Proceedings Tailings and Mine Waste 2011
Vancouver, BC, November 6 to 9, 2011

Osburn Repository Siting—Case History; Bunker Hill Mining and Metallurgical Complex Superfund Site Cleanup

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Abstract

The location for the new Coeur d'Alene Basin Repository was selected based on a two-phased siting process. The first phase was to develop an inventory of potential candidate sites through research at the County assessor's office and communication with realtors; local, state, and federal agencies; and the Coeur d'Alene Indian Tribe. A total of 94 candidate sites were carried forward to the second phase, which involved an initial screening exercise to winnow the 94 sites to a workable number for further assessment. During this phase, citizens' input was incorporated into the repository siting process. To achieve this goal, two workshops were held to identify the important siting factors from the public's perspective. The public input was distilled into a list of nine screening criteria. Performance scores/values from stakeholders were developed for every candidate site for each of the criteria. Based on citizen criteria ranking, the Osburn Tailings Impoundment was recommended for further evaluation.

Phase 1

The new Coeur d'Alene Basin Repository is needed to dispose of waste from mining-related remediation activities at the Bunker Hill Mining and Metallurgical Complex Superfund Site near Kellogg, Idaho. The United States Environmental Protection Agency (USEPA) and Idaho Department of Environmental Quality (IDEQ) have developed a Basin-wide Waste Management Strategy to guide waste repository siting and design to safely contain contaminated soils from the Superfund cleanup. The Strategy includes development of a new repository to contain the projected waste quantities. The study area for locating a suitable site for a new repository site was determined to be the upper drainage basin of the South Fork of the Coeur d'Alene River (SFCDR). The purpose of the first phase was to identify potential repository locations to support remedial activities at Bunker Hill Mining and Metallurgical Complex Superfund Site near Kellogg, Idaho. The identification process included the following steps:

1. Conduct an area-wide reconnaissance to identify land that is geographically suitable for repository construction.
2. Identify land ownership using county property records and locate the property by Global Positioning System (GPS) coordinates.
3. Perform site reconnaissance-level investigation and prepare qualitative descriptions of suitability, access, volume of storage, floodplain delineation, land use, etc.
4. Complete a comparative site ranking and identify most favorable sites.

Guidelines for evaluation of potential repository locations include the regulatory requirements identified in the Code of Federal Regulations, Title 40, Part 257 "Criteria for Classification of Solid Waste Disposal Facilities and Practices" and Title 40, Part 264 "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities." In general, siting criteria include:

1. Facilitation of future redevelopment and reuse of repository sites,

2. Maximization of the use of existing impacted areas,

3. Minimization of impacts to human health,

4. Minimization of impacts to the environment, and

5. Maximization of long-term effectiveness and permanence.

The criteria utilized in the site screening were established with the goal of siting each repository to reduce net impacts to all encountered environmental systems in the SFCDR. Thus, sites that had pre-existing contamination were considered to be more favorable than uncontaminated sites for development into a soil repository. In addition, Section 8.5 of the Coeur d'Alene Basin Proposed Plan (USEPA, 2001) identified the following criteria to evaluate potential disposal sites:

- Redevelopment and reuse potential,
- Community support,
- Land owner consent,
- Access to roadways and transportation impacts,
- Location of material relative to consolidation/fill areas,
- Nature of material and cap requirements,
- Concentrations of metals at potential consolidation/fill areas,
- Proximity to residences and populated areas,
- Proximity to streams and waterways,
- Proximity to groundwater resources, and
- Long-term Operations and Maintenance (O&M) costs.

The process of preliminary repository site identification required a pre-field, field, and post-field analysis. Prior to entering the field, informational resources were accessed. These resources include but are not limited to the following:

1. Topographic maps (1:24,000) from the US Geological Survey (USGS),

2. US Forest Service maps of Shoshone County,

3. Aerial photographs,

4. Geographic information system database maps depicting subject area boundaries, locations of slated soil removal volumes, property ownership (private, mining, public), etc.,

5. Coeur d'Alene Basin Remedial Investigation,

6. Coeur d'Alene Basin Feasibility Study Report,

7. Coeur d'Alene Basin Proposed Plan, and

8. Idaho Gazetteer.

Following the preliminary site identification, a screening site visit was conducted to evaluate access, floodplain delineation, surface water bodies, land use, proximity to residences, and proximity to removal areas. While traveling to the potential site, accessibility consisting of the road condition, type, and width was visually assessed and noted. In addition, distance to nearest removal areas was evaluated by estimating the time and distance (odometer reading) to approximate city centers. Although this is a rough estimate of distance to removal areas, it assures a standardized means of site comparison and permits (if necessary) future determination of relevant travel times and distances for planning purposes.

Upon arrival at a potential site, investigators recorded site information for each site as follows. Odometer readings, a tape measure, or site association (e.g., residence on northern perimeter of site) were used to determine proximity to residences. In addition, the tape measure was used to determine site dimensions for volume calculations. A qualitative assessment of the nature and extent of surface water bodies (rivers, creeks, run-on, run-off characteristics) was recorded. Next, investigators noted indicators of groundwater presence (seepage) as well as any apparent current land use. Also, a single GPS reading was taken at each site to establish site location for future reference and for use in determining property ownership. Finally, investigators took at least one digital photograph of each site.

A post-field analysis was conducted by defining rating criteria and conducting a site evaluation based on these criteria. Volume calculations were conducted by selecting an appropriate volumetric shape based on the site configuration (e.g., fill in the hole, mound over a flat area, back soil against a hillside or side slope, and mound over a tailings pond) to estimate a potential storage volume of each site. After evaluating the sites, a volume definition of >55,000 cubic meters capacity was designated as high volume capacity and <55,000 cubic meters was qualified as low volume capacity. Finally, analysts conducted a “Consumer Reports”-style site evaluation. Rating criteria were determined and defined based on the evaluated topics and ranges of values or conditions viewed at all sites in the investigation process. Data for all sites were presented in tabular format, with each of the stated screening criteria evaluated as good, average, or poor. A site was determined to have high potential if, of the six screening categories, three or more were categorized as good, and no more than two were rated as poor. A site was determined to have low potential if, of the six screening categories, three or more were categorized as poor, and no more than two were rated as good. All other sites were subsequently rated as having average potential for development into a soil repository. Upon completion of the site screening process in November 2002, a total of 83 potential sites were identified in the SFCDR Basin. Of these 83 sites, 29 were rated as good, 39 were average, and 15 were rated as poor.

Phase 2

Between November 2002 and April 2009, 11 more sites were added to the initial list using the same process that was used to develop the earlier list of 83 potential sites. At the start of the Upper Basin repository siting process, a “fatal flaw” analysis was conducted using the screening criteria to assess the 94 potential sites. The purpose of the “fatal flaw” analysis was to reduce the number of sites to a smaller, more manageable number to undergo further evaluation prior to selection of the Upper Basin repository site. Based upon the approximate disposal capacity for the 94 sites, those with an estimated volume less than 300,000 cubic meters were eliminated during this analysis. This reduced the number of potential sites from 94 to 10 sites. Next, these 10 sites were reviewed to determine if the site was part of an active operational facility; active sites were excluded from further investigation. This step excluded two sites. The remaining eight potential Upper Basin repository sites are presented in Table

1. The eight sites in Table 1 were subjected to a detailed screening and scoring process as described below.

Table 1: Screened Upper Basin Repository Candidate Sites

Site Name	Estimated Volume (Cubic Meters)
Star Tailings Impoundment	1,200,000
Willow Creek – East Mullan	600,000
Burns-Yaak	2,100,000
Osburn Tailings Impoundment	2,100,000
Vacant RV Park, Smelterville	400,000
Gun Range, Smelterville	500,000
Government Gulch	600,000
Cole and Larson Roads	500,000

These candidate sites were presented at a public workshop. Based upon public viewpoints and comments, key assumptions and siting criteria were developed. The key assumptions included:

1. The repository will be sited in the upper portion of the SFCDR drainage basin.

2. The site must have at least 400,000 cubic meters of capacity and currently be inactive.

3. The site preferably will be located in an area already contaminated with metals from mining and ore processing wastes.

4. All sites will be designed to minimize the potential for groundwater contamination.

5. After closure, the site must be secured and maintained to prevent contaminant release.

6. The site must be reasonably flat.

7. The site must be accessible from existing roads.

The following siting criteria were developed based on public input and other important environmental considerations:

1. Minimize potential for impact to wetlands and related wildlife.

2. Minimize potential for impact to surface waters and fish and wildlife.

3. Minimize potential for impact to floodplain.

4. Site is not near a mapped fault or likely to be affected by landslide.

5. Site is not likely to result in impacts to persons living or working near the repository (residences, schools, urban areas).

6. Truck route from I-90 to the repository is not likely to affect existing persons or businesses.

7. Minimize trucking costs by locating site close to removal areas.

8. Site preserves potential economic benefits by not using land that would otherwise be readily developable.

9. Site can accommodate large volume of material.

Methodology Overview

The methodology (CH2MHILL, 2010) used for the site screening analysis is called multi-objective decision analysis (MODA), which is a quantitative technique for making decisions that involve multiple financial, environmental, and social objectives. The technique is based on the principles of multi-attribute utility theory (Keeney & Raiffa, 1976). MODA proceeds through a series of defined steps, including:

- Establish the decision goal and key assumptions.
- Identify and specify fundamental objectives or siting criteria.
- Develop performance scales and measures for each criterion.
- Score how well each site meets each criterion.
- Assign relative value weights to the criteria.
- Calculate total scores for each site and conduct sensitivity analysis.

Decision Goal, Siting Criteria and Performance Measures

The decision goal, siting criteria, measurement scales, and performance measures are shown in Table 2. The criteria were developed by the project team using input received at the May 14, 2009, public workshop and other criteria (such as hauling distances) deemed to be important factors to consider in the siting decision. The measurement scales establish how well each site met each criterion, and the performance measures show the best and worst possible outcome for each criterion. All criterion presented in Table 2 take into account the key assumptions listed above.

Measurement scales can be quantitative or qualitative, depending upon the criterion. Wherever possible, quantitative measures were used to characterize the performance of sites against the criteria. For example, truck travel times from one location to another were measured in minutes. When a quantitative measure could not be developed, such as minimizing the impact to surface waters, a 1-5 scale was used where one (1) is the worst potential outcome, and five (5) is the best potential outcome for that criterion.

Performance Scores for Each Criterion

Staff from TerraGraphics conducted analyses to assign performance scores to each site for each criterion. Table 3 provides the performance scores.

Relative Value Weights

Table 4 shows the relative value weights assigned to each criterion. Relative value weights reflect the relative importance of each criterion in selecting a preferred site. These weights are a representation of the relative value received as each measurement scale is varied from its worst outcome to its best outcome. When assigning relative value weights, one should consider both the relative importance of a criterion and the variability of the criterion.

These relative value weights were developed during a meeting with the Project Focus Team (PFT) on August 20, 2009. The PFT consists of representatives from Shoshone County, the Coeur d'Alene and

Spokane Tribes, the Citizens Coordinating Council, and local, state, and federal agencies. In the August 20 meeting, participants were asked to think about relative value of each criterion as it is varied from the worst to best outcome compared to the value received for this criterion as the other criteria were varied in a similar manner. Each participant submitted his or her weights, and the results were discussed. The final column of Table 4 shows the relative value weights as a percent of total value, where the sum of the relative value weights equals 100%. This information is used in the calculation of the total value score for each site.

The Result – Total Value Scores

The total value score is calculated as a weighted average of normalized performance scores and relative value weights. Performance scores were normalized by arithmetically transforming each measure to a scale of zero-to-one, where the worst outcome is given a score of zero and the best outcome is given a score of one. For example, for a criterion with a 1-5 scale, a score of 3 was transformed to a normalized score of 0.5; a score of 4 was transformed to a normalized score of 0.75.

The total value score, summed over all nine criteria, was calculated as follows:

*Normalized performance score * relative value weight in percent * 100*

The results of the analysis using the group weights are shown in Table 5, with the total scores for each site. As shown, the Osburn Tailings Impoundment is the highest scoring site, followed by the Star Tailings Impoundment site.

Pre-Conceptual Cost Analysis

TerraGraphics provided a pre-conceptual design and cost analysis (TerraGraphics, 2009) to assist IDEQ and USEPA in selecting new Upper Basin repository sites. The pre-conceptual design and cost estimate was intended to identify significant cost factors that are reasonably foreseeable for repository construction and operation. A pre-conceptual design was created for each site based on existing information and new information collected through site visits. Each pre-conceptual design was site-specific and tailored to each site's unique topography, physical boundaries, ownership boundaries, and other features which directly influence waste placement. The goal of the pre-conceptual design was to maximize the waste storage capacity while providing a stable and constructible repository design. To achieve a stable waste placement configuration, a limiting design criterion was incorporated into the pre-conceptual design. The criterion is to limit exterior waste slopes to a three horizontal to one vertical (3H:1V) configuration.

An estimate of each expected cost is obtained by using these known values and applying them to the volume and surface area calculations determined from the pre-conceptual repository designs. These individual costs are then compiled to arrive at the cost estimate totals presented in the pre-conceptual design and cost analysis (TerraGraphics, 2009). The cost estimates are presented in 2009 dollars, with the estimates divided into three components:

- Capital Expenditures
- Waste Disposal
- O&M Costs

Table 2: Siting Criteria and Performance Measures

Goal Statement: Select a site for development of a repository for material excavated during remedial actions and from Institutional Controls Program projects in the Coeur d'Alene Basin.				
	Siting Criterion	**Measurement Scale**	**Performance Measures**	
			Worst	**Best**
1	Minimize potential for impact to wetlands and related wildlife	1-5 scale reflecting likelihood of wetlands impacts	Wetlands clearly present onsite and site is near an area conducive to the presence of wetlands	No wetlands in vicinity of site
2	Minimize potential for impact to surface waters and fish and wildlife	1-5 scale reflecting distance to surface water	Surface waters clearly present onsite	No surface waters in vicinity of site
3	Minimize potential for impact to floodplain	Percent of site estimated to lie within floodplain	Located completely within floodplain (100%)	Located completely outside floodplain (0%)
4	Site is not near a mapped fault or likely to be affected by a landslide	Distance to fault (meters); divided by 2 if landslide potential	Site is directly on top of a fault and there is landslide potential	Site is 600 meters from a fault with no landslide potential
5	Site is not likely to result in impacts to persons living or working near the repository (residences, schools, urban areas)	Parcels with residential or commercial structures within 5 zones (1-100 m, 101-200 m, 201-300 m, 301-400 m, 401-500 m). Parcels multiplied by the following factors: 16, 8, 4, 2, 1, for the respective zones	255 residential, business, or institutional parcels within a 500 meter radius = total score of 1,145.	Two residential, institutional, or business parcels within a 500 meter radius = total score of 5.
6	Truck route from I-90 to the repository is not likely to affect existing persons or businesses	1-5 scale reflecting the estimated number of residences and businesses along truck route multiplied by 1=state highway; 2 = urban paved; 3 = rural	65 residential, business, or institutional parcels along urban paved road = 130	Two residential, institutional, or business parcels along urban paved road = 4
7	Minimize trucking costs by locating site close to removal areas	Estimated haul time from Canyon Creek via I-90 Wallace interchange	19 minutes	3 minutes
8	Site preserves potential economic benefits by not using land that would otherwise be readily developable	1-5 scale reflecting the extent to which the site preserves developable land	Site considered to be currently developable and siting of repository would hinder future	Significant constraints exist to developing this site

			development	
9	Site can accommodate large quantity of material	Estimated cubic meters of capacity	400,000 cubic meters	2.1 million cubic meters

Table 3: Scores for Potential Repository Sites

		Performance Scores							
		Site 1	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**
	Siting Criterion	Star Tailings Impoundment	Willow Creek - East Mullan	Burns-Yaak	Osburn Tailings Impoundment	Vacant RV park, Smelterville	Gun Range, Smelterville	Government Gulch	Cole and Larson Roads
1	Minimize potential for impact to wetlands and related wildlife	5	3	5	5	5	5	5	5
2	Minimize potential for impact to surface waters and fish and wildlife	3	1	5	3	3	3	1	5
3	Minimize potential for impact to floodplain	0%	20%	0%	0%	100%	100%	25%	0%
4	Site is not near a mapped fault or likely to be affected by a landslide	0	2000	900	500	600	600	0	600
5	Site is not likely to result in impacts to persons living or working near the repository (residences, schools, urban areas)	955	57	1145	5	143	20	10	7
6	Truck route from I-90 to the repository is not likely to affect existing persons or businesses	60	51	130	45	4	4	30	30
7	Minimize trucking costs by locating site close to removal areas	3	14	8	9	16	16	19	13
8	Site preserves potential economic benefits by not using	5	1	1	5	1	1	1	1

	land that would otherwise be readily developable								
9	Site can accommodate large quantity of material	1,200,000	600,000	2,100,000	2,100,000	400,000	500,000	600,000	500,000

Table 4: Relative Value Weights

Goal Statement: Select a site for development of a repository for material excavated during remedial actions and from Institutional Controls Program projects in the Coeur d'Alene Basin.			
		Baseline: Geometric Mean of Responses	
	Siting Criterion	**Change in Relative Value as Measurement Scale Goes from Worst to Best**	**Relative Value Weights, Percent of Total**
1	Minimize potential for impact to wetlands and related wildlife	52	8.6%
2	Minimize potential for impact to surface waters and fish and wildlife	65	10.7%
3	Minimize potential for impact to floodplain	69	11.4%
4	Site is not near a mapped fault or likely to be affected by a landslide	42	6.9%
5	Site is not likely to result in impacts to persons living or working near the repository (residences, schools, urban areas)	100	16.5%
6	Truck route from I-90 to the repository is not likely to affect existing persons or businesses	55	9.1%
7	Minimize trucking costs by locating site close to removal areas	63	10.4%
8	Site preserves potential economic benefits by not using land that would otherwise be readily developable	84	13.9%
9	Site can accommodate large quantity of material	75	12.4%

Estimates for each site are presented as both a lump sum total and the total cost per cubic meter. While the lump sum total for each repository is necessary for the decision-making process, the cost per cubic meter for each repository is a meaningful cost comparison between the two potential sites. The large difference in potential capacity of the two sites, with Osburn Tailings Impoundment's capacity being approximately three and a half times that of Star Tailings Impoundment, allows for the capital costs for Osburn Tailings Impoundment to be divided over a larger volume, decreasing the cost per cubic meter.

Analysis of the site data collected and the pre-conceptual designs presented indicate that both the Osburn Tailings Impoundment Site and Star Tailings Impoundment Site are viable candidates for the

location of a new Upper Basin repository. Neither site has technical reasons for exclusion from further consideration. The pre-conceptual designs meet the fundamental criteria set forth in the screening process. Table 6 presents a comparison of capacities and costs for the two sites.

Table 5: Calculation of Final Value Scores

		Final Value Score							
		Site 1	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**
	Siting Criterion	Star Tailings Impoundment	Willow Creek - East Mullan	Burns-Yaak	Osburn Tailings Impoundment	Vacant RV park, Smelterville	Gun Range, Smelterville	Government Gulch	Cole and Larson Roads
	Total Score	**63.4**	**46.7**	**53.4**	**82.6**	**41.6**	**44.2**	**42.7**	**61.5**
1	Minimize potential for impact to wetlands and related wildlife	8.6	4.3	8.6	8.6	8.6	8.6	8.6	8.6
2	Minimize potential for impact to surface waters and fish and wildlife	5.4	0.0	10.7	5.4	5.4	5.4	0.0	10.7
3	Minimize potential for impact to floodplain	11.4	9.1	11.4	11.4	0.0	0.0	8.6	11.4
4	Site is not near a mapped fault or likely to be affected by a landslide	0.0	6.9	3.1	1.7	2.1	2.1	0.0	2.1
5	Site is not likely to result in impacts to persons living or working near the repository (residences, schools, urban areas)	2.8	15.8	0.0	16.5	14.5	16.3	16.5	16.5
6	Truck route from I-90 to the repository is not likely to affect existing persons or businesses	5.1	5.7	0.0	6.1	9.1	9.1	7.2	7.2
7	Minimize trucking costs by locating site close to removal areas	10.4	3.3	7.2	6.5	2.0	2.0	0.0	3.9
8	Site preserves potential	13.9	0.0	0.0	13.9	0.0	0.0	0.0	0.0

	economic benefits by not using land that would otherwise be readily developable								
9	Site can accommodate large quantity of material	5.9	1.6	12.4	12.4	0.0	0.8	1.9	1.1

Final Value Score = (Scores Normalized to 0-1 scale) * (Weights) * (100)

Table 6: Upper Basin Repository Site Comparison

Site Comparison		
Site	**Osburn Tailings Impoundment**	**Star Tailings Impoundment**
Waste Capacity	2,100,000 cubic meters	600,000 cubic meters
Surface Area	17 Hectares	13 Hectares
Capital Cost	$13,303,000	$7,461,000
Waste Disposal Cost	$44,573,000	$12,600,000
O & M Cost	$4,570,000	$4,570,000
Total Cost	$62,445,000	$24,631,000
Total Cost Per Cubic Meter	$29.74	$41.05

Conclusion

Based upon the results from Phase 2, the Osburn Tailings Impoundment Site was selected for design of the Upper Basin Repository.

References

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