

Analysis of Institutional Controls at California Superfund Sites

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Abstract

Superfund legislation was originally passed in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA dictates cleanup procedures for sites added to the National Priorities List. Included in CERCLA are provisions for usage of institutional controls, which are based on reduction of risk through limiting of exposure time and pathways. The text of this legislation is broad, leading to subjective cleanup standards. This paper serves to analyze these standards in two different methods – First, whether these standards promote unsafe cleanup and second, whether these subjective standards are used more toward certain subgroups of the entire population. My work found that institutional controls are implemented in 21 of the final 45 study sites. Additionally, the results of this study indicate that statistical significance was found between instances of institutional controls and community size and the size of the minority population in the same area as the Superfund site.

Introduction

The Environmental Protection Agency's Superfund program was set forth in the Comprehensive Environmental Response, Liability and Compensation Act. Originally passed in 1980, Superfund was to have cost much less than present day cleanups. In the past they averaged \$25.7 million each, at an annual cost of over \$1.4 billion in the peak year of 1995 (Viscusi and Hamilton 1996).

Currently there are some 1,300 Superfund sites on the National Priorities List. These sites receive cleanup oversight by the Federal EPA. Eighty-three sites are located in the state of California and have reached a Record of Decision (ROD)— a contract that the responsible party helps to create and ratifies. Each ROD has cleanup targets and expectations that the responsible party meet through its funding of the cleanup.

According to the EPA, the purpose of the remedy selection is to implement remedies that eliminate, reduce, or control risks to human health and the environment. Risk assessment is the identification of potential adverse effects to humans or ecosystems resulting from exposure to environmental hazards.

Risk assessment is primarily composed of three broad categories. The amount of risk to human health a site causes is the composite of the amount of toxic materials located on the site, the pathway efficiency of the site, and the exposure time that a human would be subject to the pathways. The pathways are created based on many assumptions and estimations such as contaminated medium or medium location. Traditional or conventional treatment targets a reduction for toxic waste present in the site, while new options for protecting human health (such as institutional controls) use reductions the pathway efficiency or reductions the exposure time to reduce the human health risk. The Environmental Law Institute states that institutional controls “impose limitations on land uses in specific contaminated areas in lieu of requiring a more comprehensive cleanup.” They continue by stating that cost effectiveness is achieved when cleanup standards are made consistent with the future usage of the site (Environmental Law Institute 1995).

Institutional Controls According to the International City/County Management Association (ICMA), institutional controls are “legal mechanisms employed at contaminated sites to ensure that human and environmental health will be protected as long as

contamination remains on site” (ICMA). The three categories for institutional controls that the ICMA studied were traditional zoning, groundwater restrictions, and deed restrictions.

The EPA does use institutional controls as remedies to counteract the human health risk posed by Superfund sites. CERCLA includes expectations on the usage of institutional controls. The following appears from the Federal Register:

EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long term-threat or where treatment is impracticable.

EPA expects to use institutional controls such as water use and deed restrictions to supplement engineering controls as appropriate for short and long-term management to prevent or limit exposure to hazardous substances, pollutants, or contaminants. Institutional controls may be used during the conduct of the remedial investigation/feasibility study (RI/FS) and implementation of the remedial action and, where necessary, as a component of the completed remedy. The use of institutional controls shall not substitute for active response measures (e.g., treatment and/or containment of source material, restoration of ground waters to their beneficial uses) as the sole remedy unless such active measures are determined not to be practicable, based on the balancing of trade-offs among alternatives that is conducted during the selection of remedy. (57 FR 28087)

The guidelines set forth for the EPA are limited at best and are supplemented by additional rulings. Institutional controls are based on the formulation of risk based on factors determined by the EPA. This risk assessment uses hazard identification, dose-response, assessment, exposure assessment, and risk characterization for its model. According to the EPA, these factors can include age, gender, and ethnic groups.

With respect to the decision making process, the EPA has acknowledged that there are no guidelines. They further recognize that the risk management decisions greatly influence the addressing of environmental equity issues (Environmental Protection Agency 1992).

The Superfund Amendments and Reauthorization Act (SARA) of 1986 gave EPA officials a list of criteria on which cleanup was to be based. The EPA was to choose based on long-term effectiveness and permanence; reduction of toxicity, mobility; and cost-effectiveness. The EPA also stated that carcinogenic contaminants would represent an excess upperbound lifetime cancer risk to an individual to between 10^{-4} and 10^{-6} lifetime

excess risk. Any non-carcinogenic compounds were to have no lifetime risk implications. (Viscusi and Hamilton 1996)

These targets are goals to be achieved by means agreed to by the responsible party, and the EPA. Institutional controls are important because as long as they are found less costly than their traditional cleanup counterparts, they are authorized for usage.

Risk assessment does have subjective portions to the process. The National Research Council found that there might be as many as fifty opportunities for discretionary judgements in the process of preparing risk assessments. Examples of these decisions are stacked sampling – where samples from sites are not taken randomly, and exposure pathway dismissal (National Research Council 1983).

Environmental Justice Environmental Justice has been defined as the pursuit of equal and fair environmental protection. On February 11, 1994, President Bill Clinton signed Executive Order 12898 on environmental justice. This order made it the nation's goals to have no segment of the population suffer disproportionate human health or environmental effects. Additionally, public participation was emphasized in the order (Environmental Protection Agency 1995).

Some research has suggested that the nation's environmental laws, regulations, and policies are not uniformly applied (Bullard 1994). Another group notes that there is a racial divide in the way the U.S. government cleans up toxic waste sites and punished polluters. White communities see faster action, better results and stiffer penalties than communities where Blacks, Hispanics and other minorities live. This unequal protection often occurs whether the community is wealthy or poor (National Research Council 1983).

Another one of the issues associated with using Superfund sites as an indicator of environmental justice is that there has been evidence that sites located in minority communities take longer to be evaluated and added to the National Priorities List. The additional time has been estimated to be about 20% longer for sites in minority areas (Bullard ed. 1996).

Environmental justice is also more than just the study of the placement of hazardous waste sites in minority and poor areas. The next step in environmental justice is to examine the social and economic variables that shape the decision making process. Stretsky and Hogan (1998) write that examination of Superfund sites helps the environmental justice field

in two different aspects. First, they state that identifying the statistical correlation between the existence of sites and race, ethnicity, or income points to environmental injustice in policy and previous actions. Secondly, they state that analysis of the data should include comparisons between factors positively associated with placement of sites.

This paper has two goals. First, there will be a simple count of the sites containing institutional controls. An examination of the Records of Decision produced by the responsible party of the cleanup and the EPA will be sufficient to determine the usage of institutional controls. The group of California Superfund sites was selected because of its relative ease in data collecting, compared to a random sampling of the entire country's Superfund sites. The group of sites will be revised to reflect a consistent group for analysis. In addition, the statistical significance of the demographics of the location of the Superfund site and the cleanup method used for the site will be examined.

The first research goal is to determine the prevalence of institutional controls in selection of a remediation plan. The second research goal is to determine the statistical significance of the occurrence of institutional controls with respect to community demographics.

Methods

One question that should be asked is how prevalent are institutional controls? If the basis of institutional controls is on controversial risk assessment techniques, then how often has it been used?

Nationally, there are over 1,300 Superfund sites that have reached a Record of Decision. This group first was narrowed to the 83 sites that completed RODs. However, some of these sites were removed from the National Priorities List before the completion of their cleanup. The aforementioned sites were removed from the grouping. Several sites were also federal facilities. Federal facilities undergoing Superfund cleanup have lead agencies other than the national EPA. The change in power structure, is sufficient to eliminate the group of federal facilities from the study group. Finally, all sites without a responsible party were also removed because the structure of the ROD contract differed from those with a responsible party. With these steps taken, 45 sites remained in the study group.

Environmental Justice is other component of the analysis. Research in the area of institutional controls has been limited and is needed in respect to the field of environmental justice (Barkenbus et. al. 1996).

Using the records of decision, the zip codes of the 45 California Superfund sites in the study group were determined. Census information from the 1990 census was available from the government. The following was used from the 1990 census: total population, median household income, per capita income, Black population, White population, Asian population, Native American population, Hispanic population.

The average amount of these groups was determined with respect to the presence of deed restrictions, RCRA caps, and overall usage of institutional controls (deed restrictions and RCRA caps). The averages were then compared using an independent t-test.

Non-white population was obtained by subtracting the white population from the total population for the area. The t-test was then applied to this group as well. With respect to the surrounding community statistic, the following groups were used: Residential, Commercial, Industrial, Light Industrial, Agricultural, and Not Developed. A chi-square test was then applied to this group.

Site size was determined from the records of decision as well. Sites were grouped into two categories – either larger or smaller than 10 acres. A t-test was then applied to compare the means of the two groups.

Finally, the identification of the primary contaminant was determined from the record of decision. The contaminant was determined to either be a volatile organic compound (VOCs) or categorized as a non-VOCs contaminant. A chi-square test was used to determine the significance of the categorization.

Results

Of the 45 sites in the study group, 13 had deed restrictions and 18 had RCRA caps. Overall, 21 of the 45 sites had institutional controls implemented as part of the final remedial action.

	Total Population	Household Median Income	Per capita Income
Deed Restrictions & RCRA Caps	*	*	t < 0.05
Deed Restrictions	*	*	t < 0.05
RCRA Caps	t < 0.05	*	t < 0.05

* not statistically significant

Table 1: Statistical significance of differences of various community demographics

Total population was inversely significant (to 95% confidence) for the usage of RCRA caps. The 18 sites that had RCRA caps averaged 22,868 persons in the zip code, while the 27 sites that did not contain RCRA caps averaged 32,851 persons.

Per capita income was also inversely related (statistically with 95% confidence) to the presence of RCRA caps. The per capita annual income for zip codes with capping was \$13,454, while non-capped sites had per capita income of \$17,921. Similarly, the per capita income was significantly different (to 95% confidence) between deed restricted and non-deed restricted sites. Average income for the areas that contained deed restricted sites was \$13,033 while non-deed restricted areas had average per capita income of \$17,394. For all institutional controls, which are both deed restrictions and caps, per capita income was again significantly different for areas containing sites with ICs and sites not using ICs. Per capita income averaged \$17,889 for areas with sites without ICs and \$14,129 for areas with sites with ICs. Median household income, although higher in areas without ICs (and deed restrictions and RCRA caps separately), was not significantly different.

	% Black	% Asian	% Hispanic
Deed Restrictions & RCRA Caps	*	*	*
Deed Restrictions	*	*	t < 0.05
RCRA Caps	*	*	t < 0.05

* not statistically significant

Table 2: Statistical significance of differences of various community demographics

There was no significant difference between percentage of Blacks and Asians with respect to the difference in cleanup methods used at Superfund sites. The percentage of Hispanics in the same area as either a deed restricted or capped Superfund site was significantly higher than the percentage of Hispanics in areas where the Superfund was not to

use institutional controls. The average Hispanic percentage in areas with a deed restricted Superfund site was 31.1%, while the average Hispanic percentage in areas without the deed restriction was 18.6%. The average Hispanic percentage in an area with a RCRA capped Superfund site was 29.8%, while the average Hispanic percentage in an area without the capped site was 17.2%. For the overall usage of ICs, there is no significance in the difference in the size of the Hispanic population in the areas surrounding the sites.

	% Non-white
Deed Restrictions & RCRA Caps	*
Deed Restrictions	t < 0.10
RCRA Caps	*

* not statistically significant

Table 3: Statistical significance of differences of non-white population versus cleanup methods

The average percentage of non-whites in an area with a deed restricted Superfund site was 50.2%, while the average percentage of non-whites in an area with a non-deed restricted site was 37.4%. There was no statistical significance between the population with respect to the usage of RCRA caps or the overall usage of institutional controls.

	Surrounding Community	Size of Site	Contaminants of Site
Deed Restrictions & RCRA Caps	*	*	X < 0.01
Deed Restrictions	*	*	X < 0.10
RCRA Caps	*	*	X < 0.01

* not statistically significant

Table 4: Statistical Significance of the correlation between various factors and the usage of institutional controls.

Chi square tests showed that there was significant correlation between the contaminants of the site and the methods chosen for cleanup. Of the 27 sites with VOCs, 6 of them were capped, while 12 of the 18 non-VOCs contaminated sites had remedies that included RCRA caps. Additionally, 5 of the 27 VOCs contaminated sites had deed restrictions, while 8 of the 18 non-VOCs sites were deed restricted. Overall, the 8 of the 27 VOCs sites had implemented institutional controls, and 13 of the 18 non-VOCs sites had institutional controls.

Discussion

The usage of institutional controls as in the remedial action has been fairly implemented as evidenced by the 21 California sites that contain a version of institutional control. In addition, the seeming difference in community demographics between sites that have implemented institutional controls and those that have not, point to a more complex issue.

Evaluation of ICs The ICMA report found a lot of information about local interaction with institutional controls. In their survey of local governments, 26% of the respondents reported recording institutional controls in central repositories. Additionally, 59% of the respondents noted making the appropriate changes on zoning maps and 48% actually making deed restriction changes on site deeds (ICMA).

Locally, institutional controls were evaluated in two cases. Although they were not part of the study group, they do provide insight as to the effectiveness of institutional controls. In tours conducted of two such sites in November 1999, several of the institutional controls used for remediation were identified.

The first site was Hunters Point Naval Shipyard and Annex located in southeast San Francisco, CA. The Record of Decision for this site was signed in November of 1995, although the U.S. Navy has not used the base since 1978. Hunters Point has yielded a mixed result. Deed restrictions were placed on usage of Building 606 on the Hunters Point Site. In leasing the building, the San Francisco Police Department agreed to put an asphalt helicopter pad of a certain size on the property. The purpose of the deed restriction was to limit exposure pathways from the soil around the building. After signing the agreement, the San Francisco Police Department proceeded to create a smaller helicopter pad than previously specified. A court battle ensued, with the SFPD attempting to change the text of the ROD to reflect its new helicopter pad size. (Bloom 1999 pers. comm.)

This incident showed that institutional memory loss did not simply occur, but was encouraged. However, the actual text of the Record of Decision shows institutional controls quite differently. Hazardous groundwater levels in parcel B were to be monitored by the US Navy. An increase in vinyl chloride in the groundwater would trigger contingency plans paid for and executed by the US Navy to clean up the additional contamination. (CERCLIS – Comprehensive Environmental Response Compensation, and Liability Information System)

Alameda Naval Air Station has also been placed on the National Priorities List. This site used temporary cleanup during the Remedial Investigation/Feasibility Study phase to expedite the transfer of the lands to the city of Alameda. An example of an institutional control that has not accounted for potential breeches are the soccer fields on the site. Grass was grown on the site to prohibit development and to reduce pathway efficiency. These fields were then turned into athletic fields, and contaminant exposure is increased due to turnover in the soil. (Bloom 1999 pers. comm).

The significance of the data collected thus far is again mixed. The large distribution of institutional controls among sites is not surprising if the EPA expects the usage of such controls as a supplement for remediation. The additional data that will provide more context for the usage of institutional controls will be the comparison between dates of EPA regulated institutional controls and non-regulated controls. A showing of prevalence of controls in pre-regulated cleanup might indicate that usage was not intended as a supplement, but rather as a cost reducing method.

The differences in effectiveness of institutional controls in a ROD, compared to that in actuality would need to be examined more carefully. If in the case of the ROD for Hunters Point Naval Shipyard, in which no agency could enforce a deed restriction, then there seems little that can be achieved when a party fails to comply with the ROD.

Institutional controls, however, have more problems than just risk miscalculation. Breeches in the site because of future construction, or even animals may cause the control to fail. The lack of a required contingency plan, would not account for new remedies, new information, or failed institutional controls negatively impacts the effectiveness of the treatment. Institutional memory loss as well is an important factor. This memory loss occurs when a party decides to breach the original institutional control without its own knowledge.

In fact in the ICMA study, the majority of respondents (63%) said that breaches in the institutional controls on a site were highly or somewhat likely. Following up on that question, 30% of the respondents reported that no formal inspection schedule was set up to evaluate the site as required by law (ICMA).

Environmental Justice Results Several issues of methodological concern are present when environmental justice research is conducted. The first is the choice of the units of comparison for Superfund placement, or in the case of this study, the occurrence of

institutional controls. Studying smaller units of association, provide better methodology (Anderton 1996).

The ongoing debate over the usage of zip codes or census tracts has been one of great importance to the study of environmental justice. While Anderton (1996) advocates census tracts and Bullard (1996) advocates block groups within census tracts, Mohai (1996) argues that the differences in the results using census tracts did not differ significantly from those obtained from using zip codes. Additionally, smaller tracts sometimes suppress identifying data. Coupled with the high cost of obtaining detailed community information from across California for census block groups, the measurement of choice must be zip codes. (Yandle and Burton 1996).

Another issue is that that of causal order. Causal order argues that environmental injustice occurs when sites are placed into poor or minority communities. Communities that currently contain non-poor or non-minority citizens and that have demographic shifts to poor or minority communities are not seen as being affected by environmental injustice. Stretesky and Hogan (1998) argue that environmental injustice, on the other hand, is indeed shown when community demographics change.

Finally, one unaccountable problem occurs with the analysis of Superfund sites. The current list of Superfund sites is constantly changing and there is no feasible way of anticipating the discovery of new sites. If there have been simply more sites found in a community of a certain demographic group, there would be a significant effect on the analysis of the data.

With respect to the results of the study, total population is inversely related to the usage of institutional controls. The usage of zip codes is a proxy for density as opposed to census tracts, since each tract roughly contains the same number of people (Yandle and Burton 1996). This can be most likely explained by the usage of cost-benefit analysis for cleanup methods. With the surrounding population less likely to be effected because of the less dense community, an institutional control would be implemented.

Household median income is most commonly used to compare the financial wealth of the community with other communities. Although they median income is higher in those sites it was again not significantly different. Per capita income on the other hand, did show a significant difference. Per capita income measures the income divided among all people in

the area. This may point to lower overall wealth in these communities, although this is not supported by any previous work.

In ethnic correlation with the implementation of ICs, it is interesting to note that only Hispanics have significant differences in population among sites with or without ICs. This can be due to the community patterns of Blacks. The Black population makes up about 7.4% of California's total population. Yet, in areas with Superfund sites, there are only three sites with percentages of the Black population greater than the average. An overall geographic clumping of the Black population into concentrated regions causes this discrepancy. It is interesting to note that other studies have found a strong relationship between the locations of hazardous waste landfills and socio-economic demographics of the community. In a General Accounting Office study, African Americans were over represented in sites containing such waste sites. African American neighborhoods contained 60% of hazardous waste sites, while the total population of African Americans in the region (EPA region IV) amounted to 20%. (Bullard ed. 1996).

The significance difference in the Hispanic population and the overall non-white population in areas with and without institutional controls and more research needs to be conducted to further confirm these results.

Finally, the correlation between site contaminants and the cleanup methods shows that the contaminants are taken into account when institutional controls are implemented. It does also point to the extreme possibility that it is mere coincidence that there is racial bias (both direct and indirect) shown in the data.

Conclusion

Institutional controls are an interesting facet of cleanup. They are widely used and seen by the EPA officially as a way to minimize health risk at the lowest cost. However, through a variety of reasons, institutional controls are not entirely effective, and in some extreme cases, entirely ineffective.

Specific studies of sites need to be conducted in order to determine the actual effectiveness of the controls, especially in light of the significance found between the makeup of the community and the prevalence of the controls. Additional research comparing

public participation and the occurrence of institutional controls would add to the ongoing discussion as to the cause of the injustice.

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