



# Importance Of Source Control: Recontamination Of Completed Sediment Remedial Projects

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# Magnitude of the Contaminated Sediment Problem

- In its 1998 Contaminated Sediment Management Strategy document, U.S. EPA estimated that 1.2 billion cubic yards of sediment is contaminated, using only the top 5 cm of the areas identified.
- Assuming an average sediment thickness of 2 to 3 feet, an estimated 20 billion cubic yards of sediment is likely to require some form of management.



# Magnitude of the Contaminated Sediment Problem

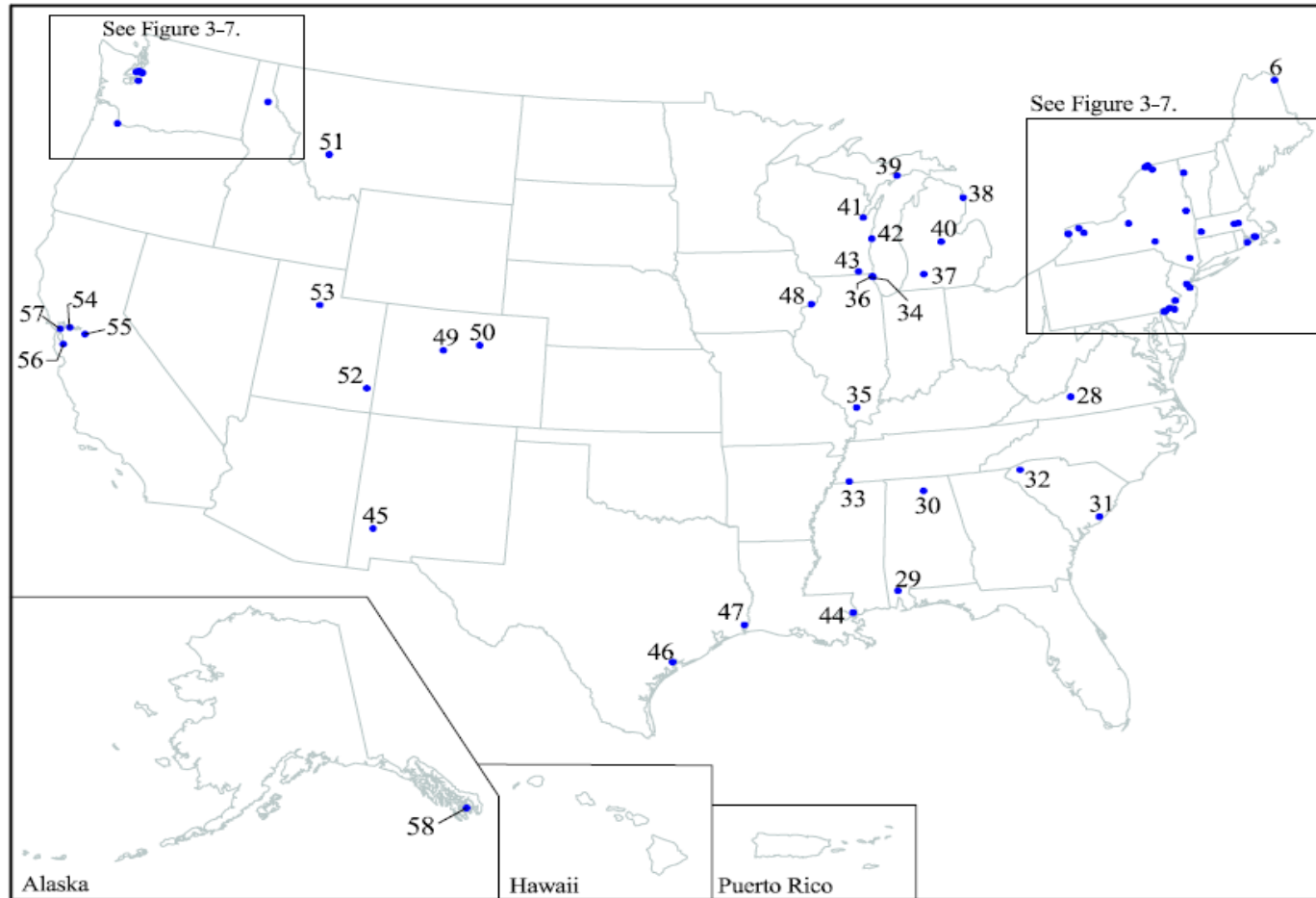
- To put this in perspective, 20 billion cubic yards of contaminated sediment equates to:
  - 24 years of our entire national household trash volume
  - 12,000 years of our entire national RCRA landfill trash volume



# CURRENT STATISTICS

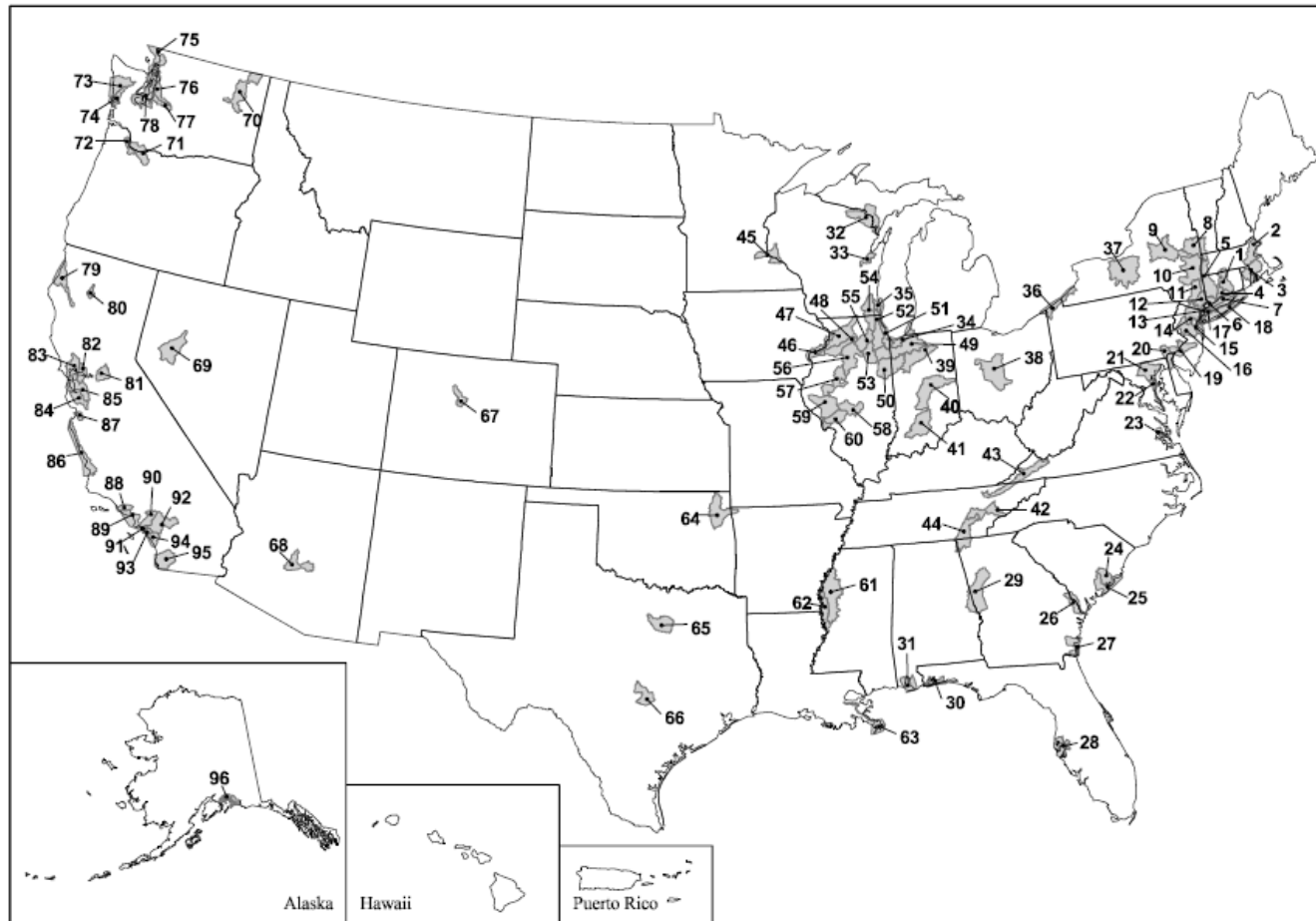
- The 2004 U.S. EPA *Updated Report on the Incidence and Severity of Sediment Contamination in Surface Waters of the United States* notes that in the 2800 waterbodies with fish advisories include:
  - 33% of the nation's total lake acreage
  - 15% of the total river miles
  - 100% of the Great Lakes
- The Superfund Program has decided to address sediment issues at over 150 sites
- Over 65 of these sites are large enough that they are being tracked at the national level
- 96 watersheds were identified as being areas of probable concern for sediment contamination

# Nationally Tracked CERCLA Sites



***From U.S. Environmental Protection Agency. 2004. The Incidence and Severity of Sediment Contamination in Surface Waters of the United States.***

# Areas of Probable Concern



***From U.S. Environmental Protection Agency. 2004. The Incidence and Severity of Sediment Contamination in Surface Waters of the United States.***



# EPA's Emphasis on Source Control

- *Contaminated Sediment Management Strategy* (1998):
  - “Before initiating any remediation, active or natural, it is important that point and nonpoint sources of contamination be identified and controlled.” (p. 55)



# EPA's Emphasis on Source Control

- *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites (2002):*
  - Principle #1: CONTROL SOURCES EARLY



# EPA's Emphasis on Source Control

- *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (2005):*
  - “Identifying and controlling contaminant sources typically is critical to the effectiveness of any Superfund sediment cleanup.” (p. 2-20)
  - “In most cases, before any sediment action is taken, project managers should consider the potential for recontamination and factor that potential into the remedy selection process.” (p. 2-21)



# Recontamination Following Remediation

- Survey of recently completed projects identified 19 sites where recontamination occurred.
- Sites varied widely in geomorphic and geographic settings.
- Included freshwater and estuarine locations.



# Recontamination Following Remediation

- Initial remedial actions included dredging, capping, and combinations of dredging and capping.
  - 8 capping sites
  - 6 dredging sites
  - 5 combination capping & dredging sites

# Recontaminated Sites

Site	Response Measure(s)	Recontamination Information
Anacostia River, DC	2004 cap	2006 urban sources, upstream sources
Bloomington, IN (3 creeks)	1987 sediment removal	1992 all sources unclear – point source discharge included
Convair Lagoon, CA	1998 cap	2002 public storm drain discharges
Denny Way Site, WA	1990 cap	1993 CSO point source discharges
Duwamish Norfolk CSO, WA	1999 dredge-cap	2001 CSO point source discharges; unremediated adjacent contaminated sediment
Duwamish River Diagonal, WA	2004 dredge	2005 sewage system discharges
Eagle Harbor Site, WA	1994 cap	1999 “surface sources,” “offsite sources”
Ford Outfall/River Raisin, MI	1997 dredge	2001 unremediated upstream sediments and/or upland sources; sediments sloughed from adjacent navigational channel
Fox River SMU 56/57, WI	2000 dredge-cap	2005 1.2-1.5 m of new impacted sediment deposited in 5 years
Housatonic River, MA	2002 dredge-cap	2005 upstream sources, CSO and SSO point source discharges

# Recontaminated Sites

Site	Response Measure(s)	Recontamination Information
Lauritzen Canal, CA	1996 dredge-cap	1998 undetected point source(s); incomplete remediation near margins of site
Long Beach North Energy Island Borrow Pit (NEIBP), CA	2001 cap	2004 "deposition from the surrounding harbor"
Pier 51 Ferry Terminal, WA	1989 cap	1990 PAHs due to pile pulling; metals from "new sediment deposition"
Pier 53-55, WA	1992 cap	2002 prop wash resuspension near edges; PAHs due to pile removal
Pier 64-65, WA	1994 cap	2002 piling repair work released creosote
Puget Sound Naval Shipyard Pier D, WA	1994 dredge	1998 suspected resuspension of sediments from outside response area
Sitcum Waterway/Nearshore Tidelats, WA	1993 dredge	2002 "continued source input from recent sediment deposition or off-loading activities"
St. Clair Shores, MI	2002 dredge	2003 sewer pipe discharges
Thea Foss Waterway, WA	2002 dredge-cap	2006 city storm drain discharges



# Common Sources of Recontamination

- Point sources:

- combined sewer overflows (CSOs)
- storm sewer outfalls (SSOs)
- municipal sewage treatment plants

- Sediment sources:

- upstream sources
- unremediated nearby sediments



# Common Sources of Recontamination

## ■ Runoff sources:

- industrial manufacturing and storage sites
- erosion of streambank and/or adjacent upland soils
- mining sites
- agricultural runoff

## ■ Other sources:

- atmospheric deposition
- contaminated groundwater advection
- spills



# Sources of Recontamination for the 19 Sites

- Point sources (10 of 19 sites - 53%):
  - Most frequent source: CSO and other public storm water discharges
  - Absent: industrial sources (but could be unidentified upstream contributors to CSOs)
- All 10 sites located in urban areas
  - Many of the 96 APCs identified in U.S. EPA's 2004 sediment inventory are in urban areas
  - 9 of these 10 sites are located in APCs



# Sources of Recontamination for the 19 Sites

- Sediment sources (7 of 19 sites - 37%):
  - Relocation of unremediated nearby sediments into the response area
- Runoff sources (8 of 19 sites - 42%)
  - Recent sediment deposition
  - From surrounding harbor
  - Upland/upstream sources



# Sources of Recontamination for the 19 Sites

- Other processes (3 of 19 - 16%):
  - Processes other than those already described as “other sources” (E.g., associated with pile pulling and/or pile repair along piers)
- Other sources (0 of 19 – 0%):
  - No reported recontamination due to contaminated groundwater advection, mining site impact, or agricultural runoff



# Case Study: Anacostia River

## ■ Site characteristics:

- Freshwater Tidal System

## ■ COCs:

- PAHs, PCBs, metals, other

## ■ Remedy:

- Innovative “active” cap (2004)
- Successfully contained targeted contaminated sediment

## ■ Recontamination:

- Deposition of contaminated sediments on top of the cap from urban sources in the area and relocation of unremediated sediments present elsewhere in the waterway (2006).



# Case Study: Ford Outfall

- Site characteristics:

- River

- COCs:

- PCB Aroclor 1248

- Remedy:

- Dredged 20,600 m<sup>3</sup> (1997)
- Post-dredging sampling confirmed that cleanup level was achieved

- Recontamination:

- Deposition of sediment contaminated with a different PCB Aroclor -- 1242 -- likely from unremediated sediment and land soil sources (such as the former paper mill) upstream of the dredged area.



# Case Study: Convair Lagoon

- Site characteristics:

- 4 hectare embayment in North San Diego Bay

- COCs:

- PCBs

- Remedy:

- 2.3 hectare area remediated by placement of a cap (1998)

- Recontamination:

- Deposition of contaminated sediments on top of the cap from adjacent public storm drain systems (2002).



# Case Study: St. Clair Shores

- Site characteristics:
  - Lange and Revere Canals, which connect to Lake St. Clair
- COCs:
  - PCBs
- Remedy:
  - Dredging (2002-2003)
- Recontamination:
  - Recurrence of elevated concentrations of PCBs due to an adjacent public storm water sewer. After source controls were implemented, waterways were redredged (2006).



# Case Study: Lauritzen Canal

- Site characteristics:

- Tidally influenced marine site off San Francisco Bay

- COCs:

- DDT and dieldrin

- Remedy:

- 82,000 m<sup>3</sup> dredged, followed by placement of 30 cm thick cap (1996-1997)

- Recontamination:

- Sampling in 1998 & 1999 showed recontamination with DDT. One source thought to be from slumping and erosion from undredged areas but capped beneath docks and around pilings.
- Second source later discovered to be waters discharged from embankment outfall.



# Case Study: Thea Foss Waterway

- Site characteristics:

- 2,440 m long tidal marine waterway

- COCs:

- PAHs, PCBs, DDE, DDD, bis(2-ethylhexyl) phthalate

- Remedy:

- 400,000 m<sup>3</sup> dredged, plus application of 8.5 hectare cap (Response actions began in 2002)

- Recontamination:

- Sampling in 2005 showed recontamination by di(2-ethylhexyl) phthalate, which was attributed to waters discharged from 2 city storm drains.



# Rapid Recontamination

- All 19 sites became recontaminated relatively quickly following remediation.
- Not a failure of the initial remedial action.
- Reasons for recontamination:
  - No assessment of source control made prior to remedy selection
  - Incomplete assessment of source control made prior to remedy selection
  - Remediation conducted at locations where source control known to be incomplete



# Conclusions

- Survey identified 19 sites that were recontaminated.
- U.S. EPA's sediment strategy, policies, and guidance have consistently focused on avoiding this problem.



# Conclusions

- Recontamination most likely to arise from uncontrolled Point Sources and/or incomplete remediation in adjacent/upstream areas.
  - 10 of the sites were recontaminated from public discharge systems such as CSOs and SSOs
- Careful study of potential Point Sources is necessary.
- Control of Point Sources must be as great or greater a priority as the sediment response action.



# Conclusions

- 7 sites recontaminated due to incomplete remediation – contaminated sediment from outside the response area entered via resuspension, etc.
- Lesson: Avoid remediating single or discrete locations (especially downstream) out of a larger area until a thorough understanding is developed of how the unremediated area may affect the long-term effectiveness of the remediation.



# Bottom Line

CONTROL SOURCES EARLY



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