Attachment 3

COST ESTIMATE FOR REMEDIAL AND REMOVAL ACTIONS
GARFIELD GROUNDWATER CONTAMINATION SITE
GARFIELD, NEW JERSEY

The purpose of this report is to present the remedial and removal actions evaluated to compare the cost effectiveness of these two approaches to address the Garfield Groundwater Contamination Site (GGCS).

The definition of effectiveness centers around the criteria established in 40 CFR Section 300.430 (f) (1)(ii)(D) where each remedial action selected shall be protective of human health and the environment. The effectiveness criteria for the GGCS consist of the permanent elimination of exposure of residents and workers to the chromium contamination.

This cost estimate references the following attached documents:

- E.C. Electroplating site, Permeable Reactive Barrier Treatment for Chromium Contaminated Surficial Aquifer, Garfield, NJ; Weston Solutions Inc.
- POLREP NO.1, E.C. Electroplating Site, Andrew Confortini, On-Scene Coordinator, U.S. EPA Region 2
- Transmittal Letter, E.C. Electroplating Unit Cost, Garfield, NJ; Weston Solutions Inc.

The E.C. Electroplating site, Permeable Reactive Barrier Treatment for Chromium Contaminated Surficial Aquifer (PRB report) report has been prepared to provide a preliminary cost estimate as a potential remedial alternative. The Permeable Reactive Barrier (PRB) is designed to treat contaminated groundwater in the surficial aquifer within the area of concern (AOC). EPA considers the surficial (overburden) ground water the primary mechanism of transport of hexavalent chromium contamination into residential and commercial buildings within the AOC. This remedial alternative is designed to reduce, and with time, eliminate the concentration of hexavalent chromium contamination in groundwater. The PRB alternative is considered to present a practical and effective alternative to permanently address hexavalent chromium contamination within the AOC.

The POLREP NO. 1 report presents costs incurred by the Removal Program during the implementation of the ongoing cleanup and maintenance program. This report presents costs incurred by Region 2 in cleaning up eleven (11) buildings within the AOC.

The E.C. Electroplating Unit Cost transmittal letter presents unit cost factors for the following elements of the removal cleanup and maintenance program:

- Surveillance
- Pre-Removal Sampling
- Pre- and Post-Removal Sampling
- Quarterly Monitoring (O&M)

These costs will be used to calculate the removal alternative budgetary cost estimate for the cleanup and maintenance program.

Removal Action Cost Estimate

The removal action cost estimate consists of a series of actions intended to identify, mitigate, and monitor continued hexavalent chromium exposures to residents and workers at the GGCS. These actions consist of property surveys or surveillance, testing, cleanup, and maintenance monitoring. Based on preliminary investigations, the AOC consists of approximately 705 properties located between Monroe St., Van Winkle Avenue, Sherman Place, and the Passaic River. Many buildings within the GGCS are vulnerable to groundwater infiltration. A number of these buildings have experienced events of contamination with hexavalent chromium in the past and are expected to experience additional recontamination events in the future. As indicated in the ATSDR Health Advisory, as long as groundwater remains contaminated with high levels of hexavalent chromium, it has the potential to continue to migrate and infiltrate into buildings. For budgetary purposes, the removal action assumes there is no implemented action to reduce the hexavalent chromium contamination in groundwater.

Property Surveillance Program

This task includes developing background information on the site, obtaining tax records, initial outreach to the property owner, and performing an initial inspection of the basement. The purpose of the initial inspection of the basement is to identify evidence of groundwater seepage and the potential for chromium contamination. The unit cost assumes that the experience in obtaining access to conduct the initial inspection will be similar to the experience Weston has had with the 705 buildings in the AOC.

In 2000 and 2001, the New Jersey Department of Environmental Protection (NJDEP) conducted investigations in several residential properties to investigate the presence of chromium contamination. Analytical results for basement sump water samples from seven residences indicated total chromium was detected in six residences and hexavalent chromium was detected in three residences. Analytical results for residue solids collected from within the basement sumps of four residences indicated total chromium was detected in all residences while hexavalent chromium was not detected.

These investigations also indicated flooding events had occurred at the Golden Towers apartments. The flooding incident, which occurred at an unspecified time prior to a January 2003 sampling event, left a yellow powder-type residue on the basement floor. Two samples of the residue indicated the presence of total chromium and hexavalent chromium (ATSDR 2007). Based on the presence of hexavalent chromium

contamination, the basement was remediated in February 2003 through services retained by consultants under contract with the Garfield Housing Authority.

The results from these previous investigation indicated the incidence of hexavalent chromium contamination in residential properties was not isolated to any particular section of what is currently defined as the AOC. These investigations also did not reveal a specific contamination pattern. Therefore, EPA assumes a total of 700 buildings will be included in this cost category. A per unit cost estimate of $190 per building is calculated in the attached cost transmittal letter (Weston transmittal letter).

Property Testing Program

The property testing program consists of a baseline sampling effort designed to identify the presence of hexavalent chromium in buildings. The sampling effort also identifies potential exposure scenarios to hexavalent chromium that require clean up action. The selection of properties for this program was based on EPA's evaluation of survey responses. The testing program generally consists of the collection of basement floor, walls, and sump wipes, and sump liquid samples. The samples were analyzed for total chromium and hexavalent chromium with trivalent chromium being the difference of the two. Based on current expenditures, per unit costs are calculated at $2,400 per building (Weston transmittal letter). EPA assumes that 700 buildings will require one initial sampling event to evaluate possible hexavalent chromium contamination.

Property Cleanup Program

The property cleanup program consists of the cleanup of contaminated surfaces, mainly walls and floors, in basements of residential and commercial buildings within the AOC. In general, the cleanup program includes the following activities:

- Pre-cleanup action sample collection and analysis
- Removal cleanup activities
    - Disposal of contaminated material/debris
    - Washing and cleaning of contaminated surfaces
    - Implementation of measures to reduce groundwater seepage into buildings (installation of sump pump pits, cutting of channels in basement floors to direct groundwater into sump pits, and plumbing and electrical connections to discharge groundwater into the sanitary sewer system)
- Post-cleanup action sample collection and analysis

Property cleanup costs are based on actual costs to clean up 10 buildings within the AOC. These costs are included in the Finance Section, Cleanup Contractor Costs, of the Initial Pollution Report (POLREP NO. 1). In addition, pre- and post-cleanup sampling and analysis costs per building are included in the Weston transmittal letter.

As of to date, EPA has conducted cleanup activities at 12 buildings. In addition, EPA assumes that 350 buildings will require three cleanup actions; at years 10, 20, and 30,

within the 30 year removal time period. The cleanup cost per unit is $24,000 [$240,000 / 10 buildings] (POLREP No. 1). The pre- and post-cleanup sampling and analysis is estimated at $5,560 per building.

Property Continuous Monitoring Program

The Continuous Monitoring and Maintenance Program consist of the collection of basement floor, walls, and sump wipes, and sump liquid samples from building basements within the AOC. This program is assumed to be the O&M element of the removal program cost estimate.

The purpose of this program is to:

- Monitor new chromium contamination or re-contamination events in buildings within the AOC
- Monitor how building contamination levels change over time
- Identify buildings with increasing levels of contamination that may require a cleanup action
- Monitor the continued effectiveness of the implemented cleanup actions in buildings with completed clean up actions

For estimating purposes, EPA assumes 700 buildings will be included under the Continuous Monitoring Program. A per unit cost of $780 per building per quarter was used to estimate this cost (Weston Transmittal letter). EPA assumes that monitoring activities will be conducted four times per year (once every three months) for the next 30 years. A contingency of 30% was applied to the O&M cost estimate.

Capital Cost Estimate Summary

Item	**Cost**
Property Survey/Surveillance	$133,000
Property Testing	$1,680,000
Property Cleanup	$9,647,751
Total Capital Cost	$11,460,751

O & M Cost Estimate Summary

Item	**Cost**
Annual Property Continuous Monitoring Program	$2,184,000
Contingency (30%)	$655,200
Total Annual O&M Cost	$2,839,200

Present Worth Estimated Cost

Total Present Worth (PW) costs includes the estimated Present Worth Capital and 30 year O&M costs. Present Worth calculations used a discount rate of 7%. The 30 year present worth cost is itemized below:

Item	**Total**
Total Capital Cost	$11,460,751
Total Annual O&M	$2,839,200
PW Annual O&M	$35,236,376
Total PW Cost (Capital and O&M)	**$46,697,127**

Remedial Action Cost Estimate

The Remedial Action Alternative assumes the installation of a series of zero valent iron vertical barriers along streets in the AOC across the inferred groundwater flow. Technical and budgetary details are discussed in the PRB report. The estimated capital cost, operation and maintenance (O&M), and present worth costs to implement the Permeable Reactive Barrier (PRB) are included in Section 5 of the PRB report.

The remedial action estimate is based on the following elements:

- Remedial costs to implement the PRB alternative, and
- Removal costs to continue to monitor and address any additional contaminated groundwater seepage into residential and commercial buildings within the AOC.

The EPA assumptions for the removal cost estimate factored into the remedial action cost estimate are:

- Costs for the property survey/surveillance, testing program, cleanup, and continuous monitoring programs were added to the remedial action costs.
- Removal costs were added for the first five years of the 30 year remedial program (This assumption is based on average groundwater velocity distribution and calculated average groundwater velocity between or each wall and the associated residence time of groundwater between walls (PRB report). It is estimated that the travel times between walls range from 0.8 to 4.4 years).
- Property Survey/Surveillance, Testing and Continuous Monitoring Programs costs were applied to 700 buildings within the AOC
- Property Cleanup costs are based on one cleanup action required at 350 buildings. For estimating purposes, the cleanup action cost is calculated at year 5 of the first five years of the implemented remedial action.
- EPA assumes that continuous monitoring activities will be conducted four times a year (once every three months) for the next five years.
- A contingency of 30% was applied to the O&M cost estimate.

The table below summarizes the Capital and O&M costs of the remedial action:

Capital Costs	Cost
Property Survey/Surveillance (removal)	$133,000
Property Testing (removal)	$1,680,000
Property Cleanup (removal)	$7,374,198
Pre-design Pilot test (remedial)	$147,000
Permeable Reactive Barrier system (remedial)	$10,786,000
Total Capital Cost (removal)	$9,187,198
Total Capital Cost (remedial)	$10,933,000
O&M Costs	
Total Annual O&M for Continuous Maintenance Monitoring (removal)	$2,839,200
PW Costs	
Total PW Capital and O&M (removal)	$20,831,802
Total PW Capital and O&M (remedial)	$23,063,000
Total PW Remedial + Removal (Remedial Alternative)	**$43,894,802**

Conclusion

The Removal Program Cost estimate is based on initial surveys, testing, cleanups, and the implementation of water infiltration mitigation measures to temporarily address hexavalent chromium infiltration into residential/commercial buildings within the AOC. These measures are necessary to continue to identify and address future hexavalent chromium contamination events at the GGCS site. The removal program cost estimate is based on the scenario that there are no engineered controls implemented to reduce the volume of hexavalent chromium contamination in groundwater. Under this scenario, EPA Region 2 anticipates that the measures implemented under the Removal Program will address the contamination as a temporary measure, and will require continuous actions to prevent unacceptable exposures to residents and workers. The total 30 year-present worth cost to implement these actions is $46,697,127.

The Remedial Program alternative consists of a series of zero valence iron Permeable Reactive Barriers to reduce and with time eliminate the volume of hexavalent chromium contamination in ground water. In addition, the alternative under the Remedial Program includes a series of actions described under the Removal Program alternative to continue to address hexavalent chromium in residential and commercial buildings within the GGCS until the PRB eliminates the threat of contaminated groundwater seeping into buildings. The Remedial Alternative is considered a practical and effective alternative to permanently address hexavalent chromium contamination within the AOC. The total 30 year-present worth cost to implement these actions is $43,894,802.

EPA anticipates the remediation of the GGCS would be more appropriate and cost effective under the remedial program authority rather than under the removal program authority. The remedial alternative represents a more permanent solution which, in the long term, will be more cost effective and protective of human health and the environment.