PRE-ASSESSMENT SCREEN DETERMINATION/PRELIMINARY INJURY ASSESSMENT

LOWRY LANDFILL SUPERFUND SITE
Denver, Colorado
May 17, 2010

A. Action

This document is a Pre-Assessment Screen Determination/Preliminary Injury Assessment for the Lowry Landfill Superfund Site ("Lowry Landfill"), and has been prepared by the Office of the Colorado Attorney General in consultation with and on behalf of all the Natural Resources Trustees for the State of Colorado.

B. Purpose

The purpose of this document is to "ensure that there is a reasonable probability of making a successful claim."[1] This document is not intended to serve as an actual assessment of natural resource injuries or damages.

C. Authority

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Governor Romer designated the Executive Director of the Colorado Department of Public Health and Environment (CDPHE), the Executive Director of the Colorado Department of Natural Resources (DNR), and the Attorney General of Colorado as the three Natural Resources Trustees for the State. State trustees shall act on behalf of the public as trustees for natural resources, including their supporting ecosystems, within the boundary of a state or belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the state.[2]

The trustees have the right to assess damages to the state's natural resources resulting from the release of hazardous substances, and seek to hold responsible parties liable for injuries.[3]

The trustees may recover natural resource damages for injuries that exceed "baseline" conditions. Baseline means the condition or conditions that would have existed at the

---

[1] 43 C.F.R. § 11.23(a)(b).
[2] CERCLA § 107(f)(1), 40 CFR § 300.605, CERCLA § 101(16).
[3] CERCLA § 9607(f)(1) and (2)(B).

assessment area had the release of the hazardous substance not occurred.[4] The baseline level is compared to the level existing or anticipated upon completion of the response action to determine the residual injury. [5]

In addition, the trustees may recover damages for interim lost use and value of the natural resource during the period of time required to restore, replace or acquire the equivalent of the injured natural resource.[6]

D. Regulatory Guidance

Pursuant to section 301(c) of CERCLA, the Department of the Interior promulgated regulations for natural resource damage assessments ("NRDA"), which can be found at 43 C.F.R. Part 11. Adherence to these regulations is not mandatory and does not preclude the State trustees' use of alternate methods of assessing damages or arriving at a negotiated settlement with responsible parties. However, an assessment made in accordance with the regulations has the force and effect of a rebuttable presumption of correctness on behalf of the trustees.[7]

E. Key Terms

To aid in the public review of the proposed settlement, key terms are defined as follows.

Baseline refers to the conditions that would have existed in the area had the release of hazardous substances not occurred.[8] This is not necessarily the same as "pristine" conditions because other disturbances to the area might have decreased resource services without the release of hazardous substances. For example, even if no hazardous substances had been released from the Lowry Landfill, the landfill itself would obviously be different from native soil and bedrock due to waste disposal activities.

Damages is the amount of money needed to satisfy a claim in court. In the context of natural resource damages, that amount includes the cost to perform an assessment and to restore injured natural resources to baseline conditions. The amount also includes compensation for interim losses. "Residual damages" is a term used to describe any damages that remain after any response action is complete.

---

[4] 43 C.F.R. § 11.14(e).
[5] 50 Fed. Reg. 52126, 52133 (December 20, 1985).
[6] In re Acushnet River & New Bedford Harbor: Proceedings re Alleged PCB Contamination, 712 F. Supp. 1019, 1035 (D. Mass. 1989).
[7] CERCLA § 107(f)(2)(C),
[8] 43 C.F.R. § 11.14(e).

Tributary groundwater is water that is hydrologically connected to a natural stream and thus is administered in conjunction with waters of a natural stream pursuant to the constitutional doctrine of prior appropriation. All groundwaters of the State are presumed to be tributary unless proven otherwise.[9]

Injury is a measurable adverse change, either long- or short-term, in the chemical or physical quality or the viability of a natural resource, resulting either directly or indirectly from exposure to a release of a hazardous substance.

Response actions refer to activities taken to reduce threats from contaminants to acceptable levels. Short-term actions are generally termed *removals*, such as spill clean-up. Final response actions are considered *remedial actions* or the *remedy*, such as containment of contamination. Under CERCLA, the goal of response actions is to protect human health and the environment.

Restoration refers to actions undertaken to return injured resources and the services they provide to baseline conditions, and additional actions to compensate for losses of natural resources and their services. For example, restoration of groundwater might include actions that prevent further contamination from new or different sources. Restoration actions can take place off-site, away from the assessment area, or on-site, if the restoration actions improve condition of the injured resources above levels necessary to satisfy cleanup goals. *Restoration* may refer to direct restoration of injured resources, replacement of injured resources, or acquisition of the equivalent of such resources.

F. Site Overview

Lowry Landfill is located in unincorporated Arapahoe County, Colorado, about 15 miles southeast of Denver, and 2 miles east of Aurora. It comprises a 480-acre portion of the current Denver Arapahoe Disposal Site.

The site boundary includes former disposal areas and remedial components, such as a barrier wall, injection trench and extraction wells. The area is located in short-grass prairie habitat. A riparian corridor exists along an intermittent, unnamed creek at the north end of the Site, and wetlands border Murphy Creek to the north. Arapahoe County has zoned most of the surrounding areas as agricultural.

Groundwater at the site occurs as shallow unconfined groundwater in alluvium, and as deeper, confined groundwater in the bedrock below. The site is located in the Denver Basin, which extends north-south from Wyoming to Pueblo, Colorado. Within the Denver Basin, four major bedrock formations contain regionally important aquifers. These formations are, in order from the surface, the Dawson, Denver, Arapahoe, and Laramie-Fox Hills. The Dawson aquifer occurs within weathered and

[9] *Ready Mix Concrete Co. v. Farmers Reservoir and Irrigation Co.,* 115 P.3d 638, 643 (Colo. 2005).

unweathered rock within the Dawson formation, down to a clay layer that serves as an aquitard.[10] The Denver aquifer occurs within the unweathered Lower Dawson formation below the separation layer (also referred to as the Upper Denver aquifer) and in the Denver formation (Lower Denver aquifer). A lignite layer occurs at the top of the Denver formation and is considered part of the Denver aquifer. The Upper Denver aquifer is present only in some areas at and near the site. The Arapahoe and Laramie-Fox Hills aquifers occur in the Arapahoe and Laramie-Fox Hills formations beneath the Denver aquifer.

In preparing for clean-up of the site, EPA divided the site into six operable units to represent the different types and locations of contamination. Of those, Operable Unit 1 (OU1) includes the shallow ground water system within the alluvium and the Dawson aquifer directly under the landfill. Operable Unit 6 (OU6) consists of all remaining groundwater under the landfill.

G. A release of a hazardous substance has occurred.

The Site served as the principal municipal and industrial landfill for the Front Range of Colorado from 1965 through 1980, receiving liquid and solid waste. From 1980 until 1990, the Site operated only as a solid waste disposal site. Site records from Lowry Landfill indicate that approximately 138 million gallons of liquid waste were disposed at the site. Hazardous substances, as defined in CERCLA,[11] were included in the liquid waste. In 1984, under the supervision of the U.S. Environmental Protection Agency, responsible parties began remediation activities to clean up the soil and surface water, and to contain the ground water that remains contaminated.

In its Remedial Investigation, EPA determined that hazardous substances from the waste pits at Lowry Landfill had migrated to the shallow groundwater system below (OU1). The Remedial Investigation determined that most of the waste pits were in contact with shallow, alluvial groundwater upon their creation, causing the hazardous materials in the liquid waste to immediately enter the alluvial aquifers.[12]

H. Natural resources for which the State trustees may assert trusteeship under CERCLA have been injured by the release.

Colorado has trusteeship over the groundwater within the state. Colorado's Constitution states that "[t]he water of every natural stream, not heretofore appropriated, within the State of Colorado, is hereby declared to be the property of the public, and the same is dedicated to the use of the people of the State, subject to appropriation as hereinafter provided."[13] This includes water "hydraulically

[10] EMSI, 2005a.
[11] 42 U.S.C. § 9601 (14).
[12] 1992, Harding Lawson and Associates.
[13] Colo. Const. Art. XVI § 5; CRS § 37-92-102.

connected to" tributary groundwater if "it can influence the rate or direction of movement of the water in [the] alluvial aquifer or natural stream."[14] In addition, pursuant to its sovereign or trust interest, the State exercises management and control over groundwater, and its use – whether tributary or not. For example, CRS § 37-82-101 *et seq.* and CRS § 37-92-102 *et seq.* regulate the appropriation of tributary groundwater, and CRS § 37-90-102 *et seq.* regulates the appropriation of deep groundwater such as the water in the lower aquifers. Further, among other State water quality regulatory authorities, Colorado agencies have authority pursuant to CRS § 25-8-101 *et seq.* to enforce water quality standards.

Groundwater has been injured. Hazardous substances above groundwater standards for Colorado are present in groundwater under the site. Various entities instituted controls that restrict the use of groundwater under and surrounding the site that result in a loss of services from the restricted water. The contamination and service loss have resulted in an injury to groundwater, a natural resource of the State.

I. Response actions do not or will not sufficiently remedy the injury to natural resources without further action.

EPA issued a record of decision (ROD) for the Site in 1994, specifying the components for the remedial activity at the site. The remedial plan focused on containment and included a barrier wall to the north of the Site and a set of compliance monitoring wells surrounding the Site. The ROD was revised in 1995, 1997, and 2005 to reflect new information. Components of the remedy include groundwater barriers, groundwater extraction systems, a water treatment plan, covering of the landfill, treatment of landfill gasses, removal of tires, institutional controls and groundwater monitoring.

Although these measures will protect human health and the environment, they are not designed to, and will not, repair the injuries to groundwater. The remedy includes groundwater barriers and institutional controls because the groundwater is and will continue to be contaminated.

J. Data sufficient to pursue an assessment are readily available or likely to be obtained at reasonable cost.

Hazardous substances, as defined in CERCLA,[15] were included in the liquid waste disposed at the Site. Testing has focused on 40 hazardous substances in various media at the site, with 25 hazardous substances being monitored in ground water. These indicator substances were chosen because they were known to be included in the liquid waste deposited at the site and were detected in initial testing. The 25 substances monitored in ground water are shown in Table 1, below.

[14] CRS § 37-92-103(11).
[15] 42 U.S.C. § 9601 (14).

TABLE 1	Volatile Organic Compound	Semi-Volatile Organic Compound	Metal	Pesticide
1,1,1-Trichloroethane	X			
1,1,2,2-Tetrachloroethane	X			
1,1,2-Trichloroethane	X			
1,1-Dichloroethane	X			
1,1-Dichloroethene	X			
1,2-Dichloroethane	X			
1,2-Dichloropropane	X			
1,4-dioxane		X		
Acetone	X			
Arsenic			X	
Benzene	X			
Bromoform	X			
Cadmium			X	
Carbon tetrachloride	X			
Chlorobenzene	X			
Chloroform	X			
Dibromochloromethane	X			
Ethylbenzene	X			
Methylene chloride	X			
Naphthalene	X			X*
Tetrachloroethene (PCE)	X			
Toluene	X			
Trans-1,2-Dichloroethene	X			
Trichloroethene (TCE)	X			
Vinyl chloride	X			

* in solid form

K. The quantity and concentration of the released hazardous substance is sufficient to potentially cause injury to those natural resources.

To determine the appropriate monetary damages relative to the injury, the State must first establish the amount of injury. According to federal regulations, quantification of injuries is conducted to "quantify the effects of the discharge or release on the

injured natural resources for use in determining the appropriate amount of compensation."[16]

Injuries to groundwater at Lowry Landfill include:

- Concentrations of substances in excess of drinking water standards, in ground water that was potable before the release[17]
- Concentrations and duration of hazardous substances sufficient to have caused injury to other resources if exposed to groundwater[18]
- Institutional controls that prevent the future use of the groundwater[19]

Injury to Ground Water in Shallow Aquifers Below Site

Ground water in OU1 is encountered from 7 to 65 feet below ground. After reaching the shallow groundwater, the contamination seems to spread mostly horizontally, moving outward and generally flowing to the north within the aquifer system . This northward flow can be affected by sand channels, bedrock and other topographic occurrences. The remedy selected by EPA included a pump and treat system on the north end of the site, and slurry walls to act as barriers to prevent normal groundwater flow from flushing contaminants from the landfill area. The ground water in these shallow aquifers is known to contain hazardous substances exceeding ground water standards, and cannot be used in any way that could cause exposure to humans or animals.

Injury From Institutional Controls

Although the shallow and deep groundwater systems are separated by a barrier of clay, to ensure the health and safety of people, the EPA remedy requires institutional controls limiting the use of the deep aquifers under the landfill mass.

In addition, the City and County of Denver and the Lowry Trust[20] have placed limits on the use of groundwater surrounding the site through zoning, executive order, and purchases of groundwater rights.

Injury Associated with 1,4-Dioxane Plume Off-Site

While monitoring the remedy established for the site, the Lowry Trust discovered a plume of 1,4-dioxane extending to the north of the site, past the point where the pump and treat system was operating. In response, the treatment system was altered to

[16] 43 CFR § 11.70(c).
[17] 43 CFR § 11.62(c)(1)(i).
[18] 43 CFR § 11.62(c)(1)(iv).
[19] 43 CFR § 11.15(a)(1), 11.62(c)(4).
[20] Lowry Environmental Protection/Cleanup Trust Fund, established by the responsible parties for the clean-up of the site.

capture 1,4-dioxane exiting the site, but the existing plume continues to travel north, up the Murphy Creek area. There is no evidence that the 1,4-dioxane-contaminated water affects any drinking water sources, or reaches any of the deep ground water aquifers.

Quantity of Injury

The State estimates that hazardous substances released from activities at Lowry Landfill have injured 151,935 acre feet of ground water in the alluvium, weathered Dawson aquifer, unweathered Dawson aquifer and Denver aquifer, Arapahoe aquifer and Laramie-Fox Hills aquifer under and surrounding the site, due to contamination and service losses.

L. Explanation of How Damages May Be Estimated for an Injury

Damage calculations are an attempt to place a monetary value on a natural resource. Many theories are available for such an endeavor, because natural resources may have different values for different reasons to different people. In general, the State considers damages through two methods: a restoration-based approach and a market-based approach.

A **restoration-based approach** uses a resource equivalency analysis to quantify the amount of groundwater restoration that would be required to offset or compensate for the injury to groundwater. The cost of implementing these restoration actions is then used as an estimate of damages. According to federal regulations, restoration alternatives need to "restore, rehabilitate, replace, and/or acquire the equivalent of the injured resources."[21] Restoration actions that can provide the public with the equivalent of the injured groundwater include projects that are designed to: 1) generate clean water; 2) conserve water; 3) store water for times of scarcity, and 4) access new sources of water that were previously inaccessible or unusable.

To estimate the amount of restoration required to offset a groundwater injury, the state must take three steps, all of which require estimates or assumptions.

First, the State must determine the "debit" of the injury. This is an attempt to determine how much water was injured over a period of time. Because we can't see groundwater and cannot know exactly where it goes and how quickly, we must make some assumptions based on water depths, locations and flow rate. With these assumptions, we can take into account the time the contamination began (date of release), how long the release continued, and how soon the area of water might be free of the hazardous substance at issue. In other words, we try to determine exactly how "indebted" the responsible party is to the public.

[21] 43 CFR § 11.82(b)(1).

Next, we identify potential restoration projects that meet the requirements to restore, rehabilitate, replace and/or acquire the equivalent, and determine a cost per volume of groundwater for the project(s).

Finally, we determine how much restoration, or how much project (or credit) is needed to balance out the debit. While this is expressed in dollars, it is also expressed in project quantity. Because the restoration-based approach must estimate many of the variables in the calculation, it will likely produce a range of values to consider.

A **market-based approach** considers the market value of water that could have been available as extractable yield from the site. In general, a restoration-based approach provides a preferred measure of damages for natural resource injuries because a market value may understate the value of the resource and not provide adequate damages to accomplish restoration.[22] Nevertheless, to give a reference point for the proposed settlement, a discussion of how one could calculate market value for the injured groundwater resource follows. Damages estimated with the market-based approach use market prices of water rights transactions to apply to injured amounts of water. There are separate markets for shallow aquifer groundwater (which is tributary) and deep aquifer groundwater (which is non-tributary).

As in the restoration-based approach, the State must first determine the debit of the injury, but in this case, the debit only includes the extractable yield of water that could have been used. In Colorado, the amount of water legally extractable from a particular body of water is limited by statute. In addition, we must consider the likelihood of extraction, based on location and quality of the aquifer(s) at issue.

The cost of purchasing water rights, which is the basis of the debit calculation, changes with the market, the year of the purchase, the aquifer at issue, and the geographical location of the purchase. Again, using different assumptions for each of these variables gives us a range of values to consider.

Using the market-based approach, the State calculated two damage estimates using different assumptions about when groundwater rights would have been purchased. The first assumes that there were active markets for groundwater in 1981, 1993, and 2001. This estimate assumes that water rights would have been purchased in the first year that the injury occurred.

The second estimate accounts for the increased demand for water in the Northern Denver region. This estimate assumes that water rights would have been purchased in 2008. Because demand and water right prices are higher today than in the past, this estimate is higher.

[22] Ohio v. USDOI, 880 F.2d 432.

The advantage of the first calculation is that it captures the cost of the injury at the time it occurred, but it may not provide enough funds to purchase sufficient water rights in today's market. Conversely, the second calculation allows for the purchase of water rights today, but does not account for the fact that the injuries occurred in the past.

The price of an acre-foot of water rights for tributary water captures the stream of benefits associated with an acre-foot of water available *each* year. In other words, an acre-foot water right provides potential access to an acre-foot of water each year into perpetuity. The price of an acre-foot of water rights proxies the discounted value of benefits stemming from current and future water access and can therefore be used to estimate the damage of an injured acre-foot of shallow aquifer groundwater.

The groundwater in the shallower aquifers (Dawson and Denver) is valued using the market price of reliable surface water multiplied by a "firming-up" factor that accounts for the junior status of the right. Because any new water rights purchased would be junior water rights, they are not as valuable as the overall price of water in the region. The price of a water right must be adjusted to account for this. Based on analysis of water market transactions between 1965 and 2007, Howitt (2008) predicts a market price of water for the Northern Denver region. He adjusts his market price estimate to represent an estimated price for a right to in-situ, shallow aquifer groundwater, and subtracts the costs of firming the water (e.g., store water for use and augmentation) from the price. The price of in-situ groundwater is estimated to be about 64% of the estimated price of water transactions in the region.

Groundwater in non-tributary deeper aquifers (Arapahoe and Laramie-Fox Hills) is often used by municipalities, but is not traded in the market as often as the shallow aquifer groundwater. Developing additional deep aquifer groundwater is expensive and municipalities have the right to extract the safe yield under their service area for 100 years, so they do not readily purchase additional rights to deep aquifer groundwater. However, even though the demand is lower, non-tributary groundwater is generally cleaner than surface water and is not subject to augmentation. To account for the decreased demand for this groundwater, the State estimates the current price to be about 19% of the market price.

These rudimentary market-based calculations give us a range of damages from $2,418,000 to $3,470,000.

M. Additional Considerations

In determining whether a settlement is appropriate, the State must consider the cost of proving a case, both in time and money, and the litigation risks of the case. These considerations are weighed against the settlement offers the State receives in a given case in determining appropriate settlement dollars.

Proving injuries and appropriate damages through litigation is a labor-intensive and expensive procedure. The State generally must employ outside experts to assemble information and testify. In the past, the State has found it necessary to spend or budget hundreds of thousands of dollars to litigate these cases, due to the staff time and expertise required. In addition, such a case, if successful, can easily take years to see through to collection of damages and restoration of resources.

In this case, the State found the Responsible Parties to be responsive with reasonable settlement offers, allowing the state to move much more quickly to a restoration of its resources.

N. Conclusions

Responsible parties have released hazardous substances to the environment from the Lowry Landfill. These releases have caused injuries to groundwater. CERCLA established the right for a state to pursue damages for injuries to natural resources of the state, in order to compensate the public for its loss of the resources. The trustees for natural resources have determined that the injuries caused to groundwater at Lowry Landfill require compensation to the citizens of Colorado.

In weighing the settlement offer dollars and time to restoration against the costs and time of litigation, the State has determined the settlement offers described in the *Consent Decrees* in this case appropriately compensate for the injuries incurred to natural resources at the Lowry Landfill Superfund Site.