following control options:
Base Control = No plastic sheeting, baseline cleaning;
Control Option 1 = No plastic sheeting, rule cleaning;
Control Option 2 = Plastic sheeting, baseline cleaning; and
Control Option 3 = Plastic sheeting, rule cleaning.

Table 7-18: Primary Estimate and Sensitivity Analyses for Child Access to the Work Area – Interior Events

Row	(1) Rule-Style Containment	(2) Percent of All RRP Events	(3) Child Access to the Work Area	(4) Percent of Uncontained RRP Events	(5) Percent of All RRP Events - Primary Estimate in Econ Analysis	(6) Child Access in the Approach*	(7) Child Spends Time in	(8) Average Whole-House Loadings**	(9) Renovation Loadings ***
Primary Estimate									
1	Rule-Style Containment	46%	No access	---	46%	0%	Rest of house only	Rest of house only	C.O. 2 & 3
2	Uncontained	54%	No access	50%	27%	0%	Rest of house only	Rest of house only	Base & C.O. 1
3			Access	50%	27%	100%	Entire house	Work area and rest of house	Base & C.O. 1
0% Access for Uncontained Work Area Sensitivity Analysis									
4	Rule-Style Containment	46%	No access	---	46%	0%	Rest of house only	Rest of house only	C.O. 2 & 3
5	Uncontained	54%	No access	100%	54%	0%	Rest of house only	Rest of house only	Base & C.O. 1
6			Access	**0%**	0%	100%	Entire house	Weighted average of work area and rest of house	Base & C.O. 1
100% Access for Uncontained Work Area Sensitivity Analysis									
7	Rule-Style Containment	46%	No access	---	46%	0%	Rest of house only	Rest of house only	C.O. 2 & 3
8	Uncontained	54%	No access	0%	0%	0%	Rest of house only	Rest of house only	Base & C.O. 1
9			Access	**100%**	54%	100%	Entire house	Weighted average of work area and rest of house	Base & C.O. 1

Shaded cells in the sensitivity analysis sections represent changes from the primary estimate.

Table 7-19: Summary of Analysis for Child Access in the Work Area in the Baseline – Events with Exterior Components

Row	(1) Rule-Style Interior Containment	(2) Percent of All RRP Events	(3) Child Access to the Work Area	(4) Percent of Uncontained RRP Events	(5) Percent of All RRP Events	(6) Baseline Percent of Exterior Events with Rule-Style Containment	(7) Exterior Plastic Status	(8) Percent of All RRP Events – Primary Estimate in Econ Anal*	(9) Average Whole-Yard Soil Concentration	(10) Exterior Renovation Loadings**
1	Rule-Style Containment	46%	Child does not access the work area during renovation	---	46%	89%	Exterior Plastic = Yes	41%	Rest of yard (=background)	Control Option B
2						11%	Exterior Plastic = No	5%	Rest of yard (=background)	Control Option A
3	Uncontained	54%	Child does not access the work area during renovation	50%	27%	89%	Exterior Plastic = Yes	24%	Rest of yard (=background)	Control Option B
4						11%	Exterior Plastic = No	3%	Rest of yard (=background)	Control Option A
5			Child accesses the work area during renovation	50%	27%	89%	Exterior Plastic = Yes	24%	Weighted average of work area, nearby area, and rest of yard	Control Option B
6						11%	Exterior Plastic = No	3%	Weighted average of work area, nearby area, and rest of yard	Control Option A

* Column 8 = column 5 x column 6

** Control Option A = No plastic sheeting;

Control Option B = Plastic sheeting.

Table 7-20: Primary Estimate and Sensitivity Analyses for Child Access to the Work Area – Events with Exterior Components

Row	(1) Interior Containment	(2) % All RRP	(3) Child Access to Work Area	(4) %Uncontained RRP Events	(5) % All RRP	(6) Exterior Events	(7) Exterior Plastic Status	(8) Percent All RRP Events	(9) Whole-Yard Soil Concentration	(10) Exterior Loadings
Primary Estimate										
1	Rule-Style Containment	46%	No access	---	46%	89%	Exterior Plastic	41%	Background	Cont Opt B
2						11%	No Exterior Plastic	5%	Background	Cont Opt A
3	Uncontained	54%	No access	50%	27%	89%	Exterior Plastic	24%	Background	Cont Opt B
4						11%	No Exterior Plastic	3%	Background	Cont Opt A
5			Access	50%	27%	89%	Exterior Plastic	24%	Entire yard	Cont Opt B
6						11%	No Exterior Plastic	3%	Entire yard	Cont Opt A
0% Access to Uncontained Work Areas Sensitivity Analysis										
7	Rule-Style Containment	46%	No access	---	46%	89%	Exterior Plastic	41%	Background	Cont Opt B
8						11%	No Exterior Plastic	5%	Background	Cont Opt A
9	Uncontained	54%	No access	100%	54%	89%	Exterior Plastic	48%	Background	Cont Opt B
10						11%	No Exterior Plastic	6%	Background	Cont Opt A
11			Access	**0%**	0%	89%	Exterior Plastic	0%	Entire yard	Cont Opt B
12						11%	No Exterior Plastic	0%	Entire yard	Cont Opt A
100% Access to Uncontained Work Areas Sensitivity Analysis										
13	Rule-Style Containment	46%	No access	---	46%	89%	Exterior Plastic	41%	Background	Cont Opt B
14						11%	No Exterior Plastic	5%	Background	Cont Opt A
15	Uncontained	54%	No access	0%	0%	89%	Exterior Plastic	0%	Background	Cont Opt B
16						11%	No Exterior Plastic	0%	Background	Cont Opt A
17			Access	**100%**	54%	89%	Exterior Plastic	48%	Entire yard	Cont Opt B
18						11%	No Exterior Plastic	6%	Entire yard	Cont Opt A

Shaded cells in the sensitivity analysis sections represent changes from the primary estimate.

Table 7-21 shows that the benefit estimates are sensitive to the assumptions about children's access to the work area. However, net benefits are still substantial even under the extreme assumption children never access the work area before final cleanup in the baseline.

Table 7-21: Alternative Benefits Estimate: Percentage of Children with Access to the Work Area (Annualized, 3 percent discount rate, millions 2005$)

Description	Benefits		Net Benefits	
	Estimate	Percent Change	Estimate	Percent Change
Primary Estimate (50% work area access prior to final cleaning when baseline rule-style containment is not used)	~~$2,342~~ $1,670		$1,~~923~~ 266	
0% work area access prior to final cleaning	$1,~~432~~ 144	-~~39%~~31%	$~~1,010~~ 740	-~~47%~~42%
100% work area access prior to final cleaning when baseline rule-style containment is not used.	~~$3,253~~ $2,196	~~39%~~31%	~~$2,831~~ $1,792	~~47%~~42%

References:

U.S. Department of Housing and Urban Development (HUD). 2001. National Survey of Lead and Allergens in Housing.

U.S. Environmental Protection Agency (EPA). 2007b. Revised Final Report on Characterization of Dust Lead Levels after Renovation, Repair, and Painting Activities. Prepared by Battelle (Columbus, OH) for the Office of Pollution Prevention and Toxics (Washington, D.C.). November 13, 2007.

U.S. Environmental Protection Agency (EPA), 2008. The Approach Used for Estimating Changes in Children's IQ from Lead Dust Generated During Renovation, Repair, and Painting in Residences and Child Occupied Facilities. Office of Pollution Prevention and Toxics. 2008.

8. Estimated Impacts of §402(c)

In addition to the cost and benefit analyses presented in Chapters 4 to 6, several other types of impacts are important to consider in evaluating the effects of a regulation. This chapter presents analyses that report the impact of the Lead Renovation, Repair and Painting (LRRP) Rule on the paperwork burden, the financial condition of small entities, whether the regulation has a disproportionate effect on low-income and or minority persons, and the environmental health risk or safety risk to children due to the regulation. It also responds to the Unfunded Mandates Reform Act (UMRA) and the National Technology Transfer and Advancement Act (NTTAA), as well as to Executive Orders 13132 (Federalism), 13175 (Tribal Implications), 13211 (Energy Effects), and 12898 (Environmental Justice).

8.1 Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (PRA) (superseding the PRA of 1980) is implemented by the Office of Management and Budget (OMB) and requires that agencies submit a supporting statement to OMB for any information collection that solicits the same data from more than nine parties. The PRA seeks to ensure that Federal agencies balance their need to collect information with the paperwork burden imposed on the public by the collection.

The definition of "information collection" includes activities required by regulations, such as permit development, monitoring, recordkeeping, and reporting. The term "burden" refers to the "time, effort, or financial resources" the public expends to provide information to or for a Federal agency, or to otherwise fulfill statutory or regulatory requirements. PRA paperwork burden is measured in terms of annual time and financial resources the public devotes to meet one-time and recurring information requests (44 U.S.C. 3502(2); 5 C.F.R. 1320.3(b)).

Information collection activities may include:

- reviewing rule requirements;
- using technology to collect, process, and disclose information;
- adjusting existing practices to comply with requirements;
- searching data sources;
- completing and reviewing the response; and
- transmitting or disclosing information.

Agencies must provide information to OMB on the parties affected, the annual reporting burden, and the annualized cost of responding to the information collection.

8.1.1 RRP Entity Paperwork Burden

Certification and Recordkeeping

LRRP contractors, landlords, schools, and public or commercial building daycare centers performing regulated RRP work are estimated to spend approximately half an hour to fill out and mail the Application for Renovator Certification when they are applying for initial certification or re-certification (which occurs every three years). It is estimated that these entities will spend an average of three hours to familiarize themselves with the RRP rule's requirements when becoming certified. Entities performing

RRP tasks on target housing units and public and commercial buildings will spend, on average, about five hours annually for recordkeeping tasks. This adds up to an average burden in the first year of 7.8 hours per contractor, landlord, and public or commercial building COF entity. At a loaded wage rate of $31.64, the paperwork cost in the first year will average $263 per firm (See Table 8- 1). Additional costs are minor; these costs include an application printout, one photocopy for personal records, an envelope, and a stamp. The total first year information collection cost is estimated to average $263 per contractor, landlord, and public or commercial building COF firm. Every ~~three~~five years entities must complete the certification form to apply for re-certification, as well as keep records that demonstrate compliance with the RRP Rule. The total time required during a re-certification year is 5.3 hours at a cost of $168 per contractor, landlord, and public or commercial building COF entity. In years when entities do not need to apply for certification or re-certification, contractor and public or commercial building COF entities will only incur the five-hour recordkeeping burden at a cost of $152.[1]

Table 8- 1: Costs to Firms Associated with Information Collection			
	Contractor, Landlord and All Public or Commercial Building COFs		
	First Year/Initial Certification Year	Re-Certification Year	Other Years
Rule familiarization (3 hours)	$94.93	$0	$0
Certification form (half hour)	$15.82	$15.82	$0
Recordkeeping (4.8 hours per entity)	$151.89	$151.89	$151.89
2 photocopies	$0.16	$0.16	$0
1 envelope	$0.02	$0.02	$0
1 stamp	$0.37	$0.37	$0
Total*	**$263**	**$168**	**$152**
* Rounded to nearest dollar. *Source: EPA Calculations and U.S. Bureau of Labor Statistics 2005.*			

Pre-Renovation Education Requirements

Under TSCA § 406(b), persons renovating target housing and public or commercial buildings for compensation must provide the owner and the occupant of the housing with a lead hazard information pamphlet before renovations commence. This analysis assumes that all public or commercial building COF contractors will work both in COFs that rent space and in those that own space. Landlords will only perform work in the buildings that they own.

Landlords and contractors working in COFs that own their own space will need to prepare one set of acknowledgement and certification forms, distribute the pamphlet to the COF owner only, and obtain proof that the pamphlet was provided to the COF owner. Contractors working in COFs that are renting space will need to prepare two sets of acknowledgement and certification forms (one for the building

[1] The estimates presented in Section 8.1.1 do not include costs associated with the extension of the Pre-Renovation Education Rule to child-occupied facilities in public or commercial buildings.

owner, and the other for the COF owner), distribute the pamphlet to both individuals, and obtain proof that both individuals have received the pamphlet. In this analysis, it is estimated that contractors or landlords will need two minutes to prepare each set of acknowledgement and certification forms, two minutes to photocopy each pamphlet, and an additional two minutes to deliver the pamphlet to each individual involved and obtain proof of pamphlet receipt. Furthermore, it is estimated that contractors will need a total of three minutes to file all of the signed acknowledgement forms or mailing certificates. Pamphlet costs are estimated at $0.56 per pamphlet.

This requirement does not apply to events where a test kit indicates that LBP is not present; therefore it is assumed that costs are only incurred for events where LSWP are used. A detailed explanation of the estimated burden and cost associated with the extended pre-renovation education requirements is provided in the *Second Proposed Rule Related Addendum to Existing EPA ICR Entitled: TSCA § 402/404 Training and Certification, Accreditation, and Standards for Lead-Based Paint Activities* (EPA ICR No. 1715.08; OMB 2070-0155). Table 8-2 presents the resultant total cost to landlords and contractors of preparing acknowledgement and certification forms, photocopying pamphlets, distributing pamphlets, and obtaining proof of pamphlet receipt.

The predicted number of events under Option F is the same as under Option E; however, the actual number of events under Option F is expected to be lower than under Option E due to the difference in the definitions of the minor maintenance exception.

Table 8-2: Average Cost per Firm, Option F

	Year 1	Year 2	Year 3
Total Cost to Landlord Firms	$31,749	$11,528	$11,481
Number of Landlord Firms	13,279	13,224	13,170
Average Cost per Landlord Firm	***$2.39***	***$0.87***	***$0.87***
Total Cost to Contractor Establishment	$956,568	$233,730	$232,772
Number of Contractor Establishments	3,223	3,210	3,197
Average Cost per Contractor Establishment	***$297***	***$73***	***$73***
Average Cost, Landlord and Contractor Firms	**$60**	**$15**	**$15**

In addition, the Final Rule would require that the renovation firm either distribute the pamphlet and general information on the renovation project to the parents or guardians of children using the facility, or post informational signs describing the general nature and locations of the project and the anticipated completion date. These signs must be posted in areas where they can be seen by the parents or guardians of the children frequenting the child-occupied facility. The signs must be accompanied by a posted copy of the lead hazard information pamphlet or information on how interested parents and guardians can review a copy of the pamphlet or obtain a copy from the renovation firm at no cost to the parent or guardian.

To comply with this requirement it is assumed that a copy of the pamphlet will be posted together with the information specific to the planned renovation. This requirement does not apply to events where a test kit indicates that LBP is not present, therefore it is assumed that these costs are only incurred for events where LSWP are used. The labor burden associated with this activity is assumed to be three minutes and the estimated wage rate is $31.64. Thus, the total labor cost per-activity is estimated to be $1.58. The materials cost per-activity is estimated as the cost of a copy of the pamphlet, $0.56, plus one additional

$0.07 copy of the job-specific renovation information. Table 8-3 presents the resultant total cost to firms of posting the pamphlet and job-specific renovation information.

Table 8-3: Average Cost per Firm, Option F			
	Year 1	**Year 2**	**Year 3**
Total Cost to Firms	~~$955,591~~$797,602	~~$359,308~~$304,017	~~$357,835~~$302,771
Number of Firms	211,721	210,853	209,988
Average Cost per Firm	***$~~5~~4***	***$~~2~~1***	***$~~2~~1***

8.1.2 Training Provider Paperwork Burden

EPA has also estimated the information collection burden imposed on Training Providers. Similarly to certified firms, accredited Training Providers incur an accreditation and re-accreditation paperwork burden. To comply with the RRP rule, Training Providers must gain accreditation and keep records on both the courses they provide and the students they train. In addition, they must notify EPA before offering each course (to facilitate EPA's enforcement activities) and after each course (so EPA has a record of the individuals who have completed the course).

Burden Associated with Obtaining and Maintaining Accreditation

It is assumed that Training Providers will spend an average of four hours of professional time and two hours of clerical time completing the accreditation statement.[2] It is assumed that accredited Training Providers will spend an average of eight hours familiarizing themselves with the rule. One additional hour of clerical time will be spent on annual recordkeeping. This results in a burden of 15 hours in the first year. Using a loaded wage rate of $38.76 for professional time and $23.54 for clerical time, the average accreditation cost to Training Providers is $536. Additional costs considered include one printout of the accreditation statement, one copy of course records, an envelope, and a stamp. Training Providers applying for re-accreditation will incur an average of four hours of professional time and two hours of clerical time, as well as one hour of recordkeeping time. This is an average of seven hours of burden at a cost of $226. In other years, the Training Providers will only incur the average of one hour of recordkeeping time at a cost of $24.

Burden Associated with Notification Requirements

It is assumed that the pre-notification for each class requires an average of 0.15 hours and that each post-notification requires 1.54 hours. The post notifications are more time consuming because the Training Provider must send records pertaining to each student who attended the course. Approximately 12 percent of courses will also require a re-notification, which is also estimated to take 0.15 hours. This adds up to an average of 1.7 clerical hours per course. The number of courses offered per year depends on the number of individuals who need to be trained. It is assumed that under Option ~~E~~F, Training Providers offer 56 courses in the first year, or a total of 97 hours. It is assumed that each notification requires one photocopy, one envelope, and one stamp; thus approximately two of each are required per-course. Under Option ~~E~~F, the cost of notifications in the first year is approximately $2,~~342~~455 per Training Provider.

[2] Time assumptions are based on information provided in the EPA's (2005) *Supporting Statement for OMB Review under The Paperwork Reduction Act: TSCA Sections 402/404 Training, Certification, Accreditation and Standards for Lead-Based Paint Activities. (EPA ICR No. 1715.06, OMB Control No:2070-0155)*

There will be approximately 19 courses offered per Training Provider in the second year of the rule and will cost ~~a little over $778~~$488. In year three of the rule there will be 19 courses offered per training provider with a total cost of about $~~774~~488.

Total Training Provider Burden

As shown in Table 8-4, training providers who are accredited in the first year the rule is in affect will incur a little ~~less~~more than $2,~~900~~990 of paperwork costs in year one ($536 in accreditation costs and $2,~~342~~455 in notification costs). Total costs for subsequent years of the rule depend on whether or not the Training Provider undergoes accreditation or re-accreditation in that year.

Table 8-4: Costs to Training Providers Associated with Information Collection, Option F

Accreditation Costs						
	First Year/Initial Accreditation Year		**Re- Accreditation Year**		**Other Years**	
Accreditation/Re-Accreditation Activities	**Burden Hours**	**Cost**	**Burden Hours**	**Cost**	**Burden Hours**	**Cost**
Accreditation statement [a]	4	$155.04	4	$155.04		$0
Rule familiarization [a]	8	$310.08		$0		$0
Clerical time statement [a]	2	$47.08	2	$47.08		$0
Recordkeeping [a]	1	$23.54	1	$23.54	1	$23.54
2 photocopies[b]		$0.16		$0.16		$0
1 envelope[c]		$0.02		$0.02		$0
1 stamp[d]		$0.37		$0.37		$0
Total*	15	$536.29	7	$226.21	1	$23.54
Notification Costs						
	Year 1 of the RRP Rule (55 Courses)		**Year 2 of the RRP Rule (40 Courses)**		**Year 3 of the RRP Rule (20 Courses)**	
Notification Activities	**Burden Hours**	**Cost**	**Burden Hours**	**Cost**	**Burden Hours**	**Cost**
Clerical time burden ~~[a]~~	97	$2,286	~~32~~19	$~~759~~457	~~32~~19	$~~756~~458
~~Photocopies[b]~~Photocopies		$10		$~~3~~2		$~~3~~2
~~Envelopes[c]~~Envelopes		$2		$~~1~~0		$~~1~~0
~~Stamps[d]~~Stamps		$44		$~~15~~9		$~~15~~9
~~Total*~~Digital Photos	-	$~~2,342~~112	-	$~~778~~19	-	$~~774~~19
Total		**$2,455**		**$488**		**$488**

* Rounded to nearest dollar.

Sources: [a]Wages: Bureau of Labor Statistics (SOC 47-1011); [b] The average price of a photo copy at Copy Cop, Kinkos, Staples, and Office Max is eight cents; [c]The average cost of a business envelope at Staples, Office Max, and Office Depot [d]U.S. Postal Service

8.2 Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) of 1980, amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996, requires regulators to assess the effects of regulations on small entities including businesses, nonprofit organizations, and governments. In some instances, agencies are also required to examine regulatory alternatives that may reduce adverse economic effects on significantly impacted small entities. The RFA requires agencies to prepare an initial and final regulatory flexibility analysis for each rule unless the Agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. The RFA, however, does not specifically define "a significant economic impact on a substantial number" of small entities. Sections 603 and 604 of the RFA require that regulatory flexibility analyses identify the types, and estimate the numbers, of small entities to which the rule will apply; and describe the rule requirements to which small entities will be subject and any regulatory alternatives, including exemptions and deferral, which would lessen the rule's burden on small entities.

This analysis looks at the impacts of the LRRP rule on small entities in the affected construction, real estate, and child-occupied facility industry sectors. The rule affects small entities that provide childcare for compensation, including private sector firms (e.g. daycare centers and family daycare), small governments (particularly school districts) and non-profit organizations; small construction-related contracting firms that provide RRP services to residences or public and commercial buildings containing COFs; and property managers and lessors who lease residential space or space to COFs and use their own staff to conduct RRP work in their buildings.

The Lead Renovation, Repair, and Painting Rule requires that all entities that perform renovation, repair and painting work for compensation in target housing or public and commercial buildings with COFs become certified by EPA, ensure that their employees are trained as either renovators or workers, and use lead-safe work practices when disturbing more than the exempt amount of lead-based paint.
The impacts on training providers are not analyzed because the rule will result in an increased demand for their services and thus the impacts are positive. Although the rule may also result in additional costs for training providers (i.e. costs of additional recordkeeping and submitting notifications), training providers are expected to recoup these costs via tuition fees. These tuition fees are accounted for elsewhere in the analysis in the estimation of training costs that are incurred by the other entities subject to the rule.

8.2.1 Definitions of Small Entity

The Regulatory Flexibility Act defines a small government as a government of a city, county, town, school district or special district with a population of less than 50,000. A small non-profit organization is defined as any not-for-profit enterprise which is independently owned and operated and is not dominant in its field. The RFA relies on the definition of a "small business" found in the Small Business Act, which authorizes the Small Business Administration (SBA) to develop definitions for "small business." For this analysis, EPA uses SBA's definition of a small business for each industry.

For many industry sectors, the SBA definition of a small business is based on revenues, with the revenue standards varying by industry. In establishing revenue standards, SBA considers a number of economic and market characteristics that may allow a firm to exercise dominance in an industry. These standards represent the maximum revenue that a for-profit enterprise may have, and still qualify as a small business. The following twelve NAICS codes are the general and specialty contractors this rule will likely impact, and their respective SBA threshold. These are followed with two NAICS codes for residential real estate industries, two NAICS codes for nonresidential real estate industries, and one NAICS code for child day care services that are also likely to be affected by the rule.

Table 8-5: SBA Revenue Thresholds for Small Business by NAICS Code		
NAICS	**Industry Description**	**SBA Revenue Threshold (Millions $)**
General and Specialty Contractor Industries		
236118	Residential remodelers	$28.5
236220	Commercial Building Construction	$31
238170	Siding contractors	$12
238350	Finish carpentry contractors	$12
238290	Other building equipment contractors	$12
238390	Other building finishing contractors	$12
238340	Tile and terrazzo contractors	$12
238220	Plumbing and HVAC contractors	$12
238150	Glass and glazing contractors	$12
238320	Painting and wall covering contractors	$12
238210	Electrical contractors	$12
238310	Drywall and insulation contractors	$12
Property Owners and Managers		
531120	Lessors of nonresidential buildings (except miniwarehouses)	$6.5
531312	Nonresidential property managers	$2.0
531311	Residential Property Managers	$1.5
531110	Lessors of Residential Buildings and Dwellings	$6.0
Providers of Day Care Services, Pre-Kindergarten and Kindergarten		
624410	Child day care services	$6.5
Source: U.S. Small Business Administration 2004; U.S. Small Business Administration 2006.		

The RFA classifies small entities as small businesses, small non-profit organizations, or small governments. Property managers and lessors, and construction-related contractors, are all assumed to be for profit operations. All daycare providers operating in individual homes (frequently referred to as family daycare) are assumed to be for-profit operations. Daycare centers can be operated by for-profit or non-profit organizations. Kindergartens and pre-kindergartens refer to facilities in either public schools (governmental) or in private schools (assumed to be non-profits). These classifications are summarized in the following table.

Table 8-6: Small Entity Classifications			
Type of Entity	**Business**	**Non-Profit**	**Governmental**
Day Care Centers	X	X	--
Kindergartens and Pre-Kindergartens in Public Schools	--	--	X
Kindergartens and Pre-Kindergartens in Private Schools	--	X	--
Property Managers and Lessors	X	--	--
Construction-Related Contractors	X	--	--

8.2.2 General Assumptions and Approach

This analysis measures the potential impacts of the Lead Renovation, Repair and Painting (LRRP) Rule on small businesses in terms of annual compliance costs as a percentage of annual revenues[3], or the cost impact ratio. This approach is based on the premise that the cost impact percentage is an appropriate measure of an entity's ability to afford the costs attributable to a regulatory change. For purposes of determining small entity impacts, comparing annual compliance costs to annual revenues provides a reasonable indication of the magnitude of the regulatory burden relative to a commonly available and objective measure of a company's business volume. Where regulatory costs represent a very small fraction of a typical establishment's revenue, the impacts of a regulation are likely to be minimal. This analysis considers eight different groups of entities: public school districts, private schools, daycare centers, family daycare, construction contractors (residential and non-residential), and property lessors and managers (residential and non-residential). The goal of this analysis is to evaluate the impacts of the LRRP Rule on small entities in a typical year. In order to develop a realistic portrayal of the long-term effects of the rule on small entities, annualized costs of the rule, rather than first-year costs, are used to measure its impacts. Furthermore, when presenting the number of businesses affected, the analysis presents the annual average values, rather than first or second year numbers.

The SBA size standards are measured at the firm or parent company level, and conceptually the small entity analysis would also be conducted at that level. Due to data limitations, this small entity analysis is conducted at the establishment level rather than at the firm or parent organization level for most sectors. Census information was available primarily at the establishment level, making an organization-level analysis unfeasible. The only sectors where organization-level data are used are non-residential managers and lessors, and public schools. Because establishments, and not organizations, are analyzed, an assumption is made that none of the small establishments are subsidiaries of larger organizations. This assumption leads to an overestimate of the number of small independent establishments affected by the rule. Furthermore, since organization-level revenues of multi-establishment businesses are higher than establishment revenues, the use of establishment data may result in a higher cost-impact ratio than actually exists.

The cost-impact ratios estimated for the residential and non-residential real estate industries (NAICS 531110, 531311, 531120, 531312) in this small entity analysis are based on employment and revenue data for employer establishments only. It is assumed that the majority of non-residential property lessors and managers are businesses with employees. Further, the analysis assumes that a self-employed lessor or manager is likely to hire a contractor to perform work on his property, particularly in a non-residential building.

This small entity analysis looks at the impacts of the rule on small entities under Option E, and not the ~~preferred option for the~~final rule. (Option F). Options E ~~applies~~and F apply to all renovation work performed for compensation in pre-1978 public or commercial building COFs, target housing rental units, target housing COFs, and target housing units where a child under the age of six or a ~~woman who is or may be~~ pregnant woman resides. The predicted number of events under Option F is the same as under Option E; however, the actual number of events under Option F is expected to be lower than under Option E due to the difference in the definitions of the minor maintenance exception. Further, as Option F requires firm certification and renovator training every five years rather than three years under Option E,

[3] For private schools, where adequate revenue data were not available, costs are compared to annual expenditures.

Option F is predicted to have lower certification and training costs per firm. Because Option E is more costly than Option F, using Option E to calculate small entity impacts will tend to overstate the impacts of the rule.

Costs Incurred by Small Establishments

To estimate the costs incurred by the small entities subject to the requirements of the rule, this analysis calculates the number of people trained, certifications sought, and events performed by each of the small entities in a typical year under Option E.

- **Average Annualized Unit Cost Estimates**

Unit training costs were calculated by annualizing the total 50-year costs of training renovators and workers performing RRP projects in affected target housing and public or commercial buildings under Option E, then dividing this total by the average annual number of renovators and workers trained by these establishments. Similarly, the annualized total cost of maintaining certification and complying with work practice standards under Option E was divided by the average annual number of firms certified and events performed. This single set of average annualized unit costs was used to calculate total costs to small entities working in target housing and public or commercial buildings. The use of annual numbers of firms, individuals and events in calculating average annualized costs takes into account the fact that the pre-1978 housing and building stock is expected to decrease by 0.41 percent per year due to demolition of a portion of the building stock.

The numbers of events, individuals and firms were averaged over the 50 years covered in this analysis using the following formula:

$$\text{Annual Average} = \frac{[A1+(A2*(1-r^n))/(1-r)]}{50}$$

Where:

A1 = First year number of events, individuals or firms

A2 = Second year number of events, individuals or firms

r = (1 – 0.41% demolition rate), or 0.9959

n = 50 years covered by the analysis

Table 8-7 presents these calculations and the resulting average annualized unit costs.

Table 8-7: Average Annualized Unit Cost Calculations			
	Total Annualized 50-Year Cost	**50-year Average Number of Individuals Trained, Entities Certified or Events Performed**	**Average cost per individual, entity, or event**
Option E			
Renovator training	$38,030,816	213,701 individuals trained	$178 per individual
Worker training	$8,720,489	306,069 individuals trained	$28 per individual
Firm certification	$60,833,283	191,784 entities certified	$317 per entity
Work practices[a]	$314,550,953	10,289,972 events performed	$31 per event
Landlord/Contractor Pre-Renovation Education for Events in COFs	$468,212	129,462 events performed	$4 per event
a. Work practice costs include the cost of posting a project-specific sign and pamphlet.			

8.2.3 Residential Contractors and Real Estate Industries

Establishments that perform RRP work in regulated housing will incur the costs of training, certification and using lead-safe work practices during projects that involve lead-based paint. In order to distribute the total costs of the rule between small and large establishments, EPA assumed that the compliance cost incurred by each establishment is a function of the number of regulated renovation events that the establishment performs in a typical year. For each of eleven residential contractor NAICS groups and two residential real estate NAICS groups, EPA calculated the average annualized numbers of small entities seeking certification, workers being trained by small entities, and events being performed by small entities. Using the average annualized unit costs, EPA calculated the average annualized total costs to small entities affected by the rule. The use of annualized costs provides a more accurate representation of the long-term (typical year) impacts of the rule than would be provided by first or second year costs. The following six steps were used to calculate the cost-impact ratios for the target housing contractor and residential real estate industries. To estimate the impacts of the costs of the rule on small entities in the affected industries, the following calculations were performed for each NAICS industry:

1. Certified establishments were classified as either small or large businesses, depending on their revenues. Self-employed contractors were combined with small employer establishments to form one small business category.
2. Census data were used to characterize a "typical" small establishment (including revenues and number of employees) in each of the affected industry sectors.
3. The average number of regulated events performed by an establishment each year was estimated by multiplying the ratio of regulated events to trained personnel by the establishment employment size.
4. An average work practice compliance cost per event[4], certification cost per firm, and training cost per renovator were calculated for Option E using the total annualized 50-year costs to entities working in affected target housing and child-occupied facilities and the 50-year average number of renovation events, renovators trained, and firms certified as a result of the rule.
5. Establishment compliance costs were calculated by multiplying the number of events performed, the number of renovators trained, and the number of firms becoming certified by the average

[4] The work practice cost per event includes the cost to landlords and contractors of complying with the pre-renovation education regulations.

annualized work practice cost per event, training cost per renovator, and certification cost per firm under Option E.

6. Cost-impact ratios were calculated for a typical small establishment in each industry sector by dividing the total compliance costs incurred by the establishment (Step 5) by the establishment's revenues (Step 2).

Number of Small Residential Contractors and Real Estate Entities Affected by the Rule

The data used in this analysis were drawn primarily from the 2002 U.S. Economic Census. As discussed in Chapter 2, Census data were used to estimate the number of non-employer establishments (self-employed contractors) in the affected construction industries (see Table 2-21 in Chapter 2). The 2002 Census also provides data on the number, revenue and employment of establishments with payroll by revenue bracket for each of the eleven construction industry sectors affected by the rule. In Chapter 2, these data were used to classify construction establishments into two main size classes – establishments with annual revenues of less than $10 million, and establishments with annual revenues of $10 million or more. The percent of establishments, employees, net value of construction and total value of business contributed by establishments in each revenue bracket can be found in Table 2-23 of Chapter 2. Because 2002 revenue bracket data for Lessors of Residential Buildings and Dwellings and Residential Property Managers are not yet available, 1997-year data were used to estimate the percent of establishments in these sectors that were small businesses. These percentages, as well as the percent of industry revenues and employment contributed by small and large establishments, are presented in Table 2-17 (Chapter 2).

The Small Business Administration revenue thresholds for establishments in the construction sectors are currently set at $28.5 million for Residential Remodelers and at $12 million for the ten specialty contractor industries. However, in applying the U.S. Economic Census data to the SBA definition of small business, it is not possible to estimate the exact number of construction establishments that have revenues below the SBA threshold because the U.S. Economic Census groups all establishments with revenues of $10 million or more into one revenue bracket. Applying the U.S. Economic Census data therefore requires either under or overestimating the number of small businesses affected by the rule. On the one hand, using data for the entire industry would overestimate the number of small businesses affected by the rule. It would also underestimate the rule's impact on small businesses because the impacts would be calculated using the revenues of large businesses in addition to small businesses. On the other hand, applying the closest, albeit lower, revenue bracket would underestimate the number of small businesses affected by the rule while at the same time overestimating the impacts. For example, because the $10 million cut-off is below the SBA threshold for the Residential Remodeler industry, using the U.S. Economic Census data may lead to an underestimate of the number of small businesses in this sector, although likely a small underestimate.[5] At the same time, using these data may lead to a slight overestimate of the impacts of the rule, as the average revenues of small businesses will appear smaller when larger establishments (those with revenues of $10 to $28.5 million) are left out. Section 8.2.2 already discussed assumptions that may result in an overestimation of the number of affected small businesses. Moreover, using data on all businesses regardless of size would defeat the purpose of estimating impacts on small business. EPA has chosen to be more conservative in estimating the cost

[5] Because 99.7 percent of Residential Remodeler establishments earn less than $10 million per year, any underestimate of the number of establishments is likely to be minimal.

impacts of the rule on small businesses by using the $10 million threshold for construction industry sectors.

As with the Residential Remodelers and the ten specialty contractor industries discussed above, it is not possible to estimate the exact number of small Residential Property Manager establishments or Lessor of Residential Buildings and Dwellings establishments, because Census-defined revenue brackets group establishments with revenues of $1 million to $5 million and $5 million to $10 million, respectively. For the same reasons set forth above (the Agency had the choice to either overestimate or underestimate the impacts), the Agency has chosen to overestimate the impacts. Thus, EPA has applied the U.S. Economic Census data for establishments with revenues of less than $1 million to Residential Property Managers, and the U.S. Census Economic data for establishments with revenues of less than $5 million to Lessor of Residential Buildings.[6]

In order to estimate the number of certified small establishments with paid employees, EPA assumed that the number of certified small employers is proportional to the total number of small employer establishments in the industry. The total number of certified establishments in each industry (calculated in Chapter 4) was multiplied by the percentage of establishments in that industry that have revenues below the revenue thresholds described above. For the eleven residential construction industry sectors, the resulting number of small employer establishments was added to the total number of certified self-employed contractors to obtain the total number of small certified establishments.

Table 8-8 shows the 50-year average number of small businesses affected by the regulations. The number of affected businesses is expected to decrease proportionally to the number of regulated events, which in turn decline at an annual rate of 0.41 percent (see Chapter 4 for discussion).

Table 8-8: 50-Year Average Number of Small Residential Contractors and Real Estate Establishments Affected, Option E	
Non-Employer Establishments [a]	55,096
Employer Establishments	96,422
Total Small Establishments	**151,517**
a. Also referred to as "self-employed" individuals.	
Source: EPA Calculations	

Training and Certification Costs – Residential Contractors and Real Estate

- **Number of Individuals Trained – Residential Contractors and Real Estate**

In order to estimate the employment size of an average small establishment in each affected industry, EPA used U.S. Economic Census data to determine the portion of each industry's employees that work for small businesses. This percentage was applied to the estimated number of trained supervisors and workers in each sector to calculate the number of trained supervisors and workers employed by small certified establishments. For each of the construction industry sectors, the total number of employees

[6] Approximately 85 percent of Residential Property Manager establishments earn less than $1 million per year, and about 99 percent of Lessor of Residential Buildings and Dwellings establishments earn less than $5 million per year.

(including non-employers[7] who are trained as supervisors) was divided by the total number of small establishments to calculate an average small business employment size.

Table 8-9 presents the percent of the workforce employed by small establishments[8] and the estimated 50-year average numbers of trained professionals working for small certified establishments in each industry under Option E.

Table 8-9: 50-Year Average Number of Professionals Trained by Small Residential Contractors and Real Estate Establishments, Option E

NAICS	Description	% Workforce employed by Small Employers [a,b]	Number of Trained Employees, Small Estab. [c]	Average Small Estab. Number of Trained Employees [d]
236118	Residential remodelers	95%	38,061	0.9
238170	Siding contractors	90%	4,710	1.6
238350	Finish carpentry contractors	86%	19,224	0.7
238290	Other building equipment contractors	60%	6,221	4.6
238390	Other building finishing contractors	81%	3,126	1.7
238340	Tile and terrazzo contractors	91%	3,912	0.9
238220	Plumbing and HVAC contractors	70%	46,519	3.3
238150	Glass and glazing contractors	82%	2,517	2.0
238320	Painting and wall covering contractors	92%	14,563	0.9
238210	Electrical contractors	68%	32,681	3.3
238310	Drywall and insulation contractors	64%	12,104	1.8
Total, Small Construction Establishments			**183,639**	**1.4**
531311	Residential Property Managers	40%	39,386	6.8
531110	Lessors of Residential Real Estate	86%	84,590	5.3
Total, All Industries			**307,614**	**2.0**

a. EPA applied U.S. Economic Census data regarding: entities with less than $10 million in revenues to establishments in the 11 construction sectors; entities with less than $1 million in revenues to Residential Property Manager establishments; and entities with less than $5 million in revenues to Lessors of Residential Real Estate.
b. Percentages shown for presentation purposes only. Calculations used unrounded ratio of small establishment data to industry data.
c. Total number of trained employees working for small construction establishments is the sum of trained personnel working for small employers and the total number of certified self-employed contractors.
d. For construction industry sectors calculated by dividing the total number of trained employees of small establishments by the sum of certified small employer establishments and certified self-employed contractors.

Source: U.S. Census Bureau 2000d; U.S. Census Bureau 2004; U.S. Census Bureau 2005 b-e,g,h; U.S. Small Business Administration 2005.

- **Total Certification and Training Costs to Small Residential Contractor and Real Estate Establishments**

[7] Also referred to as "self-employed" individuals.
[8] See Section 2.5.1 of Chapter 2 for discussion of these percentages.

To estimate small residential contractor and real estate establishment training and certification costs, the numbers of individuals and firms in Table 8-8 and Table 8-9 were multiplied by the average annualized costs of training a single certified renovator and worker, and maintaining certification from Table 8-7. The resulting average annualized training and certification costs are presented in Table 8-10.

Table 8-10: Average Annualized Training and Certification Costs for Small Residential Contractors and Real Estate Establishments, Option E

Regulatory Option	Certified Renovator Training Cost[a]	Worker Training Cost[a]	Certification Cost[a]	Total Training/ Certification Cost[a]	Average Training and Certification Cost/ Establishment
Option E	$21,944,379	$5,251,214	$48,060,870	$75,256,464	$497
a. Total costs are calculated using unrounded unit costs.					

Work Practice Costs – Small Residential Contractors and Real Estate Establishments

- **Number of Events Performed Annually by Small Residential Contractor and Real Estate Establishments**

As discussed in Section 8.2.2 and the beginning of this section, this analysis attributes the work practice costs of the rule to establishments on a per-event basis. In order to estimate the total number of events performed by establishments in each of the affected industries, and in order to distribute these events between small and large establishments, EPA assumed that the number of events performed by each establishment is proportional to the number of people the establishment employs. Furthermore, EPA assumed that the number of events performed by each trained employee will be the same across all industries, including Residential Property Managers and Lessors of Residential Buildings and Dwellings. If property managers and lessors perform fewer events than estimated here, the impacts on these establishments will be slightly smaller, and the impacts on construction firms will be larger.
The number of events per small establishment in a particular industry was calculated as follows:

Number of Events = (Events/Employee) X (Establishment Employment Size)

EPA estimated the 50-year average number of events per certified renovator or worker by calculating the ratio of the total number of regulated RRP events to the total number of trained personnel (using the 50-year averages). Because the number of people trained, as estimated in Chapter 4, was assumed to be proportional to the regulated housing stock and the number of regulated events, the number of RRP events per employee does not change over time and is approximately the same across options.
To estimate the average number of events performed by a small establishment in a given industry, the establishment's average employment size was multiplied by the average number of events per person. Table 8-11 presents the 50-year average estimated number of events per small establishment.

Table 8-11: 50-Year Average Annual Number of Events performed by Small Residential Contractors and Real Estate Establishments, by Option				
Regulatory Option	**Average Small Employment Size**	**Average Number of Annual Events Per Employee**	**Total Number of Small Establishments**	**Total Annual Number of Events Per Small Establishment**
Option E	2.0	23.1	151,517	46.8

❖ Total Work Practice Compliance Costs – Residential Contractors and Real Estate

Table 8-7 presents the annualized average per event work practice costs of the rule, which include the cost of using lead-safe work practices and complying with the pre-renovation education requirements. On average, establishments have approximately two employees performing 23.1 annual events each. Multiplying the average cost by the 50-year average annual number of events performed by small residential contractors and real estate establishments, or approximately 47 events per establishment (the beginning of Section 8.2.3 describes the calculation of this number), yields the total annualized work practice costs. These costs are presented in Table 8-12.

Table 8-12: Average Annualized Work Practice Costs for Small Residential Contractors and Real Estate Establishments				
Regulatory Option	**Total 50-Year Average Events**	**Annualized Average WPC per Event[b]**	**Total Work Practice Costs[a]**	**Average Work Practice Costs per Small Establishment**
Option E	7,092,266	$34	$238,264,828	$1,573
a. Total costs are calculated using unrounded unit costs.				
b. Includes the cost of using lead-safe work practices and complying with the pre-renovation education requirements.				

Residential Contractors and Real Estate Industry Revenues

Cost-impact ratio analysis compares the cost of a regulation to a firm's (in this case, establishment's) total revenues, not just to its revenues from the regulated activity. As such, for construction establishments, the costs of the rule were compared to the total value of business done, rather than just to the total value of construction work. For real estate establishments, total revenues were used. Because no data are available specifically for establishments expected to seek certification under the regulations, EPA assumed that average revenues of these businesses do not differ significantly from industry averages. EPA calculated the revenues of a small certified construction business as a weighted average of small employer and non-employer revenues. The 2002 U.S. Economic Census presents data on the number of and total value of business done by construction establishments with total annual revenues of $0 to $10 million and $10 million or more. To estimate the average revenues of small employers in each of the affected construction sectors, the total value of business done by establishments in the $0 to $10 million bracket was divided by the total number of establishments in that bracket. Since the Census presents revenue figures in year 2002 dollars, the resulting average revenues were inflated to 2005 dollars using the Consumer Price Index.[9] Per-establishment revenues for non-employers were estimated for the cost impact ratio analysis by dividing non-employer revenues (inflated to 2005 dollars) by the number of non-employer establishments in each industry. Average revenues of certified small establishments are presented in Table 8-13. Because the 2002 U.S. Economic Census does not yet provide data by revenue bracket for Residential Property Manager and the Lessor of Residential Buildings and Dwellings sectors, EPA used data from the 1997 Economic Census to estimate the percent of establishments in each industry that qualify for small business status. EPA used 1997 Census data to calculate the percent of industry revenues contributed by these establishments. These percentages were then applied to the 2002 numbers of establishments and industry revenue figures to estimate the number and revenues of small and large employers in each industry. Average small and large employer revenues (calculated by dividing the revenues of establishments in each industry and revenue bracket by the corresponding number of establishments) were inflated to 2005 dollars using the Consumer Price Index.[10] The resulting estimates are presented in Table 8-13.

Table 8-13: Average Revenues of Small Businesses Affected by the LRRP Rule

NAICS	Industry Description	Small Business Revenues (2005$)
236118	Residential remodelers	$182,932
238170	Siding contractors	$201,569
238350	Finish carpentry contractors	$100,713
238290	Other building equipment contractors	$585,771
238390	Other building finishing contractors	$231,442
238340	Tile and terrazzo contractors	$130,097
238220	Plumbing and HVAC contractors	$432,677
238150	Glass and glazing contractors	$336,896
238320	Painting and wall covering contractors	$86,839
238210	Electrical contractors	$351,694
238310	Drywall and insulation contractors	$240,488
Total	**Average, Construction Establishments**	**$217,546**
531311	Residential Property Managers	$342,477
531110	Lessors of Residential Real Estate	$821,350
Total	**Average, All Industries**	**$289,530**

Weighted average of employer and non-employer revenues.
Source: EPA Calculations; U.S. Census Bureau 2005b,d,e; U.S. Small Business Administration 2005; U.S. Census Bureau 2004; U.S. Census Bureau 2000d.

Impacts on Small Residential Contractors and Real Estate Establishments

Impacts of the rule on small residential contractors and real estate industries are measured by comparing the costs of the rule incurred by an establishment to the establishment's revenues. The impacts on small residential contractors and real estate establishments were estimated by summing the total annualized work practice, training and certification costs incurred by these entities under Option E and dividing these

[9] All items, US city average, Series Id: CUUR0000SA0. Used annual data for 2002 and half-year data for 2005.
[10] All items, US city average. Series Id: CUUR0000SA0.

total costs by the number of establishments. Average costs per establishment were then divided by average expenditures to calculate a cost-to-expenditure ratio. These calculations, and the resulting cost-to-revenue ratios, are presented in Table 8-14.

Table 8-14: Cost-to-Revenue Ratios for Small Residential Contractors and Real Estate Industries

Regulatory Option	Total Regulated Small Entities	Total Cost of Rule to Small Entities	Average Cost of Rule per Small Entity	Estimated Average Small Entity Revenues	Cost-to-Revenue Ratio
Option E	151,517	$313,521,291	$2,069	$288,374	0.72%

8.2.4 Non-Residential Contractors

Jobs that are not performed in-house by public and private schools, non-residential property managers/lessors, and daycare centers will be performed by general and specialty contractors, including painters, electricians, plumbers/HVAC specialists, and non-residential building contractors. Under Option E, 3,223 establishments are expected to become certified in the first year as a result of the newly regulated projects in public or commercial buildings. Because different contractors are generally expected to work in public or commercial buildings and target housing, this analysis considers impacts on these groups of establishments separately.

This analysis assumes that only contractors with employees will work on COFs in public or commercial buildings.[11] Furthermore, the types of jobs performed in public or commercial buildings are less varied; these events are assumed to consist primarily of painting, window/door replacement, and plumbing and electrical projects. As such, it is likely that only painting, plumbing/HVAC, electrical and commercial contractors (NAICS 236320, 238210, 238320 and 236220, respectively), will work on most of these projects.

Number of Small Non-Residential Contractors Affected by the Rule

To estimate the number of construction establishments working in public or commercial building COFs, the percentage of newly trained workers and supervisors that those establishments employ, the number of jobs they perform, and their average revenues, this analysis makes the following assumptions:

1. The analysis assumes that the number of additional contractors getting trained and certified in each sector is proportional to the number of jobs likely to be performed by each type of contractor. For example, since painting jobs are estimated to make up 5 percent of all jobs performed by contractors in public or commercial building COFs, 5 percent of the 3,223 contractor establishments estimated to become certified are assumed to be painting contractors. Table 8-15 presents the distribution of jobs by job type, describes the assumptions made to assign these jobs to each type of contractor, and presents estimates of the number of contractor establishments seeking training and certification in the first year under Option E.

[11] In contrast, the analysis of target housing contractors assumes that both employer and non-employer (i.e., self-employed) contractors will work on COFs in target housing.

Table 8-15: Estimated Number of Non-Residential Contractors by NAICS Sector				
Type of Event	**Type of Contractor performing Event**	**Number of Events**	**Percent of all Contractor Events**	**Estimated first-year number of contractors**
Painting	NAICS 238320 - Painting Contractors	13,448	4.8%	155
Window/ Door	NAICS 236220 - Commercial Building Contractors	6,943	2.5%	80
Unscheduled maintenance (Non-plumbing/ electrical)[a]	NAICS 236220 - Commercial Building Contractors	2,192	0.8%	25
Plumbing (Routine and unscheduled)[b]	NAICS 238210 - Plumbing/HVAC contractors	128,926	46.0%	1,482
Electrical (Routine and unscheduled)[b]	NAICS 238220 - Electrical Contractors	128,926	46.0%	1,482
Total Jobs		**280,434**		3,223

a. The majority of unscheduled maintenance events are expected to be plumbing or electrical events, which must be performed by a specialized contractor. It is assumed, however, that every other year, one of the unscheduled maintenance events in each building will be a painting or window/door project (for example, a soccer ball may break a window that will then need to be replaced).
b. To simplify the analysis, it is assumed that half of the scheduled plumbing and electrical projects and all other unscheduled maintenance projects will be performed by plumbers, and the other half by electricians.

2. The analysis assumes that these newly certified contractors will only perform projects in public or commercial building COFs. In reality, however, these additional contractors may perform some residential work and some commercial work, while contractors with employees that were included in the residential contractor section of this analysis may also do some of the non-residential COF work. As such, to define the size and revenues of the average small firm working in public or commercial building COFs, the number of certified non-residential contractors with employees were added to the pool of already certified small employer establishments in their corresponding sectors to calculate the weighted average percent of establishments below SBA's revenue threshold, the percent of workers employed (and thus jobs performed) by these establishments, and average establishment revenues. The percent of small establishments in each sector, percent of workers employed by these establishments, and percent

of total value of business earned by these establishments were calculated using 2002 Economic Census data (U.S. Census Bureau 2005a). Average revenues of small establishments were estimated by dividing the total value of business earned by establishments with revenues below $10 million in each sector by the total number of establishments with revenues below $10 million in that sector. The results of these calculations are presented for Option E in Table 8-16. Note that because only establishments with employees are assumed to work in public or commercial building COFs, average revenues of small establishments in Table 8-16 are higher than the average revenues of residential construction establishments, which include self-employed contractors.

Table 8-16: Estimated Numbers and Characteristics of Small Non-Residential Contractors

NAICS Contractor Description	Estab., Residential	Estab., Non-Residential	Est., Total	Percent Small	Number Small	Percent Workers at Small Estab.	Average Revenues of Small Estab.
238220 - Plumbing/ HVAC	6,306	1,482	7,788	97.9%	7,621	70.1%	$850,881
238210 - Electrical contractors	3,842	1,482	5,324	97.9%	5,213	67.9%	$809,692
236220 - Commercial building contractors	0	105	105	88.1%	93	41.4%	$1,750,332
238320 - Painting/ wall covering	2,599	155	2,753	99.7%	2,746	91.5%	$380,165
Total/ Weighted Avg. Small Non-Residential Contractor Firm	**12,747**	**3,223**	**15,970**	**98.1%**	**15,672**	**69.2%**	**$760,023**

Training and Certification Costs – Non-Residential Contractors

- **Number of Individuals Trained – Non-Residential Contractors**

On average, 98 percent of the 3,223 non-residential construction contractor establishments certified in the first year as a result of the LRRP Rule under Option E are small businesses. Since the number of jobs performed by an establishment is proportional to the number of people that establishment employs, these small businesses are expected to perform 69 percent of the non-residential COF contractor jobs, and employ 69 percent of the non-residential contractor staff trained as a result of the rule. Table 8-17 presents the total numbers of small contractor establishments certified, as well as the number of small establishment employees trained as workers and renovators in the first year under Option E.

Table 8-17: First year Number of Small Non-Residential Contractor Establishments, Employees, and Jobs Performed

	Total, non-residential COF contractor				Small, non-residential COF contractor			
	Estab	Renovators	Workers	Events	Estab	Renovators	Workers	Jobs
Option E	3,223	3,672	5,488	280,434	3,163	2,539	3,796	193,957

Since the number of firms certified and individuals trained is expected to decrease proportionally to the size of the regulated housing stock, to portray the impacts of the rule on small businesses in a typical year, this analysis estimated the 50-year average numbers of certified firms, trained workers and supervisors, and regulated events. These numbers are presented in Table 8-18.

Table 8-18: 50-Year Average Annual Number of Small Trained Non-Residential Contractor Staff and Certified Establishments				
Regulatory Option	**Number of Certified Renovators Trained**	**Number of Workers Trained**	**Number of Firm Certifications Sought**	**Number of Jobs Performed**
Option E	2,300	3,438	2,865	175,693

❖ **Total Training and Certification Costs**

To estimate contractor training and certification costs, the numbers of small establishments and employees trained by these establishments (Table 8-18) were multiplied by the average annualized costs of training a certified renovator and worker, and maintaining certification from Table 8-7. The resultant average annualized training and certification costs are presented in Table 8-19.

Table 8-19: 50-Year Average Annualized Training and Certification Costs for Small Non-Residential Contractors					
Regulatory Option	**Renovator Training Cost[a]**	**Worker Training Cost[a]**	**Establishment Certification Cost[a]**	**Total Training/ Certification Cost[a]**	**Average Training and Certification Cost/ Estab.**
Option E	$409,371	$97,961	$908,758	$1,416,089	$494
a. Total costs are calculated using unrounded unit costs.					

Total Work Practice Compliance Costs – Non-Residential Contractors

To estimate work practice costs incurred by small non-residential construction establishments working in public or commercial buildings housing COFs, the 50-Year average annual number of events performed by these establishments (approximately 61 per firm) was multiplied by the sum of average annualized work practice and contractor pre-renovation education costs per event ($34; see Table 8-7). Table 8-20 presents the resulting annualized total and average work practice costs to small non-residential construction establishments.

Table 8-20: Average Annualized Work Practice Costs for Non-Residential Contractors				
Regulatory Option	**Average Annual Events Performed**	**Annualized Average WPC per event**	**Total Work Practice Costs[a]**	**Average Work Practice Costs per Small Establishment**
Option E	175,693	$34	$6,006,106	$2,096
a. Total costs are calculated using unrounded unit costs.				

Impacts of the Rule on Non-Residential Contractors

Impacts of the rule on small non-residential contractors are measured by comparing the costs of the rule incurred by an establishment to the establishment's revenues. The impacts on small non-residential contractors were estimated by summing the total annualized work practice, training and certification costs incurred by these entities under Option E and dividing these total costs by the number of establishments. Average costs per establishment were then divided by average expenditures to calculate a cost-to-expenditure ratio. These calculations, and the resulting cost-to-revenue ratios, are presented in Table 8-21.

Table 8-21: Cost-to-Revenue Ratios for Non-Residential Contractors

Regulatory Option	Total Small Contractor Establishments	Total Cost of Rules to Small Contractor Establishments	Average Cost of Rule per Small Contractor Establishments	Average Small Contractor Establishment Revenues	Cost-to-Revenue Ratio
Option E	2,865	$7,422,196	$2,591	$760,023	0.34%

8.2.5 Non-Residential Property Lessors and Managers

Lessors and managers of pre-1978 public or commercial (non-residential) buildings that rent space to daycare centers and perform regulated projects on their own properties will incur work practice, training, and certification costs under the rule. As discussed in Chapter 4, this analysis estimates that 13,279[12] daycare centers will rent space in pre-1978 non-residential buildings in the first year. On average (over 50 years), 12,028 daycare centers are expected to rent space in pre-1978 buildings each year under Option E. Because daycare centers are only one of many types of establishments renting non-residential space, and because the LRRP Rule applies only to centers in buildings constructed prior to 1978, the analysis also assumes that each property manager or lessor firm owns only one non-residential building containing a COF. As such, the number of affected lessor/manager firms is equivalent to the number of affected daycare centers renting space, or 12,028 under Option E. Due to the lack of data on the extent to which these firms perform renovation work in their own buildings, this analysis assumes that they will behave similarly to the operators of other public or commercial buildings with child-occupied facilities, namely that they will perform all of their own painting and window/door carpentry projects, as well as an average of one unscheduled maintenance project per building every year.

Number of Non-Residential Property Lessors and Managers Affected by the Rule

Lessors and managers of non-residential properties fall under NAICS 531120 and 531312, respectively. In order to estimate the number of regulated firms in each of these sectors, it is assumed that the percent of regulated firms in each industry is equivalent to the total percent of firms in that industry. In other words, since Lessors of Non-Residential Buildings (NAICS 531120) make up 73 percent of establishments in NACIS 531120 and 531312 combined, 73 percent of the 12,028 lessor/manager firms affected by the rule under Option E are also assumed to fall in this sector, while the remaining 27 percent are assumed to fall under NAICS 531312 (Calculated based on U.S. Census Bureau 2005f).

[12] This number reflects a compliance rate of 75 percent.

As discussed Section 2.4.2 of Chapter 2, 96 percent of Lessors of Non-Residential Real Estate, and 81 percent of Non-Residential Property Managers qualify for small business status under the SBA definition of a small business in these sectors (U.S. Census Bureau 2005f). This analysis assumes that the size distribution of regulated firms mirrors the size distribution of the entire non-residential property lessor and manager industry. Table 8-22 presents the resulting estimates of the number of small non-residential property lessors and managers affected by the rule under Option E in a typical year.

Table 8-22: Average Annual Number of Small Non-Residential Property Lessors and Managers	
	Option E
A. Total number of firms leasing to daycare centers	12,028
B. Number of firms in NAICS 531120 (73% of A)	8,782
C. Number of firms in NAICS 531312 (27% of A)	3,246
D. Number of firms in NAICS 531120 that are small (96% of B)	8,417
E. Number of firms in NAICS 531312 that are small (81% of C)	2,639
Total Number of Regulated Small Firms (D+E)	**11,056**
Regulated Small Firms as % of All Regulated Firms	**92%**

Training and Certification Costs – Non-Residential Property Lessors and Managers

- **Number of Individuals Trained - Non-Residential Property Lessors and Managers**

Since non-residential property lessors and managers are estimated to own only one regulated building each, they are expected to typically train one staff member as a certified renovator and another as a worker. Each firm will also need to obtain certification from EPA. The number of people trained as renovators and workers and the number of certifications sought by small lessor and manager firms will thus equal the total number of small firms that rent space to daycare centers (Table 8-23).

Table 8-23: Average Annual Numbers of Trained Small Non-Residential Property Lessor/ Manager Staff and Certified Firms			
Regulatory Option	**Number of Certified Renovators Trained**	**Number of Workers Trained**	**Number of Certifications Sought**
Option E	11,056	11,056	11,056

- **Total Training and Certification Costs – Non-Residential Property Lessors and Managers**

To estimate daycare center training and certification costs, the numbers of individuals and firms in Table 8-23 were multiplied by the average annualized costs of training a single certified renovator and worker, and maintaining certification from Table 8-7. The resulting average annualized training and certification costs are presented in Table 8-24.

Table 8-24: Average Annualized Training and Certification Costs for Small Non-Residential Lessor/Manager Firms

Regulatory Option	Renovator Training Cost[a]	Worker Training Cost[a]	Firm Certification Cost[a]	Total Training/ Certification Cost[a]	Average Training and Certification Cost/ Firm
Option E	$1,929,628	$315,009	$3,507,564	$5,752,201	$520
a. Total costs are calculated using unrounded unit costs.					

Work Practice Costs – Non-Residential Property Lessors and Managers

The estimation of work practice costs incurred by each property lessor or manager is based on the average number of events per-building and the average work practice costs per event.

- **Total Work Practice Compliance Costs – Non-Residential Property Lessors and Managers**

The annual number of events performed by each of these firms is estimated to be 0.71 events per year (See Section 4.4). This average number of events was multiplied by the 50-year average number of small lessor/manager firms to estimate the number of regulated projects performed by these businesses in a typical year. The total number of regulated events, in turn, was multiplied by the sum of annualized work practice costs and pre-renovation education costs per event (see Table 8-7) to calculate these firms' total annualized work practice costs. Table 8-25 presents these calculations, as well as the average work practice costs per small firm.

Table 8-25: Work Practice Costs of Non-Residential Property Lessors and Managers				
Regulatory Option	**Total In-House Events**	**Annualized Average WPC per event**	**Total Work Practice Costs[a]**	**Average Work Practice Costs per Small Firm**
Option E	7,895	$34	$267,747	$24
a. Total costs are calculated using unrounded unit costs.				

Impacts of the Rule on Non-Residential Property Lessors and Managers

This small entity analysis measures the impacts of the rule on small non-residential property lessors and managers by comparing rule costs incurred by these firms to the weighted average revenue of small firms in NAICS 531120 and 531312, calculated based on 2002 Census Data. The weighted average revenue figure of $111,460 was inflated to 2005 dollars using the Consumer Price Index to obtain estimated revenues of $126,256. The impacts on small non-residential property lessors and managers were estimated by summing the total annualized work practice, training and certification costs incurred by these entities under Option E and dividing these total costs by the number of establishments. Average costs per establishment were then divided by average expenditures to calculate a cost-to-expenditure ratio. The average annual numbers of businesses affected, average annualized per-business costs and revenues, and the resulting cost-to-revenue ratio are presented in Table 8-26.

Table 8-26: Cost-to-Revenue Ratios for Non-Residential Property Managers and Lessors					
Regulatory Option	**Total Small Lessor/ Manager Firms**	**Total Cost of Rules to Small Lessor/ Manager**	**Average Cost of Rule per Small Lessor/ Manager**	**Average Small Lessor/ Manager Firm Revenues**	**Cost-to-Revenue Ratio**

		Firms	Firm		
Option E	11,056	$6,019,948	$544	$126,256	0.43%

8.2.6 Daycare Centers (Small Non-Profits)

Number of Small, Non-Profit Daycare Centers Affected by the Rule

As discussed in Chapter 2, there are an estimated 87,840 daycare centers in the United States. These daycare centers include facilities that provide day care outside of a residential home, and outside of schools. Assuming a 75% compliance rate, and adjusting the total number of centers for building age using HUD data on the age of education buildings, an estimated 38,210 daycare centers will be affected by the LRRP Rule in the first year under Option E, respectively.[13] As discussed in Chapter 4, because of their locations, for-profit daycare centers are expected to hire outside contractors to perform their renovations and repairs, or to have their landlord handle these activities. The costs and impacts for these events are accounted for in the sections of this chapter dealing with contractors and landlords.

On the other hand, daycare centers located in religious establishments such as churches or synagogues frequently use their own staff to perform some of their RRP events. According to the HUD survey of child care centers (HUD 2003), approximately 73 percent of daycare centers located in churches and other religious establishments use their own (or the religious organization's) staff to perform painting projects. This analysis assumes that, similar to public school districts and private schools, these establishments will also use their own staff to perform all window/door carpentry work, as well as one unscheduled maintenance project every year.

The number of daycare centers located in religious establishments was estimated with data from the HUD survey of child care centers (HUD 2003). According to these data, 41 percent of all daycare centers are situated in churches or other similar organizations. (In contrast, the US Census reports that about 35 percent of daycare centers located outside of schools are non-profits (U.S. Census Bureau 2005c).) The other 59 percent of daycare centers are assumed to use outside contractors for their RRP work, rather than in-house staff. Because the estimate of centers that are in religious settings is relatively large, and there is no independent data on other non-profits, this analysis estimates that about 30 percent of daycare centers (0.73*0.41=.299) will perform their own renovation work and thus incur direct work practice, training, and certification costs.[14] Because all of these establishments are treated as though they are operated by religious organizations, all daycare centers considered in the small entity analysis are considered to be non-profit organizations. All the non-profit organizations operating these day care centers are assumed to qualify as small entities. This assumption may overestimate the number of impacted small non-profits, since some of these non-profit organizations may not be small entities.

---

[13] Based on 2003 HUD data, 58 percent of all education buildings were constructed before 1978, and 55 percent of the pre-1978 buildings were constructed before 1960.

[14] Given the small size of the HUD survey sample, and the difference between the HUD and Census figures, the estimate may include some non-profits operating daycare facilities that are not in religious settings but perform their own repair work. Other non-profit daycare facilities may be hiring outside contractors, the same as for-profit daycare facilities are assumed to do.

Table 8-27 presents the number of daycare centers regulated under Option E in a typical year, the total number of daycare centers operated by non-profit organizations (based on the number in religious organizations), and the number expected to perform some renovation work in-house. The use of annual average numbers accounts for the fact that, after the first year, the number of regulated daycare centers is expected to decrease by 0.41 percent per year due to building demolition.

Table 8-27: Average Annual Number of Non-Profit Daycare Centers Performing their Own Work			
Regulatory Option	**(A) Total Number of Daycare Centers**	**(B) Number of Centers in Non-Profit Organizations (41% of A)**	**(C) Number of Centers Doing RRP Work In-house (73% of B)**
Option E	34,612	14,339	10,481

Training and Certification Costs – Non-Profit Daycare Centers

- **Number of Individuals Trained and Entities Seeking Certification – Non-Profit Daycare Centers**

Because non-profit daycare centers are generally smaller than private schools, they are expected to typically train only one of their staff to perform regulated RRP projects. Since under the rule, each organization performing regulated work must have a certified renovator, this staff member will be trained as a renovator, rather than worker. Daycare centers are not expected to train any additional workers, but each center will need to obtain firm certification. The number of people trained as renovators and the number of certifications sought by daycare centers will thus equal the number of daycare centers in religious organizations that perform their own work (Table 8-28).

Table 8-28: Average Annual Number of Trained Non-Profit Daycare Center Staff and Certified Centers			
Regulatory Option	**Number of Certified Renovators Trained**	**Number of Workers Trained**	**Number of Certifications Sought**
Option E	10,481	0	10,481

- **Total Training and Certification Costs – Non-Profit Daycare Centers**

To estimate daycare center training and certification costs, the numbers of individuals and firms in Table 8-28 were multiplied by the average annualized costs of training a single certified renovator, and maintaining certification from Table 8-7. The resulting average annualized training and certification costs are presented in Table 8-29.

Table 8-29: Average Annualized Training and Certification Costs for Non-Profit Daycare Centers					
Regulatory Option	**Renovator Training Cost[a]**	**Worker Training Cost**	**Center Certification Cost[a]**	**Total Training/ Certification Cost[a]**	**Average Training and Certification Cost/ Center**
Option E	$1,865,311	$0	$3,325,260	$5,190,571	$495
a. Total costs are calculated using unrounded unit costs.					

Work Practice Costs – Non-Profit Daycare Centers

The estimation of work practice costs incurred by each daycare center is based on the average number of events per-building performed in-house, and the average work practice costs per event.

- **Total Work Practice Compliance Costs – Non-Profit Daycare Centers**

As discussed in Section 4.4 of Chapter 4, staff in non-profit daycare centers (such as those operated by religious establishments) are expected to perform all painting and window/door carpentry work in their building, as well as one unscheduled maintenance event every year, in-house. Center staff are expected to perform 0.71 events per year in-house.

As discussed in Section 0, the average annualized work practice cost per event in COFs in public and commercial buildings is $30 under Option E (see Table 8-7).[15] Multiplying this average cost by the total 50-year average annual number of events in daycare centers that perform their own work yields the total annualized work practice costs incurred by these centers in an average year. The total annual number of events is the product of 0.71 and the number of centers doing in-house RRP work from Table 8-27. These costs, and average per-center work practice costs, are presented in Table 8-30.

Table 8-30: 50-Year Average Annualized Work Practice Costs for Non-Profit Daycare Centers

Regulatory Option	Total In-House Events	Annualized Average WPC per event	Total Work Practice Costs[a]	Average Work Practice Costs per Small Center
Option E	7,484	$30	$226,764	$22
a. Total costs are calculated using unrounded unit costs.				

Non-Profit Daycare Center Expenditures

The small entity analysis measures impacts on small non-profit establishments in terms of the ratio of rule costs to annual operating expenses. In analyzing impacts of the rule on an entity, the analysis conceptually should compare rule costs to the revenues or expenditures of an entire organization. As such, costs of the rule to non-profit daycare centers should be compared to the expenditures of the parent organization (such as the religious organization that operates them), rather than a single center. Due to a lack of data both on the structure of these organizations and on their finances, such a comparison was not possible. Furthermore, data on daycare center expenditures was not available. Since in non-profit establishments, revenues should be approximately equal to expenditures, this analysis used daycare center revenues as a proxy for expenditures. Ten state childcare industry impact studies were reviewed to obtain daycare center revenue data.[16] Nine of these studies did not differentiate between revenues of non-profit and for-profit centers. The Virginia *Economic Impact of the Child Care Industry* report (Voices of Virginia's Children 2004), however, provided revenue data specific to religiously affiliated daycare centers. The state reported annual total revenues of $236 million for its 929 religious daycare facilities, or average revenues (inflated to 2005$) of $287,605 (U.S. Bureau of Labor Statistics 2006). In the absence of daycare center expenditure data, this figure was used to measure the impacts of the rule on non-profit centers.

[15] The pre-renovation compliance cost of $4 only applies to landlords and contractors. Because these non-profit daycare centers are performing the work using in-house staff, there is no pre-renovation education compliance cost.
[16] Data were available for the following states: Oklahoma, New Jersey, Iowa, Hawaii, Ohio, Kansas, South

Impacts on Non-Profit Daycare Centers

The impacts on non-profit daycare centers were estimated by summing the total annualized work practice, training and certification costs incurred by these entities under Option E and dividing these total costs by the number of centers. Average costs per center were then divided by average expenditures to calculate a cost-to-expenditure ratio. These calculations and the resulting ratios are presented in Table 8-31.

Table 8-31: Cost-to-Expenditure Ratios for Non-Profit Daycare Centers

Regulatory Option	Total Daycare Centers Doing Work	Total Cost of Rule to Daycare Centers	Average Cost of Rule per Daycare Center	Estimated Average Daycare Center Expenditures	Cost-to-Expenditure Ratio
Option E	10,481	$5,417,334	$517	$287,605	0.18%

8.2.7 Public Schools (Small Governments)

The RFA defines a small government jurisdiction as the government of a city, county, town, school district or special district with a population of less than 50,000. This economic analysis relies on National Center for Education Statistics (NCES) Common Core of Data (CCD) survey data to estimate the number of school districts that have schools with pre-kindergarten or kindergarten programs, the number of such schools per district, and district revenues.[17] Furthermore, for most districts, a cross-reference system with the 2000 Decennial Census provides a means for estimating the size of the population served by the district.

Number of Small Public School Districts Affected by the Rule

- **Number of Small Public School Districts**

As discussed in Chapter 2, there are approximately 18,000 public school districts in the United States. Based on CCD data, 14,473 of these school districts have at least one school with a kindergarten or pre-K program; in total, these districts have 52,129 such schools (NCES 2006b,c). Of the 14,473 school districts, 13,330 serve a population of fewer than 50,000 people. These 13,330 districts have a total of 26,779 schools with kindergartens or pre-kindergartens (NCES 2006b,c,g). (These counts are not limited to pre-1978 schools.)

Since the Regulatory Flexibility Analysis is only concerned with the direct costs of regulation, this small entity analysis only considers the costs that school districts will incur if they perform regulated renovation, repair, or painting projects using their own maintenance staff instead of hiring a contractor.

Carolina, West Virginia, Louisiana, Virginia, New York, South Dakota, Indiana, Maine and Massachusetts.

[17] It is possible that government agencies also operate some of the childcare facilities included in the daycare center counts throughout this economic analysis. Due to insufficient data, it was not possible to estimate the number of such government-run facilities, or the number or size of the agencies that operate them. As such, this small government impact analysis is limited to public school districts.

Costs and impacts associated with work performed by a contractor are accounted for in the contractor section of this analysis.

As discussed in Chapter 4, this analysis assumes that public schools will perform all painting and carpentry events using in-house staff. In addition, they are assumed to perform in-house one of the unscheduled maintenance events in each building year.[18] Thus, all small school districts that have at least one pre-1978 building will incur training, certification and work practice costs under the rule.

❖ Number of Small Public Schools Affected by the Rule

The number of small school districts with at least one regulated building was estimated based on the number of school buildings in the district and the likelihood that any one of the buildings is old enough to be regulated. Using 2003 HUD data, 58 percent of school buildings are estimated to have been built before 1978, and 55 percent of the pre-1978 buildings are estimated to have built before 1960 (U.S. HUD 2003). Thus, for example, under Option E the probability that any particular school building was built after 1978 is 0.42 (1-0.58). The likelihood that a district has no pre-1978 buildings is a function of the number of buildings and 0.42 as follows[19]:

(0.42)^X, where X is the number of schools with kindergarten or pre-kindergarten in the district

For example, a district with three buildings has a (0.42)*(0.42)*(0.42) = 0.074 probability of containing no pre-1978 buildings. As such, 92.6 percent of districts with three school buildings are estimated to have at least one building that is pre-1978. To estimate the average number of pre-1978 buildings in a 3-building district with at least one pre-1978 school, the total number of schools in 3-building districts was multiplied by the percent of all schools constructed before 1978 (58 percent) and divided by the number of districts with at least one pre-1978 school.

Table 8-32 presents the 50-year average numbers of small school districts with at least one pre-1978 building, and the average number of buildings in these districts under Option E. The use of 50-year average, rather than first or second year numbers accounts for the fact that, after the first year, the numbers of regulated districts and pre-1978 schools are expected to decrease by 0.41 percent per year due to building demolition. Note that all numbers are adjusted to account for a rule compliance rate of 75 percent.

Table 8-32: Number of Regulated Small School Districts and Public School Buildings

Regulatory Option	Number of Small School Districts with at Least 1 Regulated Building[a]	Total Number of Regulated Buildings in Small Districts	Average Number of Regulated Buildings per Small District
Option E	6,492	10,552	1.6

[18] The analysis assumes that all electrical, plumbing and HVAC work, as well as the remaining unscheduled maintenance projects, are contracted out.

[19] It is assumed that the age of each building is independent of the age of all other buildings in the district. This may somewhat overestimate the number of districts that have at least one pre-1978 buildings. But data are not available to calculate the joint probabilities.

a. A regulated building is defined as having a kindergarten or pre-kindergarten program.

Training and Certification Costs – Public Schools

- **Number of Individuals Trained and Establishments Seeking Certification – Public Schools**

As discussed in Chapter 4, this analysis estimates that districts with fewer than 20 regulated buildings will train only one certified renovator, and districts with more than 20 regulated buildings will train an average of one certified renovator per every 20 schools. Given that schools are estimated to perform approximately 2.9 events using in-house staff each year, a single certified renovator can oversee workers in multiple school buildings in a single school district. Since none of the small school districts are expected to have more than 20 regulated buildings, the analysis estimates that each small district will typically train only one certified renovator. In addition, school districts are expected to typically train one worker per regulated building. Finally, each school district will need to be certified as a firm. Table 8-33 presents the total number of certified renovators and workers trained, and the total number of firm certifications sought by small school districts in a typical year under Option E.

Table 8-33: Average Annual Number of Trained Public School Staff and Certified Districts

Regulatory Option	Number of Certified Renovators Trained	Number of Workers Trained	Number of Certifications Sought
Option E	6,492	10,552	6,492

- **Total Training and Certification Costs – Public Schools**

To estimate small school district training and certification costs, the numbers of individuals and firms in Table 8-32 and Table 8-33 were multiplied by the average annualized costs of training a single certified renovator and worker, and maintaining certification from Table 8-7. The resulting average annualized training and certification costs are presented in Table 8-34.

Table 8-34: Average Annualized Training and Certification Costs for Public School Districts

Regulatory Option	Certified renovator Training Cost[a]	Worker Training Cost[a]	District Certification Cost[a]	Total Training/ Certification Cost[a]	Average Training and Certification Cost/ District
Option E	$1,155,387	$300,644	$2,059,690	$3,515,722	$542
a. Total costs are calculated using unrounded unit costs.					

Work Practice Costs – Public Schools

The estimation of work practice costs incurred by each district is based on the number of regulated buildings in these districts, the average number of events per-building performed in-house, and the average work practice costs per event.

- **Number of Events Performed Annually by Schools in Small Districts – Public Schools**

Public and private schools (except for private schools with less than 100 students) are expected to perform all painting and window/door carpentry work, as well as an average of one unscheduled maintenance

event per building every year, in-house. (Private schools with fewer than 100 students are assumed to contract out all of their RRP work, instead of doing RRP work in-house.) School maintenance staff are expected to perform 2.9 maintenance events per building per year.
Table 8-35 presents the total and average numbers of events performed by public school districts in a typical year under Option E.

Table 8-35: Average Annual Number of Events performed by Public School Staff

Regulatory Option	Number of Small Districts	Total Number of Buildings in Small Districts	Average In-house Events per Building	Total In-House Events	Average Number of In-house Events per District
Option E	6,492	10,552	2.87	30,246	4.7

❖ **Total Work Practice Compliance Costs**

As discussed in Section 0, the average annualized work practice cost per event in COFs in public or commercial buildings is $30 (see Table 8-7). Multiplying this average cost by the average annual number of events in small school districts yields the total annualized work practice costs incurred by small districts in a typical year. These costs, and resulting work practice costs per district, are presented in Table 8-36.

Table 8-36: Average Annualized Work Practice Costs for Public Schools

Regulatory Option	Total In-House Events	Annualized Average WPC per Event	Total Work Practice Costs[a]	Average Work Practice Costs per Small District
Option E	30,246	$30	$916,419	$141
a. Total costs are calculated using unrounded unit costs.				

Public School Revenues

The impact of the rule on small government jurisdictions is estimated by comparing the estimated costs of the rule to the annual government revenues of small regulated jurisdictions. Revenue data for school districts is available from NCES's *Common Core of Data* "Local Education Agency (School District) Finance Survey (F-33)" dataset (NCES 2006d). Small districts include local school boards, supervisory unions, regional education agencies, and other agencies, which primarily include charter schools. Revenue data are available for the vast majority of districts. Average revenues for all small districts were estimated by a) calculating the average revenues of each type of district based on available data, b) multiplying the average revenues by the total number of districts of that type, then c) summing the resulting total revenues and dividing by the total number of small districts. This approach presumes that there is no non-response bias among districts within each category.

Table 8-37 presents small district revenue calculations and resulting estimates.

Table 8-37: Estimated Annual Revenues for Small Public School Districts

District Type	Total Small Districts	Small Districts w/ Revenue Data	Total Small District Revenues Reported	Average Reported Revenues	Estimated Total Revenues	Estimated Average Revenues

			(Million $)	(Million $)	(Million $)	(Million $)
Local School District (A)[a]	10,930	10,868	$179,530	$16.5	$180,554	$16.5
Local School District (B) [a]	1,200	1,197	$13,926	$11.6	$13,961	$11.6
Supervisory Union	84	76	$1,186	$15.6	$1,311	$15.6
Regional Education Agency	167	158	$7,612	$48.2	$8,046	$48.2
Other (Charter School)	949	773	$2,074	$2.7	$2,546	$2.7
Total	**13,330**	**13,072**	**$204,329**	**$15.6**	**$206,419**	**$15.5**

a. There are two different types of local school districts in NCES data – independent districts and districts that are connected to a supervisory union office. These local school districts are combined in Chapters 2 and 4, but are treated separately in estimating weighted average revenues.

Impact of the Rule of Small Public School Districts

Table 8-34 presents the total annualized work practice, training, and certification costs incurred by small public school districts, as well as the average annualized costs per small district. Average annualized costs are then divided by annual district revenues, as calculated in Table 8-38 to obtain a cost-to-revenue ratio. The small entity analysis shows that under Option E the LRRP rule will result in average costs amounting to less than 0.01 percent of average small district revenues.

Table 8-38: Cost-to-Revenue Ratios for Small Public Schools

Regulatory Option	**Total Regulated Small Districts**	**Total Cost of Rule to Small Districts**	**Average Cost of Rule per Small District**	**Estimated Average Small District Revenues (Million $)**	**Cost-to-Revenue Ratio**
Option E	6,492	$4,432,141	$683	$15.5	0.004%

8.2.8 Private Schools (Small Non-Profits)

Number of Small Private Schools

As discussed in Chapter 2, according to the 2003-2004 NCES *Private School Universe Survey* Data, there are a total of 26,531 private schools with kindergarten or pre-kindergarten programs in the United States (NCES 2006e,f). Based on HUD data, 58 percent, or 15,387 of these schools were constructed before 1978, and 55 percent of the pre-1978 buildings, or 8,463 schools, were constructed before 1960. Because no data source providing the number of private schools at different revenue levels was identified, all private schools are considered to be small entities. In other words, the analysis assumes that each private school is independently run and is not part of a larger organization. As such, the analysis may overestimate the number of affected non-profit organizations and the impacts of the rule on these entities. Similarly to public schools, private schools will only incur direct costs as a result of this rule if they use their own maintenance staff to perform regulated RRP work. Schools that perform regulated jobs in-house will incur training, certification, and work practice costs. This analysis assumes that private schools with fewer than 100 students will contract out all of their renovation and repair work because of their small size. Private schools serving more than 100 students are assumed to use their own staff to perform all painting and window/door carpentry work, as well as an average of one unscheduled maintenance event every two years, and to hire contractors to perform all other renovation, addition, and alteration projects.

As discussed in detail in Chapter 2, based on NCES's Private School Universe survey data, 41 percent of private schools with a kindergarten and/or pre-kindergarten have fewer than 100 students. Table 8-39 presents the total number of private schools regulated under Option E in a typical year, the number of schools with fewer than 100 students, and the number of schools with more than 100 students. The use of average annual numbers accounts for the fact that after the first year, the numbers of pre-1978 schools are expected to decrease by 0.41 percent per year due to building demolition. Note that all numbers are adjusted to account for a rule compliance rate of 75 percent.

Table 8-39: Average Annual Number of Private Schools with Kindergarten or Pre-Kindergarten

Regulatory Option	Total Number of Private Schools with Kindergarten or Pre-Kindergarten	Percent of Private Schools with <100 Students	Number of Private Schools with <100 Students	Number of Private Schools with >100 Students
Option E	10,454	41%	4,280	6,174

Training and Certification Costs – Private Schools

- **Number of Individuals Trained and Districts Seeking Certification – Private Schools**

Because the LRRP rule requires each entity that performs regulated work to have a certified renovator on staff, this analysis assumes that each private school that qualifies as a COF and that performs any renovation work in-house will typically train one employee as a renovator. In addition, it is assumed that each of these schools will typically train one worker and will become certified as a firm.
The number of people trained as renovators and workers, and the number of certifications sought by private schools will thus equal the number of private schools with over 100 students under Option E (Table 8-40).

Table 8-40: Average Annual Number of Trained Private School Staff and Certified Schools

Regulatory Option	Number of Certified Renovators Trained	Number of Workers Trained	Number of Certifications Sought
Option E	6,174	6,174	6,174

- **Total Training and Certification Costs – Private Schools**

To estimate small school district training and certification costs, the numbers of individuals and districts in Table 8-39 and Table 8-40 were multiplied by the average annualized costs of training a single certified renovator and worker, and maintaining certification from Table 8-7. The resulting average annualized training and certification costs are presented in Table 8-41.

Table 8-41: Average Annualized Training and Certification Costs for Private Schools					
Regulatory Option	**Renovator Training Cost[a]**	**Worker Training Cost[a]**	**School Certification Cost[a]**	**Total Training/ Certification Cost[a]**	**Average Training and Certification Cost/ School**
Option E	$1,098,750	$175,910	$1,958,724	$3,233,384	$524
a. Total costs are calculated using unrounded unit costs.					

Work Practice Costs – Private Schools

Schools are expected to perform an average of approximately 2.9 events in-house per year. Table 8-42 presents the total number of private schools regulated in the first year under Option E, the total number of events performed in these schools, and the total annualized work practice costs associated with these events. Total work practice costs are estimated by multiplying the average annual number of events by the average annualized work practice cost per event ($30; see Table 8-7). Average annualized work practice costs per private school are calculated by dividing total work practice costs by the number of affected schools.

Table 8-42: Average Work Practice Costs for Private Schools				
Regulatory Option	**Number of Private Schools w>100 Students**	**Total Annual Number of In-house Events**	**Total Annualized Work Practice Costs[a]**	**Average Annualized Work Practice Costs per School**
Option E	6,174	17,697	$536,206	$87
a. Total costs are calculated using unrounded unit costs.				

Impacts on Small Private Schools

Conceptually, impacts on non-profit establishments such as schools might be measured in terms of the ratio of rule costs to annual operating expenses. Due to the scarcity of data on private school operating expenditures (schools are excluded from the U.S. Economic Census, and NCES does not have a financial data set for private schools), annual private school expenditures are approximated based on estimated operating expenses per student obtained from a 1995 study by NCES entitled *Estimates of Expenditures for Private K-12 Schools* and information on the number of students enrolled at each school, as reported in NCES's 2003-2004 Private School Universe Survey data set.

Based on NCES data (1995), this analysis estimates that private school expenditures average about $3,377 (2005$) per child per year. Appendix 8A explains the derivation of this estimate in detail.
To estimate average private school expenditures for schools with over 100 students, and with a pre-kindergarten or kindergarten program, the average number of students per school meeting this criteria was calculated based on 2003-2004 NCES survey data (NCES 2006f). Schools for which no total student enrollment data was available were assumed to have the average enrollment at schools with more than 100 students where student data was provided. Using these assumptions, the average private school with over 100 students was estimated to serve 283 students per year. As such, average expenditures for private schools are estimated to be $3,377*283, or $956,697.

Impacts on private schools were estimated by summing the total annualized work practice, training and certification costs incurred by these schools under Option E, then dividing these total costs by the number of regulated schools. Average costs per school were then divided by average expenditures to calculate a cost-to-expenditure ratio. These calculations and the resulting ratio are presented in Table 8-43.

Table 8-43: Cost-to-Expense Ratios for Private Schools

Regulatory Option	Total Regulated Private Schools with > 100 kids	Total Cost of Rule to Private Schools	Average Cost of Rule per Private school	Estimated Average Small School Expenditures	Cost-to-Expenditure Ratio
Option E	6,174	$3,769,590	$611	$956,697	0.06%

8.2.9 Summary of the LRRP Rule Impacts on Small Governments, Non-Profit Organizations, and Small For-Profit Businesses

The vast majority of entities in the industries affected by this rule are small. The renovation, repair, and painting program will affect approximately 188,586 small entities under Option E.
The average annualized cost to a typical small entity is estimated to range from $517 to $2,603 under Option E, depending on the number of renovation, repair, and painting events undertaken by a small entity in the industry sector involved. As shown in Table 8-44, the cost impact of the rule on small entities ranges from about 0.004% to 1.8% of revenues, depending on the industry sector, under Option E.

Table 8-44: Typical-Year Number of Small Entities with Regulated RRP Events

		Option E	
Description	**Type**	**Number of Small Entities**	**Cost-Impact Ratio**
Public School Districts	Government	6,492	0.004%
Private Schools	Non-Profit	6,174	0.06%
Daycare Centers	Non-Profit	10,481	0.18%
Non-Residential Landlords	Business	11,056	0.43%
Non-Residential Contractors (working in public or commercial building COFs)	Business	2,865	0.34%
Residential Contractors (working in target housing)			
Residential remodelers	Business	41,359	0.61%
Siding contractors	Business	3,008	0.84%
Finish carpentry contractors	Business	29,369	0.88%
Other building equipment contractors	Business	1,365	0.73%
Other building finishing contractors	Business	1,868	0.76%
Tile and terrazzo contractors	Business	4,195	0.86%
Plumbing and HVAC contractors	Business	14,114	0.73%
Glass and glazing contractors	Business	1,244	0.61%
Painting and wall covering contractors	Business	16,302	1.24%
Electrical contractors	Business	10,035	0.89%
Drywall and insulation contractors	Business	6,863	0.77%
Residential Property Managers	Business	5,824	1.81%
Lessors of Residential Real Estate	Business	15,970	0.60%
Total		**188,586**	

Table 8-45 presents the total number of small governments, non-profit organizations, and small for-profit businesses, and the average cost-to-revenue ratios for each category. It is estimated that under Option E, a total of 188,586 small entities would be affected by the program, including 165,439 small businesses with average impacts of 0.73 percent, 16,655 small non-profits with average impacts of 0.10 percent, and 6,492 small governments with average impacts of 0.004 percent.

Table 8-45: Aggregate Small Entity Impacts of Combined RRP Rules

	Total Number of Small Entities Affected	Average Impacts, All Small Entities
	Option E	
Small Governments	6,492	0.004%
Non-Profit Organizations	16,655	0.10%
Small For-Profit Businesses	165,439	0.73%
Total	**188,586**	

8.3 Unfunded Mandates Reform Act (UMRA)

Title II of the Unfunded Mandates Reform Act of 1995, Pub. L. 104-4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and Tribal governments, and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "Federal mandates" that might result in expenditures by State, local, and Tribal governments, in the aggregate, or by the private sector, of $100 million or more (when adjusted annually for inflation) in any one year.[20]

Before promulgating a regulation for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective, or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective, or least burdensome alternative if the Administrator publishes with the rule an explanation of why that alternative was not adopted. Before EPA establishes any regulatory requirements that might significantly or uniquely affect small governments, including Tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant intergovernmental mandates, and informing, educating, and advising small governments on compliance with regulatory requirements.

This section identifies the government entities that may be affected by the rule.

8.3.1 Affected Government Entities

[20] When the original $100 million UMRA threshold is adjusted for inflation from 1995 to 2005 dollars using an implicit price deflator for gross domestic product, the result is a threshold of $118 million.

The LRRP Rule will affect activities in publicly owned child-occupied facilities, specifically publicly owned housing and public schools.[21] As with the private sector, the LRRP regulations will increase the cost of operating these facilities by requiring that staff be trained and appropriate work practices be undertaken, including cleaning verification. Each school district that uses its own in-house staff to perform RRP activities in regulated buildings is required to become certified in lead-safe work practices. Thus, state and local governments will incur costs when school districts train staff, seek certification, and implement the required work practices during the renovation, repair, and painting of public school buildings.

The Final Lead Renovation, Repair, and Painting (LRRP) Rule will affect activities in publicly owned housing. While most of what is commonly referred to as public housing is owned by state or local governments and provided for the benefit of low-income and/or elderly households, other public entities (such as public colleges and universities) may provide regulated housing. As with the private sector, the LRRP regulations will increase the cost of operating this housing by requiring that staff be trained and appropriate work practices be undertaken, including cleaning verification.

Public housing that receives funding from the U.S. Department of Housing and Urban Development already must comply with HUD regulations regarding lead paint and so are unlikely to incur additional costs due to this rule. These housing units and their RRP events have been excluded from the cost and benefit estimates presented in Chapters 4, 5 and 6 of this report. Four states (Massachusetts, New York, Hawaii, and Connecticut) and one local government (New York City) have been identified as operating public housing that does not receive HUD funds. RRP activities in these units are likely to be covered by this rule.

Massachusetts has approximately 50,000 state-funded public housing units operated through 235 local housing authorities (Stainton 2001).

New York is home to the country's first state-subsidized public housing program. New York has constructed 143 housing developments that are owned by 42 municipal housing authorities since the program began in 1939. Due to the increased burden on the State's Public Housing Modernization Program (PHMP), New York has federalized some of their units. Units that have been federalized must adhere to federal rules and regulations, including existing lead standards (DHCRb 2005). Housing that has been updated through PHM has undergone lead testing.

The New York City Housing Authority (NYCHA) is the largest public housing authority in North America, housing 175,116 families in 345 developments. Of these, 12,158 units are state-funded and 7,971 of these units are city-funded.

The Housing and Community Development Corporation of Hawaii (HCDCH) manages 6,200 units in 81 developments of federal and state public housing, which support 14,000 residents. State-funded public

[21] It is possible that government agencies also operate some of the childcare facilities included in the daycare center counts throughout this economic analysis. Due to insufficient data, it was not possible to estimate the number of such government-run facilities, or the number or size of the agencies that operate them. As such, this Unfunded Mandates Reform Act is limited to public school districts.

housing makes up 14 percent (868 units) of HCDCH's housing stock. Both private and public employees manage these units and operating costs are completely funded by rental income (HCDCH 2002).

The state of Connecticut does not officially sponsor public housing. Local housing authorities run Connecticut public housing. These housing authorities receive municipal tax-breaks and municipalities receive Payments in Lieu of Taxes (PILOT) from the state.

While these state and local programs make up only a relatively small percentage of all public housing, they are locally important. At the same time, it is important to note that in Massachusetts state regulations already require the use of certain work practices when performing renovations in pre-1978 housing. New York City also has an extensive regulatory program that applies to multi-unit dwellings where children under the age of seven reside. In both cases, these requirements may partially reduce the incremental burden of complying with the LRRP Rule. See Chapter 3 of this Economic Analysis for more information on these programs.

In 2000, there were over 14 million students enrolled in colleges and universities in the United States and over 3 million students enrolled in graduate or professional schools. Of these students, over 11 million attend public colleges and nearly 2 million attend public graduate schools (U.S. Census Bureau 2000e). According to the US Census, over 2 million students reside in dormitories—group quarters that are not affected by the LRRP rule (U.S. Census Bureau 2000f). The remaining students must either reside off-campus in private housing, or in college-owned apartments and individual units. Individual, college-owned housing units include but are not limited to, undergraduate suites and apartments, married student housing, graduate student apartments, and faculty housing. These types of units are not differentiated from the general housing stock in the Census; therefore it is difficult to determine how many of these units exist or the age of these units.

8.3.2 Expenditures by State, Local, and Tribal Governments

Public School Districts

State, local, and Tribal governments will incur the incremental costs imposed by this rule when public school districts engage in certain RRP activities.[22] Based on available data and the economic analysis presented in Chapter 4 and Section 8.2, Section 0 assumes that all public school districts will perform all painting- and window/door carpentry tasks themselves, as well as some unscheduled maintenance and repairs. Public schools are assumed to hire third-party contractors to perform the remainder of their RRP work. Since all public school districts use their own staff to perform some of their RRP activities, all public school districts will seek certification, train workers, and use the work practices outlined in Chapter 4.[23] Table 8-46 presents the estimated total annualized costs of the rule that would be incurred by public school districts~~. It should be noted that these costs reflect~~ under Option F. The predicted number of events under Option F is the same as under Option E~~ as it is the preferred, and most comprehensive, option.~~

[22] As discussed in Chapter 4, states would be able to apply for, and receive authorization to administer these proposed requirements, but would be under no obligation to do so.

[23] It is important to note that this analysis uses a 75 percent compliance rate. See Chapter 4 and the small entity analysis (Section 8.2) for a more comprehensive discussion of these cost estimates.

; however, the actual number of events under Option F is expected to be lower than under Option E due to the difference in the definitions of the minor maintenance exception.

Table 8-46: Total Annualized Costs to All Public School Districts, Option F				
Average Annual Number of Districts Affected[a]	Average Annual Number of Buildings Affected[a]	Total Average Annual Number of Events[b]	Average Annualized Cost Per District (2005$)	Total Annualized Cost (2005$)
6,492	10,552	30,246	$683 675	$4,432,131 $4,385,515

a. In the first year, the COF Rule is expected to affect 7,782 public school districts and 24,448 school buildings in these districts. Every year thereafter, the number of affected districts and schools is expected to decrease by 0.41 percent as older buildings are demolished. The use of 50-year average numbers of districts and schools captures this annual decrease.

b. Schools are expected to perform 2.87 events per year per building using their own maintenance staff (see Section 8.2 for more details).

The cost to revenue ratio for affected small school districts (which make up almost ninety percent of all affected school districts) is 0.004 percent under Option EF, which covers pre-1978 COFs in all years of the rule. These calculations are summarized in Table 8-47 (which is repeated below as Table 8-47).

Table 8-47: Cost-to-Revenue Ratios for Small Public Schools					
Regulatory Option	Average Annual Regulated Small Districts	Total Annualized Cost of Rule to Small Districts	Average Annualized Cost of Rule per Small District	Estimated Average Small District Revenues (mil)	Cost-to-Revenue Ratio
Option EF	6,492	$4,432,131$4,385,515	$683675	$15.5	0.004%

8.4 Executive Order 13132 - Federalism

Executive Order 13132, entitled *Federalism* (64 FR 43255, August 10, 1999), directs federal agencies to consider whether a rule has federalism implications (i.e. whether it has substantial direct effects on the states, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132). As discussed in Chapter 4, states would be able to apply for, and receive authorization to administer these requirements, but would be under no obligation to do so. In the absence of a state authorization, EPA will administer these requirements. While the cost analysis assumes that EPA will administer and enforce the program in all places, it also assumes that states would incur similar costs if they administer and enforce the regulation. Given the low cost per event, this rule is not expected to have a significant impact on states.

8.5 Executive Order 13175 - Tribal Implications

Executive Order 13175, entitled *Consultation and Coordination with Indian Tribal Governments* (59 FR 22951, November 6, 2000), directs federal agencies to consider whether a rule has tribal implications (i.e. whether it has substantial direct effects on tribal governments, on the relationship between the Federal government and the Indian tribes, or on the distribution of power and responsibilities between the Federal government and Indian tribes).

Under this rule, Tribes would be able to apply for and receive authorization to administer these requirements on Tribal lands, but Tribes would be under no obligation to do so. In the absence of a Tribal authorization, EPA will administer these requirements.

In addition, tribal daycare, pre-kindergartens and kindergartens may be subject to work practice, training and certification costs. The number of Tribal authorities that conduct renovation work on regulated properties is not known. However, given the low cost per event this rule is not expected to have a substantial direct effect on Tribes.

8.6 Protection of Children from Environmental Health Risk and Safety Risks

Under Executive Order 13045, a regulation must be reviewed if the regulatory action is economically significant and concerns an environmental health risk or safety risk that may disproportionately affect children. Since children are particularly susceptible to the IQ loss and adverse health effects caused by exposure to lead dust, a significant objective of the LRRP regulation is the protection of children's health. This analysis summarizes the effects of the regulation on children under the age of six in target housing units and in COFs in public or commercial buildings.

Target Housing and Child-Occupied Facilities

Options differ in terms of the age of structures covered by the rule in each phase, and in terms of whether all units or only rental units are covered by the rule. Specifically, Options P, A, and B are limited to Pre-1960 structures during Phase 1 of the regulation and their scope is expanded to structures built between 1960 and 1978 in Phase 2. Options C and D are limited to Pre-1960 structures in both Phase 1 and Phase 2. Finally, ~~Option~~ Options E ~~includes~~ and F include Pre-1978 structures in both Phase 1 and Phase 2. Options A and C include all public or commercial building COFs and target housing units within the vintage categories specified above. Options P, B, D, ~~and~~ E, and F include all rental units, plus all target housing COFs, and all owner-occupied target housing units where a child under the age of 6 or a ~~woman who is or may be~~ pregnant woman resides within the vintage categories specified above.

As shown in Table 8-48 all options (except for Option E and F) cover about ~~83~~92% of the potentially affected children in the first year. ~~Option~~Options E ~~protects~~and F protect considerably more children under the age of six in the first year ~~– approximately 1.9 million in total –~~ because ~~it covers~~they cover all units built before 1978 where a child under the age of six or a ~~woman who is or may be~~ pregnant woman resides plus all COFs in public and commercial building built before 1978[24]. This difference disappears in year two, except for Options C and D, where only ~~83~~92% of the potentially affected children are covered.

[24] The difference between the number of children under 6 residing in affected housing under Option E and F is attributable to the exemption of small wall-disturbing jobs under Option F.

Table 8-48: Number of Children Under 6 Residing in Affected Housing by Option and Year of Rule – Units where RRP take place and LBP present [a]

Option	First Year of the Rule		Second Year and Each Subsequent Year of the Rule	
	Number (Thousands)	Percent of Option ~~E~~F	Number (Thousands)	Percent of Option ~~E~~F
Option P	1,~~549~~161	~~83%~~92%	1,~~857~~393	~~100%~~110%
Option A	1,~~549~~161	~~83%~~92%	1,~~857~~393	~~100%~~110%
Option B	1,~~549~~161	~~83%~~92%	1,~~857~~393	~~100%~~110%
Option C	1,~~549~~161	~~83%~~92%	1,~~542~~157	~~83%~~92%
Option D	1,~~549~~161	~~83%~~92%	1,~~542~~157	~~83%~~92%
Option E	1,~~865~~398	~~100%~~110%	1,~~857~~393	~~100%~~110%
Option F	1,268	100%	1,263	100%

a. Number is increment above those occupying units where LSWP are currently practiced in the baseline and assuming a 75% compliance rate.

Source: EPA Estimates – see chapter 5

8.7 Executive Order 13211 - Energy Effects

Executive Order 13211, entitled *Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use* (66 FR 28355, May 22, 2001), directs federal agencies to identify actions that will have a significant adverse energy effect. Adverse effects are defined as:

1. Reductions in crude oil supply in excess of 10,000 barrels per day;
2. Reductions in fuel production in excess of 4,000 barrels per day;
3. Reductions in coal production in excess of 5 million tons per year;
4. Reductions in natural gas production in excess of 25 million mcf per year;
5. Reductions in electricity production in excess of 1 billion kilowatt-hours per year or in excess of 500 megawatts of installed capacity;
6. Increases in energy use required by the regulatory action that exceed any of the thresholds above;
7. Increases in the cost of energy production in excess of one percent;
8. Increases in the cost of energy distribution in excess of one percent; or
9. Other similarly adverse outcomes.

The regulations under consideration will not significantly reduce energy production nor significantly increase energy costs.

8.8 National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (“NTTAA”), Public Law No. 104-113, 12(d) (15 U.S.C. 272 note) directs federal agencies to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs federal agencies to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

The LRRP rule proposes a number of work practice requirements that could be considered technical standards for performing renovation projects in target housing and child occupied facilities that contain lead-based paint. ASTM International (formerly the American Society for Testing and Materials) has developed two potentially-applicable documents: “Standard Practice for Clearance Examinations Following Lead Hazard Reduction Activities in Single-Family Dwellings and Child-Occupied Facilities”, and “Standard Guide for Evaluation, Management, and Control of Lead Hazards in Facilities”.
With respect to the first document, the LRRP rule does not propose to require traditional clearance examinations, including dust sampling, following renovation projects. However, it would require that a visual inspection for dust, debris, and residue be conducted after cleaning and before post-renovation cleaning verification is performed. The first ASTM document contains information on conducting a visual inspection before collecting dust clearance samples. The second ASTM document is a comprehensive guide to identifying and controlling lead-based paint hazards. Some of the information in this document is relevant to the work practices in the LRRP rule. Each of these ASTM documents represents state-of-the-art knowledge regarding the performance of these particular aspects of lead-based paint hazard evaluation and control practices and EPA continues to recommend the use of these documents where appropriate. However, because each of these documents is extremely detailed and encompasses many circumstances beyond the scope of the LRRP rulemaking, EPA determined that it would not be practical to incorporate these voluntary consensus standards into the LRRP rule.
In addition, the LRRP rule contains a provision for EPA to recognize test kits that could be used by certified renovators to determine whether components to be affected by a renovation contain lead-based paint.

8.9 Executive Order 12898 – Environmental Justice

Under Executive Order 12898, when promulgating a regulation, EPA investigates whether there are disproportionately high and adverse human health or environmental effects on minority and low-income populations. The LRRP regulation requires that renovators, when undertaking renovation activities in regulated facilities, reduce the risk of exposure to lead by employing the use of safe work practices. In addition, renovators are required to undertake cleaning verification at the end of each project. This environmental justice analysis first summarizes a few important points to consider when viewing the results. This is followed by a summary of the impacts from the regulation on minority and low-income populations in target housing units and then child-occupied facilities.

Racial minorities and low-income households are likely to experience greater impacts from certain of the regulatory options considered for two reasons. First, because these disadvantaged groups are more likely to reside in rental and older housing, they are more likely to be affected under the options that emphasize regulating older and/or rental housing. In addition, individuals and children with food insecurity (i.e. those who do not have healthy diets or do not eat enough because of poverty) are more susceptible to ill health effects from lead dust. Thus, they stand to accrue greater benefits under all of the options considered.

Following the work practice, cleaning, and cleaning verification steps specified in the rule will increase the costs for renovation, repair and painting activities covered by the rule. These additional costs may lead some lower income homeowners or some landlords of properties in lower income neighborhoods to avoid using certified renovators or recommended practices. The incremental costs of the rule's work practices are typically below $200[25]. These costs are likely to be a small part of the total cost of the renovation, repair, and painting projects. EPA believes that these costs are unlikely to result in significant changes in consumer behavior. If however, the increased costs result in more projects being undertaken by uncertified firms or by do-it-yourselfers, the risks in these instances would be the same as in the baseline and would not constitute new risks resulting from the rule. EPA believes that the rule would result in new risks only if the increased costs caused individuals to delay work such as painting until lead-based paint began peeling and chipping, creating a lead hazard. This is expected to occur infrequently given the rule's low cost per event.

8.9.1 Target Housing

This section of the environmental justice analysis looks at the distribution of renovation events in target housing units, and the individuals protected, across three race and two income groups. Although it would be preferable to perform a joint environmental justice analysis for the race and income groups, relevant data are not available to make these population inferences. Therefore, the analysis was performed separately for the race and income groups.

Low Income:

For the purposes of the target housing portion of this analysis, EPA defines low income individuals as individuals whose income are below the level set by the federal government's official poverty definition. Based on data from the *2000 Decennial Census*, 12.4% of individuals were living below the poverty level (U.S. Census Bureau 2000a). It is therefore relevant to determine if the potential costs and benefits resulting from the LRRP regulations will have a disproportionately greater effect on low income individuals.

The data in Table 8-49 compares the relative numbers of households below the poverty level who are owners and renters. As is evident from the data, low income households are much more likely to be renters than homeowners – 6.3 percent of owner occupants have incomes below the poverty level while 22.7 percent of renters have incomes below the poverty level. For each vintage category of housing listed (i.e. pre-1980[26], pre-1960, pre-1950), renters are more than three times as likely as owners to have

[25] This is adjusted for baseline work practices and assumes a 75% compliance rate. See Chapter 4.

[26] Note: For the purposes of this analysis, since Census data are not available for the category of all pre-1978 housing, pre-1980 housing data is used to approximate pre-1978 housing.

incomes below the poverty level. The number of households living below the poverty line in rental housing is almost double the number who are living in owned occupied housing. Because of the disproportionately high number of low income households living in rental housing, it is reasonable to conclude that a rule affecting all pre-1978 rental housing will benefit a significant proportion of low income families in housing where lead-based paint is disturbed by RRP activities.

Table 8-49: Number and Percentage of Householders Below Poverty by Year Housing Built by Tenure

	Owner Occupied Housing		**Renter Occupied Housing**	
Year Housing Built	**Total Below Poverty**	**Percentage of All Pre-2000 Owner Housing Below Poverty**	**Total Below Poverty**	**Percentage of All Pre-2000 Rental Housing Below Poverty**
Pre-2000	4,371,712	6.26%	8,086,254	22.67%
Pre-1980	3,133,302	4.49%	6,059,817	16.99%
Pre-1960	1,765,185	2.53%	3,100,214	8.69%
Pre-1950	1,167,604	1.67%	2,093,142	5.87%
Source: U.S. Census Bureau 2000b.				

Race:

The 2000 Census data shows that Black/African American households and Asian households are more likely than White households to reside in rental housing. The data in Table 8-50 compares the percentages of owners and renters for three categories of race, "White Alone," "Black/African American Alone," and "Asian Alone." Compared with 28.73% of White individuals who resided in rental housing in 2000, 53.67% and 46.76% of Black/African American and Asian households, respectively, resided in rental housing. Thus, an RRP regulation that targets rental housing will serve to benefit these minority groups. Because no data were available for race by age of housing unit, this analysis uses pre-2000 housing to provide a general idea of these proportions.

Table 8-50: Number and Percentage of Householders by Race by Tenure in 2000

Race	**Total**	**Percentage Owner**	**Percentage Renter**
White Alone	83,715,168	71.27%	28.73%
Black/African American Alone	11,977,309	46.33%	53.67%
Asian Alone	3,117,356	53.24%	46.76%
Source: U.S. Census Bureau 2000c.			

8.9.2 Child-Occupied Facilities

This section of the environmental justice analysis looks at the distribution of potentially affected children in various types of non-parental care arrangements across four race and two income groups. The information is drawn from the NCES statistical report entitled "Child Care and Early Education Arrangements of Infants, Toddlers, and Preschoolers: 2001." Although it would be preferable to perform a joint environmental justice analysis for the race and income groups, relevant data were not available to make these population inferences. Therefore, the analysis was performed separately for the race and income groups. It was also not possible to quantify the number of potentially affected children by the age of the childcare facility.

Low Income Populations:

The NCES report considered children "poor if living in households with incomes below the poverty threshold, which is a dollar amount determined by the federal government to meet the household's needs, given its size and composition."[27] The data in Table 8-51 present the number and percentage of children under six from families below and above the 2001 poverty threshold by the type of non-parental care arrangement. Children under the age of six from families living below the poverty threshold are more likely to be cared for solely by parents, i.e., have no weekly non-parental care arrangement, than children from families living above the poverty threshold (47% and 38%, respectively). Also, children under the age of six from families below the poverty threshold are more likely to have relatives care for them than children from families above the poverty threshold (26% and 21%, respectively). However, it is difficult to use this data to judge how the rule will impact low income children, since the categories in the table are not congruent with the rule's requirements. Some of these children may be cared for in facilities that do not qualify as COFs.[28] In addition, these figures do not indicate whether the care occurs in pre-1978 buildings, nor whether lead-based paint is present at the facility (and thus which children will benefit from the rule's requirements). The data also do not include children attending kindergartens. Furthermore, there is likely to be an overlap between the children identified here and those discussed under the target housing section of the environmental justice analysis.

Table 8-51: Number and Percentage of Children under Six Years Old from Families above and below the Poverty Threshold by Type of COF

	Children from Families below the Poverty Threshold		**Children from Families above the Poverty Threshold**	
Non-parental Care Arrangement	**Number (1,000)**	**Percentage**	**Number (1,000)**	**Percentage**
Relative	1,106	26%	3,359	21%
Non-relative	383	9%	2,719	17%
Center	1,149	27%	5,599	35%
No weekly non-parental care arrangement	2,000	47%	6,078	38%
Total	4,255		15,996	

[27] For example, the U.S. Census Bureau reports that in 2001, a family of three people with one child under 18 was considered as living in poverty if they earned $14,255 dollars or less per year (U.S. Census Bureau 2001.)

[28] To qualify as a COF, a building must be visited regularly by the same child on at least two different days within any week, provided that each day's visit lasts at least 3 hours and the combined weekly visits last at least 6 hours, and the combined annual visits last at least 60 hours.

Note: The percentages of children in specific types of care do not sum to 100% because some children had more than one type of arrangement. *Sources: Mulligan, et al 2005*

Minority Populations:

The data in Table 8-52 present the numbers and percentages of children under the age of six for four categories of race, "White, non-Hispanic," "Black, non-Hispanic," "Hispanic," and "Other," by the type of non-parental care arrangement. NCES data reports that about 52 percent of Hispanic children, compared with 27 percent of Black children, 40 percent of White children, and 36 percent of "Other" children, received no child care on a weekly basis from persons other than their parents. As with the analysis of income levels, it is difficult to judge how the rule will impact minority children, since the categories in the table are not congruent with the rule's requirements. Some of these children may be cared for in facilities that do not qualify as COFs. These figures do not indicate whether the care occurs in pre-1978 buildings, nor do they provide data on whether lead-based paint is present at the facility (and thus which children will benefit from the rule's requirements). The data also do not include children attending kindergartens. There is likely to be an overlap between the children identified here and those discussed under the target housing section of the environmental justice analysis.

Table 8-52: Number and Percentage of Children by Race and Non-parental Care Arrangement

	Children, by Race							
	White, non-Hispanic		**Black, non-Hispanic**		**Hispanic**		**Other**	
Type	**Number (1,000)**	**%**	**Number (1,000)**	**%**	**Number (1,000)**	**%**	**Number (1,000)**	**%**
Relative	2,347	19%	986	33%	849	23%	268	22%
Non-relative	2,224	18%	358	12%	406	11%	183	15%
Centers	4,324	35%	1,195	40%	776	21%	451	37%
No weekly non-parental care arrangement	4,941	40%	806	27%	1,920	52%	439	36%
Total	12,353		2,987		3,693		1,219	

Note: The percentage of children in specific types of care do not sum to 100% because some children had more than one type of arrangement.
Sources: Mulligan, et al 2005

8.9.3 Conclusions

The Lead Renovation, Repair and Painting Rule seeks to minimize the exposure of children and adults to lead-based paint hazards created during renovation, repair, and painting activities in housing where children under age 6 reside and in housing or other buildings frequented by children under age 6. As such, EPA concludes that the rule will not lead to disproportionately high and adverse human health or environmental effects on minority and low income populations in both target housing units and public or commercial buildings. On the contrary, since a larger percentage of poor and minority households reside in rental housing, they may reap a greater than proportional share of the benefits.

APPENDIX 8A – Estimating average per-pupil expenditures of private schools

This appendix outlines the methodology used to estimate total annual private school expenditures for the small entity analysis. Total annual school expenditures were estimated based on per-student operating expense data and information on the number of students enrolled. This analysis used per-pupil expenditure values for 1991-92, first calculated in a working paper published by the National Center for Education Statistics (NCES) entitled "Estimates of Expenditures for Private K-12 Schools" (NCES 1995). The two mean per-pupil expenditure values (one for elementary schools and one for combined schools) presented were combined into one value - the private school per-pupil expenditure value - using selected weights. Finally, this value was inflated to 2005 dollars using the CPI. The inflated value was used to estimate the total expenditures of private schools with various sized student bodies. The assumptions made in order to calculate the per-pupil expenditure values presented here are outlined throughout this appendix.

The NCES working paper divided 1991-92 Private School Survey (PSS) data into 19 mutually exclusive and exhaustive sectors of schools based on grade level (elementary, secondary, and combined elementary and secondary), and the religious or other affiliation. The paper relied on expenditure data collected by three school associations (The National Catholic Education Association (NCEA), the Lutheran Church-Missouri Synod (LCNS), and the National Association of Independent Schools (NAIS)) to calculate average annual per-student expenditures for their associated schools. Data from the three surveyed school associations accounted for 45% of the total private school as presented in the PSS (NCES 1995). For the remaining schools, NCES estimated two sets of per-student expenditures, using data obtained from Catholic and Lutheran schools (referred to as the Catholic and Lutheran School Models, respectively). Table 8A-1 presents the number of schools and the annual per-student expenditures for the 19 sectors of schools, using the Lutheran school data to estimate missing expenditure values.

Table 8A-1: Estimated Per-pupil Expenditures of Private Schools by School Level and School Type (Based on the Lutheran Model)		
School Level and School Type	**Number of Schools**	**Estimated Mean Per Pupil Expenditures**
Elementary Schools		
Catholic	7,645	$1,895
Lutheran	1,563	$2,003
NAIS Religious	124	$6,313
NAIS Non-Sectarian	325	$8,807
Other Religious	5,240	$2,003
Other Non-Sectarian	2,084	$2,003
Special Education	114	$8,807
All Schools	17,093	$2,125
Secondary Schools		
Catholic	1,244	$3,909
Lutheran	87	$4,527
NAIS Religious	91	$16,523
NAIS Non-Sectarian	208	$58,730
Other Religious	477	$4,527
Other Non-Sectarian	342	$4,527
Special Education	171	$17,261
All Schools	2,620	$5,510
Combined Schools		
NAIS Religious	95	$9,052
NAIS Non-Sectarian	346	$9,662
Other Religious	4,085	$4,527
Other Non-Sectarian	943	$4,527
Special Education	817	$9,662
All Schools	6,285	$5,766
Sources: NCES 1995		

The per-student expenditure estimates presented are based on the Lutheran School Model, rather than the Catholic School Model because, based on the evidence presented in NCES's study, Lutheran school data are likely to be more accurate. When assessing the quality of the data, the working paper authors express concern over potential non-response bias and sampling error in the Catholic elementary and secondary school data. In addition, a comparison of the total operating expenses of private elementary and secondary schools generated by each model with an alternate estimate calculated annually by NCES indicated that while that both the Catholic and the Lutheran School Model estimates are below the alternative NCES estimates, the Lutheran School Model is the closer of the two.[29] Therefore the Lutheran School Model was used in this analysis.

To estimate per-student expenditures for schools likely to be affected by the LRRP Rule, the school sectors most likely to contain schools with pre-kindergarten and kindergarten programs were identified in the NCES study. Table 8A-2 shows Table 8A-1 with an additional column indicating whether or not the estimated mean for that sector was included in the calculation for mean per-private-school-pupil expenditure based on the assumptions made about the likelihood of that sector containing a kindergarten

[29] The NCES estimate inflates private school data collected in the late 1970's.

or pre-kindergarten program. An "x" indicates that the mean per-pupil expenditure value is included in the calculation.

Table 8A-2: Estimated Per-pupil Expenditures of Private Schools by School Level, School Type, and Inclusion in the Calculation (Based on Lutheran School Model)			
School Level and School Type	**Number of Schools**	**Estimated Mean Per-pupil Expenditures**	**Included in the Calculation**
Elementary Schools			
Catholic	7,645	$1,895	
Lutheran	1,563	$2,003	x
NAIS Religious	124	$6,313	
NAIS Non-Sectarian	325	$8,807	
Other Religious	5,240	$2,003	x
Other Non-Sectarian	2,084	$2,003	x
Special Education	114	$8,807	
All Schools	17,093	$2,125	
Secondary Schools			
Catholic	1,244	$3,909	
Lutheran	87	$4,527	
NAIS Religious	91	$16,523	
NAIS Non-Sectarian	208	$58,730	
Other Religious	477	$4,527	
Other Non-Sectarian	342	$4,527	
Special Education	171	$17,261	
All Schools	2,620	$5,510	
Combined Schools			
NAIS Religious	95	$9,052	
NAIS Non-Sectarian	346	$9,662	
Other Religious	4,085	$4,527	x
Other Non-Sectarian	943	$4,527	x
Special Education	817	$9,662	
All Schools	6,285	$5,766	
Sources: NCES 1995			

Of the 19 sectors, 6 are for secondary schools only. Since the working paper notes that secondary schools[30] spend more than twice as much as elementary schools spend per pupil, and are the least likely, by definition, to contain a COF, they are excluded from the calculation of the mean per-pupil expenditure value.

For elementary schools[31], the $2,003 mean per-pupil expenditure cost was selected. This value represents 8,887 of the 17,093 (52%) elementary schools presented in the working paper. Though Catholic schools represent approximately 45 percent of all elementary schools, their associated mean per-pupil expenditure estimate is not used due to the potential bias discussed above. The remaining elementary school per-pupil

[30] Defined as having a highest grade less than or equal to 12th and a lowest grade of greater than or equal to 6th.

[31] Defined as having a highest grade of less than or equal to 8th.

expenditure values are between 3 and 4 times larger than the chosen value, however these means represent schools unlikely to be affected by the LRRP rule. For example, the mean per-pupil expenditure values presented for NAIS schools (449 of the 561 remaining schools) are much higher since "a relatively large proportion of NAIS schools are boarding schools, and expenditures for dormitories are apparently included in the total operating expenditures for these schools." It is unlikely that a COF would be found in a boarding school. The remaining 112 schools are special education elementary schools, which are more costly because of their unique needs and are also less likely to contain a COF. Furthermore, as the working paper notes, "preschool is probably less expensive than other grades," and therefore, it is likely that the average across all elementary schools ($2,125) would overstate expenditures.

For combined schools, the $4,527 mean per-pupil expenditure cost is used. [32] This value represents 5,028 of the 6,285 (80%) combined schools presented in the working paper. The other mean per-pupil values are roughly double this value, pulling the mean for all combined schools up to $5,766. This greater value is not used as it, most likely overstates the expenditures, given that boarding schools and special education schools are again included in the calculation.

In order to get one private school per-pupil expenditure value, the previously discussed elementary school and combined school data were weighted. The weights were based on the current proportions of elementary schools and combined schools with either a pre-kindergarten or kindergarten program. In order to calculate the weights, this analysis used the data set underlying the National Center for Education Statistics (NCES) report entitled "Characteristics of Private Schools in the United States: Results From the 2003-2004 Private School Universe Survey." Note that it was assumed that per-student expenditures at K-terminal schools were the same as in elementary schools. [33]

In 2003-2004, there were a total of 18,289 private elementary schools and 4,338 private combined schools with pre-K or kindergarten programs. Thus, a weight of 0.81 (18,289/22,627) was attached to the mean per-pupil elementary school expenditure value and a weight of 0.19 (4,338/22,627) was attached to the mean per-pupil combined school expenditure value. This yields a final private school per-pupil expenditure value of $2,426.

Because the study is based on 1991-1992 PSS data, it was assumed that expenditure values were in 1992 dollars. Taking into account inflation, $2,426 in 1992 dollars is equivalent to $3,377 in 2006 dollars (U.S. Bureau of Labor Statistics 2006).

[32] A combined school is defined as having a highest grade less than or equal to 12^{th} and a lowest grade less than or equal to 5^{th}.

[33] A K-terminal school is defined as a school for which kindergarten is the highest grade. In the 2003-2004 PSS, K-terminals represented an estimated 22% of all private schools with either a kindergarten or pre-kindergarten program.

References:

ASTM International. Standard Practice for Clearance Examinations Following Lead Hazard Reduction Activities in Single-Family Dwellings and Child-Occupied Facilities (E 2271-05).

ASTM International. Standard Guide for Evaluation, Management, and Control of Lead Hazards in Facilities (E 2052-99).

Division of Housing and Community Renewal (DHCRb). 2005. Public Housing. http://www.dhcr.state.ny.us/ohm/progs/modern/ohmmod.htm.

Housing and Community Development Corporation of Hawaii (HCDCH). 2002. Annual Report, 2002. http://www.hcdch.hawaii.gov/02annualrpt.pdf.

Indiana Child Care Fund. 2005. "The Economic Dimensions of the Child Care Industry in Indiana: an Invisible Industry." http://www.in.gov/isdh/programs/mch/sunny_start/pdfs/Child_Care_Report_Findings.pdf. Downloaded 12/27/2006.

Iowa State University. Center for Family Policy. 2005. "Child Care, Parents, and Work: The Economic Role of Child Care in Iowa. http://www.extension.iastate.edu/cd-dial/pdf/ChildCareParents.pdf. Downloaded 12/27/2006.

Louisiana Department of Social Services. 2005. "Investing in the Child Care Industry: An Economic Development Strategy for Louisiana." http://www.dss.state.la.us/Documents/OFS/Investing_In_The_Chi1.pdf. Downloaded 12/28/2006.

Marshall University. Center for Business and Economic Research. 2005. "The Economic Impact of Early Child Development Programs in West Virginia." http://www.marshall.edu/cber/research/ECDfinalreport.pdf. Downloaded 12/28/2006.

Mid-America Regional Council. 2003. "Investing in the Child Care Industry: An Economic Development Strategy for Kansas. http://nieer.org/docs/?DocID=77. Downloaded 12/28/2006.

Mulligan, G.M., Brimhall, D., and West, J. (2005). Child Care and Early Education Arrangements of Infants, Toddlers, and Preschoolers: 2001 (NCES 2006-039). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

National Center for Education Statistics (NCES). 2006a. "Overview of Public Elementary and Secondary Students, Staff, Schools, School Districts, Revenues, and Expenditures: School Year 2004-2005 and Fiscal Year 2004." Available at: http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2007309. (Downloaded 12/22/2006).

National Center for Education Statistics (NCES). 2006b. Common Core of Data Public Elementary/Secondary School Universe Survey Data, 2004-2005." Available at: http:///nces.ed.gov/gov/ccd/pubschuniv.asp. (Accessed 12/22/2006).

National Center for Education Statistics (NCES). 2006c. Common Core of Data Local Education Agency (School District) Universe Survey Data. Available at: http://nces/ed/gov/ccd/pubschuniv.asp. (Accessed 12/22/2006).

National Center for Education Statistics (NCES). 2006d. Common Core of Data Local Education Agency (School District) Finance Survey (F-33) Data. Available at: http://nces.ed.gov/ccd/f33agency.asp. (Accessed 12/22/2006).

National Center for Education Statistics (NCES). 2006e. "Characteristics of Private Schools in the United States: Results From the 2003-2004 Private School Universe Survey." (Accessed 12/15/2006).

National Center for Education Statistics (NCES). 2006f. 2003-2004 Private School Universe Survey Data. Received from Stephen Broughman (NCES) December 15, 2006.

National Center for Education Statistics (NCES). 2006g. Crosswalk Between 2004-2005 Local Education Agency Universe Survey Data and Year 2000 U.S. Census Population Data. Table created at: http://www.nces.ed.gov/ccd/bat/index.asp (Accessed 12/15/2006).

National Center for Education Statistics (NCES). 1995. Estimates of Expenditures for Private K-12 Schools. Working Paper No. 95-17. Available at: http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=9517 (Accessed 3/26/2007).

National Economic Development and Law Center. 2004a. "The Economic Impact of the Child Care and Early Education Industry in Massachusetts." http://www.nedlc.org/index.htm. Downloaded 12/29/2006.

National Economic Development and Law Center. 2004b. "The Economic Impact of the Early Care and Education Industry in Ohio." http://www.nedlc.org/index.htm. Downloaded 12/27/2006.

National Economic Development and Law Center. 2005. "The Economic Impact of the Early Care and Education Industry in Hawaii." http://www.nedlc.org/index.htm. Downloaded 12/27/2006.

New Jersey Child Care Economic Impact Council. 2006. "Benefits for All: The Economic Impact of the New Jersey Child Care Industry." http://www.nedlc.org/index.htm. Downloaded 12/27/2006.

New York State Child Care Coordinating Council. 2004. "Investing in New York: an Economic Analysis of Early Care and Education Sector. "http://www.childcareinc.org/pubs/Economic Impact Report Website.pdf." Downloaded 12/28/2006.

Oklahoma State University. College of Business Administration. 2004. "The Economic Impact of Oklahoma's Child Care Industry. http://economy.okstate.edu/papers/okchildcareimpact2003.pdf. Downloaded 12/27/2006.

Richland County Early Education Council. 2006. "The Economic Impacts of the Child Care Industry in South Carolina." www.rcfirststeps.org. Downloaded 12/28/2006.

Stainton, John; Regan, Charleen. Protecting the Commonwealth's Investment: Securing the Future of State-Aided Public Housing. 2001. Citizens' Housing and Planning Association.

U.S. Bureau of Labor Statistics. 2005. Occupational Employment Statistics Series.

U.S. Bureau of Labor Statistics. 2006. Consumer Price Index: All urban consumers; other goods and services. Bureau of Labor Statistics, Washington, DC (Accessed 1/5/2007).

U.S. Bureau of Labor Statistics. 2007. Consumer Price Index - All Urban Consumers; Childcare and Nursery Schools. Bureau of Labor Statistics, Washington DC (Accessed 5/30/2007).

U.S. Census Bureau. 2000a. "QT-P34. Poverty Status in 1999 of Individuals." *American Fact Finder*. Available at: http://factfinder.census.gov/servlet/QTTable?_bm=y&-geo_id=01000US&-qr_name=DEC_2000_SF3_U_QTP34&-ds_name=DEC_2000_SF3_U&-_lang=en&-_caller=geoselect&-state=qt&-format= (Downloaded 11/2/2005)

U.S. Census Bureau. 2000b. "HCT23. Tenure by Poverty Status in 1999 by Year Structure Built." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/DTSubjectShowTablesServlet?_lang=en&_ts=149707416170 (Downloaded 11/9/2005)

U.S. Census Bureau. 2000c. "H11. Tenure by Race of Householder." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/DTSubjectShowTablesServlet?_lang=en&_ts=149707537374 (Downloaded 11/9/2005)

U.S. Census Bureau. 2000d. Establishment and Firm Size (Including Legal Form and Organization). *1997 Economic Census: Subject Series for Real Estate and Rental and Leasing.* Subject Series. EC97F53S-SZ. Available at: http://www.census.gov/prod/ec97/97f53-sz.pdf

U.S. Census Bureau. 2000e. "QT-P19. School Enrollment." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/QTTable?_bm=y&-geo_id=01000US&-qr_name=DEC_2000_SF3_U_QTP19&-ds_name=DEC_2000_SF3_U&-_lang=en&-redoLog=false&-_sse=on (Downloaded 11/4/05)

U.S. Census Bureau. 2000f. "P37. Group Quarters Population by Group Quarters Type." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/DTTable?_bm=y&-geo_id=01000US&-ds_name=DE (Downloaded 10/20/2005).

U.S. Census Bureau. 2001. "Poverty Thresholds for 2001 by Size of Family and Number of Related Children Under 1 (Dollars)." Available at: http://www.census.gov/hhes/poverty/threshld/thresh01.html. Downloaded 1/23/2007.

U.S. Census Bureau. 2004. "Sector 53: Industry Series: Summary Statistics for the US: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/EconSectorServlet?caller=dataset&sv_name=*&_SectorId=53&ds_name=EC0200A1&_lang=en&_ts=141736463723 (Downloaded 8/3/2005)

U.S. Census Bureau. 2005a. "Sector 23: Construction: Industry Series: Selected Statistics for Establishments by Value of Business Done: 2002." *American Fact Finder*. Available at:

http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-ds_name=EC0223I06&-_lang=en (Downloaded 11/13/2006).

U.S. Census Bureau. 2005b. "Sector 23: Industry Series: Selected Statistics for Establishments by Value of Business Done: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/EconSectorServlet?caller=dataset&sv_name=*&_SectorId=23&ds_name=EC0200A1&_lang=en&_ts=141735361508 (Downloaded 6/30/2005)

U.S. Census Bureau. 2005c. "Sector 62: Health Care and Social Assistance: Subject Series – Estab and Firm Size: Employment Size of Establishments for the United States: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-ds_name=EC0262SSSZ2&-_lang=en (Downloaded 11/14/2006).

U.S. Census Bureau. 2005d. 2002 Economic Census: Industry Series: Residential Remodelers EC02-23I-236118 (RV). Available at: http://www.census.gov/prod/ec02/ec0223i236118.pdf (Accessed 8/3/2005).

U.S. Census Bureau. 2005e. 2002 Economic Census: Construction: By Industry. Available at: http://www.census.gov/econ/census02/data/us/US000_23.HTM (Accessed 8/3/2005).

U.S. Census Bureau. 2005f. "Sector 53: Real Estate and Rental and Leasing: Subject Series - Estab & Firm Size: Revenue Size of Firms for the United States: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0200A1&-_skip=100&-ds_name=EC0253SSSZ4&-_lang=en. (Downloaded 12/19/2006).

U.S. Census Bureau. 2005g. "Sector 23: Industry Series: Detailed Statistics for Establishments: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/EconSectorServlet?caller=dataset&sv_name=*&_SectorId=23&ds_name=EC0200A1&_lang=en&_ts=141735361508 (Downloaded 6/30/2005)

U.S. Census Bureau. 2005h. "Sector 23: Construction: Industry Series: Selected Statistics for Establishments by Specialization in Types of Construction: 2002." *American Fact Finder.* Available at: http://factfinder.census.gov/servlet/EconSectorServlet?caller=dataset&sv_name=*&_SectorId=23&ds_name=EC0200A1&_lang=en&_ts=141735361508 (Downloaded 6/30/2005)

U.S. Department of Energy (DOE). 2003. Commercial Buildings Energy Consumption Survey (CBECS).

U.S. Department of Health and Human Services. 2003. "The Economic Impact of the Child Care Industry in Maine." http://www.propeople.org/ExecSum2a.pdf. 12/28/2006.

U.S. Department of Housing and Urban Development (HUD). 2003. First National Environmental Health Survey of Child Care Centers.

U.S. EPA. 2007. *Second Proposed Rule Related Addendum to Existing EPA ICR Entitled: TSCA § 402/404 Training and Certification, Accreditation, and Standards for Lead-Based Paint Activities* EPA ICR No. 1715.08; OMB 2070-0155.

U.S. Small Business Administration. 2004. "Small Business Size Standards matched to North American Industry Classification System." Available at: http://www.sba.gov/size/sizetable2002.html. (January 21, 2004).

U.S. Small Business Administration. 2005. "Non-Employer Statistics." *Firm Size Data*. Available at: http://www.sba.gov/advo/research/data.html. (Downloaded 8/3/2005).

U.S. Small Business Administration. 2006. "Small Business Size Standards matched to North American Industry Classification System." Available at: http://www.sba.gov/services/contractingopportunities/sizestandardstopics/tableofsize/SERV_TABLE_HTML.html(Downloaded 11/24/2006).

University of Connecticut. Connecticut Center for Economic Analysis. 2004. "The Economic Impact and Profile of Connecticut's ECE Industry." http://ccea.uconn.edu. Downloaded 12/28/2006.

University of South Dakota. 2004. "The Economic Impact of the Child Care Industry in South Dakota." http://www.sdvoicesforchildren.org/CCMOview.pdf. Downloaded 12/29/2006.

Voices for Virginia's Children. 2004. "Economic Impact of the Child Care Industry in Virginia." http://www.vakids.org/pubs/economic_impact.pdf. Downloaded 12/28/2006.