



# History, Evolution & Context of the Federal Superfund Program

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Drilling operations to verify the status of the Bruin Lagoon hazardous waste cleanup.

- Societal context of the creation of the Federal Superfund Program
- The regulatory process created to implement the Federal Superfund Program
- Evolution of the program as sites moved through the regulatory process
- Accomplishments and future directions for the Federal Superfund Program

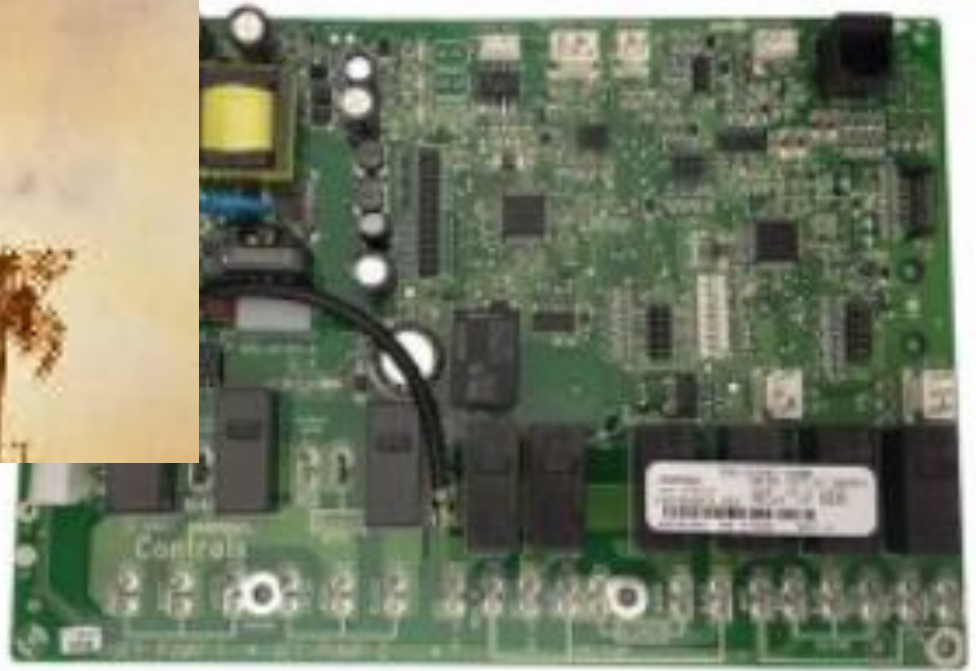
- Societal context of the creation of the Federal Superfund Program







Chlorinated solvents were used to clean the parts.





## Purge and Trap Method

Determination of Dissolved Gases in Aqueous Solutions by Gas Chromatography. Swinnerton, Linnenbom and Cheek. *Analytical Chemistry*. 32(4): 483-485 (1962).

Bellar, T., "Measurement of Volatile Organic Compounds in Soils Using Modified Purge-and-Trap and Capillary Gas Chromatography/Mass Spectrometry", U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Cincinnati, OH, November, 1991. EPA Method 5030C



Starting in the 1950s and 1960s, animal testing, epidemiology studies and a more detailed understanding of the interactions of organic chemicals and human tissues made it possible to project dose/response curves for exposure to a variety of industrial chemicals.



1979



Valley of the Drums, near Louisville, Kentucky.

The Valley of the Drums drew national attention as one of the country's worst abandoned hazardous waste sites. Thousands of drums--accumulated over a 10-year period--were strewn in pits and trenches over a 23-acre site.

1980

Toxic waste bursts into flames at a waste storage facility in Elizabeth, New Jersey

The fire burns for 10 hours as State officials issue an environmental advisory closing schools and urging residents to close all doors and windows and remain indoors.



# The Love Canal Tragedy by Eckardt C. Beck Administrator EPA Region 2.

[EPA Journal - January 1979]



Quite simply, Love Canal is one of the most appalling environmental tragedies in American history.

But that's not the most disturbing fact.

What is worse is that it cannot be regarded as an isolated event. It could happen again--anywhere in this country--unless we move expeditiously to prevent it.

Love felt that by digging a short canal between the upper and lower Niagara Rivers, power could be generated cheaply to fuel the industry and homes of his would-be model city. The canal was never completed. In the 1920s...the canal was turned into a municipal and industrial chemical dumpsite.

In 1953, the Hooker Chemical Company, then the owners and operators of the property, covered the canal with earth and sold it to the city for one dollar.

In the late '50s, about 100 homes and a school were built at the site.



February, 1978 *EPA Journal*, Beck wrote:

I visited the canal area ... Corroding waste-disposal drums could be seen breaking up through the grounds of backyards.

Trees and gardens were turning black and dying.

One entire swimming pool had been had been popped up from its foundation, afloat now on a small sea of chemicals.



February, 1978 *EPA Journal*, Beck wrote:

Puddles of noxious substances were pointed out to me by the residents.

Some of these puddles were in their yards, some were in their basements, others yet were on the school grounds.

Everywhere the air had a faint, choking smell.

Children returned from play with burns on their hands and faces.



In 1978 Lois Gibbs discovered that her 7-year-old son's elementary school in Niagara Falls, New York was built on a toxic waste dump.

Subsequent investigation revealed that her entire neighborhood, Love Canal, had been built on top of this dump.

Gibbs organized her neighbors and formed the Love Canal Homeowners Association. After years of struggle, 833 families were eventually evacuated, and cleanup of Love Canal began.



*Mark Zanatian, one of the children endangered by the Love Canal Chemicals under 99th Street, waves a banner in protest during a neighborhood protest meeting Friday, Aug. 5, 1978. AP Photo/DS*



*A protest sign stands in front of an evacuated and boarded up house in the Love Canal neighborhood in Niagara Falls, June 30, 1981. Bettmann/CORBIS*

On August 7,... President Carter approved emergency financial aid for the Love Canal area (the first emergency funds ever to be approved for something other than a "natural" disaster), and the U.S. Senate approved a "sense of Congress" amendment saying that Federal aid should be forthcoming to relieve the serious environmental disaster which had occurred.





Administrator Beck:

We suspect that there are hundreds of such chemical dumpsites across this Nation.

Through the national environmental program it administers, the Environmental Protection Agency is attempting to draw a chain of Congressional acts around the toxics problem.

The Clean Air and Water Acts, the Safe Drinking Water Act, the Pesticide Act, the Resource Conservation and Recovery Act, the Toxic Substances Control Act -- each is an essential link.

Administrator Beck:

Regarding the missing link of liability, if health-related dangers are detected, what are we as a people willing to spend to correct the situation? How much risk are we willing to accept? Who's going to pick up the tab?

One of the chief problems we are up against is that ownership of these sites frequently shifts over the years, making liability difficult to determine in cases of an accident. And no secure mechanisms are in effect for determining such liability.

- The regulatory process created to implement the Federal Superfund Program

1976

Resource Conservation and Recovery Act (RCRA)

Responding to public concern over "midnight dumping" of toxic wastes, Congress establishes authority for controls over hazardous waste from generation to disposal under the Resource Conservation and Recovery Act (RCRA).

1976

## Toxic Substances Control Act (TSCA)

Congress enacts the Toxic Substances Control Act (TSCA), which provides EPA with authority to protect public health and the environment through controls on toxic chemicals that pose an unreasonable risk of injury.



# 1978

Love Canal heightens public awareness of the grave and imminent perils of unregulated hazardous waste dumping in communities.

President Carter declares a State of Emergency at Love Canal, New York.

1980

Congress passes the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) to address the dangers of abandoned or uncontrolled hazardous waste dumps by developing a nationwide program for: emergency response; information gathering and analysis; liability for responsible parties; and site cleanup. CERCLA also creates a Trust Fund (or "Superfund") to finance emergency responses and cleanups.

1986

Congress passes the Superfund Amendments and Reauthorization Act (SARA), which in part: strengthened CERCLA's enforcement provisions; encouraged voluntary settlements instead of litigation; stressed the importance of permanent remedies and innovative treatment technologies; increased state involvement in every phase of the Superfund program; increased the focus on human-health problems posed by hazardous waste sites; and encouraged greater citizen participation in how sites are cleaned up.

1986

SARA added certain specific provisions to CERCLA that were applicable to the cleanup of contaminated sites at **federal facilities**. Under CERCLA Section 120, federal agencies are required to comply with CERCLA in the same manner and to the same extent as non-governmental entities..

1986

SARA increased the size of the trust fund to \$8.5 billion.

SARA also required EPA to revise the Hazard Ranking System (HRS) to ensure that it accurately assessed the relative degree of risk to human health and the environment posed by uncontrolled hazardous waste sites that may be placed on the National Priorities List (NPL).

1986

SARA required Superfund actions to consider the standards and requirements found in other State and Federal environmental laws and regulations.



1989

EPA initiates "Enforcement First" policy where EPA gives first priority to finding the parties who are potentially responsible for a release and gets them to address the problem they created.

## 1990

President George Bush signed the Defense Base Closure and Realignment Act , which established the Defense Base Closure and Realignment (BRAC) Commission "to provide a fair process that will result in the timely closure and realignment of military installations inside the United States."

More than 350 installations have been closed in four BRAC rounds: 1989, 1991, 1993, and 1995. The most recent round of BRAC was completed in the fall of 2005 and became law in November 2005.

- The regulatory process created to implement the Federal Superfund Program

PA/SI

NPL Listing

RI/FS

ROD

RD/RA

Construction  
Completion

Post  
Construction  
Completion

NPL Delete

Reuse

## Preliminary Assessment/Site Inspection

Investigations of site conditions. If the release of hazardous substances requires immediate or short-term response actions, these are addressed under the Emergency Response program of Superfund.

In FY 2013, the Superfund Remedial Program completed or provided oversight at 304 removal actions to address immediate and substantial threats to communities.

PA/SI

NPL Listing

RI/FS

ROD

RD/RA

Construction  
Completion

Post  
Construction  
Completion

NPL Delete

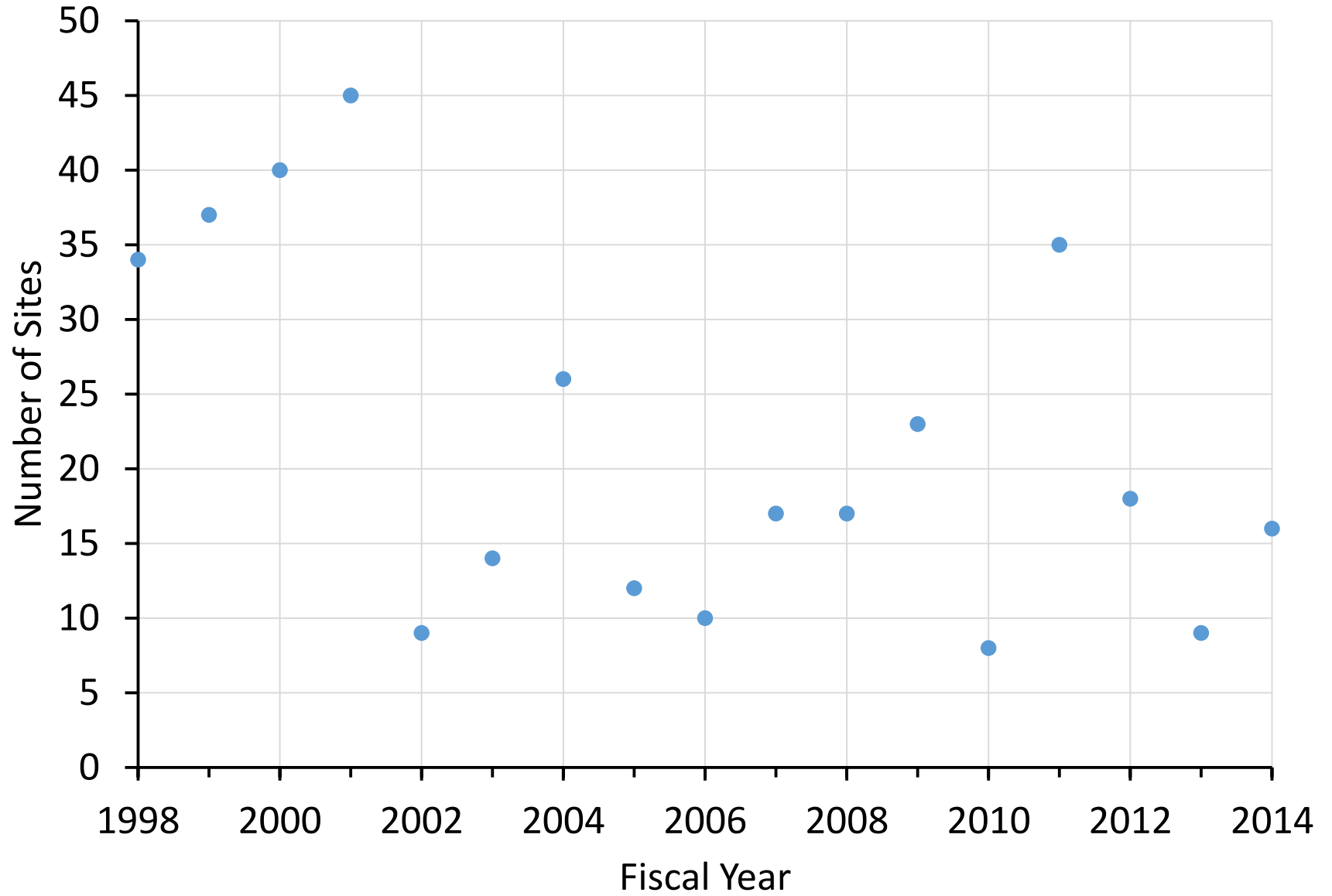
Reuse

## National Priorities List (NPL) Site Listing Process

A list of the most serious sites identified for possible long-term cleanup.

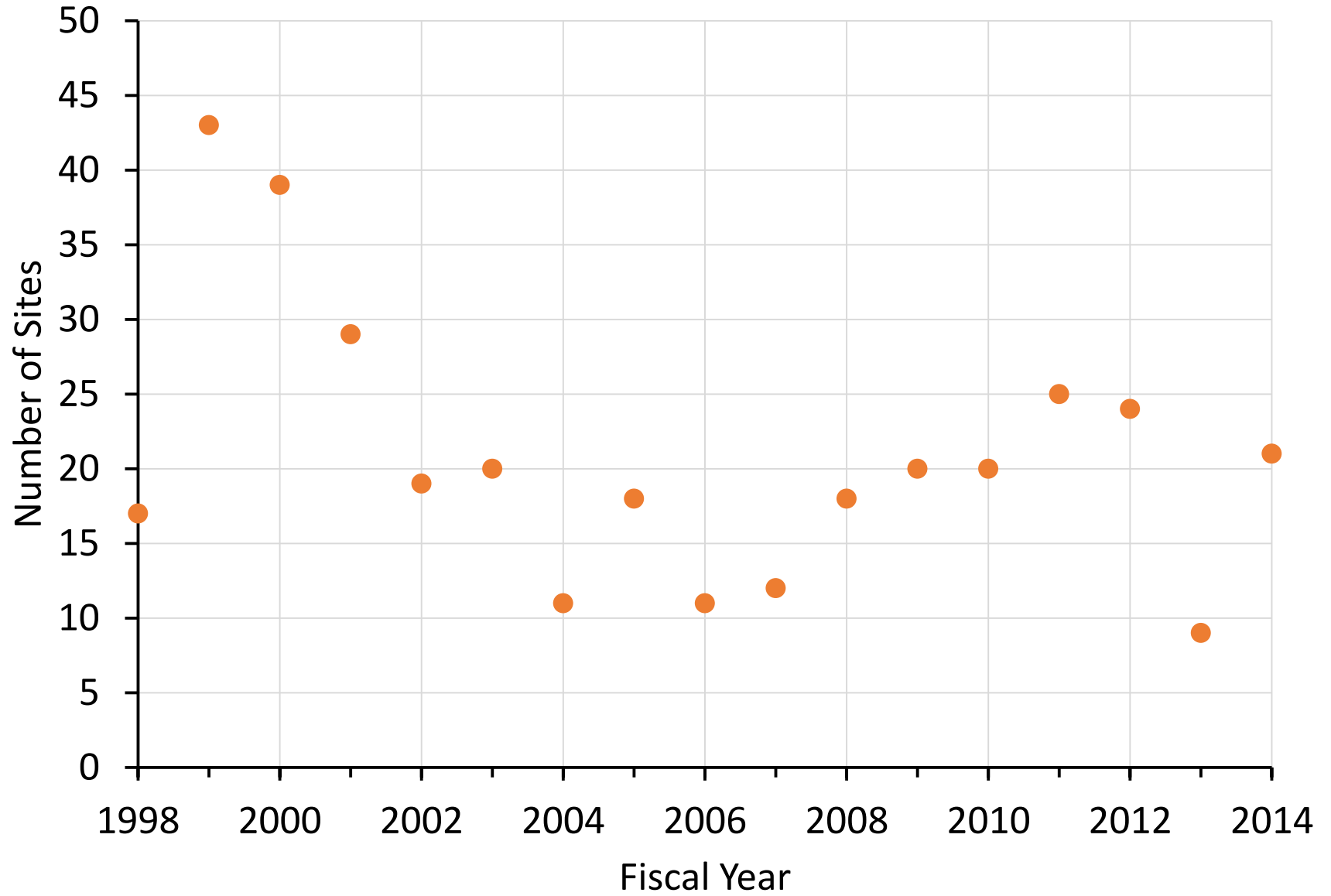
As of February 2014, there are 1,694 sites on the NPL.

# Proposed for NPL

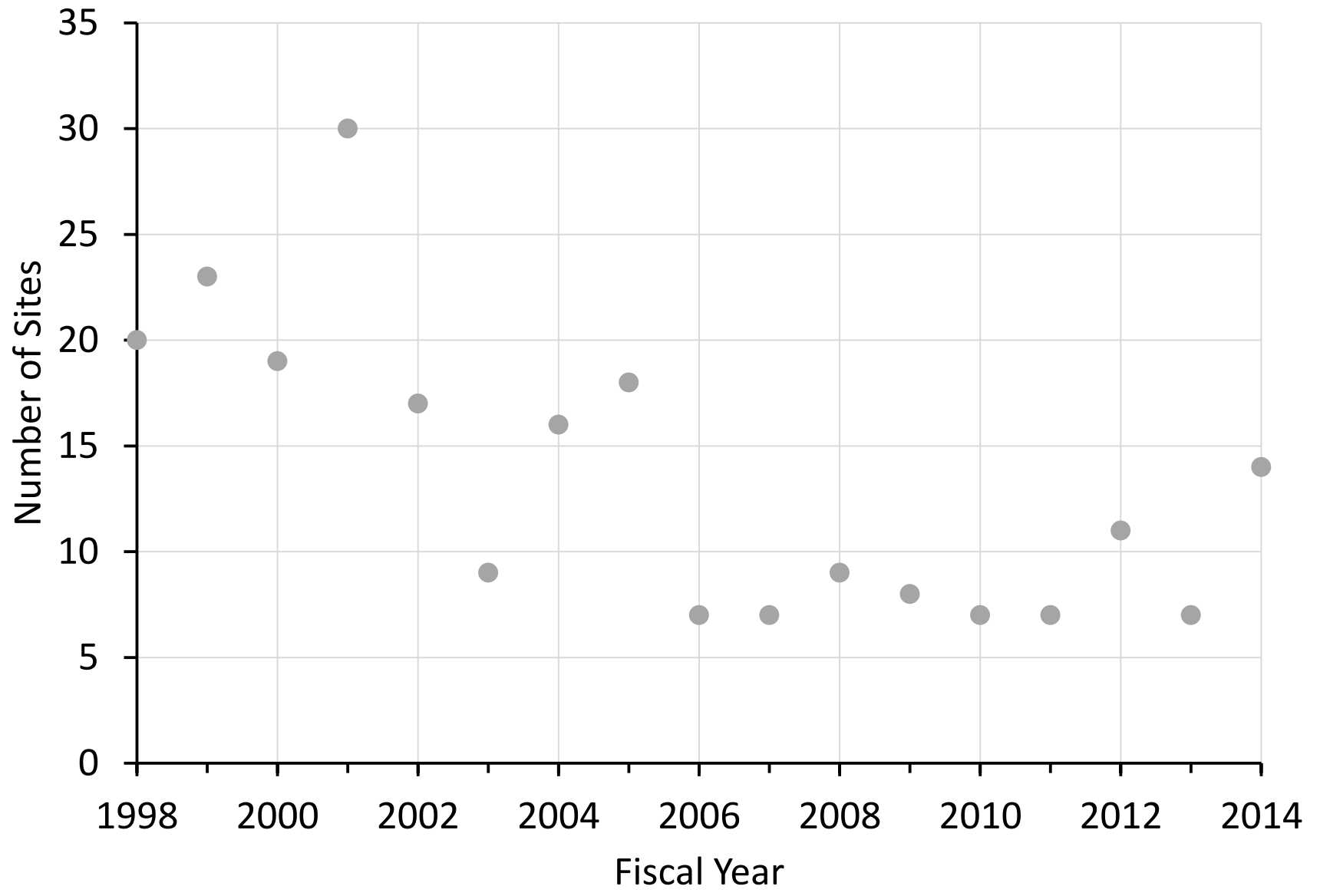




# Added to NPL



# Deleted from NPL



PA/SI

NPL Listing

RI/FS

ROD

RD/RA

Construction  
Completion

Post  
Construction  
Completion

NPL Delete

Reuse

## Remedial Investigation/Feasibility Study

Determines the nature and extent of contamination. Assesses the treatability of site contamination and evaluates the potential performance and cost of treatment technologies.

215 sites (13 percent) are pending investigation or being investigated.

PA/SI

NPL Listing

RI/FS

ROD

RD/RA

Construction  
Completion

Post  
Construction  
Completion

NPL Delete

Reuse

## Records of Decision

Explains which cleanup alternatives will be used at NPL sites.

In FY 2013, the Superfund Remedial program selected 61 cleanup remedies, amended 14 cleanup plans, and issued 36 explanations of significant differences.

PA/SI

NPL Listing

RI/FS

ROD

RD/RA

Construction  
Completion

Post  
Construction  
Completion

NPL Delete

Reuse

Preparation and implementation of plans and specifications for applying site remedies. The bulk of the cleanup usually occurs during this phase.

### Remedial Design/Remedial Action

310 sites (18 percent) are undergoing cleanup construction.

In FY 13, started 58 new remedial construction projects, including 16 EPA-funded projects and 42 PRP-funded projects, and continued to conduct or provide oversight at more than 400 remedial construction projects started in prior fiscal years.

PA/SI

NPL Listing

RI/FS

ROD

RD/RA

Construction  
Completion

Post  
Construction  
Completion

NPL Delete

Reuse

## Remedial Design/Remedial Action

In FY 13, EPA was unable to proceed with new construction work at 22 NPL sites with projects ready to start construction in FY 2013.



PA/SI

NPL Listing

RI/FS

ROD

RD/RA

Construction  
Completion

Post  
Construction  
Completion

NPL Delete

Reuse

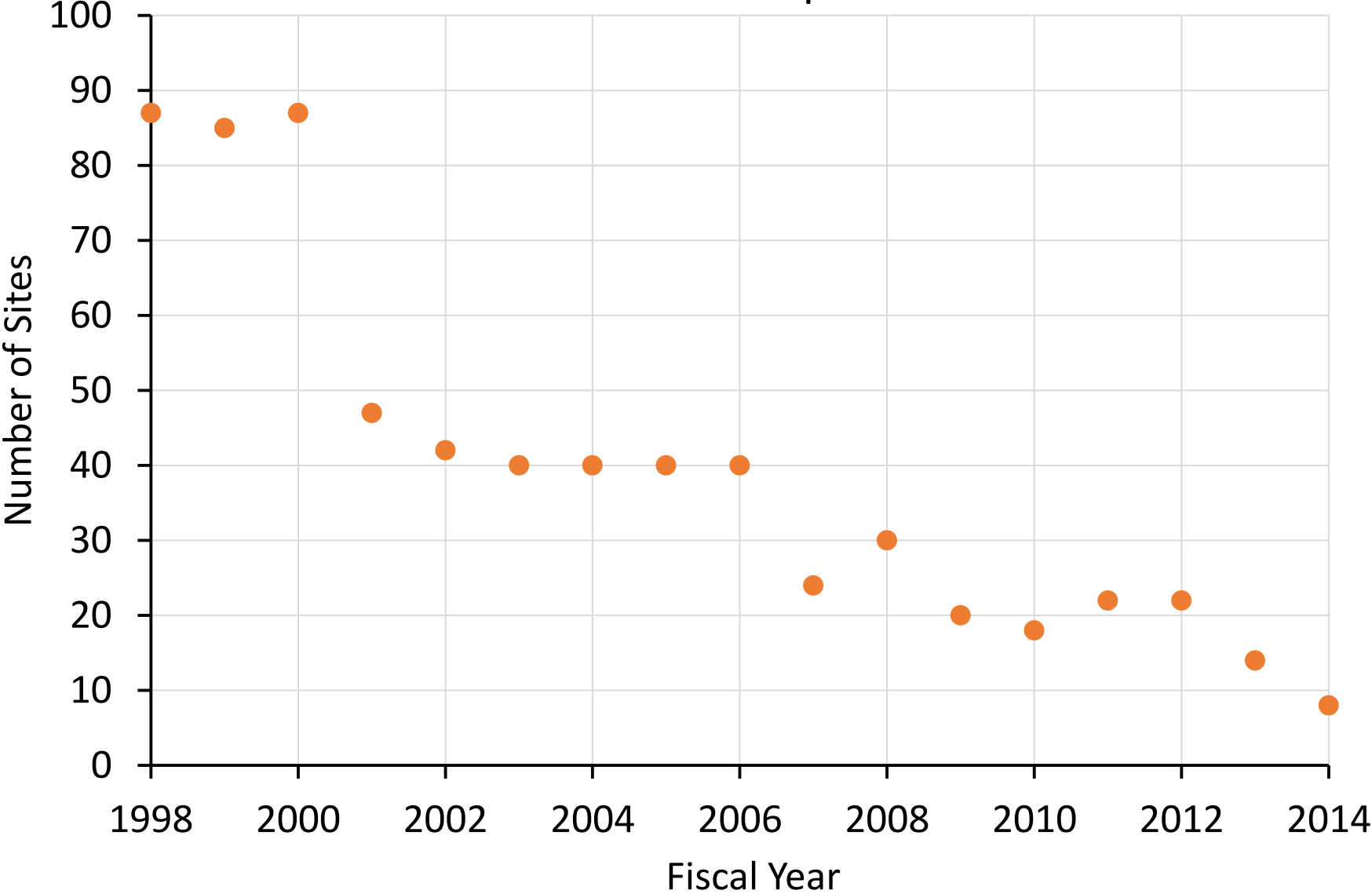
Identifies completion of physical cleanup construction, although this does not necessarily indicate whether final cleanup levels have been achieved.

## Construction Completion

1,157 sites (68 percent) are construction completed or are deleted.

In FY 2013, completed all physical construction of the cleanup remedy at 14 sites across the country

# Construction Completions



PA/SI

NPL Listing

RI/FS

ROD

RD/RA

Construction  
Completion

Post  
Construction  
Completion

NPL Delete

Reuse

Ensures that Superfund response actions provide for the long-term protection of human health and the environment. Included here are Long-Term Response Actions (LTRA), Operation and Maintenance, Institutional Controls, Five-Year Reviews, Remedy Optimization.

### Post Construction Completion

In FY 13, 56 NPL sites had all long-term protections, including institutional controls, in place necessary for anticipated use, bringing the cumulative total of sites ready for anticipated use to 662 (470,000 acres).

PA/SI

NPL Listing

RI/FS

ROD

RD/RA

Construction  
Completion

Post  
Construction  
Completion

NPL Delete

Reuse

## Post Construction Completion

In FY 2013, the Superfund Remedial program conducted 233 five-year reviews, including 30 reviews at Federal facility sites, to ensure site remedies remain protective.

PA/SI

NPL Listing

RI/FS

ROD

RD/RA

Construction  
Completion

Post  
Construction  
Completion

NPL Delete

Reuse

Removes a site from the NPL once all response actions are complete and all cleanup goals have been achieved.

In FY 2013, the Superfund Remedial program Deleted 11 sites from the NPL, and at 2 other sites, deleted a portion of the site from the NPL.

**National Priorities List Deletion**

PA/SI

NPL Listing

RI/FS

ROD

RD/RA

Construction  
Completion

Post  
Construction  
Completion

NPL Delete

Reuse

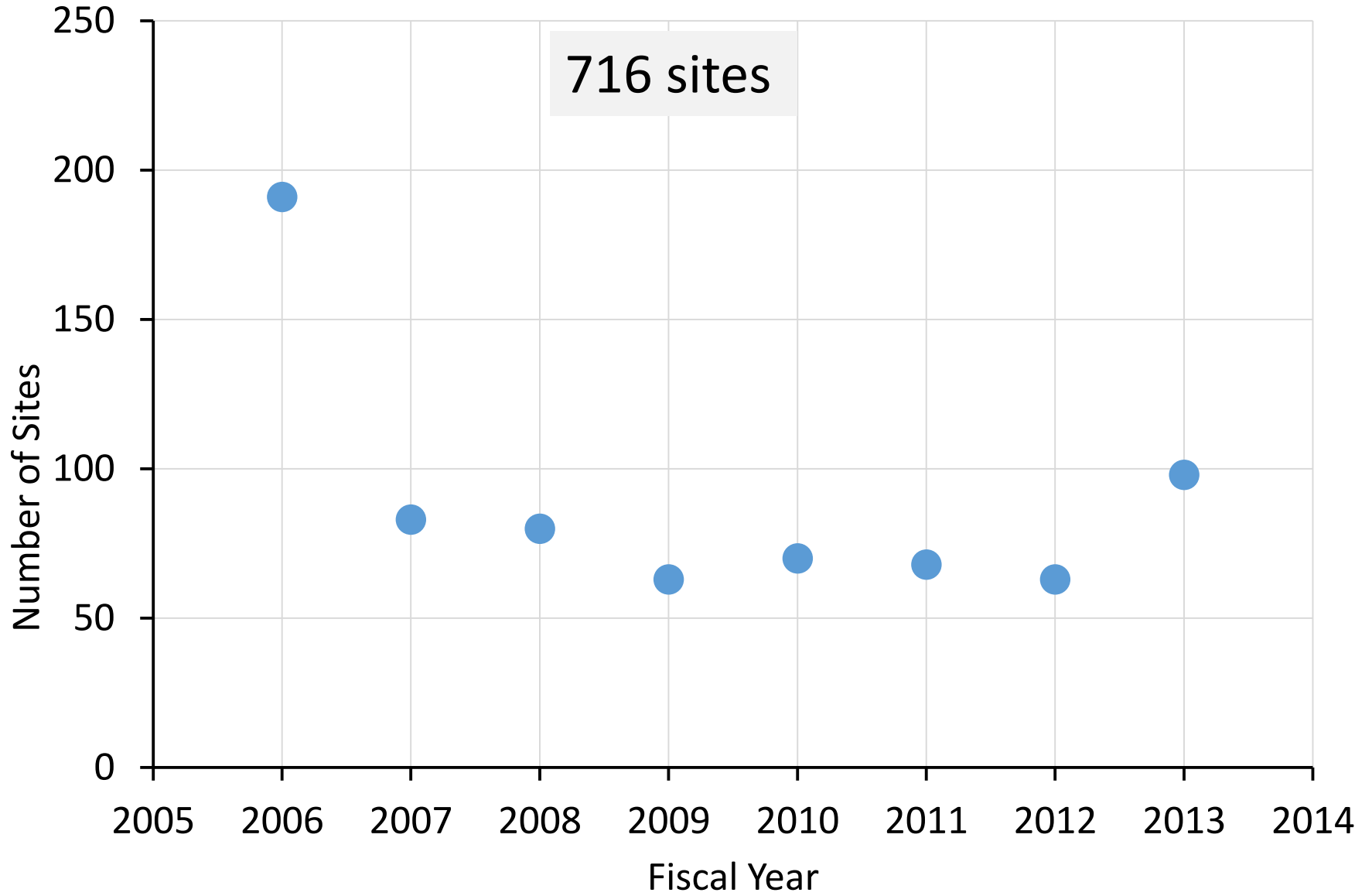
The Superfund program is working with communities and other partners to return hazardous waste sites to safe and productive use without adversely affecting the remedy.

Site Reuse/Redevelopment



# Sitewide Ready for Anticipated Use

716 sites



- Evolution of the program as sites moved through the regulatory process



EPA 542-R-13-016  
November 2013  
Solid Waste and Emergency Response  
[www.clu-in.org/asr](http://www.clu-in.org/asr)  
[www.epa.gov/superfund](http://www.epa.gov/superfund)

# Superfund Remedy Report

FOURTEENTH EDITION

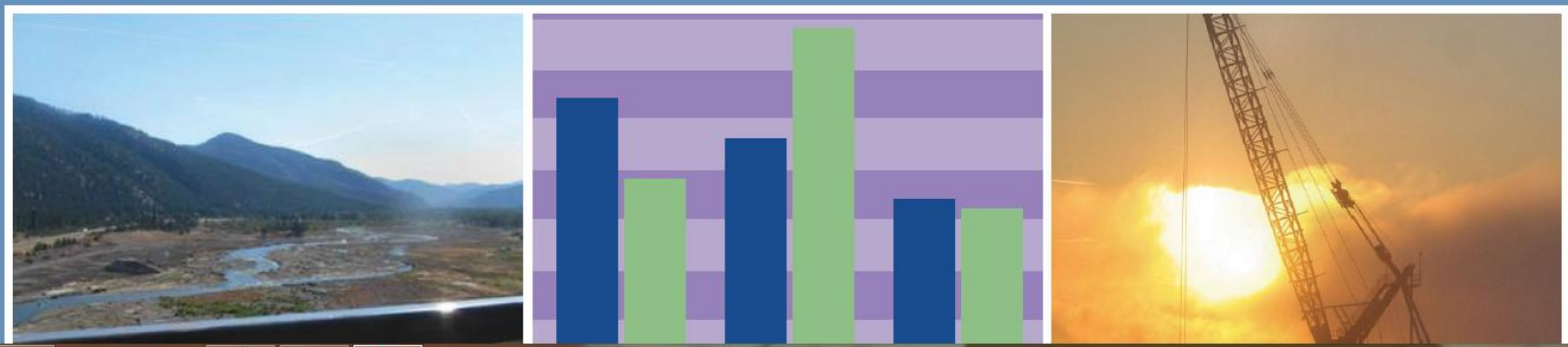
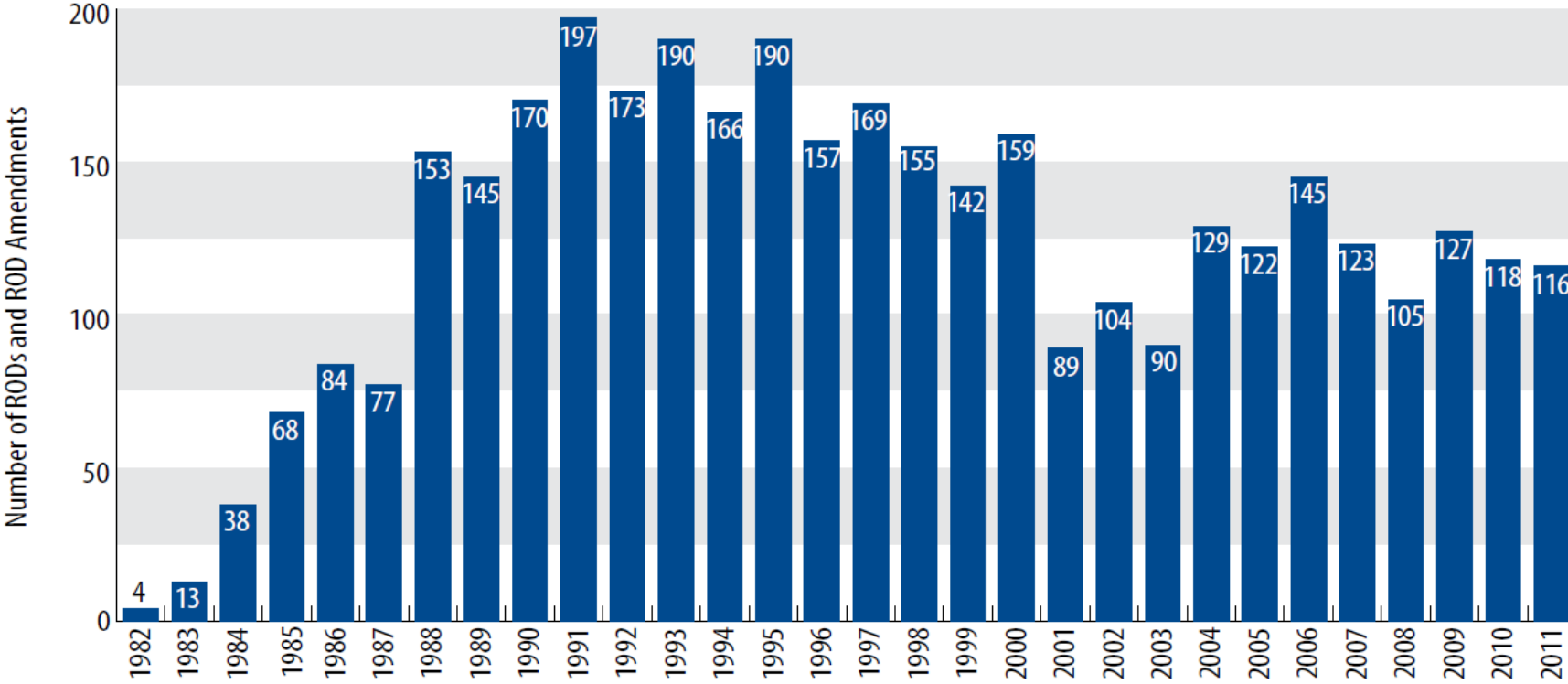
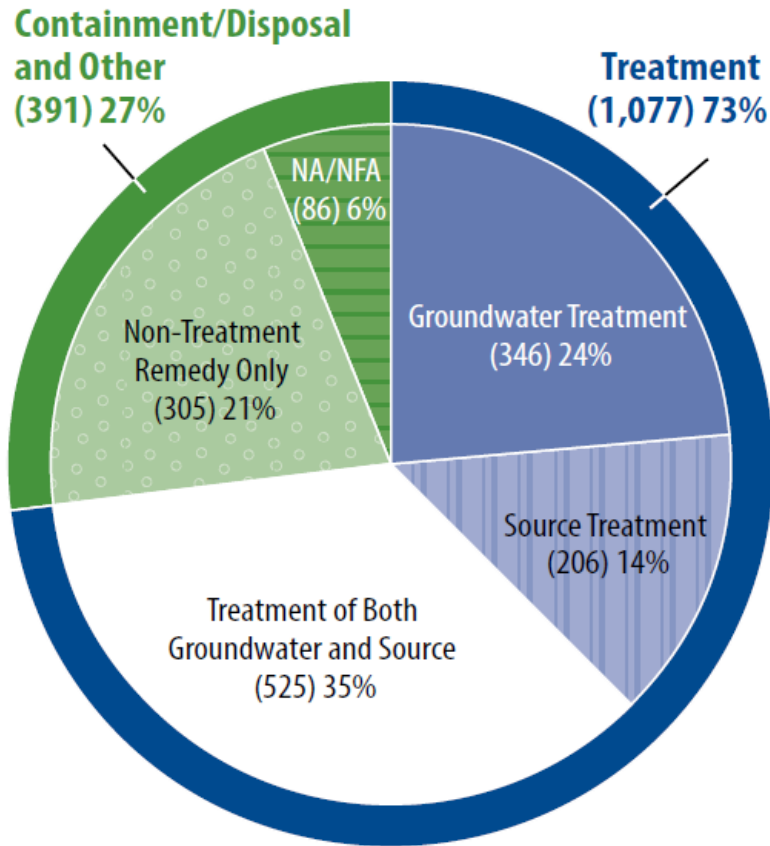


Figure 1: Total Number of RODs and ROD Amendments per Year (FY 1982–2011)



**Figure 3: NPL Sites with Treatment Remedies  
(FY 1982–2011)**



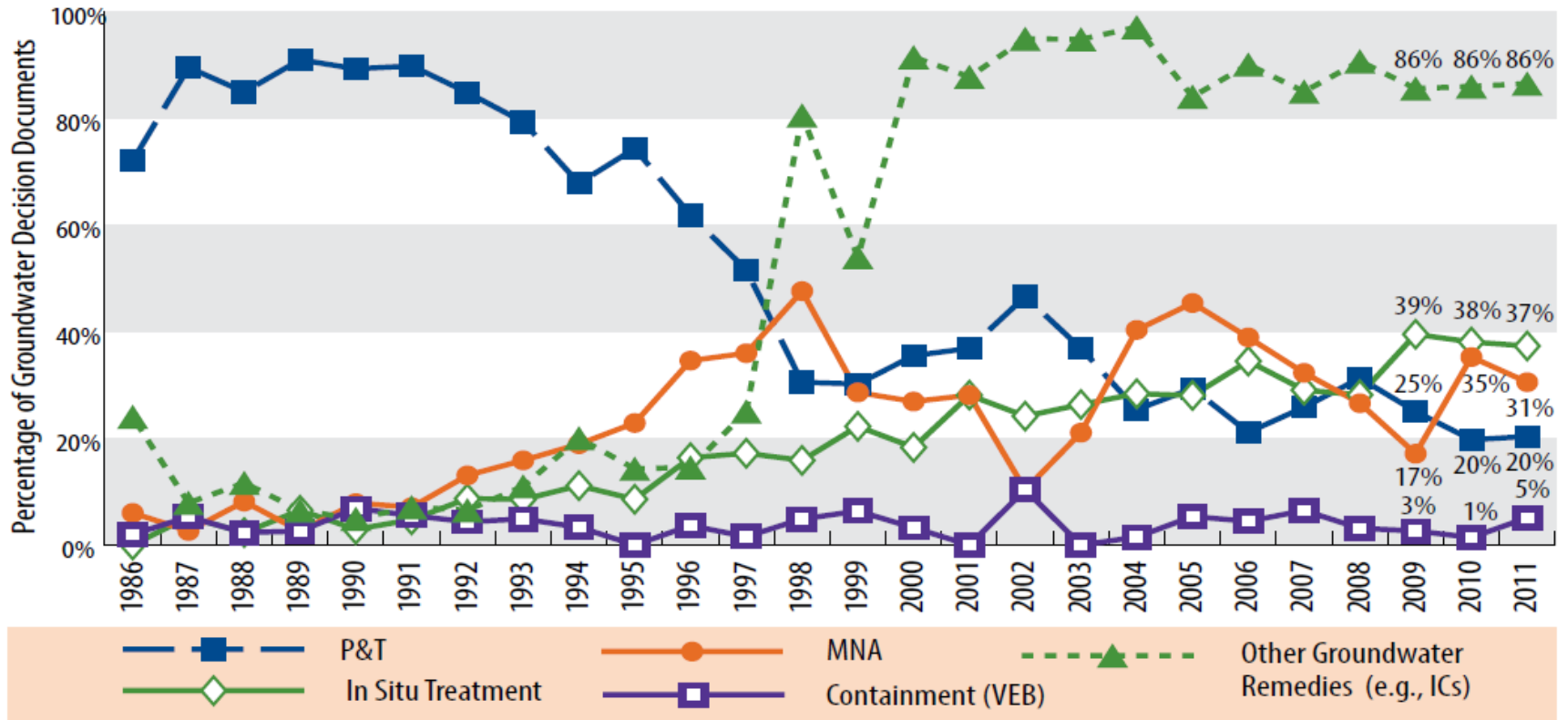
Number of sites with remedies = 1,468.

Sites with treatment remedies include in situ or ex situ treatment, and may also include non-treatment remedies.

Non-treatment remedies include sediment EMNR, groundwater MNA, sediment MNR, containment/disposal, and Institution Controls (ICs).

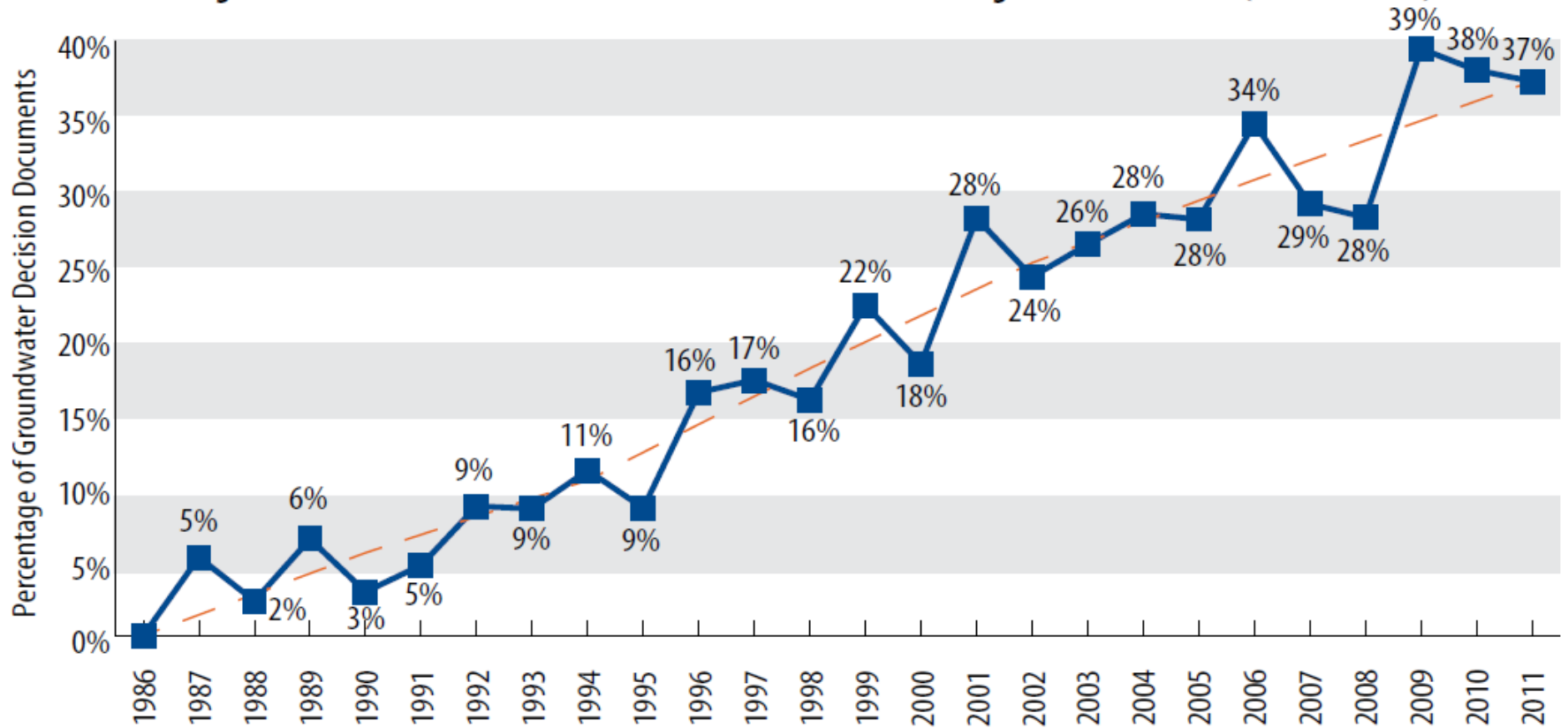
Sites with only No Action or No Further Action (NA/NFA) do not have treatment or non-treatment remedies selected in any decision document.

Figure 11: Selection Trends for Groundwater Remedies (FY 1986-2011)



- Number of groundwater decision documents = 1,919.
- Decision documents may be included in more than one category.
- "Other groundwater remedies" include ICs and other remedies not classified as treatment, MNA or containment.

**Figure 13: Trends in Groundwater Decision Documents Selecting In Situ Treatment (FY 1986-2011)**



• Number of groundwater decision documents = 1,919.

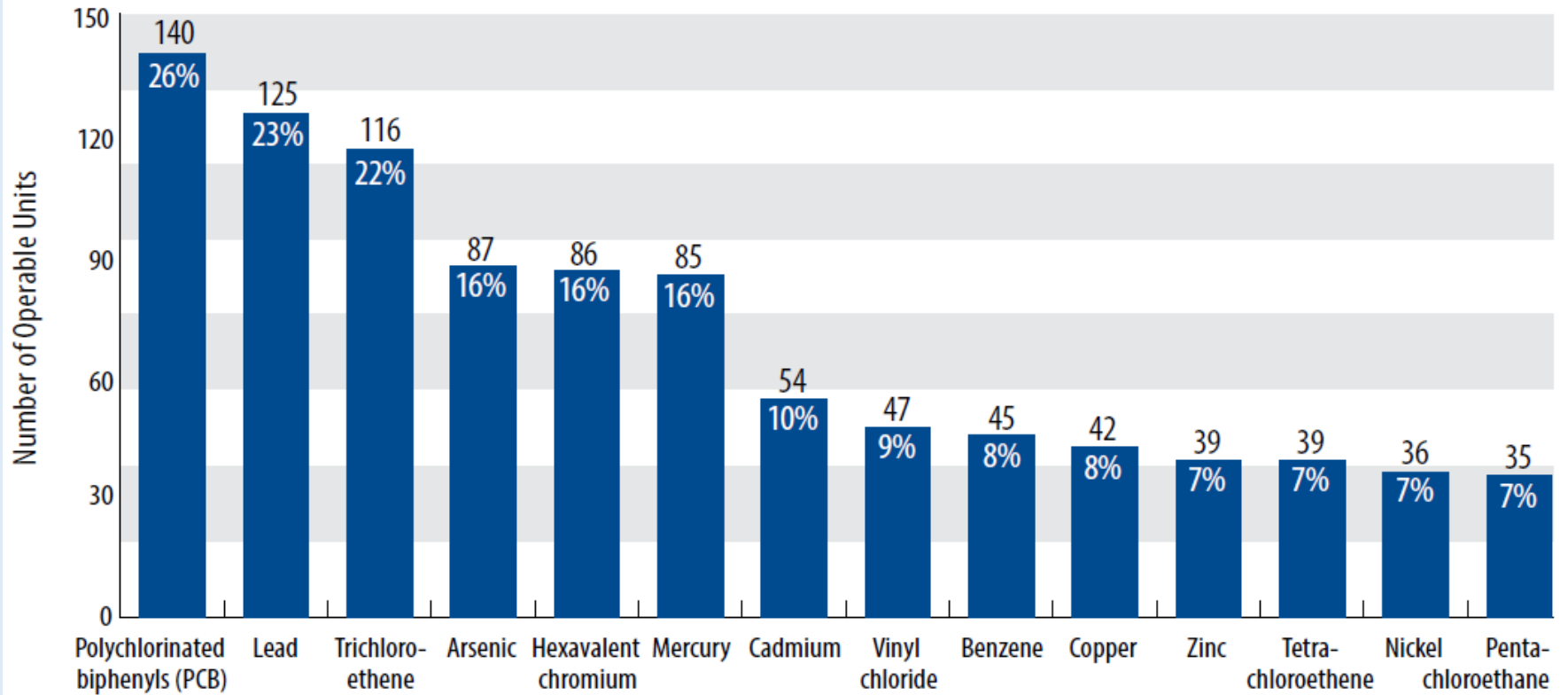
**Table 5: Vapor Intrusion Remedies Selected in Decision Documents (FY 2009–2011)**

Technology	2009	2010	2011	Total
Vapor Intrusion Mitigation in Existing Structures	0	8	7	15
Sub-Slab Depressurization	0	6	6	12
Sealing Cracks and Openings	0	4	2	6
Sub-Membrane Depressurization	0	4	1	5
Interior Ventilation	0	4	0	4
Vapor Intrusion Mitigation (Unspecified)	0	2	1	3
Passive Barrier (Impermeable Membrane)	0	0	2	2
Passive Soil Ventilation	0	0	1	1
Positive Indoor Pressurization	0	0	1	1
Institutional Controls	0	8	9	17
Future Construction	0	8	9	17
Existing Structures	0	3	2	5

- Number of decision documents selecting vapor intrusion remedies = 21.
- Decision documents may be included in more than one category.

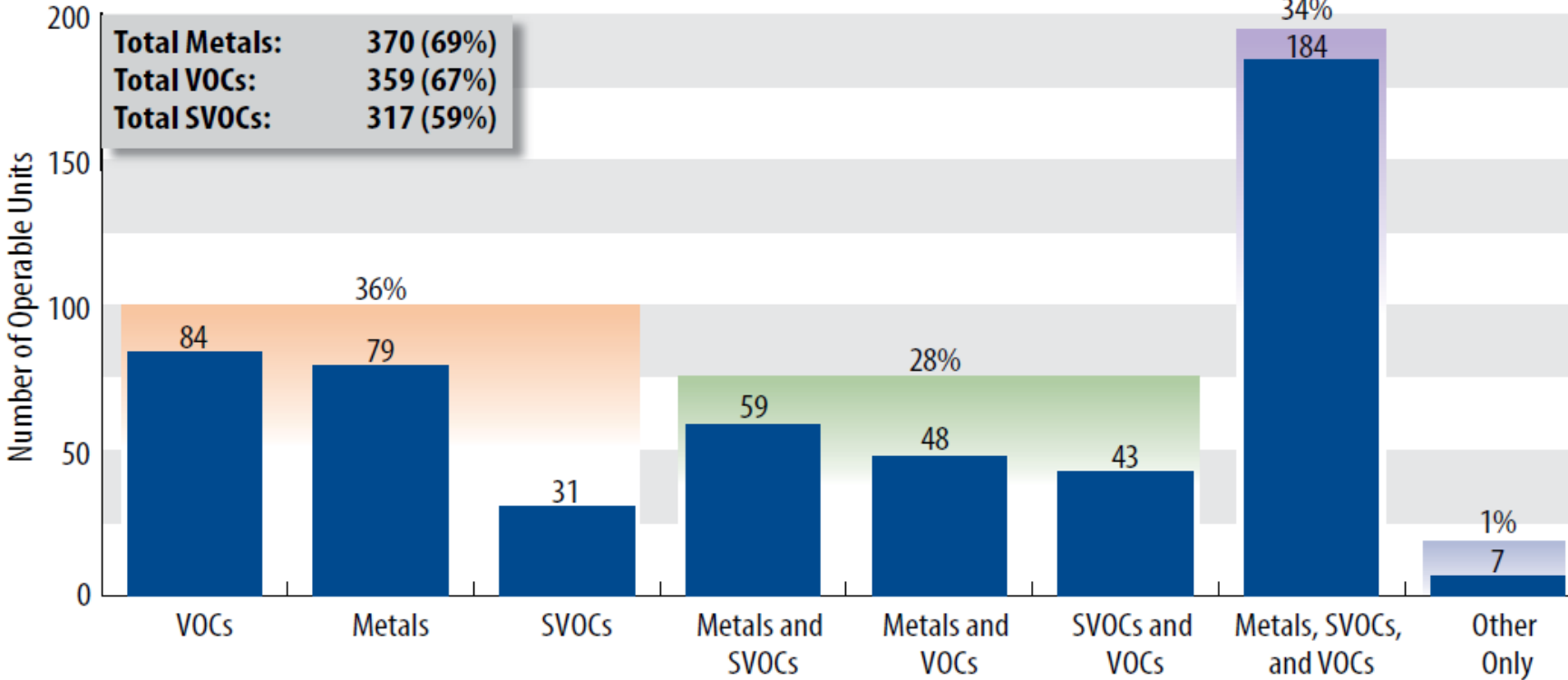


Figure 14: Most Frequently Occurring Contaminants at OUs in the RI/FS Phase



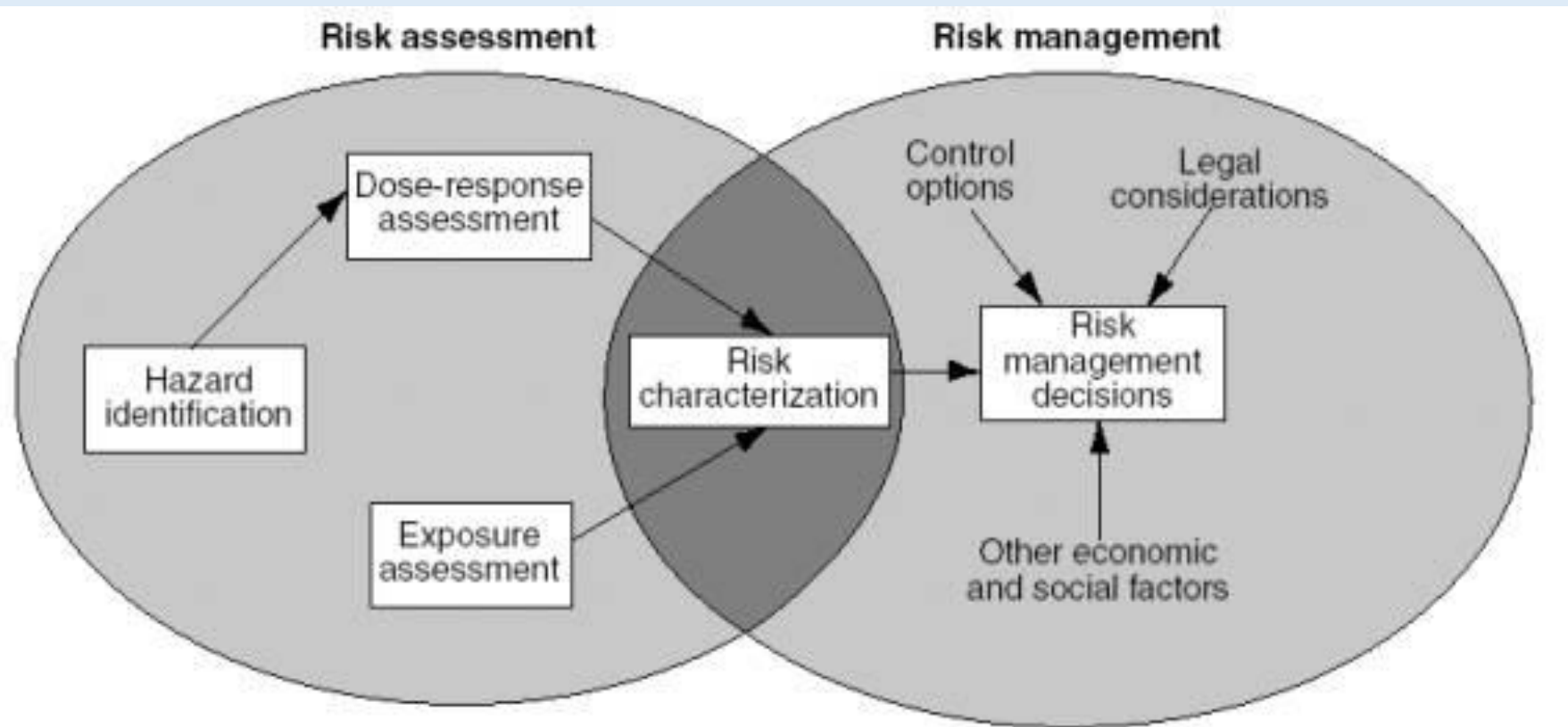
• Total Number of OUs = 447

**Figure 15: Number of OUs in the RI/FS Phase by Contaminant Group**



• Total Number of OUs = 535

- **Accomplishments** and future directions for the Federal Superfund Program



Source: EPA Office of Research and Development.

In FY 2013, the Superfund Remedial Program increased the total number of sites where EPA actions controlled a potential or actual exposure risk to humans by 13, bringing the program's cumulative total to 1,389 National Priorities List (NPL) sites where exposure is under control.

Increased the total number of sites where EPA actions controlled the migration of contaminated groundwater through engineered remedies or natural processes by 18, bringing the program's cumulative total to 1,091 NPL sites where contaminated groundwater migration is under control.

The Superfund Remedial program will continue to maintain focus on completing projects at various stages in the response process and maximizing the use of site-specific special accounts.

The EPA and its partners will focus on completing construction activities at 13 site wide construction completions as well as 105 individual project completions by the end of FY 2015, while achieving human exposure and groundwater migration under control at 9 and 13 sites, respectively.

FY 2015 EPA Budget in Brief. [www.epa.gov](http://www.epa.gov)

In FY 2013, EPA Superfund Remedial Program

Completed 772 remedial site assessments, for a cumulative total of 92,282 remedial assessments completed since the program's inception in 1980.

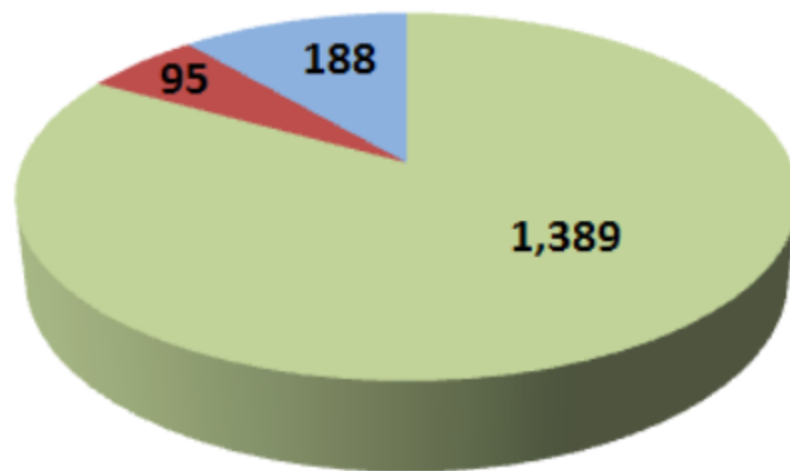
Placed 9 new sites on the NPL, and proposed 9 sites to the NPL. The NPL had, at the end of FY 2013, 54 proposed sites and 1,685 final and deleted sites; EPA may delete a final NPL site if it determines that no further response is required to protect a community's health or environment.

As of February 2014, there are 1,694 sites on the NPL.

The Superfund Remedial program increased the total number of sites where EPA actions controlled a potential or actual exposure risk to humans by 13, bringing the program's cumulative total to 1,389 National Priorities List (NPL) sites where exposure is under control.



## Site-Wide Human Exposure Under Control at NPL Sites as of October 2013

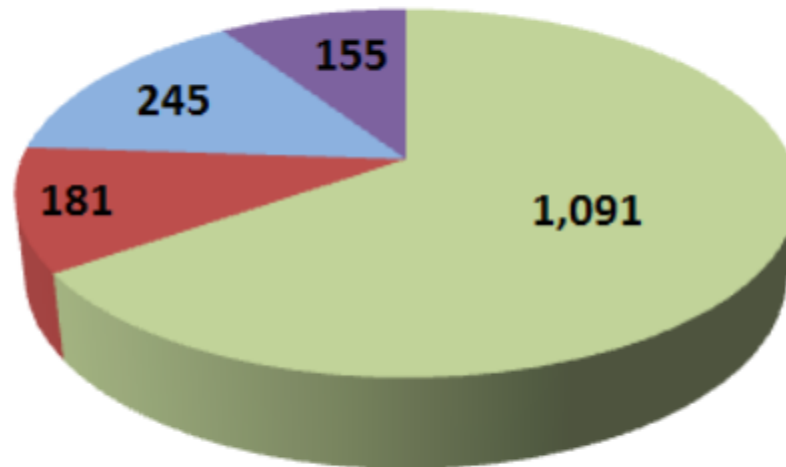


■ Under Control   ■ Not Under Control   ■ Insufficient Data

As of February 2014, there are 1,694 sites on the NPL.

The Superfund Remedial program increased the total number of sites where EPA actions controlled the migration of contaminated groundwater through engineered remedies or natural processes by 18, bringing the program's cumulative total to 1,091 NPL sites where contaminated groundwater migration is under control.

### Contaminated Groundwater Migration Under Control at NPL Sites as of October 2013



■ Under Control

■ Not Under Control

■ Insufficient Data

■ Not a Groundwater Site

In recent times, there has been a substantial reduction in the production output of trichloroethylene; alternatives for use in metal degreasing abound, chlorinated aliphatic hydrocarbons being phased out in a large majority of industries due to the potential for irreversible health effects and the legal liability that ensues as a result.

The U.S. military has virtually eliminated its use of the chemical, purchasing only 11 gallons in 2005. About 100 tons of it is used annually in the U.S. as of 2006.

- Accomplishments and **future directions** for the Federal Superfund Program

Approximately 70 percent of Superfund cleanup activities historically have been paid for by parties responsible (PRPs) for the cleanup of contamination.

The only time cleanup costs are not borne by the responsible party is when that party either cannot be found or is unable to pay for the cleanup.

For those sites, the Superfund law originally paid for cleanups through a tax on petroleum and chemical industries. The chemical and petroleum fees were intended to provide incentives to use less toxic substances.

The last full fiscal year (FY) in which the Department of the Treasury collected the tax was 1995.

This fund was exhausted by the end of FY 2003.

Since that time funding for superfund sites for which the potentially responsible party (PRP) could not be found has been appropriated by Congress out of general revenues.

Since the inception of special accounts through the end of FY 2013, the EPA has collected approximately \$4.1 billion from PRPs and earned approximately \$0.413 billion in interest.

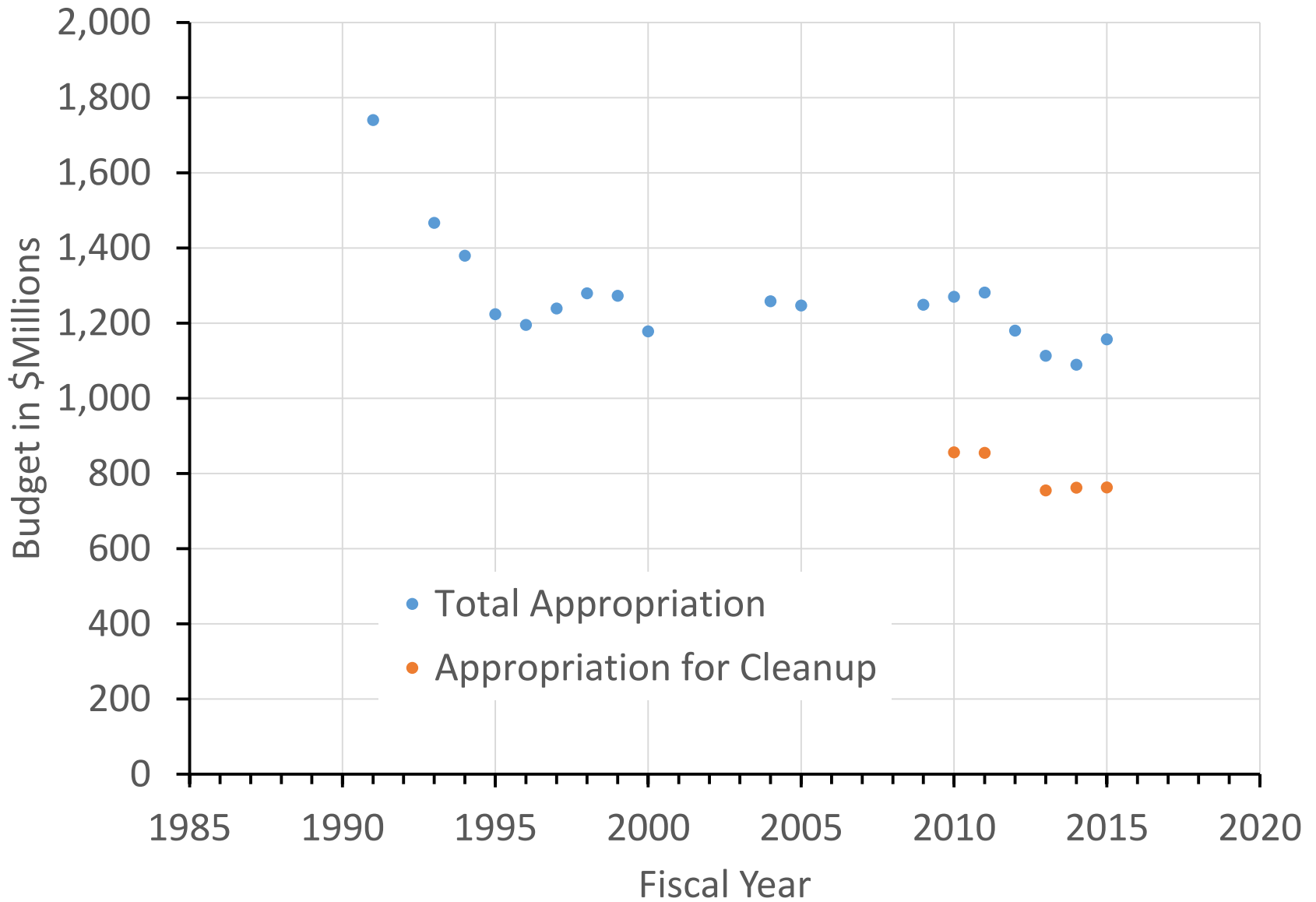
In addition, the EPA has transferred \$0.237 billion to the Superfund Trust Fund.

As of the end of FY 2013, over \$2.5 billion has been disbursed to finance site response actions and approximately \$0.270 billion has been obligated but not yet disbursed.

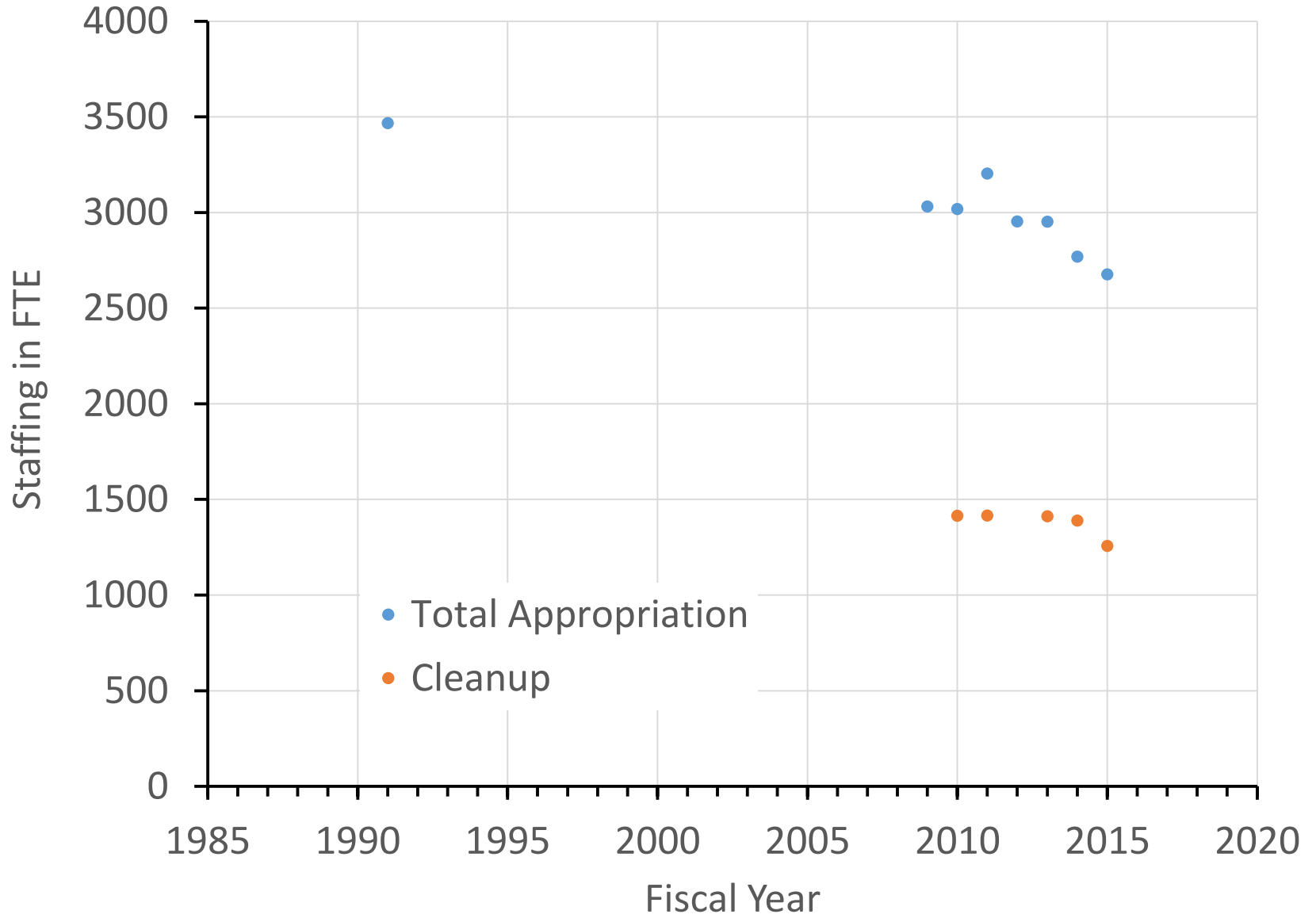
The EPA has spent more than 62 percent (\$2.8 billion) of all special account funds.



# Appropriation for Superfund



# Staffing for Superfund





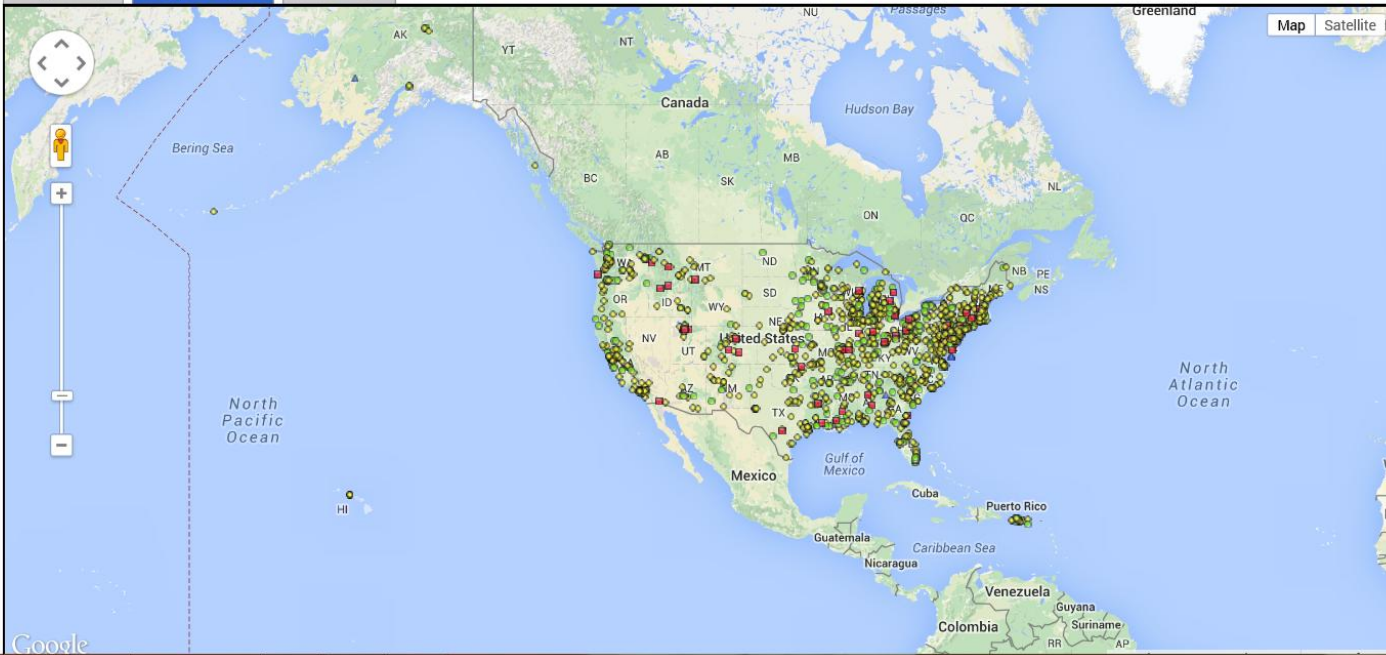
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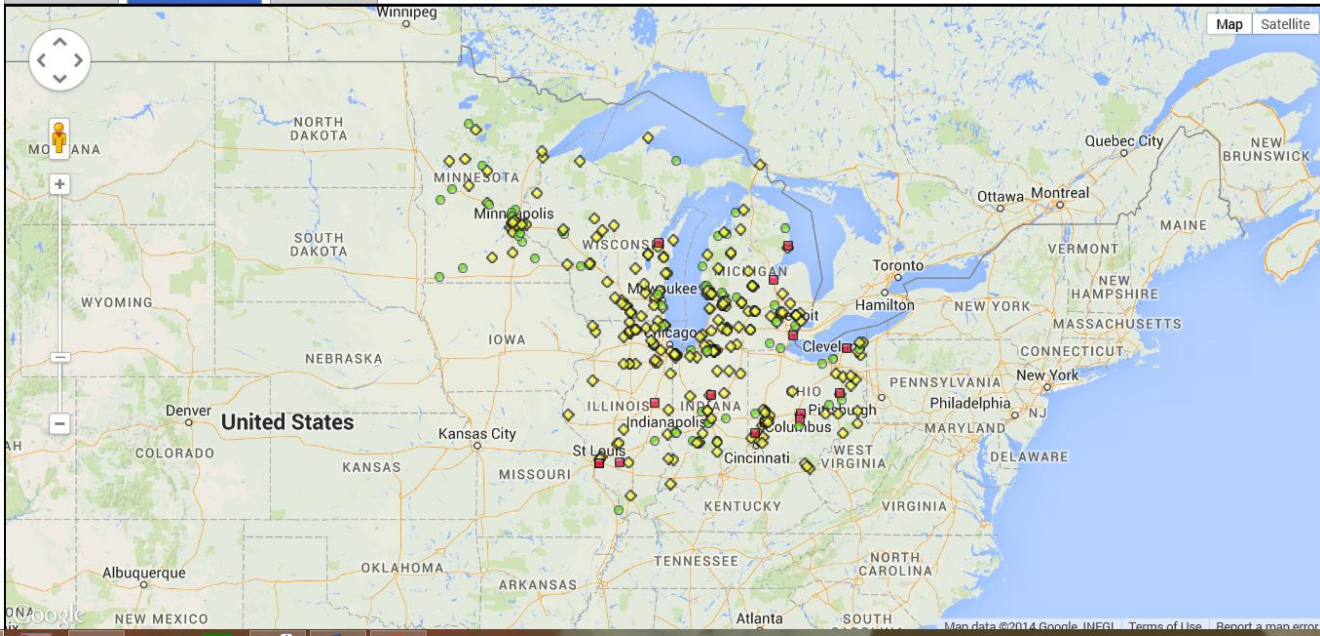
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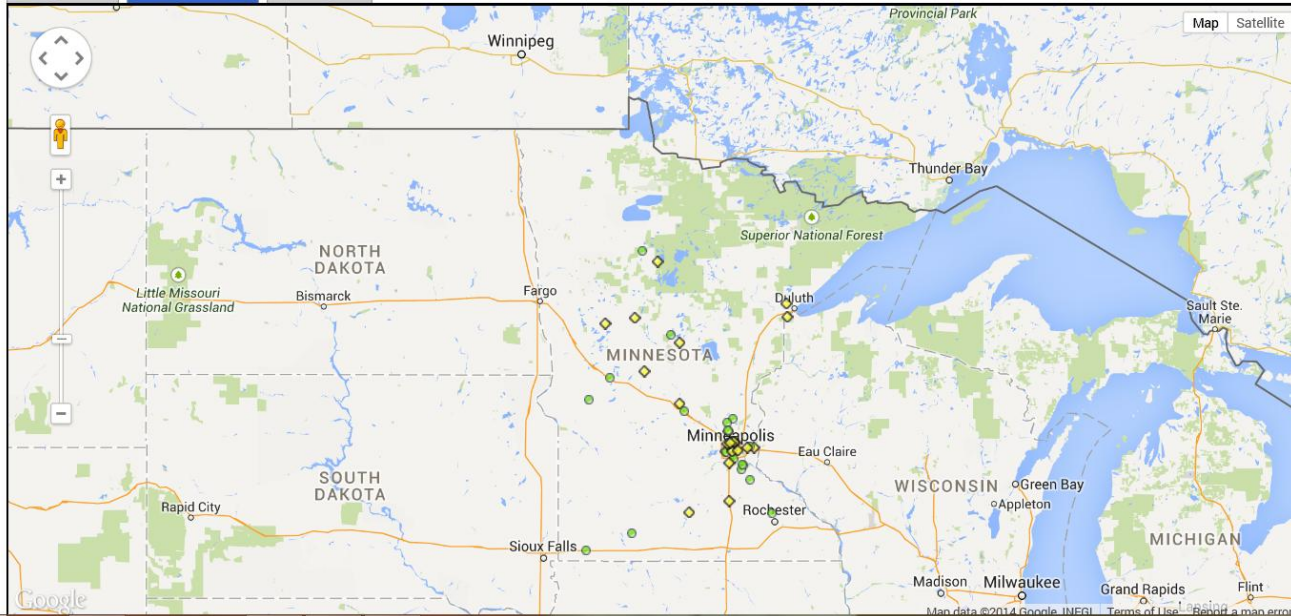


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Minnesota





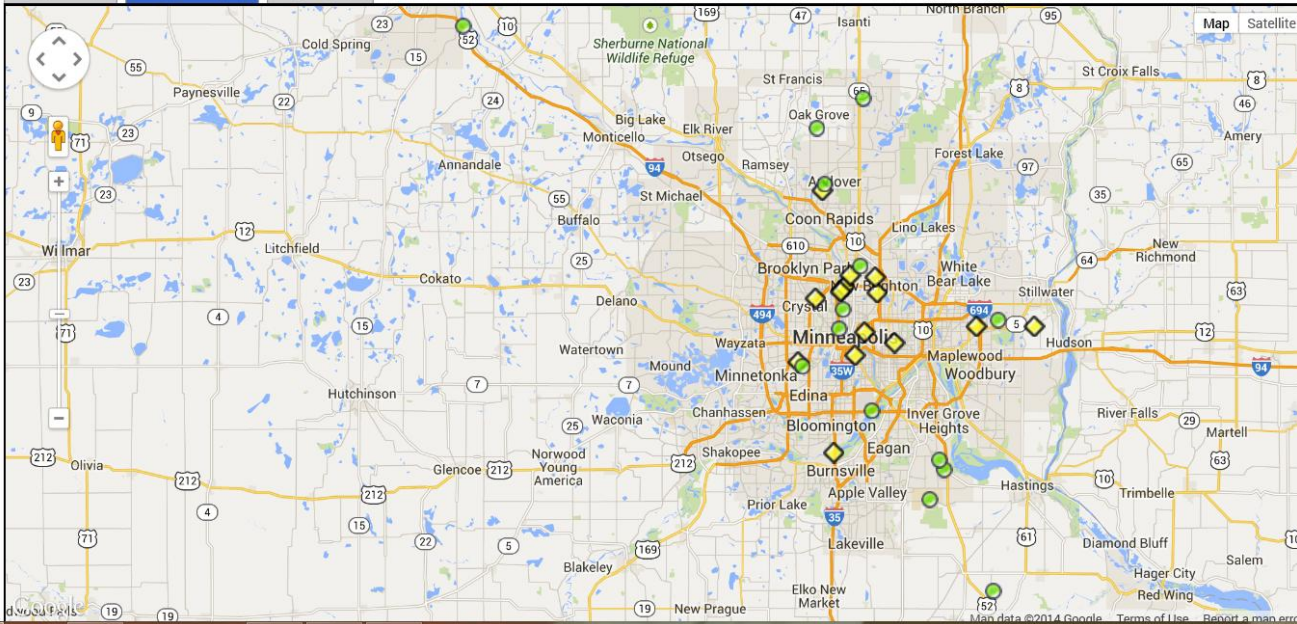
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- Construction Completion
- Partial Deletion

**Region Filter**

**State Filter**

<b>Program/ Agency</b>	<b>Number Contaminated Facilities</b>	<b>Number Contaminated Sites</b>	<b>Estimated Cost to Complete (\$Billions)</b>
DoD		4,329	\$12.8
Superfund	1,364		\$16-\$23
RCRA	2,844		\$32.4
UST		87,983	\$11
DOE		3,650	\$17.3-\$20.9
Other Federal		>3000	\$15-\$22
State Sites		>23,000	\$5

## **Redefining the End Game for Groundwater**

**Remediation** Laura J. Ehlers and Michael C.

Kavanaugh. *Groundwater* 51(2) 170-174 (2013).

The restoration of contaminated groundwater to a condition allowing for unlimited use and unrestricted exposure (UU/UE), usually defined as achieving drinking water standards or better when the groundwater is an actual or potential source of drinking water, remains a significant technical and institutional challenge



NRC. 2012. *Alternatives for Managing the Nation's Complex Contaminated Groundwater Sites*.  
Washington, DC: National Academies Press.

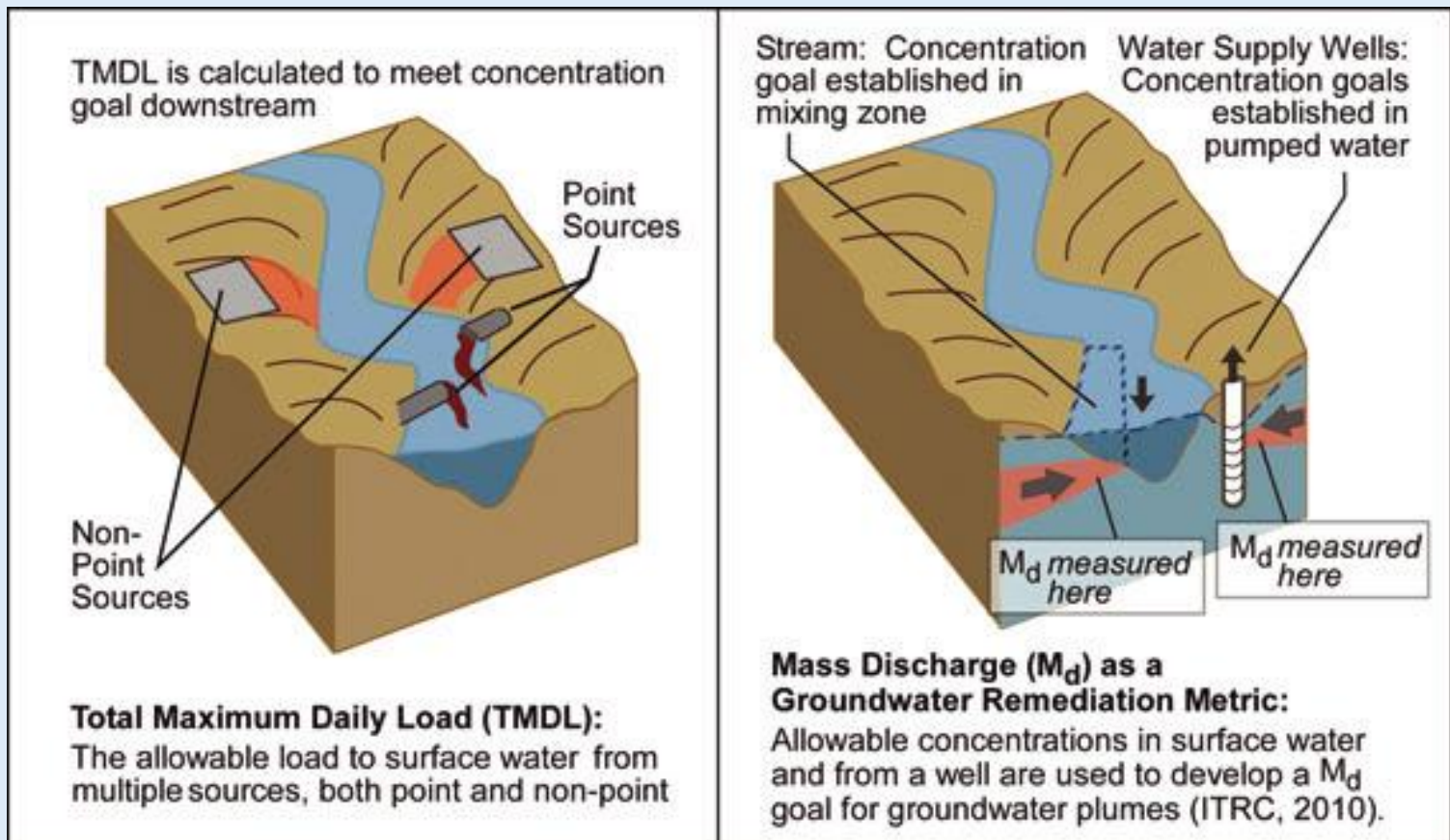
Existing cleanup programs do not fully reflect the fact that at a large number of complex groundwater sites drinking water standards will not be attained within a period of 50 to 100 years. Thus, the NRC report proposes a process to accelerate the transition of sites to one of three possible end states:

The restoration of contaminated groundwater to a condition allowing for unlimited use and unrestricted exposure (UU/UE), usually defined as achieving drinking water standards or better when the groundwater is an actual or potential source of drinking water, remains a significant technical and institutional challenge

1. *Clean closure* in which UU/UE levels have been attained;
2. *Long-term passive management* (e.g., using MNA, physical containment, permeable reactive barriers, and/or institutional controls), and
3. *Long-term active management* (e.g., indefinite hydraulic containment using pump and treat).

# Groundwater Remediation: The Next 30 Years

Paul W. Hadley and Charles J. Newell. *Groundwater* 50(5): 669-678 (2012)



## MCL Approach

### Before Remediation



NOTE: Actual presence and location of receptors NOT important.

### After Remediation



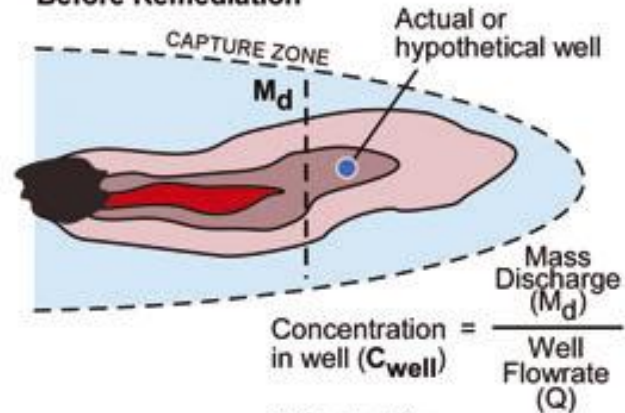
### Analysis

MCLs not achieved. Future concentration reductions progressively more difficult and expensive.

## OoMs / Mass Discharge Approach

### Water Supply Well

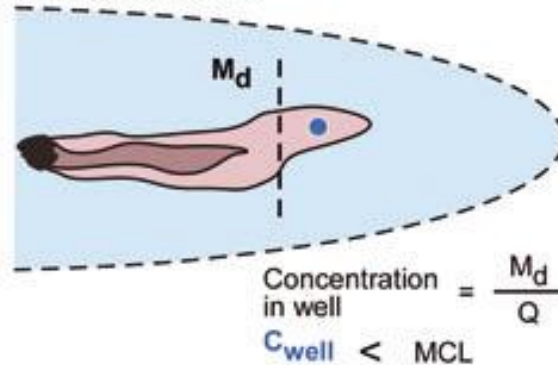
### Before Remediation



If  $M_d$  too big:

$$C_{well} > \text{MCL}$$

### After Remediation



### Analysis

Actual risk reduction is at well location. Remediation achieves Risk Reduction Goal.