REPORT

EXIDE CLASS 2 LANDFILL RISK EVALUATION OF REMEDIAL ALTERNATIVES

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EXECUTIVE SUMMARY

A Class 2 landfill is located on the northern portion of Exide Technologies' (Exide's) Frisco Recycling Center (FRC) in Frisco, Texas. This landfill accepted treated slag from on-site lead battery recycling operations. The recycling operations used two furnaces to melt the lead-bearing components of batteries to produce lead bullion and a slag by-product. When cooled, slag is a fused (rock-like) material that contains concentrations of lead and other metals that are relatively immobile due to the fused nature of the material (after cooling). The slag was treated with reagents to immobilize metals in the slag prior to placement in the landfill. The treatment of the slag typically used cement in addition to reagent, which resulted in the slag curing to a concrete-like consistency. Operations at the FRC ceased as of November 30, 2012 and no slag has been generated since then. Most of the FRC has been demolished with the only remaining buildings being an administrative office building, a wastewater treatment building, and a crystallizer (which is part of the wastewater treatment operation).

The landfill was designed with a multi-layer bottom liner and multi-layer capping system to prevent release of landfill contents to the environment. The landfill consists of a series of 15 cells: cells 1 through 9 are full and capped, cells 10 through 12 received treated slag waste but are not full and remain open, and cells 13 through 15 are part of a partially constructed expansion. Cells 13 through 15 will have to be completed to finish out the original landfill design and create necessary slopes for final closure of the landfill. No wastes have been placed in cells 13 through 15 to date. Treated slag was routinely analyzed to confirm applicable treatment standards (Universal Treatment Standards [UTS]) were met. A small fraction of analytical results during the period when the capped cells 1 through 9 were in operation were above the UTS for lead and/or cadmium, and a small subset of those were also above the concentrations for characterization as hazardous waste. Exide conducted an in-place sampling investigation of cells 10 through 12, the results of which indicated that portions of the treated slag in cells 10 through 12 were above the UTS for lead and/or cadmium, primarily in the 0 to 0.5 foot depth and at greater depths in a few discrete areas. A smaller subset of these materials above the UTS was also above the concentrations for characterization as hazardous waste.

Exide conducted a pilot test, following approval of a work plan by the Texas Commission on Environmental Quality (TCEQ). Exide excavated and retreated a portion of the material in cells 10 through 12 that was above the UTS to determine whether it would be feasible to excavate, retreat, test, and re-deposit this material in cells 10 through 12. For the pilot test, large equipment crushed limited areas of the material to break it loose and then further crushed it to a size suitable for retreatment. Because of conflicting analytical results from different laboratories received during the pilot test program, the retreatment project was suspended at the direction of TCEQ.

RISK EVALUATION

This risk evaluation is being conducted to evaluate potential remedial alternatives for insufficiently treated material in the Class 2 landfill in a systematic and comprehensive manner to determine which alternative provides the best balance of the criteria evaluated, with the primary criteria being minimization of short-term and long-term risks to human health and the environment, and implementability.

Three remedial alternatives for the Class 2 landfill were identified for detailed risk evaluation. The three alternatives are:

- **Alternative 1: Closure in Place** – This alternative assumes the landfill would be closed in place and there would be no excavation or crushing of the material currently in the landfill. Remaining capacity in the cells that have not yet been capped and those currently being constructed will be used for disposal of Class 2 wastes including treated slag that has been accumulated at the FRC pending a decision regarding the remediation requirements for the Class 2 landfill and wastes generated at the FRC during site closure and remediation activities. When the remaining capacity is filled, the open cells will be covered with a multi-layer cap, including compacted clay, a liner, general clean fill, and a hydroseeded topsoil layer like that used for the capped cells. The implementation of this remedy is assumed to occur over a 3 to 4 month period once the remaining capacity is filled. Long-term cover maintenance and inspections would be conducted.
- **Alternative 2: On-Site Ex Situ Retreatment** – This alternative assumes that the material in the landfill (an estimated volume of 130,000 cubic yards [yd^3] of concrete-like material) would be excavated, crushed on-site to a specified size fraction, retreated on-site, tested to confirm adequate treatment, and placed back in the landfill. An additional estimated 25,000 yd^3 of cover and liner material would be removed from the Class 2 landfill, and also treated on-site as necessary before placement back in the landfill. The remaining capacity of the landfill would then be used for Class 2 wastes including treated slag that has been accumulated at the FRC pending decision on the remediation requirements for the Class 2 landfill and wastes generated during site closure and remediation activities and then capped as described in Alternative 1. It is assumed that this excavation and retreatment would occur over a 2-year period, plus 3 to 4 months to replace the cap on the landfill. Long-term cover maintenance and inspections would be conducted.
- **Alternative 3: Excavation and Off-Site Retreatment and Disposal** – This alternative assumes that all of the treated slag material in the landfill (an estimated volume of 130,000 yd^3 of concrete-like material) would be broken to allow excavation, excavated and loaded into haul trucks, and that this material and impacted portions of the cover/liner material (an aggregate volume of 155,000 yd^3) would be transported to a permitted hazardous waste facility for crushing, retreatment, and disposal. An estimated 15,500 truckloads would be required to transport the material to the permitted off-site disposal facility at a rate of about 21 to 42 trucks per day. The nearest permitted off-site disposal facility identified to date that currently would accept this material is 250 miles from the Exide facility. It is assumed that this alternative would occur over a 1.5- to 3-year period.

Conceptual site models (CSMs) were developed for each alternative to enable analysis of each aspect of the activities, including identification of potential routes of exposure to human and ecological receptors, potential hazards associated with the activities, and potential effects to the surrounding environment. The elements identified in the CSMs are categorized into the following primary criteria:

- Long-Term Risks – This criterion addresses the potential risks remaining after implementation of the remedy has been completed, including risks to the community, ecological receptors, and future site workers. This includes the consideration of the long-term reliability of the alternatives at reducing risks.
- Short-Term Risks – This criterion addresses potential risks while the alternative is being implemented, including risks to site workers, the community, and ecological receptors. For example, evaluations include potential health effects to the community from emissions of construction dust, including potentially lead/metal-bearing dust, truck emissions, traffic, transportation risks, potential health effects to site workers from exposure to materials in the landfill, safety risks from construction activities, etc.
- Implementability – This criterion addresses the feasibility of and the degree of difficulty in implementing the remedial alternatives, technically and administratively.

Costs of implementation are relevant and presented for consideration.

For each exposure route/hazard and receptor combination, the likelihood of occurrence is evaluated on a scale of one (almost certain likelihood) to five (rare likelihood). Then the consequence of the exposure, if it were to occur, is evaluated on a scale of one (critical consequence) to five (minimal consequence). These two semi-quantitative values, assigned based on best professional judgment, are then multiplied to calculate CSM risk values (on a scale of 1 to 25) for each long- and short-term exposure/receptor combination. The risk value scores are categorized as follows:

Table ES-1: Risk Analysis Matrix

		Consequence				
		Minimal	**Minor**	**Medium**	**Major**	**Critical**
Likelihood	**Score**	**5**	**4**	**3**	**2**	**1**
Rare	**5**	25	20	15	10	5
Unlikely	**4**	20	16	12	8	4
Possible	**3**	15	12	9	6	3
Likely	**2**	10	8	6	4	2
Almost Certain	**1**	5	4	3	2	1

Risk Rating	**Risk Score**
Minimal Risk	19.6 - 25
Minor Risk	14.6 - 19.5
Medium Risk	7.6 - 14.5
Major Risk	3.6 - 7.5
Critical Risk	0.0 - 3.5

Table ES-2: Implementability Matrix

Implementability Rating	Implementability Score
Very High	19.6 - 25
High	14.6 - 19.5
Medium	7.6 - 14.5
Low	3.6 - 7.5
Very Low or Negligible	0.0 - 3.5

The CSM risk values are used to develop the Indicator Scores in the risk assessment of the remedial alternatives. The higher the indicator score, the less likelihood/consequence of the risk for that exposure route and receptor combination (i.e. the higher the score the more favorable).

In addition to the CSM risk values, which are used to set the Indicator Scores for exposure-related criteria, several additional non-exposure related criteria (e.g., regulatory compliance, impacts on property values) were evaluated and assigned Indicator Scores on a scale of 1 (least optimal) to 25 (most optimal). Examples of how to follow the steps presented in this report for determining the Indicator Scores are included in Attachment A, Readers' Guide to Risk Evaluation Scoring.

RESULTS

Alternative 1: Closure in Place

There are minimal to minor risks of long-term effects from human or ecological exposure to lead or other metals present in the treated slag or associated dust for this alternative because the treated slag would remain undisturbed in place. This alternative does not involve excavation, crushing or transport activities that would generate potentially lead/metal-bearing dust. Based on best professional judgment, lead and other metals in slag material typically demonstrate low mobility. Further, given the analytical data for the material in the landfill and the landfill design, which includes a multi-layer bottom liner and a multi-layer cap, it is unlikely that there would be a release to the surrounding environment.

Short-term risks associated with the implementation of this alternative are estimated to be minimal to minor, and include increases in traffic and on-site machinery. Although some dust may be generated during implementation (which would be controlled by water trucks and other dust control measures), the potential for migration of dust to off-site soil would be expected to be dust from clean materials, in contrast to Alternatives 2 and 3.

Alternative 2: On-Site Ex Situ Retreatment

Similar to Alternative 1, there are minimal to minor risks of long-term effects from human or ecological exposure to landfill material. The material would be retreated and confirmed to be below UTS standards, and the landfill is designed with both a multi-layer bottom liner and a multi-layer cap. Potential long-term effects include the risks associated with potential future release from the landfill, which, as with Alternative 1, are unlikely. There are medium risks associated with aerial dispersion and off-site deposition to soils of lead/metal-bearing construction dust generated from breaking and crushing 130,000 yd^3 of concrete-like treated slag. An additional estimated 25,000 yd^3 of cover and liner material would also be removed from the Class 2 landfill and also treated on-site as necessary before placement back in the landfill.

The material in the landfill would be excavated and crushed on-site, which would result in short-term generation of potentially lead/metal-bearing dust, truck emissions, increased traffic, and noise. It is estimated that the total volume of material could be processed in at least a 2-year period, followed by about 3 to 4 months of capping the landfill area. The crushing and retreatment operations involve an increase in on-site machinery and the potential for incidents during implementation. The short-term risks during implementation of this alternative are estimated to be medium for off-site residents and ecological receptors, to major for on-site remediation workers.

Implementation is expected to require additional development of and agency acceptance of protocols to demonstrate the effectiveness and reliability of the retreatment and the analytical confirmation that treatment criteria are met. The generation of potentially lead/metal-bearing dust could result in frequent reductions in, or temporary cessations of remediation work to properly control dust. In addition, air permitting authorizations for certain equipment may be required, which may be complicated by the lead nonattainment status of the area. The potential for generation of lead/metal-bearing dust during the implementation of this alternative is likely to receive increased scrutiny for regulatory acceptance in light of the requirement to attain and maintain the lead National Ambient Air Quality Standard (NAAQS).

Alternative 3: Excavation and Off-Site Retreatment and Disposal

There are minimal to minor risks of long-term effects from human or ecological exposure to landfill material. The potential long-term risks in the vicinity of the Class 2 landfill and along the transportation route include off-site soil effects from potentially lead/metal-bearing dust generation and deposition related to on-site breakage, excavation, loading, and hauling of 130,000 yd^3 of concrete-like treated slag. The long-term risks include risks associated with potential future releases at the off-site treatment, storage and disposal facility (off-site TSD) because the material in the Class 2 landfill would be removed and placed at that facility. Given that this would be a permitted landfill facility that has met siting and engineering regulatory requirements, the risk of releases to the surrounding environment is expected to be minimal.

The total volume of material to be excavated (which would require some crushing or breaking of the material to allow excavation and handling) is 155,000 yd^3 of landfill material and cover/liner material. This volume corresponds to 15,500 truckloads that would be hauled 250 miles to the off-site TSD at a rate of about 21 to 42 trucks per day for a total of 7,750,000 truck miles travelled to implement this alternative.

The potential short-term risks for this alternative at the Class 2 landfill include medium risks to off-site residents, on-site workers, and ecological receptors related to the generation of potentially lead/metal-bearing construction dust from breaking and excavation of the concrete-like treated slag material; medium to major risks to off-site residents and ecological receptors from increased traffic; major risks to on-site workers from on-site machinery; and medium to major risks from increased noise to off-site residents, on-site workers, and terrestrial organisms. The potential short-term risks along the transportation route include minimal to medium risks to off-site residents and ecological receptors from generation of potential lead/metal-bearing dust, increased traffic, and potential spills of landfill material during transport to the off-site TSD. The potential short-term risks at the off-site TSD include minor risks from increased traffic, potential contact with landfill material, and potential chemical incidents (treating the material). In addition, there are medium risks for on-site workers at the off-site TSD from on-site machinery, noise, and inhalation of potential lead/metal-bearing dust.

The potential for air and other off-site impacts could negatively affect regulatory approval and community acceptance of this alternative. The potential for generation of lead/metal-bearing dust during the implementation of this alternative is likely to receive increased scrutiny for regulatory acceptance in light of the requirement to attain and maintain the lead NAAQS.

CONCLUSIONS

The main conclusions of this evaluation are:

- For long-term risk minimization, all three alternatives scored as presenting minimal risks (Scores for Alternatives 1, 2, and 3 are 20.1, 19.7, and 20.7, respectively).
- For short-term risk minimization, Alternative 1 (Closure in Place, score = 23.0) scores 15% higher than Alternative 2 (On-Site Ex Situ Retreatment, score = 19.5) and 37% higher than Alternative 3 (Excavation and Off-Site Retreatment and Disposal, score = 14.5). Alternatives 2 and 3 score lower because they involve removing and processing the existing waste material, creating the potential for lead/metal-bearing dust generation, and traffic and noise issues, among other considerations.
- For implementability, Alternative 1 (score = 17.8) scores 30% higher than Alternative 2 (score = 12.5) and 6% higher than Alternative 3 (score = 16.6). The Alternative 2 implementability score is medium, which is lower than the other alternatives because it involves removing and processing the existing waste material, creating the potential for

lead/metal-bearing dust generation, developing analytical procedures, more complex regulatory approval, and community acceptance challenges. The Alternative 3 implementability score is high, but lower than Alternative 1 due to the challenges to be faced in gaining acceptance for landfill material excavation, lead/metal-bearing dust, long-distance hauling, retreatment, and disposal.

The long-term risk minimization criteria scores for all three alternatives indicate minimal long-term risk, with little variability between scores, indicating that all three alternatives have high potential to provide long-term protection to human and ecological receptors, and the environment.

In contrast, Alternative 1 scores higher than the other two alternatives in the remaining two primary criteria (short-term risk and implementability). While all three remedial alternatives achieve the long-term goals of risk minimization, there are some moderate to major concerns in short-term risk management and implementability for Alternatives 2 and 3.

Short-term risk minimization represents a more substantial concern for Alternatives 2 and 3 than Alternative 1 due to the intrusive nature of these alternatives, which entail excavation of a substantial volume of concrete-like landfill material, crushing or breaking the material, loading the material into containers or trucks, and (for Alternative 3) hauling the material for off-site retreatment and disposal. As a result, the potential short-term impacts to nearby communities, on-site workers related to emissions of lead/metal-bearing construction dust, noise, and truck traffic are substantially greater for Alternatives 2 and 3 than for Alternative 1. It should be noted that the scores for short-term risk minimization are averaged over 42 indicators (which tends to attenuate the individual scores). For Alternative 2 there were 11 indicators scored medium, and 3 indicators scored major; and for Alternative 3 there 11 indicators that scored medium and 5 indicators that scored major.

Implementability is also a greater concern with Alternatives 2 and 3 than for Alternative 1. An analytical testing protocol to confirm effectiveness of the retreatment process would likely be necessary and would need to gain agency concurrence, which poses a challenge for regulatory acceptance. Also, the generation of potentially lead/metal-bearing dust could result in frequent reductions in, or cessation of remediation work to properly control dust. In addition, Alternatives 2 and 3 may involve air quality program implications. Alternative 3 also includes a substantial volume of truck traffic in and out of the Class 2 landfill and through the local community over an extended period of years, along the expected 250-mile transportation route, which could negatively affect regulatory and community acceptance.

The estimated cost for Alternative 1 (estimated to be less than $2 million) is more than an order of magnitude less than the estimated cost for Alternative 2 (estimated to be over $30 million), and the cost for Alternative 3 estimated to be about $80 million) is over twice the cost for Alternative 2, and approximately 40 times the cost of Alternative 1. Thus Alternatives 2 and 3 entail significantly higher costs. Despite entailing significantly higher cost, implementation of these higher cost alternatives would not achieve a distinguishable difference in long-term risks or the ultimate goal of long-term effectiveness, and as noted above, would result in increased short-term risks.

Given that all three Alternatives score comparably for long-term risk minimization and Alternative 1 scores higher than Alternatives 2 and 3 with respect to short-term risk minimization and implementability, from a risk evaluation standpoint, Alternative 1 is the best option.

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1.0 INTRODUCTION

A Class 2 landfill is located on the northern portion of Exide Technologies' (Exide's) Frisco Recycling Center (FRC) in Frisco, Texas (Figure 1). The Class 2 landfill received treated slag from on-site lead battery recycling operations.[1] The recycling operations used a furnace to melt the lead-bearing components of batteries to produce lead bullion and a slag by-product. When cooled, slag is a fused (rock-like) material that contains lead and other metals that are relatively immobile due to the fused nature of the material. The slag was crushed and treated with reagents to further immobilize metals in the slag prior to placement in the landfill. The treatment of the slag typically used Portland cement in addition to reagent, which resulted in the slag curing to a concrete-like consistency. The Class 2 landfill consists of 15 cells, which are not physically separated from each other (i.e., the Class 2 landfill is one continuous unit divided into 15 areas or cells of relatively equal size starting from the south and moving north). Cells 1 through 9 are capped. Cells 10 through 12 have additional capacity and remain uncapped, and cells 13 through 15 are part of a partially constructed expansion. Cells 13 through 15 will have to be completed to finish the original landfill design and create necessary final slopes for closure of the landfill.

Under the Resource Conservation and Recovery Act (RCRA), a waste stream must be characterized prior to disposal. Characterization includes determining whether a waste stream is listed as a hazardous waste or is a characteristically hazardous waste based on specific regulatory criteria for the characteristics of toxicity, ignitability, reactivity, or corrosivity. Hazardous wastes that will be land disposed are required to meet the applicable Universal Treatment Standards (UTS) as prescribed by United States Environmental Protection Agency (USEPA) in 40 CFR § 268.48. The UTS represent the maximum level of treatment determined to be technologically achievable by the USEPA. The UTS are treatment standards rather than risk-based standards.

Metal-bearing slag from the FRC is not a listed hazardous waste and is not otherwise a hazardous waste unless it exhibits the toxicity characteristic under RCRA (this type of slag does not exhibit the characteristics of ignitability, reactivity and/or corrosivity). The hazardous waste toxicity characteristic is evaluated using the toxicity characteristic leaching procedure (TCLP) analysis on waste materials. The toxicity characteristic criteria for cadmium and lead are TCLP results above 1.0 milligrams per liter (mg/L) and 5.0 mg/L, respectively. Waste that exceeds the toxicity characteristics for metals when generated (before treatment) must comply with the UTS after treatment. The UTS for cadmium and lead in metal-bearing slag are 0.11 mg/L and 0.75 mg/L, respectively. Texas standards for wastes to be placed into Class 2 landfills, as defined by 30 Texas Administrative Code §335.506, for cadmium and lead are TCLP

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[1] In addition, furnace refractory bricks from occasional maintenance activities were also placed in the Class 2 landfill.

results less than 0.50 mg/L and 1.5 mg/L, respectively. However, as-generated material that was hazardous waste must meet the more stringent UTS for disposal in a Class 2 landfill.

Cells 10 through 12 were the focus of an investigation by Exide and enforcement by the Texas Commission on Environmental Quality (TCEQ) in 2011 to 2012 to determine whether the material in cells 10 through 12 met applicable treatment standards and to determine the extent of material not meeting applicable treatment standards. Exide completed an investigation of cells 10 to 12, which is documented in the *Results of Class 2 Non-Hazardous Waste Landfill Investigation Exide Technologies, Inc., North Landfill, Frisco, Texas* (Exide 2012). Some exceedances of applicable treatment standards were detected. The majority of the sampling results above UTS for lead or cadmium in cells 10 to 12 were documented in the 0 to 0.5 foot depth interval with discrete areas above the UTS for lead or cadmium identified at greater depths. A smaller subset of the material in cells 10 through 12 that was above the UTS was also above the concentrations for characterization as hazardous waste.

Exide submitted a work plan to TCEQ to retreat material in cells 10 through 12 that was above the UTS, subject to a pilot test to determine whether it would be feasible to excavate, retreat, test, and re-deposit this material in cells 10 through 12. TCEQ approved this work plan. For the pilot test, large equipment crushed limited areas of the material to break it loose and then further crushed it to a size suitable for retreatment. Because of conflicting analytical results received from different laboratories during the pilot test program, the retreatment project was suspended at the direction of TCEQ.

In 2013, Exide conducted a review of analytical data from the FRC during the period the capped cells (1 to 9) were in operation. While the FRC was operating, Exide followed a protocol for analyzing treated slag to confirm applicable treatment standards were being met. Such analyses occurred and were analyzed immediately after treatment. A small fraction of the analytical results during the period when the capped cells 1 through 9 were in operation were above the applicable UTS for lead and/or cadmium. A smaller subset of analytical results above the applicable UTS was also above the concentrations for characterization as hazardous waste. Information regarding cells 1 to 9 was submitted to TCEQ and USEPA.

Exide retained Golder Associates Inc. (Golder) to evaluate the risks associated with potential remedial alternatives to address material in the Class 2 landfill above the UTS. A range of potential remedial alternatives could be implemented. However, for the purposes of this risk evaluation, three remedial alternatives were selected that are representative of this range of potential alternatives:

- Closure of the landfill in place (closure in place)
- Excavate landfill contents, retreat, and replace in the footprint of the existing landfill (which would be on-site ex-situ retreatment)

- Excavate the landfill contents and transfer it to an off-site permitted treatment, storage and disposal facility (off-site TSD) for retreatment and disposal (excavation and off-site retreatment and disposal)

While it is possible to develop variations of these representative alternatives, risk evaluations of such variations are not expected to materially differ from those presented in this report. Therefore, this report provides a risk evaluation of these three alternatives to determine which alternative provides the best balance of the criteria evaluated. The risk-based evaluation was developed to allow evaluation of each alternative using a multi-criteria analysis. This approach is inclusive of the many aspects of the remedial alternatives related to the surrounding environment, community, and other related elements, as well as technical and economic factors. In addition, information concerning estimated costs is provided for comparison purposes.

1.1 Purpose and Scope

The purpose of this risk evaluation is to evaluate potential remedial alternatives for the Class 2 landfill in a systematic and comprehensive manner to determine which alternative provides the best balance of the criteria evaluated.

2.0 APPROACH

The approach for evaluating the three remedial alternatives is summarized in this section. This section describes the three steps in developing the problem formulation approach: 1) state the problem; 2) identify the decision parameters; and 3) explain the risk evaluation approach.

State the Problem: The Class 2 landfill contains several cells of treated slag. As described in more detail in Section 3.2, a small fraction of the analytical results for the treated slag during the period when the capped cells 1 through 9 were in operation were above the applicable UTS for lead and/or cadmium. In addition, analytical results of samples collected of in-place slag in cells 10 through 12 indicated that some treated slag in cells 10 through 12 is above the UTS for lead and/or cadmium with the majority of that material located near the surface of the material currently in the landfill (i.e., in the 0 to 0.5 foot depth interval) and discrete areas above the UTS for lead and/or cadmium located at greater depths. A subset of the analytical results above the UTS was also above the concentrations for characterization as hazardous waste. Detailed information concerning the specific areas of exceedance is not provided in this evaluation, as their exact locations do not affect the conclusions described below. Three remedial alternatives were evaluated to determine which alternative provides the best balance of the criteria evaluated.

It is possible that the three selected remedies could be implemented only in cells 10 through 12, or, alternatively, in other combinations of areas within the landfill. However, for the purposes of this risk evaluation, it is assumed that the entire landfill would be remediated under each alternative. This was assumed in order to simplify comparison among the three alternatives. The inclusion of the landfill in its entirety does not have a substantial effect on the likelihood or consequences of the risks associated with each remedy. For example, excavation of materials from the landfill (as specified in Alternatives 2 and 3) would require disturbance of cover materials, intrusive activities to delineate the areas to be excavated, and excavation of landfill materials; all of which would generate construction dust, regardless of the size of the operation.

Identify the Decision Parameters: Three remedial alternatives to address the material that exceeds the UTS have been selected for evaluation: closure in place, on-site ex-situ retreatment, and excavation and off-site retreatment and disposal.

Decision Factors: The criteria considered for the risk evaluation are:

- Protection of Human Health and the Environment; Reliability
  - Long-term risk to human health and the environment: This criterion addresses potential risks remaining after implementation of the remediation alternative has been completed, including any residual risks to the community, site workers, and ecological receptors as a result of implementation activities. This criterion also

encompasses the concept of long-term reliability: whether an alternative's remedy and controls will be adequate and effective into the future.

  - Short-term risk to human health and the environment: This criterion addresses potential risks while the alternative is being implemented, including risk to community, site workers, and ecological receptors. For example, evaluations include potential health effects to the community from emissions of potentially lead/metal-bearing dust; truck emissions; increased traffic or transportation risks; potential health effects to site workers from exposure to materials in the landfill; and safety risks from construction activities.

- Implementability: This criterion addresses the degree of feasibility of and difficulty in implementing the remedial alternatives, and is subdivided into technical feasibility (e.g., ability to effectively implement the remediation) and administrative feasibility (e.g., permitting, regulatory approval, timing, and availability of services and materials).
- As an additional relevant consideration, the estimated costs of each of the remedial alternatives are discussed for comparison purposes.

Risk Evaluation Approach: Existing data and reports were reviewed to gain an understanding of the site history and of the issues related to sampling results above the lead or cadmium UTS and the hazardous waste criteria, and to gather information on the physical parameters and design of the Class 2 landfill to understand its design and calculate areas and volumes for remedial alternative planning and estimating purposes. After reviewing existing information available for the FRC, the risk evaluation was conducted in a three-tiered approach, as summarized below.

1. A detailed list of the activities that would be conducted for each alternative was developed.
2. Conceptual site models (CSMs) were developed for the three remedial alternatives. The CSMs are used to identify the potential pathways of exposure to contaminants and potential physical hazards associated with each of the remedial alternatives for human and ecological receptors in both long-term and short-term exposure scenarios. In addition to the traditional CSMs, an analysis of the likelihood of occurrence and consequences of occurrences for each pathway and each receptor was conducted. The pathways and receptors identified in the CSMs were used to identify the indicators used in the risk evaluation.
3. Additional (non-receptor based) factors were identified for evaluation of effectiveness and implementability of the three remedial alternatives. These factors include technical and economic factors, such as regulatory compliance, reduction of toxicity, effects on surrounding property values, etc.

A risk evaluation was conducted for the indicators identified in the CSM risk analysis and the non-receptor based factors using a multi-criteria analysis methodology. This methodology provides a means for comparing the three alternatives against each other for various indicators, and to conduct a balanced, impartial and comprehensive analysis of the many factors potentially contributing risk for each remedial alternative. This analysis method is intended to provide transparency in the decision process by presenting every piece of information entered into the analysis. The resulting scores provide an indication of the relative strengths and weaknesses of each remedial alternative to determine which alternative provides the best balance of the criteria evaluated.

The Indicator Scores used in this risk evaluation were developed such that a high score represents the minimization of risk from exposures or physical hazards, and a low score represents a higher probability of risk. This way, the higher scores reflect a more favorable outcome. The indicators, scoring mechanisms, and scores are described in more detail in Section 4.0.

In addition, the relative estimated costs are discussed. Cost estimates were developed for this risk evaluation to provide an idea of the magnitude of the approximate costs for each alternative and for relative comparison across the three alternatives.

3.0 SITE BACKGROUND

A brief history and review of existing data relevant to the risk evaluation are presented in this section.

3.1 History of Operations

The Exide FRC is a former lead battery recycling facility in the City of Frisco, Collin County, Texas. The former operational area of the FRC covers approximately 87 acres overall, consisting of the former production/operation area, two closed pre-RCRA landfills (North Disposal Area and South Disposal Area), one closed Class 2 landfill (the Slag Landfill), the active Class 2 landfill, and ancillary facilities (the site). Stewart Creek, which runs through the south side of the former production area, and a tributary of Stewart Creek (the North Tributary), which runs north of the North Disposal Area and the Slag Landfill, both cross the site from east to west. The site features have been described in detail in the Affected Property Assessment Report (APAR) (Golder 2014). The extent of the Class 2 landfill that is the subject of this risk evaluation is shown in Figure 1.

Lead oxide was produced at the site starting in approximately 1964, and battery recycling operations began in 1969. From 1969 to 2012, the FRC recycled spent automobile and industrial batteries and other lead-bearing scrap materials to produce lead, lead alloys and lead oxide. Exide acquired GNB Technologies in 2000 (including the site) and operated the FRC until ceasing operations in November 2012.

In 1991, the area of Collin County surrounding the FRC was designated a lead nonattainment area under the federal Clean Air Act. Following installation of new emission control equipment at the FRC and other measures in 1999, the area was designated as an attainment area with ambient air meeting the lead National Ambient Air Quality Standards (NAAQS) of 1.5 micrograms per cubic meter (µg/m^3) (quarterly average). In 2008, USEPA lowered the lead NAAQS to 0.15 µg/m^3 (three-month rolling average) and the area was again declared a nonattainment area for lead in 2010, with an attainment demonstration date of December 31, 2015. For the purpose of implementing measures to demonstrate attainment with the 2008 lead NAAQS by the attainment demonstration date, Exide entered into an Agreed Order with TCEQ under which it agreed to either undertake certain emission reduction strategies or cease recycling plant operations. Exide ceased recycling operations at the FRC in November 2012.

The recycling operations used two furnaces to melt the lead-bearing components of batteries to produce lead bullion and a slag waste. Slag is a fused (rock-like) material that contains concentrations of lead and other metals that are relatively immobile due to the fused nature of the material. The notice of intent to build a Class 2 landfill was filed with the TCEQ in September 1995 and construction of the first cell began in November 1995. Blast furnace slag and, occasionally, refractory bricks from furnace maintenance were disposed of in the Class 2 landfill. The expansions of the landfill occurred over time, as originally contemplated. Cells 1 to 9 were capped in 2009. Cells 10 to 12 were constructed in 2009 and have additional capacity and remain uncapped, and the final cells (13 to 15) are under construction and are planned to be used for disposal of Class 2 waste generated during the FRC closure process. Cells 13 through 15 have to be completed to finish out the original landfill design and create necessary slopes for final closure of the landfill. Cells 13 to 15 do not currently contain any wastes.

Although not all slag was hazardous waste when generated, Exide (and its predecessor) conservatively elected to assume that all blast furnace slag was hazardous as generated and therefore was subject to the UTS. The slag was crushed to a specified size, screened, then mixed with cement, water and a stabilization reagent to chemically fix any remaining lead content in a non-leachable form. The stabilization reagent and formula varied over time. When placed in the Class 2 landfill, the treated slag typically had the consistency of wet concrete and hardened in place in the landfill. Samples of the treated slag were collected in accordance with an established protocol and analyzed for lead using TCLP analysis. As mentioned previously and discussed further in Section 3.2, a small fraction of the analytical results during the period when the capped cells 1 through 9 were in operation were above the UTS for lead and/or cadmium. In addition, analytical results of samples collected of in-place slag in cells 10 through 12 indicated that some of the treated slag in cells 10 through 12 is above the UTS for lead and/or cadmium with the majority of that material located near the surface of the material currently in the landfill (i.e., in the 0 to 0.5 foot depth interval) and discrete areas above the UTS for lead and/or cadmium located at greater depths.

The treated slag was disposed into the Class 2 landfill, a monofill designed to receive treated slag from on-site operations in a manner that protects against releases of constituents to the environment. The landfill was designed as a below- and above-grade landfill, with the majority of the waste volume placed below grade. The landfill was designed to cover an area of 11 acres and have a capacity of 190,000 cubic yards (yd^3), which would support approximately 30 years of recycling operations. Fifteen cells were planned. Each cell within the landfill was designed to provide an active cell life of approximately two years or 12,000 yd^3 of waste.

The landfill was designed to contain treated waste and protect groundwater with a containment system at the bottom of the landfill. Infiltration to groundwater is limited by an existing clay base and 2.5 to 3.0 feet of compacted clay with a permeability of less than 1×10^{-7} centimeters per second (cm/sec). This clay is overlain by a 60-mil high density polyethylene (HDPE) flexible membrane liner (FML), a drainage geocomposite leachate collection system (LCS), and two feet of protective soil. The LCS was designed to convey leachate to a sump in the southwestern corner of the landfill, from which leachate is pumped to an aboveground tank. The sump is backfilled with stone or gravel and overlain with a geotextile filter fabric.

Once treated waste has been placed to final grade within the landfill, the landfill is designed to receive a final cover consisting of 12 inches of intermediate soil cover, 3 feet of compacted clay, overlain by a 40-mil HDPE geomembrane, overlain by 18 inches of vegetated topsoil (GNB Technologies 1995). This cap system is currently in place on cells 1 through 9.

A solar evaporation pond is located to the southwest of the landfill, with a volume of approximately 900,000 gallons. This pond was constructed in approximately 1997 of compacted clay and a HDPE liner and has one aerator. The solar evaporation pond is used to store rainwater that falls on the open cells of the Class 2 landfill. Contact water from the Class 2 landfill is pumped to the solar evaporation pond via a hard-piped system.

For purposes of this risk evaluation, the current total volume of landfill material (in cells 1 through 12) is estimated to be 130,000 yd^3, with approximately 12,350 yd^3 in each of cells 1 through 9, and approximately 6,170 yd^3 in each of cells 10 through 12.

An approximation of the current landfill cell configuration is presented in Figure 2. Currently, cells 1 through 9 have the final cover system in place, cells 10 to 12 were constructed in 2009 and received treated slag but are not full and have not been capped (estimated to be 50 percent full), and cells 13 to 15 currently do not contain waste. The landfill area for cells 1 through 12 as constructed is approximately 6.75 acres (Golder 2014), and the average thickness of landfill material is assumed to be 17 feet, based on design drawings.

3.2 Summary of Existing Data

Relevant existing data from the landfill included analytical results from TCLP samples from the treated slag, surface soil data, nearby groundwater samples, and air monitoring from the retreatment pilot test period.

3.2.1 Treated Slag Data

The confirmation samples of the treated slag were analyzed by Exide and/or a third-party analytical laboratory (ERMI or OXIDOR) for pH and TCLP lead, and periodically for TCLP cadmium and other metals to compare against the UTS.

Of the laboratory analytical results for sampling conducted by Exide, EMRI, and Oxidor of the capped cells (1 through 9), which were in use from 1997 to 2009, approximately 2.4% were above the UTS for lead and/or cadmium and of those same results 0.7% were above the concentrations for characterization as hazardous waste. Cells 10 to 12 came into service in 2009. On May 19, 2011 TCEQ collected two treated slag samples from cells 10 to 12 and analyzed them for TCLP lead and cadmium. Both samples exceeded UTS criteria for lead and cadmium. Exide then completed an investigation of cells 10 to 12, which is documented in the *Results of Class 2 Non-Hazardous Waste Landfill Investigation Exide Technologies, Inc., North Landfill, Frisco, Texas* (Exide 2012). The results of the investigation indicated that some of the treated slag in cells 10 through 12 is above the lead and/or cadmium UTS, with the majority of the exceedances located near the surface of the material currently in the landfill (i.e., in the 0 to 0.5 foot depth interval) and discrete areas of exceedances located at greater depths. Analysis for other metals was performed on a subset of the samples for cells 10 through 12 and there were no exceedances of their respective UTS.

3.2.2 Surface Soil Data

During the first phase of the APAR investigation (2013), four monitoring wells (PMW-19R, PMW-20R, LMW-21, and LMW-22) were installed around the Class 2 landfill (Figure 3). Samples from the 0.0 to 0.5-foot below ground surface (bgs) depth interval from these borings were analyzed for lead and cadmium to evaluate the potential for atmospheric deposition of these metals in this area in the prevailing downwind direction from the former production area. Soil samples from PMW-19R and LMW-22 were additionally analyzed for arsenic to evaluate potential aerial deposition of arsenic in this area. The concentrations at LMW-22 exceeded the site specific TCEQ residential assessment levels (RALs) for lead and arsenic. In the remaining samples, concentrations of lead, cadmium, and arsenic were below applicable RALs in all soil samples from these locations.

During the second phase of the APAR investigation (2014), samples were collected at ten locations around the Class 2 landfill to provide additional horizontal and vertical delineation. All samples were analyzed for lead, cadmium, arsenic, and selenium, and some samples were also analyzed for antimony. Based on results of sampling, step-out samples were collected to further delineate near locations where exceedances were detected. The boring for MW-45, installed to provide upgradient groundwater data per the work plan, was also sampled for lead, cadmium, arsenic, and selenium. Grid samples of surficial soils were collected at six locations on the Class 2 landfill cap. Samples were analyzed for lead, cadmium, arsenic, selenium, and in the shallow sample at 2013-CL2-C01, also for antimony. Subsequently, step-out samples collected near 2013-CL2-C01 were analyzed for all five COC metals (Golder 2014).

Results showed concentrations exceeding the lead RAL in the shallow sample interval (0 to 0.5 feet bgs) at sample location 2013-C2L-6, located west of the Class 2 landfill. Subsequent step-out samples exceeded the lead RAL at the 2014-CL2-06A and 2014-CL2-06C locations, north and southeast of the original sample, respectively. The RALs for antimony, arsenic, and selenium were also exceeded at the 2014-CL2-06 and 2014-CL2-06C locations and the RAL for selenium was also exceeded at 2014-CL2-06A. The arsenic concentration slightly exceeded the RAL in the shallow sample at 2013-C2L-01 (17.2 milligrams per kilogram [mg/kg]), located north of the Class 2 landfill, near the north site boundary, in a former agricultural area. This exceedance is believed to represent a background concentration (Golder

2014). The arsenic concentration slightly exceeded the RAL in the 15 to 17 feet bgs sample at 2013-C2L-08 (18.5 mg/kg), located north of the Class 2 landfill, near the north site boundary.

The cap sample at 2013-CL2-C01 exceeded the RAL for lead and arsenic, and arsenic also exceeded the RAL at 2014-CL2-C01B. None of the other samples exceeded the respective RALs for the five COC metals, as applicable (Golder 2014). This surficial soil data is provided to describe the conditions around the Class 2 landfill; the lead and arsenic are likely a result of aerial distribution due to former recycling operations.

3.2.3 Groundwater Data

Recent and historical groundwater data collected from wells near the landfill were reviewed. From recent measurements in 2013 and 2014, the only detection of lead was at Well MW-45, with a total lead concentration of 0.0046 mg/L. This well is upgradient of the landfill, as determined by the APAR investigations (Golder 2014), and the measured lead concentration is less than the groundwater RAL for lead of 0.015 mg/L (Golder 2014). There were no detectable concentrations of total arsenic, cadmium, or selenium in this well from the same groundwater sample. The other upgradient groundwater well, LMW-9, was sampled but did not contain detectable lead concentrations.

There were no detectable concentrations in the groundwater immediately downgradient of the landfill of lead (detection level of 0.0029 mg/L) or cadmium (detection level of 0.00035 mg/L). These results include wells LMW-5, LMW-8, LMW-17, LMW-21, MW-28, P-1, and PMW-20R (Golder 2014). As reported in the APAR (Golder 2014), none of these wells had detectable concentrations of arsenic (detection level of 0.0033 mg/L). Two of these wells (LMW-8 and PMW-20R) had detections of selenium greater than the detection level of 0.0042 mg/L, but all concentrations were below the RAL of 0.05 mg/L for total selenium and below the groundwater protective concentration level (0.02 mg/L) for dissolved selenium (Golder 2014).

Data are available from 1997 through 2005 for the following wells: LMW-5, LMW-17, and LMW-19. There were only a few total and there were no dissolved lead concentrations greater than the RAL of 0.015 mg/L. No other metals were tested for in these water samples during that time period.

3.2.4 Dust

Lead and cadmium in airborne dust samples were collected at seven downwind locations and one upwind location from the landfill during pilot testing for retreatment of landfill materials in 2013. Other decontamination and demolition activities were also being conducted on-site at the time. A total of 42 downwind perimeter samples were collected. Dust suppression measures were in effect during these activities. Over the seven-day monitoring period, daily lead air concentrations were generally non-detect (detection limit 0.15 micrograms per cubic meter [µg/m^3]). Two samples had concentrations of 0.20 µg/m^3

and 0.22 µg/m^3 at the downwind locations. Upwind location samples were non-detect (data submitted by W&M Environmental Group to the TCEQ). There were only three detections of cadmium in the air samples (with a maximum concentration of 0.012 µg/m^3), which were slightly above the detections limits of 0.010 µg/m^3.

4.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

The three potential remedial alternatives are described in this section, along with assumptions used in the development of each alternative. Then CSMs are presented for each alternative to illustrate potential exposures and consequences of such exposures associated with implementation and long-term performance of each alternative.

The primary goal of the remedial alternative to be implemented is to protect human health and the environment. Based on the CSMs and exposure pathways identified in Section 4.4, the following Remedial Action Objectives (RAOs) have been developed to achieve this goal:

- Minimize the risk of human exposure (through inhalation, ingestion, and dermal contact) to lead or other metals in the landfill material that could be available for exposures during and after implementation of the remedial alternatives.
- Minimize the risk of ecological receptor exposure (through inhalation, ingestion, and dermal contact) to lead or other metals in the landfill material that could be available for exposures during and after implementation of the remedial alternatives.
- Minimize the risk for migration of lead or other metals from landfill material to surface water or groundwater (i.e., prevent surface water or groundwater contact with landfill material containing lead or other metals).

The remedial alternatives were evaluated against the RAOs using the general criteria (criteria column in Table 1) to identify and analyze removal action alternatives, as specified in the USEPA document (1993a) *Guidance on Conducting Non-Time-Critical Removal Actions under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*:

- Effectiveness (long-term and short-term risk) – the ability of each remedial alternative to meet the remedial action objectives
- Implementability – the ability of each remedial alternative to be implemented, technically, and administratively

The general criteria are evaluated by identifying several individual factors related to potential exposures or hazards or related to the implementation and long-term management of resources for each alternative. These factors are listed in Table 1 as indicators. The indicators are evaluated for each alternative to assist in determining which alternative provides the best balance of the criteria. Once the overall effectiveness and implementability of the alternatives are evaluated, a discussion comparing the estimated costs of implementation is presented.

The following are specific descriptions of the three remedial alternatives.

4.1 Alternative 1: Closure In Place

Alternative 1 assumes that the 11-acre landfill would be closed in place and there would be no excavation or crushing of the material currently in the landfill. Remaining capacity in cells 10 through 15 would be used for disposal of Class 2 waste, including treated slag that has been accumulated at the FRC pending a decision on the remediation requirements for the Class 2 landfill, and wastes generated during site closure and remediation activities. When the remaining capacity is filled, cells 10 through 15 would be capped.

A cross-section of the final cover design is presented in Figure 4. A 3-foot thick layer of compacted clay or an equivalent geosynthetic clay liner (GCL) system would be placed in those portions of the landfill that have not yet been capped, and the upper surface would be rolled smooth. A 60-mil linear low density polyethylene (LLDPE) geomembrane would then be installed over the compacted clay (or GCL) surface, followed by geotextile (to provide cushioning and protect the geomembrane/GCL from overlying layers and construction activity) followed by a 1-foot thick layer of general clean fill material. A 1-foot thick layer of topsoil would then be placed above the general clean fill layer. After placement, the topsoil layer would be hydroseeded. This cover design is enhanced from the 1995 design cover in that the geomembrane is thicker and the LLDPE has more favorable mechanical properties for this application than HDPE.

Because landfill material would remain in place under this alternative, it is assumed that groundwater monitoring would be implemented under the interim-approved, as well as any final groundwater monitoring plan. The interim-approved plan requires the monitoring of four existing groundwater wells, two newly installed replacement wells (installed in 2013 to replace wells that were plugged and abandoned due to insufficient well construction details), and three new wells (also installed in 2013/2014). The interim-approved monitoring plan specifies that the nine wells will be sampled quarterly for three years or until such a time that the monitoring plan is replaced by the requirements of a permit or other legal instrument governing the site. Cover inspection and maintenance is also assumed.

4.2 Alternative 2: On Site Ex-Situ Treatment

Alternative 2 assumes that materials in the Class 2 landfill (an estimated total volume of 130,000 yd^3) would be excavated from the landfill, crushed on-site to a specified size, retreated on site, tested to confirm adequate treatment, and placed back in the landfill. Pilot testing would need to be performed to identify an appropriate treatment additive and process and an analytical testing procedure that would be acceptable to TCEQ and USEPA. Landfill material would be retreated to attain TCLP results for lead and cadmium at levels below the UTS, and cells would be capped as described in Alternative 1 – with either a geomembrane or a 3-foot thick compacted clay layer or equivalent GCL system.

To implement Alternative 2, the existing cover vegetation and topsoil layer on cells 1 through 9 would be removed and pushed to the margins of the landfill, where it would be stockpiled for later reuse. The existing 40-mil geomembrane would be removed and either recycled or disposed of off-site in a municipal solid waste (MSW) landfill (geomembrane cannot be reused). The 3-foot thick compacted clay layer would also be removed and pushed to the margins of the landfill, where it would be stockpiled for later reuse. The intermediate cover immediately above the landfill material (estimated to be approximately 25,000 yd^3) would not be salvaged due to the high likelihood of mixing with the underlying landfill material during the excavation for landfill remediation. It is assumed that this material would be treated on-site as necessary and placed back in the landfill.

The landfill material would be excavated with a large excavator, assisted by a hydraulic breaker where necessary. Fragments of landfill material would be loaded into containers in or in the vicinity of the Class 2 landfill. This large-scale disturbance of the landfill material would be expected to generate potentially lead/metal-bearing dust. Landfill material would be excavated carefully near the bottom of the landfill to prevent any damage to the 60-mil geomembrane underlying the 2-foot thick protective soil layer. The protective soil layer would be restored to a 2-foot minimum thickness following the removal of landfill material.

Excavated landfill material fragments would be processed through an on-site rock crusher to produce a material with a maximum particle size of 3/8-inch, the same as for the original treatment process (USEPA 2010b). For the purposes of this analysis, it is assumed that the crushed landfill material would be mixed with 15 percent treatment additive and 12 percent Portland cement. This large-scale crushing operation would be expected to generate potentially lead/metal-bearing dust.

TCLP testing would be performed on each batch of treated material, and the treated material would not be placed in the landfill until TCLP results are received and it is verified that the material meets the applicable UTS.

After replacement of retreated material in the landfill, the remaining capacity of the landfill would then be used for stockpiled treated slag and closure/remediation-related Class 2 wastes, as described in Alternative 1. Stockpiled clay material would then be spread in uniform lifts over the top of the landfill material and compacted. Clay material would be imported as needed to provide a 3-foot thick layer of compacted clay (or an equivalent GCL system may also be used). The upper surface of this layer would be rolled smooth. A 60-mil LLDPE geomembrane would then be installed over the compacted clay (or GCL) surface, followed by geotextile (to provide cushioning and protect the geomembrane/GCL from overlying layers and construction activity) followed by a 1-foot thick layer of general clean fill material. A 1-foot thick layer of topsoil would then be placed above the general clean fill layer. Stockpiled general clean fill and topsoil would be used with additional material imported as necessary to attain the specified thicknesses. The cover surface would then be hydroseeded.

Construction dust would be controlled during excavation and crushing operations with watering by a water truck, spraying, and similar methods. It is assumed there will be requirements for perimeter air monitoring, including stop-work criteria for lead and cadmium monitor readings and for wind-speed and wind-shift factors. Potentially-contaminated water from construction operations and contact (precipitation) water would be collected while construction is being performed. It is assumed that the volume of this water can be handled by the existing solar evaporation pond and/or waste water treatment facilities.

As in Alternative 1, because landfill material would remain in place under this alternative after excavation and retreatment, it is assumed that groundwater monitoring would be required, and would be implemented under the interim-approved and any final groundwater monitoring plan. Cover inspection and maintenance is also assumed.

It is assumed that the duration of the excavation and retreatment of landfill material activities would be at least 2 years. The duration of covering and capping activities after the retreated material is placed back into the landfill and the remaining capacity is filled would be about 3 to 4 months. Overall, the implementation of this remedy would be close to 2.5 years in duration.

4.3 Alternative 3: Excavation and Off-Site Retreatment and Disposal

Alternative 3 assumes that all material in the Class 2 landfill (an estimated total volume of 130,000 yd^3) would be excavated and that this material and impacted portions of the cover/liner material (an aggregate volume of 155,000 yd^3) would be disposed of in a permitted off-site TSD.

As in Alternative 2, the existing cover vegetation and topsoil layer on cells 1 through 9 would be removed and pushed to the margins of the landfill, where it would be stockpiled for later reuse. The existing 40-mil geomembrane would be removed and either recycled or disposed of off-site in a MSW landfill. The 3-foot thick compacted clay layer would also be removed and pushed to the margins of the landfill, where it would be stockpiled for later reuse. The intermediate cover immediately above the landfill material would not be salvaged due to the high likelihood of mixing with the underlying landfill material during the excavation for remediation; it is assumed that the intermediate cover would be removed with the landfill material and disposed of off-site. The landfill material would be excavated with a large excavator, assisted by a hydraulic breaker where necessary. The protective soil layer below the landfill material would be assumed to be impacted and removed along with the landfill material. The 60-mil geomembrane would be removed from the bottom of the former landfill and either recycled or disposed of off-site in a MSW landfill. The compacted clay layer would be left in place at the bottom of the former landfill. After all removal operations have been completed, the excavation would be backfilled with general clean fill (imported as necessary) and stockpiled clay and graded to drain. Stockpiled topsoil would be spread over the backfilled area, and all disturbed areas would be hydroseeded.

Excavated intermediate cover material, landfill material, and the protective soil layer material would be loaded into trucks and hauled to the off-site TSD for retreatment and disposal. The total volume of material that would be hauled off site for disposal is estimated to be approximately 155,000 yd^3 (or 250,000 tons).

Assuming a 10-yd^3 truck for highway hauling, an estimated 15,500 truckloads would be required for off-site disposal. For purposes of this evaluation, it is assumed that existing material is removed along a working face across the width of the landfill (this prevents exposing the entire waste mass at once and thereby minimizes the potential for dust, infiltration, and surface water impacts). Given the length of the working face (about 500 feet) and the type of operations, it is reasonable to assume that a hydraulic breaker would work at one location, while an excavator would load treated slag that has been broken from another location a few hundred feet away to avoid interference. The existing waste is assumed to typically have the characteristics of a moderately strong limestone (i.e., concrete), and general industry guidelines (Atlas Copco 2006) suggest that production rates in the range of 50 to 100 tons per hour (tph) can be achieved. Each 10 yd^3 truck can carry about 16 tons of excavated waste material, so a 50-tph excavation rate fills about 3 trucks per hour, while a 100-tph rate would fill about 6 trucks per hour. If full production can be maintained for 7 hours per day, then between 21 and 42 trucks could leave the site per working day. Assuming a 5-day work week (to avoid disturbing the surrounding community on weekends), transport of excavated material from the site would occur for a duration of about 1.5 to 3 years.

The nearest off-site TSD identified to date that currently would accept this material is approximately 250 miles from the FRC. The number of truckloads and the hauling distance for transport of the landfill material to the off-site TSD (round trip) equates to an estimated total of 7,750,000 truck miles to be travelled. All of the landfill material loaded for transport to the off-site TSD will be tested to characterize the waste, as required for acceptance at the facility (one TCLP test per 1,000 tons of excavated material has been assumed for this evaluation). All of the material received at the off-site TSD will be crushed at the off-site TSD and treated at off-site TSD to meet UTS prior to disposal at that off-site TSD.

Dust would be controlled during breaking, excavation, and loading operations at the Class 2 landfill and crushing, retreatment and disposal operations at the off-site TSD with watering by a water truck, spraying, and other methods. It is assumed there will be requirements for perimeter air monitoring at the Class 2 landfill, including stop-work criteria for lead and cadmium monitor readings and, potentially, for wind-speed and wind-shift factors, which may impact the ability to maintain full production. Potentially-contaminated water from construction operations and contact (precipitation) water would be collected while construction is being performed. It is assumed that the volume of this water generated at the Class 2 landfill could be handled by the existing solar evaporation pond and/or waste water treatment facilities.

Because no landfill material would remain in place in the Class 2 landfill under this alternative, post-closure requirements for the Class 2 landfill (i.e., groundwater monitoring or cover inspection and maintenance) may not be required or may be very limited and therefore are not assumed for the Class 2 landfill. Groundwater monitoring may be required in the vicinity due to other requirements at the FRC.

The off-site TSD would have permits and monitoring requirements in place, as well as a robust liner and capping system design. Materials received at that facility would be crushed and retreated and then disposed in lined cells that would eventually be capped.

4.4 Conceptual Site Model

A CSM depicting the routes and mechanisms of contaminant transport, and the human or ecological receptors that could potentially become exposed to lead or other metals in the treated slag was produced for each of the three remediation alternatives, as shown in Figures 5, 6, and 7. The CSMs are an important tool to conceptualize the potential exposure routes of human and ecological receptors to affected media and other hazards related to the implementation of the three remedial alternatives for the landfill.

In addition to the potential exposure pathways, a semi-quantitative method of rating the likelihood and consequence was applied to each remedial alternative for long term and short term exposures based on best professional judgment by professional engineers, toxicologists and environmental scientists. The scoring used in this evaluation was developed to provide a high score for the minimization of risk or physical hazards, and a low score for increased probability of risk or physical hazards. With this approach, the higher scores reflect a more favorable outcome and the lower scores reflect a less favorable outcome.

4.4.1 Scoring Guide

For each exposure route and receptor combination, the likelihood of occurrence was evaluated and a value from one (almost certain likelihood) to five (rare likelihood) was assigned. Then the consequence of the potential exposure was evaluated and a second value from one (critical consequence) to five (minimal consequence) was assigned. These semi-quantitative risk values, assigned based on best professional judgment, were then multiplied to calculate CSM Indicator Score (on a scale of 1 to 25) for each long and short term exposure/receptor combination. Indicator Scores for each long- and short- term exposure/receptor combination are used as Indicator Scores for each Indicator, Sub-Groups and Criteria categories in the risk evaluation of the remedial alternatives, as described in Section 5.0. Examples of how to follow the steps presented in this report for determining the Indicator Scores are included in Attachment A, Readers' Guide to Risk Evaluation Scoring. The table below provides the scale used for categorizing the risk ratings derived from the likelihood and consequence evaluation.

Risk Analysis Matrix	
Risk Rating	**Risk Score**
Minimal Risk	19.6 - 25.0
Minor Risk	14.6 - 19.5
Medium Risk	7.6 - 14.5
Major Risk	3.6 - 7.5
Critical Risk	0.0 - 3.5

4.4.2 Exposure Assumptions

Scoring was based on best professional judgment, which included consideration of guidance from several resources that provide detailed evaluations of potentials for exposure, risk, and effects from environmental media. Key applicable USEPA guidance and technical support documents used as resources for developing this risk evaluation include (but are not limited to):

- Assessing Lead at Superfund Sites (USEPA 2012).
- Exposure Factors Handbook: 2011 Edition, EPA/600/R-090/052F (USEPA 2011).
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. EPA 540-R-97-006. (USEPA 1997).
- Ecological Soil Screening Levels, OWSER 9285.7-70 (USEPA 2005).
- Framework for Metals Risk Assessment. EPA 120/R-07/001. (USEPA 2007a).
- Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24. (USEPA 2002).
- Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4. EPA/240/B-06/001. Office of Environmental Information. February. (USEPA 2006).
- Human Health Toxicity Values in Superfund Risk Assessments. OSWER 9285.7-53 (USEPA 2003).
- Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A), EPA/540/1-89/002 (USEPA 1989).
- Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), OSWER Directive 9285.7-01B (USEPA 1991).
- Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments), OSWER Directive 9285.7-47 (USEPA 2001).
- Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), OSWER Directive 9285.7-02EP (USEPA 2004).
- Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), OSWER Directive 9285.7-82 (USEPA 2009).

- Toxic and Hazardous Substances: Lead (Occupational Safety and Health Administration [OSHA] 1991).
- Toxicological Profile for Lead (Agency for Toxic Substances and Disease Registry [ATSDR] 2007).
- Users Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK). Prepared for The Technical Workgroup for Metals and Asbestos. 540-D-01-005. (USEPA 2007b).
- Wildlife Exposure Factors Handbook. Office of Research and Development. EPA/600/R-93/187. (USEPA 1993b).

4.4.2.1 Likelihood of Exposure

The likelihood of exposure is determined by evaluation of the physical exposure routes and activities that could result in releases to the environment or physical hazards. The CSMs in Figures 5, 6, and 7 illustrate the potential mode of release to the environment for each Alternative. First, the primary sources are identified (for example: treated slag in the landfill). Next, the potential release mechanisms are shown (for example: accidental digging into the cap or cap failure; lead/metal-bearing dust generation). Then the potential exposure medium for each release mechanism is shown (for example: landfill material, groundwater, surface water, sediment, and soil). The potential exposure routes for each affected exposure medium are shown (for example: ingestion, dermal contact, and inhalation).

For physical hazards, the activities that have the potential to cause a hazard are listed on the CSMs (for example: increased off-site traffic, on-site machinery). Similar to the releases to the environment, each hazard has a potential exposure medium (for example: increased traffic may lead to a potential incident; on-site crushing machinery may lead to generation of lead/metal-bearing dust, potential incidents, or increased noise).

The likelihood of exposure is further described in the two following examples for lead/metal-bearing dust generated by crushing or breaking activities, and releases from the landfill.

Example 1: Lead/Metal-Bearing Dust Generation Activities

> The crushing or breaking of lead/metal-bearing materials results in particulate material (PM) that may also be lead/metal-bearing. The finer the PM, the more likely that it is to become airborne. The dispersion of dust or particulate is primarily controlled by the size distribution (large versus fine particulate), the moisture level of the material, and atmospheric conditions (such as rain or wind). In general, the finer the particulate, the easier it is to become airborne. Dust suppression activities, such as watering, serve to keep PM from becoming airborne. Monitoring conducted during crushing operations would alert operators when PM levels approach levels of concern, whereupon work stoppage or additional dust suppression would occur. Therefore, the likelihood scores for generation of lead/metal bearing dust are 4 or 5 (unlikely or rare) in Alternative 1 since

no crushing or breaking occurs, and therefore minimal dust generating activities occur. The likelihood scores for Alternatives 2 and 3 range from 2 to 4 (likely to unlikely, depending on the receptor) due to the crushing activities (Alternative 2) or breaking activities (Alternative 3), which would generate lead/metal-bearing dust.

Example 2: Releases from the Landfill

The release of constituents, such as lead or other metals, from landfill material to surrounding environmental media is controlled by the landfill liner and cap design. The liner and cap system at the Class 2 landfill, and presumably at the off-site TSD, is designed to industry standards to be effective for at least 1,000 years in the protection of groundwater (and ultimately surface water and sediment which would be affected primarily by contact with affected groundwater). Failure of the system would require three occurrences: 1) failure of the cap, 2) failure of the liner, and 3) the occurrence of both failures in an area where slag contains constituents that leach to levels that may affect groundwater. Treated slag would contain effectively immobilized lead and other metals, Therefore, the likelihood of releases of lead or other metals in landfill material is limited by the landfill design, and the immobility of the treated slag, consequently the likelihood scores for potential releases from the landfill are typically scored 4 (unlikely) or 5 (rare).

4.4.2.2 Consequences of Exposure

Consequences are determined by evaluation of the modes of exposure to the various receptors, and the adverse effects that are expected from those exposures, depending on the route of exposure. For example, lead and other metals enter the human body mainly through three routes namely: ingestion, inhalation and dermal contact. In soil, depending on geochemistry, lead is generally immobile and persistent (USEPA 2005). Dermal contact with metals in soil represents a potential route of exposure, but the relatively low lipid solubility of most metals limits absorption through the skin (USEPA 2007b). Therefore, direct ingestion and inhalation remain as potentially important routes of exposure for people working at and living or otherwise regularly present near the site. General health effects associated with exposure to inorganic lead include neurotoxicity, developmental delays, hypertension, impaired hearing acuity, impaired hemoglobin synthesis, and male reproductive impairment (ATSDR 2007). The USEPA has not developed reference doses and references concentrations for exposure to lead, as is done with other non-carcinogenic compounds. Instead, the potential for adverse effects is calculated based on an estimated blood lead concentration. Effects from exposures to lead are dose dependent, meaning that as a person is exposed to more lead, they are at increased risk for adverse effects. The consequence scores related to exposure to landfill material or exposure to construction dust, where such dust may be lead/metal-bearing, are informed by a professional assessment of lead characteristics and toxicology in the context of the particular exposure pathway, duration of exposure and other factors. The following discussion focusses primarily on the potential consequences of exposure to lead, since lead is the likely risk driver for most exposures related to the Class 2 landfill materials.

The effects of lead exposure on both terrestrial and aquatic organisms include reduced survival, reproduction and growth as well as effects on behavior, development, and heme production (USEPA 2013). In the terrestrial environment, recent research confirms the generally low mobility of lead in soil. A small fraction of lead in soil is present as the free 2+ ion, which is the bioavailable form of the metal. The fraction of lead in this form is strongly dependent on soil pH. However, there is a complex variety of factors other than pH that influence lead retention in soil, including hydraulic conductivity, solid composition, organic matter content, clay mineral content, microbial activity, plant root channels, animal holes, geochemical reactions, colloid amounts, and colloidal surface charge (USEPA 2013). Leaf litter can be an important temporary sink for metals from the soil around and below leaves. Accumulation studies conducted with earthworms (Eisenia sp.) documented the difficulty of extrapolating accumulation kinetic constants from one soil type to another, and showed that many soil physiochemical properties, including pH, organic matter, and CEC, among others, affect metal bioavailability (USEPA 2013). This assessment conservatively assumes 100% bioavailability of lead in the soil to terrestrial organisms, but could be much lower depending on actual site soil conditions.

In water, lead is transported as free ions, soluble chelates, or on surfaces of iron-rich and organic-rich colloids (USEPA 2013). At many sites the majority of lead transport by runoff occurs at the beginning of a rainfall event. Lead is rapidly dispersed in water, and highest concentrations of lead are observed near sources where lead is deposited. Transport in surface waters is largely controlled by exchange with sediments. The cycling of lead between water and sediments is governed by chemical, biological, and mechanical processes, which are affected by many factors. Organic matter in sediments has a high capacity for accumulating trace elements like lead. Binding of anoxic sediments to sulfides is a particularly important process that affects lead bioavailability (USEPA 2013). Lead is relatively stable in sediments, with long residence times and limited mobility. However, lead-containing sediment particles can be remobilized into the water column. Resuspended lead is largely associated with organic matter or iron and manganese particles. This resuspension of contaminated sediments, if present, strongly influences the lifetime of lead in water bodies. Resuspension of sediments largely occurs during discrete events related to storms.

In aquatic ecosystems affected by lead, exposures are most likely characterized as low dose, chronic exposures (USEPA 2013). Once lead enters surface waters, its solubility and subsequent bioavailability are influenced by calcium concentration, pH, alkalinity, total suspended solids, and dissolved organic carbon, including humic acids. In sediments, lead bioavailability may be influenced by the presence of other metals, sulfides, iron and manganese oxides, and physical disturbance. Recent studies provide further evidence for the role of modifying factors such as pH, dissolved organic carbon, and hardness. Toxicity of the same concentration of lead can vary greatly under different experimental conditions (USEPA 2013). Consequently, the level at which lead elicits a specific effect is difficult to establish in terrestrial and aquatic systems, due to the influence of other environmental variables on both lead bioavailability and toxicity, and also to substantial species differences in lead susceptibility (USEPA 2013). There are large differences in species sensitivity to lead, and many environmental variables (e.g., pH, organic matter) determine the bioavailability and toxicity of lead. Again, this assessment conservatively assumes that there could be sensitive aquatic organisms present, and the lead that may enter the aquatic system would be 100% bioavailable.

Consequences are scored by the severity of potential effects that may occur as a result of the potential exposures. Consequences may be minimized by reducing the level of exposure. A few examples are provided to illustrate.

Example 1. Consequences of Exposure to Affected Off-Site Soil

In the event that lead/metal-bearing dust generated from on-site crushing or breaking activities in Alternatives 2 and 3 is dispersed aerially and deposited onto off-site soil, the consequences for off-site residents are likely minor (score = 4) because airborne lead concentrations would be controlled during implementation of this alternative, and the amount of lead transported would be relatively minor. At the off-site TSD, the off-site residents may have minimal (score = 5) consequences related to exposures to off-site soil because off-site residential areas are located farther from dust generation activities, and would be exposed less to affected media.. In this case, the lower exposures equates to lower consequences of exposure. The likelihoods of exposure to affected off-site soil are low due to the controls that would be required to suppress any dust production from any landfill activity. Alternative 1 includes minor dust generation activities related to placement of cover materials. However, because there are no intrusive activities into the landfill material, any potential dust generated from this activity would be from clean materials, resulting in a consequence score of 5 (minimal).

Example 2. Consequences of Potential Incidents from Increased Traffic

For Alternatives 1 and 2, there would be increased traffic during implementation, primarily for delivery of heavy equipment and materials (for example, cement for treatment, geomembrane for cover) to the Class 2 landfill. For Alternative 3, there would be approximately 21 to 42 trucks per day over a 1.5- to 3-year period entering and exiting the Class 2 landfill. The likelihood of potential incidents for Alternatives 1 and 2 are rare and unlikely (scores of 5 and 4), respectively (Alternative 2 scores less favorably than Alternative 1 because more equipment would be needed for Alternative 2). The likelihood of potential incidents for Alternative 3 is scored lower than the other alternatives (score = 3) due to the heavy increase in traffic required for hauling the landfill material. The consequences of potential incidents for

Alternatives 1 and 2 are medium (score = 3) to reflect the occasional deliveries of heavy equipment on trailers, which would be expected to travel relatively slow and in a careful controlled manner to their destination. However, the consequences of potential incidents for Alternative 3 is scored as major (score = 2) to reflect the increased potential severity of injuries related to the relatively faster speed of numerous haul trucks entering and exiting the landfill. Similarly, potential incidents along the transportation route (Alternative 3) are also rated to have major (score = 2) consequences due to the speed of travel expected for haul trucks along that route.

4.4.3 Conceptual Site Model Evaluation and Scoring

The observations made for each indicator and the rationale for scoring the CSM risk values are described below. In general, the text highlights the aspects of each remedial alternative that affects potential exposures or hazards, and the scores that are less favorable than "minimal" risk values (that is, scores less than 19.6) are summarized in more detailed bullets.

4.4.3.1 Conceptual Site Model for Alternative 1: Closure in Place

Figure 5 illustrates the CSM for Alternative 1 (closure in place). Currently, treated slag is present in the closed cells 1 through 9, and the uncapped cells 10 through 12. As described in Section 3.2, a small fraction of the analytical results during the period when the capped cells 1 through 9 were in operation were above the applicable UTS for lead and/or cadmium, and in-place investigation of cells 10 to 12 indicated material above the UTS primarily in the 0.0 to 0.5 foot depth interval and in discrete areas at greater depths. A smaller subset of these results was also above the concentration for characterization as hazardous waste.

The likelihood of long-term off-site resident exposure to lead/metal-bearing landfill material is expected to be minimal (the most favorable risk rating) because this alternative does not involve excavation, crushing, or transporting landfill material, which would generate potentially lead/metal-bearing dust, avoiding potential for aerial dispersion to off-site soils. On-site construction work would involve hauling and placing general clean fill material for capping. Although some dust may occur (which would be controlled by water trucks and other dust control measures), any potential migration of dust off-site would be expected to be dust from clean materials in contrast to Alternatives 2 and 3. Long-term effects to groundwater, surface water, and sediments are unlikely for this alternative because the liner and cap system is designed to be effective for at least 1,000 years. Failure of this alternative would require three occurrences: 1) failure of the cap, 2) failure of the liner, and 3) the occurrence of both failures in an area where treated slag has constituents that leach to levels that may affect groundwater. Groundwater level measurements and geologic data indicate that groundwater moves very slowly from the landfill area to the southwest across the site (Golder 2014).

The consequences of potential contact with the landfill material or any other abiotic media influenced by the landfill material are minimal to minor for most of the potential exposure routes since the landfill material has been treated once and there is only limited material that is above the UTS and even less that is characteristically hazardous (see Section 3.2.1). For this reason, and due to the geochemical considerations discussed in Section 4.4.2, the amount of dissolved lead in groundwater due to the failure of Alternative 1 would be extremely low, which would minimize the effects of using the groundwater as a drinking water source in the future. Aquatic organisms would be subject to more of an adverse effect than terrestrial organisms if lead leached into the groundwater and then to a stream, since aquatic organisms will have more contact with the lead in the water or sediment than terrestrial organisms that will only have occasional drinks from the water.

In the short-term, the highest consequences for off-site residents are from a potential incident with truck traffic. Since the lead waste in the landfill is not being disturbed, there is no concern for it spreading to areas outside the landfill during remedy implementation.

The CSM analysis for this alternative includes the following potential long-term risks that exceed the minimal risk rating (cells highlighted in green in Figure 5):

- There are minimal to minor long-term potential risks for off-site residents, future industrial workers and ecological receptors to accidentally dig into the landfill and have the potential for exposure to lead/metal-bearing landfill materials. The risks of these exposures are minimized due to the robust nature of the landfill cover and liner design, which is a proven technology for minimizing direct contact by human and ecological receptors.
- There are minimal to minor long-term potential risks for off-site residents and ecological receptors from potential exposure to affected groundwater, surface water and sediments. The risks of these exposures are minimized due to the robust nature of the landfill cover and liner design, which is a proven technology for minimizing releases to groundwater (which is the pathway to surface water and sediments), and by cover maintenance and groundwater monitoring.

The CSM analysis for this alternative includes the following potential short-term risks that exceed the minimal risk rating (cells highlighted in green in Figure 5):

- Minor risks to off-site residents and terrestrial organisms related to construction-related truck traffic – a small amount of heavy equipment would be transported to the site for remediation work.
- Minor risks related to on-site machinery and noise (remediation workers) – heavy equipment for hauling and capping activities have the potential for a minor increased risk of incidents and increased noise for on-site remediation workers. Standard safe work procedures can prevent these types of hazards; however, the consequences of a majority of these hazards can be major in the event that they occur. The machinery in this alternative will likely travel at relatively low speeds, which can minimize the potential for accidents and their severity.

- On-site construction machinery will pose minor short-term risks of increased noise to terrestrial organisms due to operation of heavy machinery in the landfill.

4.4.3.2 Conceptual Site Model for Alternative 2: On-Site Ex Situ Retreatment

Figure 6 illustrates the CSM for Alternative 2 (on-site ex situ retreatment). This alternative would require breaking and excavating the treated slag in the landfill, crushing the treated slag to a specified particle size, retreatment of the material, testing the material to ensure that UTS are met, and upon acceptable UTS results, replacing the material into the landfill.

Exide has completed a pilot test for removal and retreatment of slag in the landfill under a TCEQ Response Action Work Plan, which was confirmed to be successful for 70 of 73 samples of retreated material. Lessons learned from the on-site pilot test for retreating the slag in the landfill include ensuring that the analytical laboratory is using appropriate sample preparation and analysis methods. Additional pilot testing would be needed in order to develop a testing procedure that is acceptable to TCEQ and USEPA. Additional material from site closure and remediation activities and treated slag that has accumulated may be added to the open cells of the landfill before closure.

Under this alternative, the existing landfill space would be used, and the landfill material would be retreated to be below UTS (given successful completion). Potential long-term effects to groundwater, surface water and sediment are minimized, similar to Alternative 1 due to the landfill cap and liner design and other factors. In addition, if implemented successfully, this alternative would result in all of the material in the landfill being treated to be below the UTS.

The CSM analysis for this alternative includes the following potential long-term risks that exceed the minimal risk rating (cells highlighted in green and yellow in Figure 6):

- Emissions of potentially lead/metal-bearing dust from excavation, crushing, loading, and hauling 130,000 yd^3 of landfill material has the potential for aerial dispersion and deposition onto off-site soils. This would pose medium long-term potential risks to off-site residents and minimal to minor long-term risks to terrestrial and aquatic organisms. On-site dust suppression efforts would reduce this potential but may not eliminate it under all conditions.

- There are minimal long-term potential risks for terrestrial organisms to accidentally dig into the landfill and potentially have contact with treated landfill material. The risks of these exposures are minimized due to the robust nature of the landfill cover and liner design, which is a proven technology for minimizing direct contact by human and ecological receptors. The consequences of exposure to lead or other metals that may be exposed in the landfill are the same as Alternative 1.
- There are minimal to minor long-term potential risks for aquatic/riparian organisms related to the potential for lead and other metals to leach to the groundwater and travel to surface water and sediments. These risks have a rare likelihood (slightly, but not materially, lower than when there is no additional treatment), since confirmatory samples will be taken during treatment, but the risk values would remain the same as in

Alternative 1 since the consequences of exposure to lead or other metals if there was leaching from the landfill are the same regardless of retreatment.

The CSM analysis for this alternative includes the following potential short-term risks that exceed the minimal risk rating (cells highlighted in green, yellow and red on Figure 6):

- Emissions of potentially lead/metal-bearing dust from excavation, crushing, and loading 130,000 yd^3 of landfill material has the potential for aerial dispersion that would pose major inhalation risks to on-site remediation workers, medium inhalation risks to off-site residents and terrestrial organisms, and minor risks to aquatic organisms. On-site dust suppression efforts would reduce but not eliminate this potential. The risk is higher than Alternative 1 since the landfill material would not be disturbed in that scenario.
- There are medium short-term potential risks to off-site residents and terrestrial organisms and minimal risks to aquatic organisms due to the increased truck traffic while bringing additional machinery and materials on-site to implement this remedy.
- There is a major short-term potential risk of potential incidents to remediation workers in the landfill due to on-site construction machinery associated with the excavation, crushing, loading, and hauling of 130,000 yd^3 of landfill material (estimated to be at least 2 years in duration). Standard safe work procedures can minimize these types of hazards; however, the consequences of a majority of these hazards can be major in the event that they occur.
- There are major short-term potential risks to remediation workers and medium risks to off-site residents and terrestrial organisms related to increased noise levels due to excavation, crushing, loading, and hauling of 130,000 yd^3 of landfill material.
- Potential exposure to landfill material during implementation will pose medium short-term potential risks to remediation workers and terrestrial organisms during implementation of the remedy since the likelihood of ingesting this material is possible (score = 3), even though the consequence is minor to minimal (scores = 4 and 5) due to the metal(s) being bound in a chemical matrix.
- Treatment of landfill material with chemical stabilizers will pose medium short-term potential risks of a chemical incident to remediation workers during the implementation of the remedy since the consequence of exposure to these chemicals has the potential for medium adverse effects.

4.4.3.3 Conceptual Site Model for Alternative 3: Excavation and Off-Site Retreatment and Disposal

Figure 7 illustrates the CSM for Alternative 3 (excavation and off-site retreatment and disposal). This alternative includes complete breaking and excavation of the material in the Class 2 landfill, loading the material into trucks, hauling the material and impacted liner materials to an off-site TSD, crushing and retreatment of the material, and disposal of the treated material at the off-site TSD.

It is estimated that approximately 130,000 yd^3 of landfill material would be excavated, which would require some crushing or breaking of the material to allow excavation and handling. An additional estimated 25,000 yd^3 of cover and liner material would be removed as part of the complete removal of the Class 2 landfill. It is estimated that approximately 155,000 yd^3 of landfill material and cover/liner material, which corresponds to 15,500 truckloads, would be hauled 250 miles to the nearest off-site TSD that is expected to accept this material, at a rate of about 21 to 42 trucks per day over a 1.5- to 3-year period. This material would be crushed and treated at the off-site TSD prior to disposal at the off-site TSD.

The potential for long-term risks primarily include risks associated with release at the off-site TSD because the material in the Class 2 landfill would be removed and placed at that facility. The potential long-term risks in the vicinity of the Class 2 landfill and along the transportation route include off-site soil effects from potentially lead/metal-bearing dust generation and deposition related to on-site breakage, excavation, loading, and hauling of a substantial volume of landfill material. The consequences of exposure to this material is minimal to minor given that the lead and other metals are contained in a solid matrix and the fraction that is leachable/available is low.

There are short-term potential risks at the Class 2 landfill and the off-site TSD for activities during implementation of the remedy, and there are potential risks from hauling the materials along the transportation route from the Class 2 landfill to the off-site TSD.

The off-site TSD is expected to be located in a semi-industrial area that is relatively remote from residential areas and likely has reduced populations of terrestrial organisms compared with undisturbed areas. However, future development around such facilities is uncertain. The remoteness of the facility limits exposures, and thus risks, due to distance and limited contact with hazardous conditions.

The CSM analysis for this alternative includes the following potential long-term risks that exceed the lowest risk rating (cells highlighted in green in Figure 7):

Class 2 Landfill and Vicinity

- On-site breaking, loading, and hauling of landfill material at the Class 2 landfill will result in generation of potential lead/metal-bearing dust. Aerial deposition of this dust to off-site soil will pose minor long-term potential risks to off-site residents and ecological receptors. The consequence of this deposition onto soil is the same as for Alternative 2.

Off-site TSD and Vicinity

- The potential long-term risks of exposure to landfill material, groundwater, surface water and sediments at the off-site TSD are minimal for all receptors. The consequences of people or terrestrial and/or aquatic organisms coming into contact with releases of lead or other metals from the off-site TSD are minimal, given that the landfill material will be retreated to fix the metals in a matrix that is not bioavailable. These are similar to the consequences that would occur in Alternative 2, since the landfill material will be retreated in either case.

The CSM analysis for this alternative includes the following potential short-term risks that exceed the minimal risk rating (cells highlighted in green, yellow and red in Figure 7):

Class 2 Landfill and Vicinity

- Emissions of potentially lead/metal-bearing dust from excavation, breaking, loading, and hauling 155,000 yd^3 of landfill material will pose medium short-term potential risk to off-site residents, remediation workers and terrestrial organisms, and minor risk to aquatic organisms. On-site dust suppression efforts would reduce but not eliminate this potential. The consequence of exposure to this dust is the same as for Alternative 2.

- There are major short-term potential risks at the Class 2 landfill for off-site residents, medium risks for terrestrial organisms, and minimal risks for aquatic organisms related to significant truck traffic to haul 15,500 round trip truckloads from the Class 2 landfill to the off-site TSD. The consequence of an incident with the truck traffic is minor to major, depending on the receptor. This consequences for off-site residents are major (score = 2), which is higher than the Alternative 2 score (3) because of the substantially higher volume of truck traffic and higher speeds expected when hauling the landfill material off-site during the implementation of Alternative 3.
- There are major short-term potential risks at the Class 2 landfill for remediation worker incidents due to on-site construction machinery associated with the excavation, loading, and hauling of 130,000 yd^3 of landfill material (estimated at 1.5 to 3 years in duration). Standard safe work procedures can minimize these types of hazards; however, the consequences of these hazards can be major in the event that they occur. This is similar to Alternative 2, given increased heavy truck traffic compared to Alternative 1.
- The increased noise levels due to breakage, excavation, loading, and hauling of 130,000 yd^3 of landfill material will pose major short-term potential risks to remediation workers at the Class 2 landfill, and medium risks to off-site residents and terrestrial organisms in the vicinity of the Class 2 landfill. The consequence of exposure to noise is the same as for Alternative 2.
- Potential exposure to landfill material during implementation will pose medium short-term potential risks to on-site remediation workers and minor risks to terrestrial organisms during implementation of the remedy. The consequence of exposure to landfill material is the same as for Alternative 2.

Transportation Route

- There are minor short-term potential risks along the transportation route to off-site residents and terrestrial organisms related to potentially lead/metal-bearing dust generated while hauling 15,500 truckloads of landfill materials 250 miles each way between the Class 2 landfill and the off-site TSD. The consequence of encountering this lead/metal-bearing material is minor to minimal (scores = 4 and 5) since there would be a small volume of dust available for exposure to an individual along the transportation route (that is, if dust were generated by hauling landfill material, it would likely be spread out over the distance of the transportation route).
- There are medium short-term potential risks along the transportation route to off-site residents and terrestrial organisms and minor risks to aquatic organisms from potential incidents related to increased traffic to haul 15,500 truckloads of landfill materials 250 miles each way between the Class 2 landfill and the off-site TSD. The consequence of a traffic accident is difficult to predict, but has the potential to have major to medium (scores = 2 and 3) consequences of injury.
- There are minor short-term potential risks along the transportation route to off-site residents and ecological receptors related to the potential for spills during the hauling of 15,500 truckloads of landfill materials 250 miles one-way from the Class 2 landfill to the

off-site TSD. The consequence of a spill is expected to be minor (score = 4) given that the bulk of the landfill material is bound in a chemical matrix. .

Off-site TSD and Vicinity

- The potentially lead/metal-bearing dust from unloading and crushing operations will pose medium short-term potential risks to remediation workers and minor risks to terrestrial and aquatic organisms at or near the off-site TSD. The consequences of these exposures are similar to those posed at the Class 2 landfill, since the procedures to retreat the metals in the landfill material will be similar.
- At the off-site TSD, there are minor short-term potential risks to terrestrial organisms related to truck traffic during the hauling of 15,500 truckloads of landfill material to the facility. The likelihood of potential off-site resident incidents with truck traffic is lower than those posed at the Class 2 landfill because the off-site TSD is located in an area remote from residential areas.
- There are medium short-term potential risks to remediation workers of potential incidents related to on-site machinery during the unloading, and crushing of 15,500 truckloads of landfill material at the off-site TSD. The consequences of these exposures are scored higher (score = 3) than those posed at the Class 2 landfill (score = 2) because there are fewer machinery activities at the off-site TSD.
- The noise levels due to unloading and potential crushing 15,500 truckloads of landfill material will pose medium short-term potential risks to remediation workers, and minor risk to terrestrial organisms at or near the off-site TSD. The consequences of these exposures are scored higher (scores = 3 and 4, respectively) than those posed at the Class 2 landfill (scores = 2 and 3, respectively) because there are fewer machinery activities at the off-site TSD.
- Exposure to landfill material will pose minor short-term potential risks to remediation workers and terrestrial organisms during unloading and crushing operations at the off-site TSD. The consequences of these exposures are similar to those posed at the Class 2 landfill, since the procedures to retreat the metals in the landfill material will be similar.
- At the off-site TSD, the treatment of landfill material will pose minor short-term potential risks of a chemical incident to remediation workers during the implementation of the remedy. The consequences of these exposures are scored higher (score = 4) than at the Class 2 landfill (score = 3) because the facility commonly accepts and treats hazardous materials.

5.0 RISK EVALUATION

The risk evaluation for the three alternatives was conducted using the relevant criteria specified in *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (USEPA 1993a), plus the indicators identified in the CSM evaluation, and several other potential physical hazards identified for each remedial alternative. Costs are a relevant consideration and are estimated and discussed.

Each potential risk or hazard was developed into indicators for their respective receptors (i.e., off-site residents, workers, ecological receptors). The indicators were categorized into three general criteria:

- Long-term effectiveness (minimization of long-term risks or hazards)
- Short-term effectiveness (minimization of short-term risks or hazards)
- Implementability (technical and administrative feasibility)

Each potential exposure or hazard scenario developed in the CSMs (Section 4.0) is an indicator with Indicator Scores for each of the three alternatives listed in Table 1. Indicator Scores for non-exposure or non-hazard related indicators (for example, technical feasibility) were also developed based on best professional judgment. The scores of each of the indicators for the related criterion were then averaged into overall criterion scores and sub-group scores for each alternative, as shown in Table 1. The scoring used in this risk evaluation was developed to provide a high score for the minimization of risk or physical hazards, and provide a low score for increased risk or physical hazard. Using this approach, a higher score reflects a more favorable outcome.

Section 5.1 presents an overview of the methods used to assign scores to each indicator. Section 5.2 provides a description of the potential effects from each remedial alternative on each indicator, Indicator Scores, and rationale considered in the scoring of each indicator. Section 5.3 presents an evaluation of each alternative per the indicators, followed by a comparative evaluation of the alternatives. It also summarizes relative cost considerations.

5.1 Indicator Scoring

To clarify the scoring of each indicator, a chart providing descriptions of the scoring scales is included at the bottom of Table 1. Scores ranging between 1 and 25 are given to each indicator, where a score of 1 represents a critical risk, and a score of 25 represents a minimal risk. In cases where there are multiple risk values in the CSM (for example, ingestion and dermal contact with groundwater), the lowest of the scores (that is, the least favorable score) is used for the indicator score. For indicators related to long- and short-term effects, such as off-site resident exposure to affected groundwater, the scoring is based on the CSM risk score that takes into account the likelihood and consequence of exposure for each alternative, where the score of 25 represents the lowest risk, and a score of 1 represents the highest risk.

For indicators related to implementability, a score of 1 represents low implementability, and a score of 25 represents the optimal implementability.

For Alternative 3, scores are provided for indicators related to the Class 2 landfill, the transportation route, and the off-site TSD. The indicators were developed so that there will be a score for only one of these locations to be compared against the other two alternatives. For example, the potential risk for noise exposure to remediation workers at the Class 2 landfill (Indicator Number 31 in Table 1) is only given a score for on-site exposure (3a) and not for off-site exposure (3b), and this one score is compared to Indicator Scores for on-site exposures developed for Alternatives 1 and 2 for the same indicator.

In Alternative 3, indicators that occur only at the off-site TSD (for example, on-site machinery at the off-site TSD, Indicator Number 34) or along the transportation route (for example, potential effects to off-site residents from a spill along the transportation route, Indicator Number 25) are given scores for the activities at the off-site TSD (3b), not the FRC, and are compared to the scores developed for Alternatives 1 and 2. The indicators that receive a score for the transportation route or the off-site TSD only are given an optimal score of 25 for Alternatives 1 and 2. This is to indicate that no adverse effects occur for Alternatives 1 and 2 for those indicators where activities occur only along the transportation route or at the off-site TSD.

The scores for each indicator are presented in Table 1, with a highest/most favorable achievable score for each indicator of 25. The scores of all indicators within a criterion are averaged to attain a Criterion Score (for example, the long-term risk minimization criterion scores for Alternatives 1, 2, and 3 are 20.1, 19.7, and 20.7, respectively). In addition, Subgroup Scores are provided for the various sub-groups within each Criterion, based on the average of the Indicator Scores within each sub-group. For example, the sub-group scores for off-site residents in the long-term risk minimization criterion for Alternatives 1, 2, and 3 are 20.4, 19.4, and 23.2, respectively.

The scores assigned in this evaluation are not assigned weights; in effect, each score receives equal weight when averaged for criteria and sub-group scores. Each indicator can be compared on a relative basis across the three alternatives and whether or not the scores are weighted has no effect on such comparison.

5.2 Evaluation Criteria and Indicators

The indicator, indicator numbers, and Indicator Scores are presented in Table 1. The Indicator Scores are the CSM Risk Values from Figures 5, 6, and 7; developed by multiplying the scores for likelihood and consequence for each indicator. A description of the potential effects from each remedial alternative on each indicator is presented below, along with the Indicator Scores, and rationale considered in the scoring of each indicator.

5.2.1 Long-Term Risk Minimization

The long-term risk minimization criterion addresses community hazard minimization, occupational hazard minimization, ecological hazard minimization, and environmental effects sub-groups. The indicators for these sub-groups are described below.

5.2.1.1 Community Hazard Minimization

This sub-group evaluates the potential risks related to long-term impacts from each alternative to off-site residents near the Class 2 landfill, and for Alternative 3 it considers off-site residents along the transportation route to the off-site TSD and residents in the vicinity of the off-site TSD. The evaluated risks include potential exposures as described below.

1. Landfill material – This indicator reflects the potential exposure to lead/metal-bearing landfill materials. These exposures have a varying potential to occur if the landfill cap were to fail (Alternatives 1 or 2) or if security is breached and the material within the landfill is excavated (Alternatives 1, 2 or 3). These potential exposures are minimized by the low permeability, multi-layer capping system on the landfill that is designed to prevent releases to the environment (Alternatives 1 or 2). For Alternative 3, the siting and engineering requirements at the off-site TSD provides safeguards against release and potential exposure at that facility. The risks for this indicator are minimal for all three Alternatives.

2. Affected groundwater – This indicator reflects the potential exposure to groundwater impacted by the landfill. This could occur in the event of cap and liner failure in an area where slag contains constituents that leach to levels of concern. These potential exposures are minimized by the liner and cover systems which are designed to prevent migration of the landfill contents to groundwater. Under Alternatives 2 and 3, the landfill material would be retreated to levels that meet the UTS. The risks for this indicator are minor for Alternative 1, and minimal for Alternatives 2, and 3.

3. Affected surface water and sediments – This indicator reflects the potential exposure to surface water or sediment by groundwater impacted by the landfill. In order for these media to be affected, releases from the landfill (related to cap and liner failure) would need to affect groundwater, and affected groundwater would need to discharge to the creek. This is minimized by the cap and liner systems designed to be protective against migration of landfill contents to groundwater. Under Alternatives 2 and 3, the landfill material would be retreated to levels that meet the UTS. The risks for this indicator are minor for Alternative 1, and minimal for Alternatives 2, and 3.

4. Affected off-site soil – This indicator reflects the potential exposure to impacted off-site soil in the event of aerial dispersion and deposition of affected materials during construction activities at the landfill. In Alternative 1, no intrusive activities into the landfill material would occur, and any construction dust generated is expected to be from clean materials. In Alternatives 2 and 3, excavation and crushing or breaking of landfill material would generate lead/metal-bearing dust. The risk of aerial dispersion can be controlled but not eliminated by dust suppression and control activities. The risks for this indicator are minimal for Alternative 1, medium for Alternative 2, and minor for Alternative 3 in the vicinity of the Class 2 landfill.

5. Affected off-site soil (off-site TSD) – This indicator reflects the potential exposure to impacted off-site soil from aerial dispersion and deposition of affected materials from the

off-site TSD. In Alternative 3, crushing activities will create potentially lead/metal-bearing dust at the off-site TSD. The off-site TSD is expected to be located in a semi-industrial area that is remote from residential areas. Dust suppression and control activities would control aerial dispersion. The risks for this indicator are minimal for Alternative 3.

5.2.1.2 Occupational Hazard Minimization

This sub-group evaluates the potential risks related to long-term impacts from each alternative to on-site future industrial workers at the Class 2 landfill. The evaluated risks include potential exposures as described below.

6. Landfill material – This indicator reflects the potential exposure of on-site workers to lead/metal-bearing landfill materials after remediation is completed. These exposures could occur due to accidental excavation of cover material or cap failure that exposes landfill materials. These potential exposures are minimized by on-site security and institutional controls, as well as the low permeability, multi-layer capping system on the landfill that is designed to prevent releases to the environment (Alternatives 1 or 2). For Alternative 3, the siting and engineering requirements at the off-site TSD provides safeguards against release and potential exposure at that facility. The risks for this indicator are estimated to be minor for Alternative 1 and minimal for Alternatives 2 and 3.

7. Affected groundwater – This indicator reflects the potential exposure of on-site workers to groundwater affected by the contents of the landfill. This could occur in the event of cap and liner failure in an area where slag contains constituents that leach to levels of concern. These potential exposures are minimized by the liner and cover systems which are designed to protect against migration of landfill contents to groundwater. Under Alternatives 2 and 3, the landfill material would be retreated to levels that meet the UTS, which would stabilize the landfill contents. The risks for this indicator are minimal for all three Alternatives.

8. Affected surface water and sediments – This indicator reflects the potential exposure of on-site workers to surface water or sediment affected by groundwater impacted by the landfill. In order for these media to be affected, releases from the landfill (related to cap and liner failure) would need to affect groundwater and affected groundwater would need to discharge to the creek. This is minimized by the cap and liner systems designed to be protective against migration of landfill contents to groundwater. Under Alternatives 2 and 3, the landfill material would be retreated to levels that meet the UTS, which would stabilize the landfill contents. The risks for this indicator are minimal for all three Alternatives.

5.2.1.3 Ecological Hazard Minimization

This sub-group evaluates the potential risks related to long-term impacts from each alternative to terrestrial and aquatic receptors near the Class 2 landfill. The indicators in this sub-group reflect the potential exposure of terrestrial or aquatic receptors to on-site or off-site contaminants. The evaluated risks include potential exposures as described below.

Terrestrial Organisms

9. Landfill material – similar to on-site worker exposures (Indicator 6). The risks for this indicator are minor for Alternative 1 and minimal for Alternatives 2 and 3.

10. Affected groundwater – similar to on-site worker exposures (Indicator 7). Terrestrial organisms have little contact with groundwater. The risks for this indicator are minimal for all three Alternatives.

11. Affected surface water and sediments – similar to off-site resident exposures (Indicator 3). The risks for this indicator are minor for Alternative 1 and minimal for Alternatives 2 and 3.

12. Affected off-site soil – similar to off-site resident exposures (Indicator 4). The risks for this indicator are minimal for Alternative 1 and minor for Alternatives 2, and 3.

13. Affected off-site soil (off-site TSD) – crushing activities will create potentially lead/metal-bearing dust at the off-site TSD. The off-site TSD is expected to be located in a semi-industrial located, which likely has reduced populations of terrestrial organisms. The risks for this indicator are minimal.

Aquatic Organisms

14. Landfill material – similar to off-site resident exposures (Indicator 1). Aquatic organisms would have little or no contact with landfill material. The risks for this indicator are estimated to be minimal for all three Alternatives.

15. Affected groundwater – similar to on-site worker exposures (Indicator 7). Aquatic organisms have little contact with groundwater. The risks for this indicator are estimated to be minimal for all three Alternatives.

16. Affected surface water and sediments – similar to off-site resident and on-site worker exposures (Indicators 3 and 8, respectively). Aquatic organisms could have adverse effects from affected surface water and sediments. The risks for this indicator are estimated to be minor for Alternatives 1 and 2, and minimal for Alternative 3.

17. Affected off-site soil – similar to off-site resident exposures (Indicator 4), however aquatic organisms would have little contact with off-site soil. The risks for this indicator are estimated to be minimal for Alternative 1 and minor for Alternatives 2 and 3.

18. Affected off-site soil (off-site TSD) – similar to off-site resident exposures (Indicator 5). The risks for this indicator are estimated to be minimal.

5.2.1.4 Environmental Effects

The reduction of toxicity, mobility, or volume through treatment is evaluated in this sub-group.

19. Reduction of toxicity, mobility, or volume through treatment – This indicator reflects the ability of the treatment technology to permanently and significantly reduce the toxicity, mobility, or volume of contaminants. For Alternative 1, there is no reduction in toxicity because no further treatment will occur; but the volume of material will not increase. For Alternatives 2 and 3, there will be some reduction of toxicity due to treatment of the landfill material to levels below the UTS. Although treatment will reduce the toxicity, it will also increase the volumes due to the addition of treatment reagents and cement. A volume increase of about 50% was assumed in this evaluation. The risks for this indicator are estimated to be minor for Alternative 1 and minimal for Alternatives 2 and 3.

5.2.2 Short-Term Risk Minimization

The short-term risk minimization criterion addresses the following sub-groups: community hazard minimization occupational hazard minimization, ecological hazard minimization, and environmental effects. The indicators for these sub-groups are described below.

5.2.2.1 Community Hazard Minimization

This sub-group evaluates the potential risks related to short-term impacts from each alternative to off-site residents near the Class 2 landfill, and also near the off-site TSD for Alternative 3. The evaluated risks include potential exposures as described below.

Class 2 Landfill and Vicinity

20. Potential lead/metal-bearing dust – This indicator reflects the potential exposure of the community, by inhalation, to potentially lead/metal-bearing airborne dust from the site. In Alternative 1, no intrusive activities into the landfill material will occur, and any construction dust generated is expected to be from general clean materials. In Alternatives 2 and 3, excavation and crushing or breaking of landfill material would generate lead/metal-bearing dust. Aerial dispersion can be controlled by dust suppression and control activities but not eliminated. The risks for this indicator are estimated to be minimal for Alternative 1 and medium Alternatives 2 and 3.

21. Increased truck traffic in and out of the Class 2 landfill – This indicator reflects the potential exposure to increased truck traffic in the vicinity of the landfill. Alternative 1 will have minimal increased traffic to import general clean fill materials. Alternative 2 will require increased traffic to deliver heavy equipment, materials, and facilities for on-site crushing and excavation. Alternative 3 will require a very high volume of traffic to transport approximately 15,500 truckloads of landfill material from the Class 2 landfill to the off-site TSD. The risks for this indicator are estimated to be minor for Alternative 1, medium for Alternative 2, and major for Alternative 3.

22. Increased noise from the Class 2 landfill – This indicator reflects the potential exposure to noise for off-site residents. Alternative 1 will have little increased noise. Alternative 2 will have increased noise due to breaking, excavating and crushing operations on-site. Alternative 3 will have increased noise, slightly less than Alternative 2, for breaking and excavating landfill material. The risks for this indicator are estimated to be minimal for Alternative 1 and medium for Alternatives 2 and 3.

23. Transportation Route (Alternative 3 only) Potential lead/metal-bearing dust along the transportation route – This indicator reflects the potential effects of exposure to lead/metal-bearing dust from the transport of landfill materials to the off-site TSD. This can be reduced by appropriate controls, such as covering the loads. The dispersion of materials along the 250-mile route would limit exposures. The risks for this indicator are estimated to be minor.

24. Increased truck traffic along the transportation route – This indicator reflects the potential effects of exposure to increased traffic during transport of landfill materials to the off-site TSD. Approximately 15,500 truckloads of landfill material would be transported along the haul route and the trucks would make return trips. Incidents can be controlled by safe driving and pedestrian practices; however, the consequences in the event of an incident can be serious. The risks for this indicator are estimated to be medium.

25. Potential effects from for accidental spills along the transportation route – The significant truck traffic along the haul route has the potential for increased spills. The risks for this indicator are estimated to be minor.

26. Off-site TSD and Vicinity (Alternative 3 only) Potential for lead/metal-bearing dust – This indicator reflects the potential to minimize community exposures to potentially lead/metal-bearing airborne dust from the off-site TSD. The crushing operations prior to retreatment at this facility would result in a probability of community exposures. This exposure would be limited by the expected remoteness of the facility from residential areas. The risks for this indicator are estimated to be minimal.

27. Increased truck traffic at the off-site TSD – This indicator reflects the potential effects from exposure to increased truck traffic into and out of the off-site TSD during transport of the landfill material from the Class 2 landfill. This exposure would be limited by the expected remoteness of the facility from residential areas. The risks for this indicator are estimated to be minimal.

28. Increased noise at the off-site TSD – This indicator reflects the potential for community exposure to increased noise during the crushing and handling of materials at the off-site TSD. This exposure would be limited by the expected remoteness of the facility from residential areas. The risks for this indicator are estimated to be minimal.

5.2.2.2 Occupational Hazard Minimization

This sub-group evaluates the potential risks related to short-term impacts from each alternative to on-site remediation workers at the Class 2 landfill, and at the off-site TSD for Alternative 3. The evaluated risks include potential exposures as described below.

29. Class 2 Landfill Potential for lead/metal-bearing dust – This indicator reflects the potential exposure of remediation workers to potentially lead/metal-bearing construction dust during implementation of the remedial alternatives. For Alternative 1, standard earth moving equipment would be employed, and no intrusive activities are planned. For Alternatives 2 and 3, there would be considerable potential for increased lead/metal-bearing dust due to the breaking and loading landfill material. Alternative 2 would require crushing to a specified particle size, which would generate finer lead/metal-bearing dust than Alternative 3. It is assumed compliance with occupational health and safety standards will mitigate this risk. The risks for this indicator are estimated to be minimal for Alternative 1, major for Alternative 2, and medium for Alternative 3.

30. On-site machinery – This indicator reflects the potential risks for accidents to on-site workers related to on-site machinery. For Alternative 1, standard earth moving equipment would be employed, and no intrusive activities are planned. For Alternatives 2 and 3, heavy equipment for breaking, loading, crushing, and hauling landfill material would be employed. It is assumed compliance with occupational health and safety standards will mitigate this potential risk. The risks for this indicator are estimated to be minor for Alternative 1 and major for Alternatives 2 and 3 due to the crushing, breaking, or hauling activities that will occur for these alternatives.

31. Increased noise – This indicator reflects the potential risks due to increased noise levels for remediation workers. For Alternative 1, standard earth moving equipment would be employed, and no intrusive activities are planned. For Alternatives 2 and 3, there would be considerable increased noise due to the breaking, loading, crushing, or hauling landfill material. It is assumed compliance with occupational health and safety standards will

mitigate this risk. The risks for this indicator are estimated to be minor for Alternative 1 and major for Alternatives 2 and 3.

32. Landfill material – This indicator reflects the potential exposures of remediation workers to lead/metal-bearing slag. For Alternative 1, no intrusive activities are planned into the landfill material. For Alternatives 2 and 3, the landfill material would be excavated, crushed or broken, and hauled. It is assumed compliance with occupational health and safety standards will mitigate this risk. The risks for this indicator are estimated to be minimal for Alternative 1 and medium for Alternatives 2 and 3.

Off-site TSD (Alternative 3 Only)

33. Potential for lead/metal-bearing dust – This indicator reflects the potential exposure of remediation workers to potentially lead/metal-bearing construction dust during implementation of the remedial alternative. Crushing operations at the off-site TSD would have a high probability to generate potentially lead/metal-bearing dust. It is assumed compliance with occupational health and safety standards will mitigate this risk. The risks for this indicator are estimated to be medium for Alternative 3.

34. On-site machinery – This indicator reflects the potential for accidents to on-site workers related to on-site machinery. For Alternative 3, heavy equipment for hauling and crushing landfill material would be employed. It is assumed compliance with occupational health and safety standards will mitigate this potential risk. The risks for this indicator are estimated to be medium for Alternative 3, which is a higher score than for the on-site machinery score for the Class 2 landfill (Indicator 30) because most of the on-site machinery activities (breaking, loading, and hauling) will be at the Class 2 landfill compared to the off-site TSD (crushing).

35. Increased Noise – This indicator reflects the potential exposure to increased noise levels for remediation workers. For Alternative 3, there would be considerable increased noise due to the hauling and crushing of landfill material. It is assumed compliance with occupational health and safety standards will mitigate this risk. The risks for this indicator are estimated to be medium for Alternative 3 which is a higher score than for the noise score for the Class 2 landfill (Indicator 31) because most of the noise-making activities (breaking, loading, and hauling) will be at the Class 2 landfill compared to the off-site TSD (crushing).

36. Landfill material – This indicator reflects the potential exposure of remediation workers at the off-site TSD to lead/metal-bearing slag. Crushing operations at the off-site TSD could result in a direct contact with the material and a high probability of worker exposure. It is assumed compliance with occupational health and safety standards will mitigate this risk. The risks for this indicator are estimated to be minor for Alternative 3, which is a higher score than for the landfill material score for the Class 2 landfill (Indicator 32) because most of the landfill material exposures (breaking, loading, and hauling) will be at the Class 2 landfill compared to the off-site TSD (crushing).

Both Facilities

37. Chemical hazards – this indicator reflects the potential for worker exposure to chemical hazards during retreatment of landfill materials. For Alternative 1, no retreatment is required. For Alternatives 2 and 3, retreatment will be conducted on excavated and crushed landfill materials at the Class 2 landfill (Alternative 2) or the off-site TSD (Alternative 3). It is assumed compliance with occupational health and safety standards

will mitigate this risk. The risks for this indicator are estimated to be minimal for Alternative 1, medium for Alternative 2, and minor for Alternative 3.

5.2.2.3 Ecological Hazard Minimization

This sub-group evaluates the potential risks related to short-term impacts from each alternative to terrestrial and aquatic organisms near the Class 2 landfill and, for Alternative 3, along the 250-mile transportation route and in the vicinity of the off-site TSD. The evaluated risks include potential exposures as described below.

Terrestrial Organisms

Class 2 Landfill and Vicinity

38. Potential for lead/metal-bearing dust – similar to off-site resident exposures (Indicator 20). The risks for this indicator are minimal for Alternative 1 and medium for Alternatives 2 and 3.

39. Increased truck traffic – similar to off-site resident exposures (Indicator 21). The risks for this indicator are minor for Alternative 1, and medium for Alternatives 2 and 3.

40. Increased noise – similar to off-site resident and on-site worker exposures (Indicators 22 and 31, respectively). The risks for this indicator are minor for Alternative 1 and medium for Alternatives 2 and 3.

41. Landfill material – similar to on-site worker exposures (Indicator 36). The risks for this indicator are minimal for Alternative 1, medium for Alternative 2, and minor for Alternative 3.

42. Transportation Route (Alternative 3 only) Potential for lead/metal-bearing dust – similar to off-site resident exposures (Indicator 23). The risks for this indicator are minor.

43. Increased truck traffic – similar to off-site resident exposures (Indicator 24). The risks for this indicator are medium.

44. Potential for accidental spills – similar to off-site resident exposures (Indicator 25). The risks for this indicator are minor.

Off-site TSD

45. Potential for lead/metal-bearing dust – this indicator reflects terrestrial organism exposure to increased lead/metal-bearing dust generated during the crushing and handling of materials at the off-site TSD. The facility is expected to be located in a semi-industrial area, which likely has reduced populations of terrestrial organisms compared with undisturbed areas. The risks for this indicator are estimated to be minor.

46. Increased truck traffic – this indicator reflects terrestrial organism exposure to increased truck traffic at the off-site TSD. The facility is expected to be located in a semi-industrial area, which likely has reduced populations of terrestrial organisms compared to undisturbed areas. The risks for this indicator are minor.

47. Increased noise –this indicator reflects terrestrial organism exposure to increased noise during the crushing and handling of materials at the off-site TSD facility. The facility is expected to be located in a semi-industrial area, which likely has reduced populations of terrestrial organisms compared with undisturbed or residential areas. The risks for this indicator are estimated to be minor.

48. Landfill material – similar to on-site worker exposures (Indicator 36). The risks for this indicator are minor.

Aquatic Organisms

Class 2 Landfill and Vicinity

49. Potential for lead/metal-bearing dust – similar to terrestrial organism exposures (Indicator 38), although scores are lower because activities would be conducted remote from stream or riparian areas. The risks for this indicator are minimal for Alternative 1 and minor for Alternatives 2 and 3.

50. Increased truck traffic – similar to terrestrial organism exposures (Indicator 39), however most traffic would not occur in stream or riparian areas. The risks for this indicator are minimal for all three Alternatives.

51. Increased noise – similar to terrestrial organism exposures (Indicator 40), however these activities will be conducted remote from stream or riparian areas. The risks for this indicator are minimal for all three Alternatives.

52. Landfill material – landfill material operations will not occur in stream or riparian areas. The risks for this indicator are minimal for all three Alternatives.

Transportation Route (Alternative 3 only)

53. Potential for lead/metal-bearing dust – similar to terrestrial organism exposures (Indicator 42), however most of the route would not be stream or riparian areas. The risks for this indicator are minimal.

54. Increased truck traffic – similar to terrestrial organism exposures (Indicator 43), however most traffic would not occur in stream or riparian areas. The risks for this indicator are minor.

55. Potential for accidental spills – similar to terrestrial organism exposures (Indicator 44). The risks for this indicator are minor.

Off-site TSD (Alternative 3 only)

56. Potential for lead/metal-bearing dust – similar to terrestrial organism exposures (Indicator 45). The risks for this indicator are minor.

57. Increased truck traffic – similar to terrestrial organism exposures (Indicator 46), however most traffic would not occur in stream or riparian areas. The risks for this indicator are minimal.

58. Increased noise – similar to terrestrial organism exposures (Indicator 47), however these activities will be conducted remote from stream or riparian areas. The risks for this indicator are minimal.

59. Landfill material – landfill material operations will not occur in stream or riparian areas. The risks for this indicator are minimal.

5.2.2.4 Environmental Effects

This sub-group evaluates the potential environmental effects related to energy consumption and non-dust-related air emissions for each alternative.

60. Energy consumption – This indicator reflects the potential for minimization of energy consumption. Alternative 1 requires relatively low energy consumption for the construction and import of general clean materials to cap the landfill. Alternative 2 requires medium energy consumption to excavate and crush the landfill material, Alternative 3 requires significant energy consumption to excavate the landfill material, transport the material (15,500 truckloads over 250 miles each way, which equates to approximately 7,750,000 truck miles travelled), and crushing the material at the off-site TSD. The energy consumption is minimal for Alternative 1, medium for Alternative 2, and major for Alternative 3.

61. Non-dust air emissions – This indicator reflects the non-dust air emissions from equipment and trucks. Alternative 1 would produce relatively low emissions during the construction and import of general clean materials to cap the landfill. Alternative 2 would produce medium emissions while excavating and crushing the landfill material. Alternative 3 would produce significant emissions while excavating the landfill material, transporting the material (15,500 truckloads over 250 miles each way, which equates to approximately 7,750,000 truck miles travelled), and crushing the material at the off-site TSD. The produced non-dust air emissions are minimal for Alternative 1, medium for Alternative 2, and major for Alternative 3.

5.2.3 Implementability

The implementability criterion addresses the degree of difficulty in implementing each alternative. Implementability issues become more significant as the complexity of the alternative increases. Implementability issues are important because they incorporate the potential for the inability to obtain the necessary approvals to implement the remedy, delays and remedy failure. The implementability criterion addresses the following sub-groups: technical feasibility and administrative feasibility. The indicators for these sub-groups are described below.

5.2.3.1 Technical Feasibility

This sub-group has two indicators that reflect the potential ability of the remedial alternative to be implemented technically.

62. Technical Feasibility (Remediation Activities) – This indicator reflects the factors that could negatively affect the technical feasibility of each alternative, including problems occurring during implementation, uncertainties, the likelihood of delays due to technical problems, and the ease of modifying the alternative, if required. Alternative 1 involves a proven technology, and readily available equipment and personnel. Alternative 2 also

involves a proven technology, available equipment and personnel; however there is a need to develop a sound protocol for treatment, testing, and placement of landfill material to gain agency acceptance. Alternative 3 is technically feasible. The technical feasibility for this indicator is very high for Alternative 1 and high for Alternatives 2 and 3.

63. Technical Feasibility (Air Quality) – This indicator reflects the physical challenges of minimizing air quality impacts and avoiding emission levels that could potentially affect the timeline for attainment demonstration with the lead NAAQS. For Alternative 1, no intrusive activities are planned, and minimal dust generation (from general clean materials) would occur. For Alternatives 2 and 3, there would be considerable increased potential for lead/metal-bearing dust generation due to the breaking, loading, and crushing landfill material. Alternative 2 would require crushing to a specified particle size, which would generate finer lead/metal-bearing dust than Alternative 3. Implementation of Alternatives 2 and 3, which will generate lead/metal-bearing dust, must account for the lead NAAQS attainment demonstration status and timeline. Perimeter air monitoring with low action levels (that is, work stoppages would occur if action levels are exceeded) may increase the duration of the implementation of Alternatives 2 and 3. The technical feasibility for this indicator is very high for Alternative 1, low for Alternative 2 and medium for Alternative 3.

5.2.3.2 Administrative Feasibility

This sub-group reflects the potential ability to comply with and secure regulatory approvals required under applicable laws and regulations, and would be negatively impacted by the degree of difficulty anticipated due to regulatory constraints or community objections. The following indicators are evaluated in this sub-group:

64. Regulatory compliance – This indicator reflects the degree of difficulty in obtaining regulatory approval for the remedial alternatives. Increased effort may be required to achieve regulatory and community acceptance depending on the extent of potential dust, traffic, and noise impacts in the vicinity of the site. TCEQ waste-program approval of each of these remedial actions would be required. Alternative 1 would involve conventional construction activities. Alternatives 2 and 3 would involve substantial increased dust (including potential lead-bearing dust), traffic, and noise. As a result, considerable effort may be required to gain community and regulatory acceptance, and it is uncertain whether such acceptance could be achieved. The administrative feasibility for this indicator is high for Alternative 1 and medium for Alternatives 2 and 3. .

65. Regulatory Compliance - Air Quality – This indicator reflects the degree of difficulty in obtaining air-quality-related regulatory approvals for each alternative. The lead NAAQS non-attainment status of the area and considerations regarding the State Implementation Plan may result in increased difficulty in obtaining regulatory approval for Alternatives 2 or 3 due to the intrusive nature of these alternatives that have the potential for generating lead/metal-bearing dust during implementation. In addition, the duration of Alternative 2 could implicate air permitting for certain equipment that may be complicated by the lead NAAQS nonattainment status of the area. The administrative feasibility for this indicator is very high for Alternative 1, low for Alternative 2 and medium for Alternative 3.

66. Land or water use restrictions - This indicator reflects the ability to minimize property or water use restrictions. It is assumed that Exide will place the property under restriction as a non-residential property in perpetuity for all three alternatives. Groundwater use restrictions are anticipated for the site in any event, regardless of potential impact from

the Class 2 landfill. The potential for minimization of additional restrictions is estimated to be high for Alternatives 1 and 2, and very high for Alternative 3.

67. Local business effects - This indicator reflects the potential for impacts to local business during the implementation of the remedial alternatives, including potential for generation of business through purchase of local goods and services, accommodations for workers, or local employment opportunities. Alternative 1 is relatively short-term, and Alternatives 2 and 3 have the potential to be longer term and possibly employ more local resources. The potential for increased local business opportunities relating to the remediation project is estimated to be medium for Alternative 1 and high for Alternatives 2 and 3.

68. Visual aesthetics - This indicator evaluates the effect of aesthetic compatibility with local surroundings for each alternative. The final condition for all Alternatives is revegetated grassland. Alternative 2 could result in a vegetated mound due to the increased volume of landfill contents as a result of adding treatment reagents. The potential for impacts to visual aesthetics is estimated to be medium for Alternatives 1 and 2, and very low for Alternative 3.

69. Surrounding property values - This indicator evaluates the effect of remedial alternatives on real or perceived surrounding property values. It is widely acknowledged that despite Exide’s presence and the potential negative effects of its operations, land values have increased in and around the FRC, significant high-end development occurred, and schools and other public buildings were constructed resulting in an increase in tax collections and generally a higher quality of life in Frisco. The potential for impacts to property values is estimated to be low for Alternatives 1 and 2, and very low for Alternative 3. The off-site TSD is currently in operation as a hazardous waste facility, the potential for impacts to property values is estimated to be very low.

5.2.4 Cost

The cost of implementation is estimated for each remedial alternative as an additional consideration.

70. Cost – This consideration includes both capital and post-closure costs (i.e., operation and maintenance and monitoring costs). Alternative costs are estimated for magnitude and compared relatively across the three alternatives. The score for cost is negatively affected by high costs. The costs are estimated to be very low for Alternative 1 (score = 25), medium for Alternative 2 (score = 8), and very high for Alternative 3 (score = 3).

5.3 Risk Evaluation of Remedial Alternatives

Table 1 presents the inputs and results of the risk evaluation of the three remedial alternatives. Figure 8 presents a diamond chart that illustrates the relative potential for each remedial alternative to achieve remedial objectives and optimize the criteria associated with the alternatives. Similar to the scoring scale, a larger area in the diamond figure reflects a more favorable outcome. Figure 9 presents bar charts illustrating the scores for each sub-group within each criterion. These charts allow a further detailed look at the individual factors contributing to the overall scores for each criterion. Figure 10 provides a bar chart for each individual indicator, which allows detailed comparison of each indicator across each alternative. As described above, the indicators are not weighted, and each indicator therefore carries equal weight.

The purpose of the charts in Figures 8, 9, and 10 is to illustrate the potential trade-offs among the remedial alternatives. Some of the alternatives optimize (that is, score high on) several parameters, but also score low on other parameters. Observing the trade-offs allows for a more objective review of the remedial alternatives when determining which alternative provides the best balance of all selection criteria.

5.3.1 Effectiveness

5.3.1.1 Long-Term Risk Minimization

Alternative 1: Closure In Place (Average Score = 20.1, Minimal Risk)

Scores for individual indicators indicate there are minimal to minor long-term risk to off-site resident and ecological receptors and future remediation workers for this alternative.

This alternative provides long-term protection of human health and the environment at the Class 2 landfill. The potential effects to groundwater, surface water and sediment are minimized with the existing liner and cover and installation of final cover on portions of the landfill that are not capped. The liner and underlying subgrade for the Class 2 landfill is comparable to the lower composite liner of the containment system required for a permitted TSD facility. The multi-layer cap would have a very low permeability, minimizing the potential for human or ecological exposure to landfill material, and minimizing the potential for surface water to contact landfill material or landfill contents to migrate to groundwater. The cover would be vegetated to minimize erosion, and long-term cover maintenance and inspections would be conducted. Groundwater monitoring would be performed as well. Given the analytical data for the material in the landfill, the typical low mobility of lead and other metals in treated slag, and the landfill design, the potential for releases that may cause adverse effects to the surrounding environment is minimal.

Aerial dispersion and off-site deposition of potentially lead/metal-bearing dust and long-term impacts to off-site soil would be negligible with this alternative because this alternative does not involve intrusive activities such as breaking, excavating, crushing, or transporting the landfill material.

Long-term reduction of toxicity and mobility through additional treatment would not occur under this alternative. However, lead and other metals in slag are not highly mobile, and the material was previously treated. Only a small fraction of laboratory analytical reports from the period cells 1 through 9 were in operation indicated results above the lead and/or cadmium UTS and the majority of the material above the lead and/or cadmium UTS in cells 10 through 12 occurs in the top 6 inches of those cells. Because no additional treatment would occur the volume of material would not increase as in the other two alternatives.

Alternative 2: On-Site Ex Situ Retreatment (Average Score = 19.7, Minimal Risk)

Scores for individual indicators indicate there are minimal to medium long-term risks to off-site residents, minimal risks to future remediation workers, and minimal to minor long-term risks to ecological receptors for this alternative.

This alternative provides long-term protection of human health and the environment at the Class 2 landfill. This alternative requires retreatment of the landfill material to levels below UTS criteria. As in Alternative 1, a multi-layer cover with very low permeability and the multi-layer bottom liner would provide physical containment of the retreated material, minimizing the potential for human or ecological exposure to the retreated material and minimizing the potential for surface water to contact landfill material or landfill contents to migrate to groundwater. The cover would be vegetated to minimize erosion and long-term cover maintenance and inspections would be conducted. Groundwater monitoring would be performed as well. Given the typical low mobility of lead and other metals in treated slag, the landfill design, and that the landfill material would be retreated, it is unlikely that there would be a release to the surrounding environment.

There are medium potential effects as a result of excavation and crushing operations required for this alternative that would generate potentially lead/metal-bearing dust that could be aerially dispersed and deposited onto off-site soil. The estimated long-term risks from affected off-site soil are medium for off-site residents and minor for ecological receptors.

Long-term reduction of toxicity and mobility through additional treatment would be implemented under this alternative. It would be important to verify treatment effectiveness by testing the material after retreatment and before replacing the material in the landfill. The addition of chemical stabilizers to retreat the material would result in an increased volume of material and, when capped, a mound a few feet above surrounding grade.

Alternative 3: Excavation and Off-Site Retreatment and Disposal (score = 20.7, Minimal Risk)

There are minor long-term risks to off-site residents near the Class 2 landfill from affected off-site soil related to the breaking and excavation of landfill material for this alternative. There are minimal long-term risks to all potential receptors at the off-site TSD.

This alternative removes all landfill material from that landfill. The materials would be transferred to the off-site TSD to be retreated and disposed, with minimal long-term risks to all potential receptors at the off-site TSD.

Potential effects in the vicinity of the Class 2 landfill include minor risk associated with aerial dispersion and off-site deposition of potentially lead/metal-bearing dust generated from the breakage, excavation, and transport of landfill material required for this alternative. At the off-site TSD, there would be minimal risks of effects from exposure to landfill material, groundwater, surface water, and sediments due to the siting and engineering requirements at that facility.

Long-term reduction of waste toxicity and mobility through additional treatment would be implemented under this alternative as material would be retreated prior to placement at the off-site TSD facility. It would be important to verify treatment effectiveness by testing the material after retreatment. The addition of chemical stabilizers to retreat the material would result in an increased volume of material being disposed.

5.3.1.2 Short-Term Risk Minimization

Alternative 1: Closure In Place (score = 23.0, Minimal Risk)

The short-term potential risks to off-site resident and ecological receptors and onsite workers from exposure to landfill material and the potential for occupational hazards would be minimal to minor for Alternative 1. This alternative would require approximately 3 to 4 months to implement (once regulatory approval is received and the remaining capacity is filled). The short-term risks for occupational hazards associated with Alternative 1 are lower than the other alternatives because this alternative involves less landfill excavation and construction activities.

This alternative does not require intrusive activities that would disturb the landfilled waste material and does not involve excavation, crushing, or transport activities that would generate emissions of potentially lead/metal-bearing dust or otherwise expose the landfill material during implementation.

Risks to off-site resident and ecological receptors and onsite workers from truck traffic and noise associated with this alternative would also be minimal to minor. Compared with the other alternatives, this alternative would also have minimal energy consumption and air emissions from trucks and construction equipment.

Alternative 2: On-Site Ex Situ Retreatment (score = 19.5, Minimal Risk)

There are minimal to major short-term risks for this alternative due to the excavation and crushing operations required for retreatment of the landfill material. This alternative would require at least 2 years to implement for retreatment (once regulatory approval is received) and about 3 to 4 months for cap construction (once the remaining capacity is filled).

The overall short-term risk minimization score for this alternative is attenuated by the optimal scores given for Alternatives 1 and 2 for indicators that describe activities that occur only along the transportation route or at the off-site TSD. The sub-group scores provide more insight into short-term risk minimization effects for this alternative. The site worker sub-group risks are minor (score = 15.2) relative to Alternative 1 (score = 21.9) due to medium to major risks for several indicators within this subgroup.

During implementation, excavation, and crushing operations performed under this alternative potentially lead/metal-bearing airborne dust would be generated, creating medium risk for off-site residents and minor to medium risk for ecological receptors. The increased traffic and noise from these operations would result in minimal to medium risks to off-site residents and ecological receptors. This alternative would also result in minimal to medium risks for ecological receptors becoming exposed to landfill material.

For on-site remediation workers, a substantial increase in on-site machinery during implementation would result in major risks of incidents, noise effects, and inhalation of lead/metal-bearing dust. This alternative would require at least 2.5 years of implementation. During implementation, there are medium risks for on-site workers from exposure to landfill material as the landfill material is excavated, crushed, retreated and put back in the landfill. In addition, because the landfill material will be retreated, on-site workers have a medium risk of chemical incidents from retreatment chemicals.

This alternative would have medium energy consumption and non-dust air emissions (including nitrogen oxide (NO_x) emissions – an ozone precursor) from excavation and crushing operations due to the intensity of operations and duration required for implementation. This could result in increased impacts to the community (for example increased diesel emissions) during the implementation of this alternative.

Alternative 3: Excavation and Off-Site Retreatment and Disposal (score = 14.5, Medium Risk)

There are minimal to major short-term risks for this alternative due to the excavation and crushing operations required for retreatment of the landfill material at the Class 2 landfill. This alternative would require from 1.5 to 3 years to implement (once regulatory approval is received).

This alternative would require hauling an estimated 15,500 truckloads of landfill material at a rate of about 21 to 42 trucks per day to the off-site TSD that is expected to be 250 miles away from the FRC.

Excavation and breakage operations performed under this alternative would generate potentially lead/metal-bearing dust during implementation, resulting in a medium short-term potential risks to off-site residents and on-site workers, and a minor to medium risk to ecological receptors at the Class 2 landfill. Contact with landfill material during implementation of this alternative at the Class 2 landfill would pose a medium risk to on-site workers, a minor risk to terrestrial organisms, and a minimal risk to aquatic organisms.

During implementation, increased traffic in the vicinity of the Class 2 landfill would result in major risks to off-site residents, medium risks to terrestrial organisms, and minimal risks to aquatic organisms. Due to the frequency and duration of use of on-site construction equipment at the Class 2 landfill, this alternative poses a major risk of potential incidents for on-site workers. Excavation and transportation activities in the vicinity of the Class 2 landfill would result in medium short-term risks of noise effects to off-site residents and terrestrial organisms, minimal risks to aquatic organisms, and major risk to remediation workers.

Along the transportation route, the increased traffic for this alternative would result in medium risks to off-site residents and terrestrial receptors and to minor risks with aquatic receptors. There would be minimal to minor risks to off-site residents and ecological receptors related to lead/metal-bearing dust and potential spills along the transportation route.

At the off-site TSD and vicinity, there would be minimal risks to off-site residents and aquatic organisms, and minor risks for ecological receptors due to increased traffic near the facility. There would be medium risks to on-site workers related to on-site machinery due to potential incidents, and increased noise. The effects of increased noise on ecological receptors would be minimal to minor. The crushing activities at the off-site TSD would result in generation of potentially lead/metal-bearing dust that would result in a minimal risk to off-site residents, minor risks to ecological receptors, and medium risks to on-site workers. Workers at the off-site TSD would have minor risks of contact with landfill material and from chemical retreatment activities.

This alterative would result in very high energy consumption and non-dust air emissions (including NO_x emissions – an ozone precursor) from equipment operations associated with breaking, excavation, crushing, retreatment, and hauling 15,500 truckloads of landfill material 250 miles one way. This alternative scores the least favorably for energy consumption and air emission indicators.

5.3.2 Implementability

The scores assigned to the implementability of the alternatives are described below.

Alternative 1: Closure In Place (score = 17.8, Minor Risk)

This alternative scored 25 (the optimal score) for the technical feasibility sub-group because it involves conventional on-site construction and does not involve any retreatment activity or activities that would generate potentially lead-bearing dust. There would be much less traffic and noise for this alternative compared to Alternatives 2 and 3. This alternative received an administrative feasibility sub-group score of 15.3. TCEQ waste-program approval of this remedial action would be required and ultimate community acceptance of this alternative is unknown.

Alternative 2: On-Site Ex Situ Retreatment (score = 12.5, Medium Risk)

This alternative received a technical feasibility sub-group score of 11.0, and an administrative feasibility score of 13.0 for several reasons. The potential for significant off-site impacts (i.e., potentially lead/metal-bearing dust, truck traffic and noise) could negatively impact regulatory approval and community acceptance. Dust generation could result in an increase in the duration of the remediation process due to dust suppression and perimeter air monitoring requirements. In addition, the duration of the project (likely involving at least 2 years of crushing activities) could require air permitting authorizations for certain equipment, which may be complicated by the lead nonattainment status of the area. The dust-generating nature of the activities to implement this alternative, including potentially lead-bearing dust, is likely to receive increased scrutiny for regulatory acceptance in light of the requirement to attain and maintain the lead NAAQS.

In addition, TCEQ waste-program approval of this remedial action would be required. Implementation is expected to require additional development of and agency acceptance of protocols to demonstrate the effectiveness and reliability of the retreatment and the analytical confirmation of the landfill material. Treatment has been used and proven to work at the site, but further pilot testing would need to be performed to identify an appropriate treatment additive and analytical confirmation process that would be acceptable to TCEQ and USEPA. A rigorous quality assurance and quality control (QA/QC) process would also need to be put in place.

Alternative 3: Excavation and Off-Site Retreatment and Disposal (score = 16.6, Minor Risk)

This alternative received a technical feasibility score of 14, and an administrative feasibility score of 17.5 for several reasons. The potential for significant off-site impacts (i.e., potentially lead/metal-bearing dust, noise, and truck traffic) could negatively impact regulatory approval and community acceptance of this alternative. Community acceptance would involve a balance of the long-term benefits against the long-term impacts (from potentially lead-bearing dust deposition onto soil) and short-term impacts related to dust, traffic, and noise. Dust generation from breaking and excavating could result in an increase in the duration of the remediation process due to dust suppression and perimeter air monitoring requirements. The dust-generating nature of the activities to implement this alternative is likely to receive increased scrutiny for regulatory acceptance in light of the requirement to attain and maintain the lead NAAQS.

TCEQ waste-program approval of this remedial action would be required. As in Alternative 2, the retreatment process has already been tested in a pilot program. Because similar retreatment would occur at the off-site TSD, it will be necessary to identify an analytical confirmation procedure that would be acceptable to the applicable state agency (TCEQ) and USEPA. A rigorous QA/QC process would likely already be in place at the off-site TSD to ensure that landfill material has been adequately treated.

5.3.3 Cost

Cost is represented by cost estimates that have been prepared for each alternative based on the descriptions presented in Section 4.0. Cost estimates include capital costs for construction and post-remediation costs (i.e., groundwater monitoring and cover inspection and maintenance). The cost evaluation for the three alternatives is summarized below.

- Alternative 1 (Score = 25, Minimal) – The estimated cost for this alternative is less than $2 million, approximately an order of magnitude less than the estimated cost for Alternative 2 and 1/40 (less than 3%) the cost of Alternative 3.
- Alternative 2 (Score = 8, Medium) – The estimated cost for this alternative is over $30 million, which is more than an order of magnitude higher that Alternative 1.

Alternative 3 (Score = 3, Critical) – The estimated cost for this alternative is nearly $80 million, which is more than twice as much as the cost estimated for Alternative 2, and approximately 40 times the costs of Alternative 1.

In addition to the implementation rating process for this assessment described above, the cost of each of the various alternatives is an important consideration. Alternatives 2 and 3 are significantly more costly. Yet, despite the substantial cost differential, neither Alternatives 2 or 3 would achieve a distinguishable difference in long-term risks or the ultimate goal of long-term effectiveness while both would carry less favorable potential short-term risks when compared to Alternative 1. Accordingly, a responsible party making environmentally and financially responsible decisions would conclude that Alternatives 2 and 3 are less implementable than Alternative 1. Further to this point, Exide is currently a debtor and debtor in possession pursuant to chapter 11 of the United States Bankruptcy Code. Currently, Exide's ongoing operations including its ordinary course environmental remediation and closure obligations are funded by proceeds received from ordinary course operations and funding provided by its post-petition debtor in possession financing facility (the "DIP Financing"). Assuming Exide emerges pursuant to a plan of reorganization, it will require funding on a go-forward basis pursuant to an "exit" financing facility (the "Exit Financing") which would be effective upon Exide's emergence from chapter 11. The DIP Financing does not now (nor does Exide anticipate the Exit Financing will) contemplate $30M or $80M to address the Class 2 landfill. Therefore it may be inappropriate to assume Exide could implement Alternatives 2 and 3.

6.0 CONCLUSIONS

The main conclusions of this evaluation are:

- For long-term risk minimization, all three alternatives scored as presenting minimal risks (Scores for Alternatives 1, 2, and 3 are 20.1, 19.7, and 20.7, respectively).
- For short-term risk minimization, Alternative 1 (Closure in Place, score = 23.0) scores 15% higher than Alternative 2 (On-Site Ex Situ Retreatment, score = 19.5) and 37% higher than Alternative 3 (Excavation and Off-Site Retreatment and Disposal, score = 14.5). Alternatives 2 and 3 score lower because they involve removing and processing the existing waste material, creating the potential for lead/metal-bearing dust generation, and traffic and noise issues, among other considerations.
- For implementability, Alternative 1 (score = 17.8) scores 30% higher than Alternative 2 (score = 12.5) and 6% higher than Alternative 3 (score = 16.6). The Alternative 2 implementability score is medium, which is lower than the other alternatives because it involves removing and processing the existing waste material, creating the potential for lead/metal-bearing dust generation, developing analytical procedures, more complex regulatory approval, and community acceptance challenges. The Alternative 3 implementability score is high, but lower than Alternative 1 due to the challenges to be faced in gaining acceptance for landfill material excavation, lead/metal-bearing dust, long-distance hauling, retreatment, and disposal.

Figure 8 provides a diamond chart illustrating the relative overall criteria scores for the three remedial alternatives. As discussed in Section 5.3, a larger area in the diamond figure reflects a better outcome (i.e. higher score) for the associated alternative.

The long-term risk is scored as minimal for all three alternatives, with comparable scores ranging between 19.7 and 20.7. This indicates that all three alternatives are expected to present minimal long-term risks, and to have high potential to provide long-term protection, to human and ecological receptors and the environment.

For short-term risks, Alternative 1 (score = 23.0) is expected to present minimal short-term risks, as it does not involve intrusive removal or processing of the existing landfill material or the attendant, the generation of lead/metal-bearing dust, and clean cover material would be applied to the landfill. The short-term risk score for Alternative 2 is less favorable (score = 19.5) because this alternative involves removing and processing the existing landfill material and has the potential to generate lead/metal-bearing dust. It should be noted that the score for short-term risk minimization for Alternative 2 is averaged over 42 indicators (which tends to attenuate the individual scores), and that 11 indicators scored medium, and 3 indicators scored major for this Alternative. The score for Alternative 3 (14.5) is lower than Alternative 2 and much lower than Alternative 1 because this alternative involves the same removal and processing as Alternative 2, plus significantly increased transportation and traffic related to hauling excavated landfill material 250 miles to the off-site TSD. Similar to Alternative 2, the Alternative 3 average score for short-term risk minimization also attenuates the individual scores, and 11 indicators scored medium, and 5 indicators scored major for this alternative. For Alternatives 2 and 3, the potential to generate lead/metal-bearing dust (and off-site soil impacts), noise, and on- and off-site traffic presents risks and hazards to off-site resident and ecological receptors and remediation workers. Although mitigation measures would be implemented, these measures might not fully eliminate the risk.

The implementability score for Alternative 1 (17.8) is higher than the scores for Alternatives 2 (12.5) and 3 (16.6). Alternative 1 involves conventional on-site construction; however some landfill material above the UTS would remain in place, which may require some effort to gain regulatory approval and community acceptance. The scores for Alternatives 2 and 3 are lower because these alternatives involve removing and processing the existing waste material, and developing analytical procedures and a protocol, creating air emission issues, and may pose a challenge in terms of gaining regulatory approval and community acceptance. For Alternatives 2 and 3, there will also likely be physical challenges of minimizing air quality impacts and avoiding emission levels that could potentially affect the timeline for attainment demonstration with the lead NAAQS.

The estimated cost for Alternative 1 (estimated to be less than $2 million) is more than an order of magnitude less than the estimated cost for Alternative 2 (estimated to be over $30 million), and the cost for Alternative 3 (estimated to be about $80 million) is over twice the cost for Alternative 2, and approximately 40 times the cost of Alternative 1. Despite entailing significantly higher cost, implementation of the two higher cost alternatives (2 and 3) would not achieve a distinguishable difference in long-term risks or the ultimate goal of long-term effectiveness. Potential short-term effects during implementation of Alternatives 2 and 3 would result in increased short-term risks relative to Alternative 1.

Given that all three Alternatives score comparably for long-term risk minimization and Alternative 1 scores higher than Alternatives 2 and 3 with respect to short-term risk minimization and implementability, from a risk evaluation standpoint, Alternative 1 would be the best option.

7.0 QUALIFICATIONS

This report was prepared to present our evaluation of potential remedial alternatives for the FRC Class 2 landfill from a relative risk perspective, in a systematic and comprehensive manner to determine which alternative provides the best balance of the criteria. While this report does not present a quantitative analysis under fully developed fate and transport evaluation of exposure scenarios, receptor uptake, and other processes, it uses extensive existing data and careful analysis to provide a rigorous comparative analysis.

The results presented in this report depend to some extent on the scoring factors assumed for this evaluation, which were based on best professional judgment after reviewing extensive data. However, a qualitative review of the evaluation process suggests that these results would unlikely change significantly over a reasonable range of values, reflecting the major differences between the three alternatives.

Please provide any comments to the undersigned.

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TABLE

Table 1: Risk Evaluation of Remedial Alternatives

Criteria	Subgroup	Receptors	Indicator Number	Means of Potential Exposure	Location	Indicator Names	Alternative 1: Closure In Place (with cell reference from CSM Figure 5)	Alternative 2: Ex Situ On-Site Re-Treatment (with cell reference from CSM Figure 6)	Alternative 3a: Excavation and Off-Site Re-Treatment and Disposal): FRC Facility and Vicinity Only (with cell reference from CSM Figure 7)	Alternative 3b: Excavation and Off-Site Re-Treatment and Disposal: Off-Site TSD Facility and Vicinity Only (with cell reference from CSM Figure 7)	Scoring Criteria	Indicator Scores					Subgroup Scores			Criteria Scores		
												1	2	3a On-Site	3b Off-Site	3	1	2	3	1	2	3
Long Term Risk Minimization	Community Hazard Minimization	Off-Site Residents	1	Cover Failure	Class 2 Landfill and Off-Site TSD Facility	Off-Site Resident Exposure to Landfill Material	A1, A2 Minimal - Landfill would have low permeability, multi-layer capping system to prevent release of landfill contents to the environment. Some materials within the landfill exceed UTS.	A1, A2 Minimal - landfill material would be re-treated to below UTS, minimizing the potential for exposure to material above UTS. Landfill would have low permeability, multi-layer capping system to prevent release of landfill contents to the environment.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	H1, H2 Minimal - the landfill material would be treated to below UTS, minimizing the potential for exposure to material above UTS. The expected remoteness of facility to residential areas would result in lowered consequences of exposure due to lower potential frequency of contact.	Probability minimized 1 High probability 25 Low probability	20	20		25	25	**20.4**	**19.4**	**23.2**	**20.1**	**19.7**	**20.7**
		Off-Site Residents	2	Affected Groundwater	Class 2 Landfill and Off-Site TSD Facility	Off-Site Resident Exposure to Affected Groundwater	A3, A4 Minor - the liner and cover system is designed according to industry standards to protect groundwater. The data on the extent of material above the hazardous waste criteria (and/or UTS), inherent low mobility of lead and other metals in the slag, and prior treatment further minimizes risk for migration to groundwater.	A3, A4 Minimal - landfill material would be re-treated to below UTS, which would result in less potential for migration to groundwater compared to Alternative 1. The liner and cover system is designed according to industry standards to protect groundwater.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	H3, H4 Minimal - the siting and engineering requirements at a TSD provide safeguards against release and potential exposure from such a facility, compared to Alternatives 1 and 2. The landfill material would be treated to below UTS, minimizing the potential for exposure to material above UTS.	Probability minimized 1 High probability 25 Low probability	16	20		25	25						
		Off-Site Residents	3	Affected Surface Water and Sediment	Class 2 Landfill and Off-Site TSD Facility	Off-Site Resident Exposure to Affected Surface Water and Sediment	A5, A6, A7, A8 Minor - same as for groundwater. In the unlikely event that groundwater becomes affected, then surface water and sediment in the vicinity could also become affected.	A5, A6, A7, A8 Minimal - same as for groundwater. In the unlikely event that groundwater becomes affected, then surface water and sediment in the vicinity could also become affected.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	H5, H6, H7, H8 Minimal - same as for groundwater. In the event that groundwater becomes affected, then surface water and sediment in the vicinity could also become affected.	Probability minimized 1 High probability 25 Low probability	16	20		25	25						
		Off-Site Residents	4	Construction Activities	Class 2 Landfill and Vicinity	Off-Site Resident Exposure to Affected Off-Site Soil	A10, A11 Minimal - landfill material will be capped to prevent off-site migration of materials to off-site soil. Construction dust is expected to be from clean material, compared to lead/metal-bearing materials that would be handled in Alternatives 2 and 3. **The score for this indicator assumes that there would be controls in place for dust suppression, such as watering trucks, air monitoring, and safe engineering practices.**	A10, A11 Medium - the lead/metal-bearing landfill material would be crushed to a fine particle size, excavated, and hauled on-site prior to re-treatment. The fine particulate has greater potential for aerial dispersion and deposition onto off-site soil, and exposures to the lead/metal-bearing materials in soil could lead to adverse health effects. **The score for this indicator assumes that there would be controls in place for dust suppression, such as watering trucks, air monitoring, safe engineering practices; and emissions would be controlled to comply with the lead NAAQS.**	A12, A13 Minor - the lead/metal-bearing landfill material would be broken into pieces to allow excavation, but particle sizes not as fine as Alternative 2. The landfill material would be handled such that there is some potential for aerial dispersion and deposition onto off-site soil, and exposures to the lead or other metals in soil could lead to adverse health effects. The score for this indicator assumes that there would be controls in place for dust suppression, such as watering trucks, air monitoring, and safe engineering practices; and emissions would be controlled to comply with the lead NAAQS.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	25	12	16		16						
		Off-Site Residents	5	Construction Activities	Off-Site TSD Facility Only	Off-Site Resident Exposure to Affected Off-Site Soil (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	H10, H11 Minimal - the crushing and excavation of landfill material prior to re-treatment at the off-site TSD facility has the potential for lead/metal-bearing dust generation, and deposition onto off-site soil. However, the off-site TSD facility is expected to be located in a large paved, semi-industrial area that is remote from residential soil. The expected remoteness of facility to residential areas would result in lowered consequences of exposure due to lower potential frequenc of contact. **The score for this indicator assumes that there would be controls in place for dust suppression, such as watering trucks, air monitoring, and safe engineering practices.**	Probability minimized 1 High probability 25 Low probability	*25*	*25*		25	25						
	Occupational Hazard Minimization	Future Industrial Workers	6	Cover Failure	Class 2 Landfill and Off-Site TSD Facility	Future Industrial Worker Exposure to Landfill Material	C1, C2 Minor - landfill would have low permeability, multi-layer capping system to prevent release of landfill contents to the environment.	C1, C2 Minimal - landfill material would be re-treated to below UTS. Landfill would have low permeability, multi-layer capping system to prevent release of landfill contents to the environment.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	J1, J2 Minimal - the siting and engineering requirements at a TSD provide safeguards against release and potential exposure from such a facility. The landfill material would be treated to below UTS, minimizing the potential for exposure to material above UTS.	Probability minimized 1 High probability 25 Low probability	16	20		25	25	**18.7**	**20.0**	**21.7**			
		Future Industrial Workers	7	Affected Groundwater	Class 2 Landfill and Off-Site TSD Facility	Future Industrial Worker Exposure to Affected Groundwater	C3, C4 Minimal - the liner and cover system is designed according to industry standards to protect groundwater. The inherent low mobility of lead and other metals in the slag, and prior treatment further minimizes migration to groundwater.	C3, C4 Minimal - the liner and cover system is designed according to industry standards to protect groundwater. Material in the landfill would be treated to below UTS, which would result in less potential for migration to groundwater compared to Alternative 1.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	J3, J4 Minimal - the siting and engineering requirements at a TSD provide safeguards against release and potential exposure from such a facility. The landfill material would be treated to below UTS, minimizing the potential for exposure to material above UTS.	Probability minimized 1 High probability 25 Low probability	20	20		20	20						
		Future Industrial Workers	8	Affected Surface Water and Sediment	Class 2 Landfill and Off-Site TSD Facility	Future Industrial Worker Exposure to Affected Surface Water and Sediment	C5, C6, C7, C8 Minimal - same as for groundwater. In the unlikely event that groundwater becomes affected, then surface water and sediment in the vicinity could also become affected.	C5, C6, C7, C8 Minimal - same as for groundwater. In the unlikely event that groundwater becomes affected, then surface water and sediment in the vicinity could also become affected. The landfill material would be re-treated to below UTS, minimizing the potential for exposure to material above UTS.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	J5, J6, J7, J8 Minimal - the siting and engineering requirements at a TSD provide safeguards against release and potential exposure from such a facility. The landfill material would be re-treated to below UTS, minimizing the potential for exposure to material above UTS.	Probability minimized 1 High probability 25 Low probability	20	20		20	20						

Table 1: Risk Evaluation of Remedial Alternatives

Criteria	Subgroup	Receptors	Indicator Number	Means of Potential Exposure	Location	Indicator Names	Alternative 1: Closure In Place (with cell reference from CSM Figure 5)	Alternative 2: Ex Situ On-Site Re-Treatment (with cell reference from CSM Figure 6)	Alternative 3a: Excavation and Off-Site Re-Treatment and Disposal): FRC Facility and Vicinity Only (with cell reference from CSM Figure 7)	Alternative 3b: Excavation and Off-Site Re-Treatment and Disposal: Off-Site TSD Facility and Vicinity Only (with cell reference from CSM Figure 7)	Scoring Criteria	Indicator Scores					Subgroup Scores			Criteria Scores		
												1	2	3a On-Site	3b Off-Site	3	1	2	3	1	2	3
Long Term Risk Minimization	Ecological Hazard Minimization	Terrestrial Organisms	9	Cover Failure	Class 2 Landfill and Off-Site TSD Facility	Terrestrial Organism Exposure to Landfill Material	D1, D2 Minor - landfill would have low permeability, multi-layer capping system to prevent release of landfill contents to the environment.	D1, D2 Minimal - landfill material would be re-treated to below UTS**,** therefore dust or landfill material could be accidentally spread to nearby areas during re-treatment. **Dust supression activities would minimize this route of exposure.** After re-treatment, landfill would have low permeability, multi-layer capping system to prevent release of landfill contents to the environment.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	K1, K2 Minimal - the siting and engineering requirements at a TSD provide safeguards against release and potential exposure from such a facility. The landfill material would be re-treated to below UTS, minimizing the potential for exposure to material above UTS. However, during re-treatment, dust or landfill material could be accidentally spread to nearby areas. **Dust supression activities would minimize this route of exposure.**	Probability minimized 1 High probability 25 Low probability	16	20		20	20	**20.7**	**19.7**	**19.2**	**20.1**	**19.7**	**20.7**
		Terrestrial Organisms	10	Affected Groundwater	Class 2 Landfill and Off-Site TSD Facility	Terrestrial Organism Exposure to Affected Groundwater	D3, D4 Minimal - **the liner and cover system is designed according to industry standards to protect groundwater.** Terrestrial organisms have very limited contact with groundwater.	D3, D4 Minimal - landfill material would be re-treated to below UTS. **The liner and cover system is designed according to industry standards to protect groundwater.** Terrestrial organisms have very limited contact with groundwater.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	K3, K4 Minimal - **the siting and engineering requirements at a TSD provide safeguards against release and potential exposure from such a facility**. The landfill material would be re-treated to below UTS, minimizing the potential for exposure to material above UTS. Terrestrial organisms have very limited contact with groundwater.	Probability minimized 1 High probability 25 Low probability	20	20		20	20						
		Terrestrial Organisms	11	Affected Surface Water and Sediment	Class 2 Landfill and Off-Site TSD Facility	Terrestrial Organism Exposure to Affected Surface Water and Sediment	D5, D6, D7, D8, D9 Minor - similar to groundwater. In the unlikely event that groundwater becomes affected, then surface water and sediment in the vicinity could also become affected. Terrestrial organisms have a higher likelihood of exposure to surface water than groundwater.	D5, D6, D7, D8, D9 Minimal - similar to groundwater. In the unlikely event that groundwater becomes affected, then surface water and sediment in the vicinity could also become affected. Terrestrial organisms have a higher likelihood of exposure to surface water than groundwater. Lower **long-term** likelihood than Alternative 1 since waste will be re-treated.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	K5, K6, K7, K8, K9 Minimal - **the siting and engineering requirements at a TSD provide safeguards against release and potential exposure from such a facility**. The landfill material would be re-treated to below UTS, minimizing the potential for exposure to material above UTS. Terrestrial organisms have a higher likelihood of exposure to surface water than groundwater.	Probability minimized 1 High probability 25 Low probability	16	20		20	20						
		Terrestrial Organisms	12	Affected Soil	Class 2 Landfill and Vicinity	Terrestrial Organism Exposure to Affected Off-Site Soil	D10, D11 Minimal - landfill material will be capped without disturbing the waste material to prevent off-site migration of materials to off-site soil. Construction dust is expected to be from clean material, compared to lead/metal-bearing materials that would be handled in Alternatives 2 and 3. **Dust suppression activities would be performed to minimize this potential.**	D10, D11 Minor - the lead- and metal-bearing landfill material would be crushed to a fine particle size, excavated, and handled on-site prior to re-treatment. The fine particulate has greater potential for aerial dispersion and deposition onto off-site soil, and exposures to the lead or other metals in soil could lead to adverse health effects. **Dust suppression activities would be performed to minimize this potential.**	C12, C13 Minor - the landfill material will be broken for excavation (to a lesser extent than the crushing activities in Alternative 2), excavated, and loaded for transport to an off-site facility, and will have the potential for lead/metal-bearing dust generation, off-site transport and deposition onto off-site soil. Dust suppression activities will be performed to minimize this potential.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	25	16	16		16						
		Terrestrial Organisms	13	Construction Activities	Off-Site TSD Facility Only	Terrestrial Organism Exposure to Affected Off-Site Soil (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	K10, K11 Minimal - the crushing and excavation of landfill material prior to re-treatment has the potential for generation and deposition of lead/metal-bearing dust onto off-site soil. **Dust suppression activities will be performed to minimize this potential.** The expected remoteness of the facility limits exposures.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		20	20						
		Aquatic Organisms	14	Cover Failure	Class 2 Landfill and Off-Site TSD Facility	Aquatic Organism Exposure to Landfill Material	E1, E2 Minimal - **landfill would have low permeability, multi-layer capping system to prevent release of landfill contents to the environment.** The data on the extent of material above the hazardous waste criteria (and/or UTS), inherent low mobility of lead and other metals in the slag, and prior treatment further minimizes migration to surface water. It is considered a rare likelihood that this could migrate to surface water.	E1, E2 Minimal - landfill material would be re-treated to below UTS. **Landfill would have low permeability, multi-layer capping system to prevent release of landfill contents to the environment.** It is considered a rare likelihood that this could migrate to surface water.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	L1, L2 Minimal - **the siting and engineering requirements at a TSD provide safeguards against release and potential exposure from such a facility.** It is considered a rare likelihood that this could migrate to surface water.	Probability minimized 1 High probability 25 Low probability	20	20		20	20						
		Aquatic Organisms	15	Affected Groundwater	Class 2 Landfill and Off-Site TSD Facility	Aquatic Organism Exposure to Affected Groundwater	E3, E4 Minimal - the liner and cover system is designed according to industry standards to protect groundwater. Aquatic organisms have limited contact with groundwater.	E3, E4 Minimal - landfill material would be re-treated to below UTS. The liner and cover system is designed according to industry standards to protect groundwater. Aquatic organisms have limited contact with groundwater.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	L3, L4 Minimal - the siting and engineering requirements at a TSD provide safeguards against release and potential exposure from such a facility. The landfill material would be re-treated to below UTS minimizing the potential for exposure to material above UTS. Aquatic organisms have limited contact with groundwater.	Probability minimized 1 High probability 25 Low probability	20	20		20	20						
		Aquatic Organisms	16	Affected Surface Water and Sediment	Class 2 Landfill and Off-Site TSD Facility	Aquatic Organism Exposure to Surface Water and Sediment, Food Web Uptake	E5, E6, E7, E8, E9 Minor - In the unikely event that groundwater becomes affected, then surface water and sediment in the vicinity could also become affected. Aquatic organisms could then have deleterious effects from affected surface water, sediments, and aquatic food items.	E5, E6, E7, E8, E9 Minor - in the unlikely event that groundwater becomes affected, then surface water and sediment in the vicinity could also become affected. Aquatic organisms could then have deleterious effects from affected surface water, sediments, and aquatic food items.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	L5, L6, L7, L8, L9 Minimal - in the unlikely event that groundwater becomes affected, then surface water and sediment in the vicinity could also become affected. Aquatic organisms could then have deleterious effects from affected surface water, sediments, and aquatic food items. Lower probability than the other alternatives given the remoteness and siting and engineering requirements at this facility.	Probability minimized 1 High probability 25 Low probability	15	15		20	20						
		Aquatic Organisms	17	Construction Activities	Class 2 Landfill and Vicinity	Aquatic Organism Exposure to Affected Off-Site Soil	E10, E11 Minimal - landfill material will be capped to prevent off-site migration of materials to off-site soil. Construction dust is expected to be from clean material, compared with the other alternatives. Aquatic organisms have minor contact with off-site soil.	E10, E11 Minor - the excavation and crushing of landfill material prior to re-treatment has the potential for lead/metal-bearing dust generation, off-site transport and deposition onto soil. **Dust suppression activities would be performed to minimize this potential.** Aquatic organisms have minor contact with off-site soil.	D12, D13 Minor - the excavation and crushing of landfill material prior to re-treatment has the potential for lead/metal-bearing dust generation, off-site transport and deposition onto soil. **Dust suppression activities would be performed to minimize this potential.** Aquatic organisms have minor contact with off-site soil.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	25	16	16		16						

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Criteria	Subgroup	Receptors	Indicator Number	Means of Potential Exposure	Location	Indicator Names	Alternative 1: Closure In Place (with cell reference from CSM Figure 5)	Alternative 2: Ex Situ On-Site Re-Treatment (with cell reference from CSM Figure 6)	Alternative 3a: Excavation and Off-Site Re-Treatment and Disposal): FRC Facility and Vicinity Only (with cell reference from CSM Figure 7)	Alternative 3b: Excavation and Off-Site Re-Treatment and Disposal: Off-Site TSD Facility and Vicinity Only (with cell reference from CSM Figure 7)	Scoring Criteria	Indicator Scores					Subgroup Scores			Criteria Scores		
												1	2	3a On-Site	3b Off-Site	3	1	2	3	1	2	3
Long Term Risk Minimization	Ecological Hazard Minimization	Aquatic Organisms	18	Affected Soil	Off-Site TSD Facility Only	Aquatic Organism Exposure to Affected Off-Site Soil (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	L10, L11 Minimal - the crushing and excavation of landfill material prior to re-treatment has the potential for dust generation and deposition onto off-site soil. **The remoteness of the facility limits exposures.**	Probability minimized 1 High probability 25 Low probability	*25*	*25*		20	20	**20.7**	**19.7**	**19.2**	**20.1**	**19.7**	**20.7**
	Environmental Effects	Environmental Effects	19	Long Term Environmental Effects	Class 2 Landfill and Off-Site TSD Facility	Reduction of Toxicity, Mobility, or Volume through Treatment	Little or no reduction in toxicity or mobility as no further treatment of material would occur. Volume would not be increased. Constituents are currently not very mobile, but no further reduction would occur.	Reduction of mobility will occur upon re-treament, but the volume of treated material will increase with additional treatment.	NA - all material in the Class 2 landfill will be removed from the site under this alternative.	High reduction of mobility will occur, but the volume of treated material will increase with additional treatment.	Probability minimized 1 High probability 25 Low probability	16	20		20	20	**16.0**	**20.0**	**20.0**			
Short-Term Risk Minimization	Community Hazard Minimization	Off-Site Residents	20	Construction Activities	Class 2 Landfill and Vicinity	Off-Site Resident Exposure to Construction Dust (Class 2 Landfill and Vicinity)	A12 Minimal - material will remain undisturbed in situ and the entire landfill will have a multi-layer cap. Construction dust would be from clean materials. Appropriate controls, such as watering, will minimize dust generation.	A12 Medium - landfill material will be excavated, loaded into trucks, and crushed on-site to a fine particle size, creating potential lead/metal-bearing dust which may become airborne and travel off-site. Appropriate controls such as watering can minimize dust generation.	A14 Medium - landfill material will be broken to manageable pieces (to a lesser extent than the crushing activities in Alternative 2), loaded into trucks, and transported off site for disposal, creating lead/metal-bearing dust which may become airborne and travel off-site. Appropriate controls such as watering can minimize dust generation.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	25	12	12		12	**23.3**	**20.3**	**15.6**	**23.0**	**19.5**	**14.5**
		Off-Site Residents	21	Construction Activities	Class 2 Landfill and Vicinity	Off-Site Resident Exposure to Increased Truck Traffic (Class 2 Landfill and Vicinity)	A13 Minor - some increased truck traffic in the vicinity of the site when importing cover materials.	A13 Medium - increased operations in the vicinity of the site for excavation, crushing, loading, treatment, and hauling over an approximate 2.5-year period.	A15 Major - very high volume of truck traffic into and out of the site to transport material for a 1.5- to 3-year period.	NA - this indicator applies to the Class 2 landfill only	Truck traffic minimized 1 High traffic 25 Low traffic	15	12	6		6						
		Off-Site Residents	22	Construction Activities	Class 2 Landfill and Vicinity	Off-Site Resident Exposure to Increased Noise (Class 2 Landfill and Vicinity)	A15 Minimal - some increased noise during cover construction from standard earth moving equipment.	A15 Medium - increased noise due to crushing, excavation, loading, and hauling.	A17 Medium - increased noise due to truck traffic, breakage, excavation, loading, and hauling.	NA - this indicator applies to the Class 2 landfill only	Noise levels minimized 1 High noise levels 25 Low noise levels	20	9	12		12						
		Off-Site Residents	23	Transportation	Transportation Route	Off-Site Resident Exposure to Construction Dust (Transportation Route)	No off-site transportation	No off-site transportation	NA - off-site transportation is scored under Alternative 3b	E20 Minor - approximately 15,500 truck loads will haul the landfill material 250 miles one way to move the material to the off-site TSD facility. Lead/metal-bearing dust could potentially be generated from transport of landfill material. Appropriate controls, such as covering truck loads, will minimize dust generation. However, any dust dispersion would likely be spread over a wide area, minimizing localized exposures.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		16	16						
		Off-Site Residents	24	Transportation	Transportation Route	Off-Site Resident Exposure to Increased Traffic (Transportation Route)	No off-site transportation	No off-site transportation	NA - off-site transportation is scored under Alternative 3b	E21 Medium - approximately 15,500 truck loads will haul the landfill material 250 miles each way for a total of 7,750,000 miles of increased truck traffic to move the material to the off-site TSD facility.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		8	8						
		Off-Site Residents	25	Transportation	Transportation Route	Off-Site Resident Effects from Accidental Spill (Transportation Route)	No off-site transportation	No off-site transportation	NA - off-site transportation is scored under Alternative 3b	E22, E23 Minor - approximately 15,500 truck loads will haul the landfill material 250 miles one way to move the material to the off-site TSD facility, with the attendant the risk of spillage or accidents.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		16	16						
		Off-Site Residents	26	Construction Activities	Off-Site TSD Facility Only	Off-Site Resident Exposure to Construction Dust (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	H24 Minimal - landfill material crushed on-site, creating potential lead/metal-bearing dust which may become airborne and travel off-site. However, the off-site TSD facility is expected to be located in remote area, which minimizes potential exposures.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		25	25						
		Off-Site Residents	27	Transportation	Off-Site TSD Facility Only	Off-Site Resident Exposure to Increased Truck Traffic (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	H25 Minor - approximately 15,500 truck loads of landfill material will enter and exit the off-site TSD facility to deliver material. However, the facility is expected to be remote from residential areas.	Truck traffic minimized 1 High traffic 25 Low traffic	*25*	*25*		20	20						
		Off-Site Residents	28	Construction Activities	Off-Site TSD Facility Only	Off-Site Resident Exposure to Noise (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	H27 Minimal - an estimated 15,500 truckloads of material from the Class 2 landfill will be received at the off-site facility. However, the facility is expected to be remote, which minimizes noise exposure to residents in the vicinity.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		25	25						
	Occupational Hazard Minimization	Site Remediation Worker	29	Construction Activities	Class 2 Landfill and Vicinity	Site Remediation Worker Exposure to Construction Dust (Class 2 Landfill and Vicinity)	B12 Minimal - operations will involve moving clean material for cover over a 3 to 4 month period.	B12 Major - increased operations for crushing, excavation, loading, and hauling over an approximate 2.5-year period will result in increased potentailly lead/metal-bearing dust. Appropriate controls, such as watering, will minimize exposure.	B14 Medium - Increased operations for breakage and excavation of landfill material and loading into trucks for off site disposal over a 1.5- to 3-year period will generate potential lead/metal-bearing dust.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	20	6	9		9	**21.9**	**15.2**	**10.9**			
		Site Remediation Worker	30	Construction Activities	Class 2 Landfill and Vicinity	Site Remediation Worker Occupational Hazards (Class 2 Landfill and Vicinity)	B14 Minor - operations will involve standard earth moving equipment over a 3 to 4 month period.	B14 Major - landfill materials crushing, excavation, loading, and hauling operations will occur over an approximate 2.5-year period.	B16 Major - significant increased truck traffic; landfill material breakage, excavation, loading, and hauling will occur over a 1.5- to 3-year period.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	16	6	6		6						
		Site Remediation Worker	31	Construction Activities	Class 2 Landfill and Vicinity	Site Remediation Worker Exposure to Noise (Class 2 Landfill and Vicinity)	B15 Minor - some increased noise during cover construction from standard earth moving equipment.	B15 Major - increased noise due to crushing, excavation, loading, and hauling.	B17 Major - increased noise due to truck traffic, breakage, excavation, loading, and hauling. Noise would be less than Alternative 2 because crushing to fine particle size is not required.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	16	4	6		6						

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Criteria	Subgroup	Receptors	Indicator Number	Means of Potential Exposure	Location	Indicator Names	Alternative 1: Closure In Place (with cell reference from CSM Figure 5)	Alternative 2: Ex Situ On-Site Re-Treatment (with cell reference from CSM Figure 6)	Alternative 3a: Excavation and Off-Site Re-Treatment and Disposal): FRC Facility and Vicinity Only (with cell reference from CSM Figure 7)	Alternative 3b: Excavation and Off-Site Re-Treatment and Disposal: Off-Site TSD Facility and Vicinity Only (with cell reference from CSM Figure 7)	Scoring Criteria	Indicator Scores					Subgroup Scores			Criteria Scores		
												1	2	3a On-Site	3b Off-Site	3	1	2	3	1	2	3
Short-Term Risk Minimization	Occupational Hazard Minimization	Site Remediation Worker	32	Construction Activities	Class 2 Landfill and Vicinity	Site Remediation Worker Exposure to Landfill Material (Class 2 Landfill and Vicinity)	B16, B17 Minimal - landfill material will not be disturbed by placement of clean cover materials.	B16, B17 Medium - landfill material will be handled by remediation workers while crushing, excavating, loading, and hauling.	B18, B19 Medium - landfill material will be handled by remediation workers while excavating, loading, and hauling.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	20	12	12		12	**21.9**	**15.2**	**10.9**	**23.0**	**19.5**	**14.5**
		Site Remediation Worker	33	Construction Activities	Off-Site TSD Facility Only	Site Remediation Worker Exposure to Construction Dust (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	I24 Medium - landfill material will be crushed on-site, generating potential lead/metal-bearing dust. Appropriate controls, such as watering, will minimize exposure.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		12	12						
		Site Remediation Worker	34	Construction Activities	Off-Site TSD Facility Only	Site Remediation Worker Exposure to On-Site Machinery (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	I26 Medium - an estimated 15,500 truckloads of material from the Class 2 landfill will be received at the off-site TSD facility, requiring heanling while crushing, re-treating, and placement into the facility.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		12	12						
		Site Remediation Worker	35	Construction Activities	Off-Site TSD Facility Only	Site Remediation Worker Exposure to Noise (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	I27 Medium - increased noise due to truck traffic, crushing, and hauling.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		9	9						
		Site Remediation Worker	36	Construction Activities	Off-Site TSD Facility Only	Site Remediation Worker Exposure to Landfill Material (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	I28, I29 Minor - the landfill material will be handled at the off-site TSD facility, which commonly accepts and treats materials.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		16	16						
		Site Remediation Worker	37	Chemical Treatment	Class 2 Landfill and Off-Site TSD Facility	Site Remediation Worker Exposure to Chemical Hazards	B18 Minimal - no further treatment activities will occur.	B18 Medium - most of landfill material will be treated on-site.	NA - treatment will occur at the Off-site TSD (Alternative 3b)	I30 Minor - landfill material will be treated upon receipt in the off-site TSD facility, which commonly accepts and treats materials.	Probability minimized 1 High probability 25 Low probability	25	9		16	16						
	Ecological Hazard Minimization	Terrestrial Organisms	38	Construction Activities	Class 2 Landfill and Vicinity	Terrestrial Organism Exposure to Construction Dust (Class 2 Landfill and Vicinity)	D12 Minimal - material will remain relatively intact while cover is placed over existing material. Construction dust would be from clean materials. Appropriate controls, such as watering, will minimize exposure.	D12 Medium - landfill material will be excavated, loaded into trucks, and crushed on-site, creating potential lead/metal-bearing dust which may become airborne and travel off-site. Appropriate controls such as watering can minimize exposure. Highest consequences would be for plant deposition compared with wildlife inhalation.	C14 Medium - landfill material will be broken to manageable pieces, loaded into trucks, and transported off site for disposal, creating potential lead/metal-bearing dust which may become airborne and travel off-site. Appropriate controls such as watering can minimize exposure. Highest consequences would be for plant deposition compared with wildlife inhalation.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	25	12	12		12	**23.7**	**21.6**	**16.5**			
		Terrestrial Organisms	39	Construction Activities	Class 2 Landfill and Vicinity	Terrestrial Organism Exposure to Increased Truck Traffic (Class 2 Landfill and Vicinity)	D13 Minor - operations will involve standard heavy equipment over a 3 to 4 month period.	D13 Medium - increased operations for excavation, crushing, loading, treatment, and hauling over an approximate 2.5-year period, hence a higher likelihood and consequence of a potential incident than Alternative 1.	C15 Medium - very high volume of truck traffic into and out of the landfill to transport material over a 1.5- to 3-year period, hence a higher likelihood and consequence of a potential incident than Alternatives 1 or 2.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	15	12	9		9						
		Terrestrial Organisms	40	Construction Activities	Class 2 Landfill and Vicinity	Terrestrial Organism Exposure to Noise (Class 2 Landfill and Vicinity)	D15 Minor - some increased noise during cover construction from standard earth moving equipment.	D15 Medium - increased noise due to crushing, excavation, loading, and hauling. Longer duration than Alternative 1.	C17 Medium - increased noise due to truck traffic, breakage, excavation, loading, and hauling. Longer duration than Alternatives 1 or 2.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	16	9	9		9						
		Terrestrial Organisms	41	On-Site Construction Activities	Class 2 Landfill and Vicinity	Terrestrial Organism Exposure to Landfill Material (Class 2 Landfill and Vicinity)	D16, D17 Minimal - landfill material will not be disturbed or exposed by placement of a new cover.	D16, D17 Medium - landfill material will be crushed, excavated, loaded, retreated and dedeposited. Therefore it is a higher likelihood that terrestrial organisms would encounter this material compared with Alternative 1.	C18, C19 Minor - landfill material will be broken, excavated, loaded, and hauled. Therefore it is a higher likelihood that terrestrial organisms would encounter this material compared with Alternative 1, but will be at a slower pace than Alternative 2.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	20	12	16		16						
		Terrestrial Organisms	42	Transportation	Transportation Route	Terrestrial Organism Exposure to Construction Dust (Transportation Route)	No off-site transportation	No off-site transportation	NA - off-site transportation is scored under Alternative 3b	F20 Minor - approximately 15,500 truck loads will haul the landfill material 250 miles to the off-site TSD facility. Lead/metal-bearing dust could potentially be generated from transport of landfill material. Appropriate controls, such as covering truck loads, will minimize exposure.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		16	16						
		Terrestrial Organisms	43	Transportation	Transportation Route	Terrestrial Organism Exposure to Increased Traffic (Transportation Route)	No off-site transportation	No off-site transportation	NA - off-site transportation is scored under Alternative 3b	F21 Medium - approximately 15,500 truck loads will haul the landfill material 250 miles to the off-site TSD facility, which with return trips would be a total of 7,750,000 miles of increased truck traffic. Even though the likelihood of an incident is low, the consequences are relatively high.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		8	8						
		Terrestrial Organisms	44	Transportation	Transportation Route	Terrestrial Organism Effects from Accidental Spill (Transportation Route)	No off-site transportation	No off-site transportation	NA - off-site transportation is scored under Alternative 3b	F22, F23 Minor - approximately 15,500 truck loads will haul the landfill material 250 miles to the off-site TSD facility, with the attendant the risk of spillage or accidents.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		16	16						
		Terrestrial Organisms	45	Construction Activities	Off-Site TSD Facility Only	Terrestrial Organism Exposure to Construction Dust (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	K24 Minor - landfill material crushed on-site, creating potential lead/metal-bearing dust which may become airborne and travel off-site. However, the facility is located in a semi-industrial area, which likely has reduced populations of terrestrial organisms compared with undisturbed or residential areas.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		16	16						
		Terrestrial Organisms	46	Construction Activities	Off-Site TSD Facility Only	Terrestrial Organism Exposure to Increased Truck Traffic (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	K25 Minor - very high volume of truck traffic into and out of the off-site TSD facility to deliver material. However, the facility is located in a semi-industrial area, which likely has reduced populations of terrestrial organisms compared with undisturbed areas.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		15	15						

Table 1: Risk Evaluation of Remedial Alternatives

Criteria	Subgroup	Receptors	Indicator Number	Means of Potential Exposure	Location	Indicator Names	Alternative 1: Closure In Place (with cell reference from CSM Figure 5)	Alternative 2: Ex Situ On-Site Re-Treatment (with cell reference from CSM Figure 6)	Alternative 3a: Excavation and Off-Site Re-Treatment and Disposal): FRC Facility and Vicinity Only (with cell reference from CSM Figure 7)	Alternative 3b: Excavation and Off-Site Re-Treatment and Disposal: Off-Site TSD Facility and Vicinity Only (with cell reference from CSM Figure 7)	Scoring Criteria	Indicator Scores					Subgroup Scores			Criteria Scores		
												1	2	3a On-Site	3b Off-Site	3	1	2	3	1	2	3
Short-Term Risk Minimization	Ecological Hazard Minimization	Terrestrial Organisms	47	Construction Activities	Off-Site TSD Facility Only	Terrestrial Organism Exposure to Noise (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	K27 Minor - increased noise due to truck traffic, crushing, and hauling. However, the facility is located in a semi-industrial area, which likely has reduced populations of terrestrial organisms compared with undisturbed or residential areas.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		16	16	**23.7**	**21.6**	**16.5**	**23.0**	**19.5**	**14.5**
		Terrestrial Organisms	48	Construction Activities	Off-Site TSD Facility Only	Terrestrial Organism Exposure to Landfill Material (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	K28, K29 Minor - landfill material will be broken, excavated, loaded, and hauled at the off-site TSD facility. However, the facility is located in a semi-industrial area, which likely has reduced populations of terrestrial organisms compared with undisturbed or residential areas.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		16	16						
		Aquatic Organisms	49	Construction Activities	Class 2 Landfill and Vicinity	Aquatic Organism Exposure to Construction Dust (Class 2 Landfill and Vicinity)	E12 Minimal - operations will not occur near stream or riparian areas. Construction dust would be from clean materials.	E12 Minor - crushing operations could increase potential dispersion of potential lead/metal-bearing dust to aquatic and riparian areas.	D14 Minor - Excavation and breakage operations could increase potential dispersion of potential lead/metal-bearing dust to aquatic and riparian areas.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	25	16	16		16						
		Aquatic Organisms	50	Construction Activities	Class 2 Landfill and Vicinity	Aquatic Organism Exposure to Increased Truck Traffic (Class 2 Landfill and Vicinity)	E13 Minimal - operations will not occur near stream or riparian areas. Consequences of exposure would be minor.	E13 Medium - increased operations for excavation, crushing, loading, retreating and redepositing over an approximate 2.5-year period. Increased likelihood and consequence of any incident compared with Alternative 1.	D15 Minimal - significantly increased traffic will occur, remote from aquatic and riparian areas.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	20	20	20		20						
		Aquatic Organisms	51	Construction Activities	Class 2 Landfill and Vicinity	Aquatic Organism Exposure to Noise (Class 2 Landfill and Vicinity)	E15 Minimal - operations will not occur near stream or riparian areas.	E15 Minimal - landfill material operations will not occur in stream or riparian areas. Crushing activities will be noisier than other activities for Alternative 1 or 3.	D17 Minimal - landfill material operations will not occur in stream or riparian areas. Breaking activities will be noisier than other activities for Alternative 1.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	25	20	20		20						
		Aquatic Organisms	52	Construction Activities	Class 2 Landfill and Vicinity	Aquatic Organism Exposure to Landfill Material (Class 2 Landfill and Vicinity)	E16, E17 Minimal - landfill material will not be disturbed or exposed by placement of a new cover.	E16, E17 Minimal - landfill material operations will not occur in stream or riparian areas.	D18, D19 Minimal - landfill material operations will not occur in stream or riparian areas.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	25	25	25		25						
		Aquatic Organisms	53	Transportation	Transportation Route	Aquatic Organism Exposure to Construction Dust (Transportation Route)	No off-site transportation	No off-site transportation	NA - off-site transportation is scored under Alternative 3b	G20 Minimal - significantly increased traffic will occur, potential lead/metal-bearing dust could be generated. Effects would be remote from aquatic and riparian areas.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		20	20						
		Aquatic Organisms	54	Transportation	Transportation Route	Aquatic Organism Exposure to Increased Traffic (Transportation Route)	No off-site transportation	No off-site transportation	NA - off-site transportation is scored under Alternative 3b	G21 Minor - significantly increased traffic will occur, remote from aquatic and riparian areas.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		15	15						
		Aquatic Organisms	55	Transportation	Transportation Route	Aquatic Organism Effects from Accidental Spill (Transportation Route)	No off-site transportation	No off-site transportation	NA - off-site transportation is scored under Alternative 3b	G22, G23 Minor - approximately 15,500 truck loads will haul the landfill material 250 miles to the off-site TSD facility, with the attendant the risk of spillage or accidents.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		16	16						
		Aquatic Organisms	56	Construction Activities	Off-Site TSD Facility Only	Aquatic Organism Exposure to Construction Dust (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	L24 Minor - the crushing facility is remote from riparian areas, however crushing operations could increase potential dispersion of potential lead/metal-bearing dust to aquatic and riparian areas. This could be controlled but not eliminated with dust suppression methods.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		16	16						
		Aquatic Organisms	57	Construction Activities	Off-Site TSD Facility Only	Aquatic Organism Exposure to Increased Truck Traffic (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	L25 Minor - very high volume of truck traffic into and out of the permitted facility to deliver material. However the traffic would be remote from riparian areas.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		20	20						
		Aquatic Organisms	58	Construction Activities	Off-Site TSD Facility Only	Aquatic Organism Exposure to Noise (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	L27 Minimal - the crushing facility is remote from riparian areas.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		20	20						
		Aquatic Organisms	59	Construction Activities	Off-Site TSD Facility Only	Aquatic Organism Exposure to Landfill Material (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	L28, L29 Minimal - landfill material operations will not occur in stream or riparian areas.	Probability minimized 1 High probability 25 Low probability	*25*	*25*		25	25						
	Environmental Effects	Environmental Effects	60	Environmental	NA	Energy Consumption	Minimal - miniml energy consumption, mostly due to construction and import of materials to the site over a 3 to 4 month period.	Medium - medium energy consumption associated with excavation and treatment activities over an approximate 2.5-year period.	Critically high - extremely high energy consumption, because a total of 7,750,000 miles of truck travel would be required to and from the off-site TSD facility over a 1.5- to 3-year period.	NA - overall energy consumption is scored under Alternative 3a	Energy consumption minimized 1 Very high energy consumption 25 Very low energy consumption	20	12		5	5	**20.0**	**12.0**	**5.0**			
		Environmental Effects	61	Environmental	NA	Non-Dust Air Emissions	Minimal - air emissions mostly due to construction and import of materials to the site over a 3 to 4 month period.	Medium - air emissions would be associated with excavation and treatment activities over an approximate 2.5-year period.	Critically high - extremely high vehicle emissions from excavation activities and a total of 7,750,000 miles of truck travel to and from the off-site TSD facility over a 1.5- to 3-year period.	NA - overall air emissions are scored under Alternative 3a	Air emissions minimized 1 Very high air emissions 25 Very low air emissions	20	12		5	5						
Implementability	Technical feasibility	NA	62	NA	NA	Technical Feasibility - Material Handling	Very high feasibility - the required equipment, personnel, and materials are readily available for cover construction activities. It is a proven technology.	High feasibility - the required equipment, personnel, and materials are readily available for cover construction activities. Slag treatment is a proven technology. Need to develop a protocol for treatment, testing, and placement of materials in the landfill, based on past analytical issues, and gain agency acceptance.	High feasibility - technically feasible, although the best methods for excavating, handling the waste will need to be determined.	NA - overall technical feasibility for material handling is scored under Alternative 3a	Technical feasibility 1 Very low feasibility 25 Very high feasibility	25	16	16		16	**25.0**	**11.0**	**14.0**	**17.8**	**12.5**	**16.6**

Table 1: Risk Evaluation of Remedial Alternatives

Criteria	Subgroup	Receptors	Indicator Number	Means of Potential Exposure	Location	Indicator Names	Alternative 1: Closure In Place (with cell reference from CSM Figure 5)	Alternative 2: Ex Situ On-Site Re-Treatment (with cell reference from CSM Figure 6)	Alternative 3a: Excavation and Off-Site Re-Treatment and Disposal): FRC Facility and Vicinity Only (with cell reference from CSM Figure 7)	Alternative 3b: Excavation and Off-Site Re-Treatment and Disposal: Off-Site TSD Facility and Vicinity Only (with cell reference from CSM Figure 7)	Scoring Criteria	Indicator Scores					Subgroup Scores			Criteria Scores		
												1	2	3a On-Site	3b Off-Site	3	1	2	3	1	2	3
Implementability	Technical feasibility	NA	63	NA	NA	Technical Feasibility - Air Quality	High feasibility - Construction dust would be from clean materials. Lead/metal-bearing materials would not be disturbed.	Low feasibility - On-site crushing and loading operations will generate lead/metal-bearing dust. Implementation must account for the lead NAAQS attainment demonstration status and timeline. Perimeter air monitoring with very low action levels may increase the duration of the remediation process.	Medium Feasibility - On-site breaking and loading operations will generate lead/metal-bearing dust, but at lower levels than Alternative 2 (materials will be broken rather than crushed to finer particles). Implementation must account for the lead NAAQS attainment demonstreation status and timeline. Perimeter air monitoring with low action levels may increase the duration of the remediation process.	NA - overall technical feasibility for air quality is scored under Alternative 3a	Technical feasibility 1 Very low feasibility 25 Very high feasibility	25	6	12		12	**25.0**	**11.0**	**14.0**	**17.8**	**12.5**	**16.6**
	Administrative Feasibility	NA	64	NA	NA	Regulatory Compliance	High feasibility - the work involves conventional on-site construction. TCEQ waste program approval would be required for this alternative. The data on the extent of material above the hazardous waste criteria and UTS, inherent low mobility of lead and other metals in the slag, and prior treatment provide support for regulatory and community acceptance.	Medium feasibility - TCEQ waste program approval would be required for this alternative. Increased effort may be needed to achieve regulatory and community acceptance due to the potential for significant off-site impacts (lead/metal-bearing dust and noise).	Medium Feasibility - TCEQ waste program approval would be required for this alternative. Increased effort may be required to achieve regulatory and community acceptance due to the potential for significant off-site impacts (lead/metal-bearing dust, noise, and truck traffic) at the Class 2 landfill, along the transportation route, and at the off-site TSD facility.	NA - overall regulatory compliance is scored under Alternative 3a	Administrative feasibility 1 Very low feasibility 25 Very high feasibility	16	12	12		12	**15.3**	**13.0**	**17.5**			
		NA	65	NA	NA	Air Monitoring Requirements	High feasibility - the work involves construction capping with clean materials. Lead/metal-bearing materials would not be disturbed.	Low feasibility - on-site crushing and loading operations will generate lead/metal-bearing dust, resulting in regulatory scrutiny toward the requirement to attain and maintain the lead NAAQS. The duration of the project could implicate air permitting authorization for certain equipment, which may be complicated by the lead NAAQS nonattainment status of the area.	Medium Feasibility - On-site breaking and loading operations will generate lead/metal-bearing dust, resulting in regulatory scrutiny toward the requirement to attain and maintain the lead NAAQS.	NA - overall air monitoring requirements are scored under Alternative 3a	Administrative feasibility 1 Very low feasibility 25 Very high feasibility	20	6	12		12						
		NA	66	NA	NA	Land or Water Use Restrictions	High potential - land use and groundwater restrictions are in progress. Long-term groundwater monitoring will be needed.	High potential - land use and groundwater restrictions are in progress. Long-term groundwater monitoring will be needed.	NA - all landfill material will be removed under this alternative. Landuse and groundwater restrictions are in progress, tough not required in relation to the Class 2 landfill. Long-term groundwater monitoring related to the removed landfill, if any, would be limited and therefore are not assumed.	Very high potential - the off-site TSD facility is already in compliance with regulatory requirements. Disposal requirements will need to be met.	Potential for minimization of additional land or water use restrictions 1 Very low potential 25 Very high potential	16	16		20	20						
	Administrative Feasibility	NA	67	NA	NA	Local Business Effects	Medium potential - some increased local business in response to the need for construction materials and equipment.	High potential - there is potential for increased local business in response to the need for construction materials and equipment. More intensive site operations (associated with crushing, excavation, loading, and retreatment) and a longer construction period (estimated to be 2.5 years) may provide additional opportunities for local businesses.	High potential - There is potential for increased local business in response to the need for construction materials and equipment. More intensive site operations (associated with breakage, excavation, loading, and hauling) and a long construction period (estimated to be 1.5- to 3-years) may provide additional opportunities for local businesses.	NA - overall local business effects are scored under Alternative 3a	Potential for increased business 1 Very low potential 25 Very high potential	12	16	16		16	**15.3**	**13.0**	**17.5**			
		NA	68	NA	NA	Visual Aesthetics	Medium potential - the landfill cover will result in a vegetated mound.	Medium potential - the addition of treatment reagent will result in a vegetated mound.	Very high potential - excavation of all landfill material and recovering to a well drained area will not adversely affect visual aesthetics.	NA - overall visual aesthetics are scored under Alternative 3a	Potential for impacts to visual aesthetics 1 Very high potential 25 Very low potential	12	12	20		20						
		NA	69	NA	NA	Surrounding Property Values	Low potential - previous plant operations that resulted in emissions did not result in negative effects on land values around the plant, as witnessed by significant high-end development of homes, schools and public buildings in the surrounding area.	Low potential - previous plant operations that resulted in emissions did not result in negative effects on land values around the plant, as witnessed by significant high-end development of homes, schools and public buildings in the surrounding area.	Very low potential - All landfill material will be excavated, and the area will be recovered to a well-drained revegetated area, which will have minimal effects on property values. The off-site TSD facility that would currently accept the material is already in place in a semi-industrial area, is in operation, and surrounding property values will be little effected by disposal of additional materials.	NA - overall surrounding property values are scored under Alternative 3a	Potential impacts to property values 1 Very high potential 25 Very low potential	16	16		25	25						
Cost	Cost	NA	70	NA	NA	Cost	Relatively low costs - approximately less than $2 million.	Relatively high costs - greater than $30 million, approximately an order of magnitude greater than Alternative 1.	Very high costs - approximately $80 million, more than two times greater than Alternative 2.	NA - overall costs are scored under Alternative 3a only	Estimated economy of project 1 Very high project costs 25 Very low project costs	25	8	3		3	**25.0**	**8.0**	**3.0**	**25.0**	**8.0**	**3.0**

Notes:

A1, A2	Cell reference numbers - providing cross reference to risk values in Figures 5, 6, and 7
25 (italicized)	Not applicable for this alternative, optimal score of 25 assigned to represent no negative impacts.
CSM	Conceptual site model
NA	Not applicable
NAAQS	National Ambient Air Quality Standards
TCEQ	Texas Commission on Environmental Quality
TSD facility	Treatment, storage, and disposal facility
UTS	Universal Treatment Standards

Risk Analysis Matrix

Risk Rating	**Score**
Minimal Risk	19.6 - 25.0
Minor Risk	14.6 - 19.5
Medium Risk	7.6 - 14.5
Major Risk	3.6 - 7.5
Critical Risk	0.0 - 3.5

Implementability Matrix

Feasibility or Potential	**Score**
Very High	19.6 - 25.0
High	14.6 - 19.5
Medium	7.6 - 14.5
Low	3.6 - 7.5
Very Low or Negligible	0.0 - 3.5

FIGURES

REFERENCE

1. SITE FEATURES - GOLDER, 2014
2. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

CLIENT
EXIDE TECHNOLOGIES

PROJECT
LANDFILL EVALUATION REPORT

TITLE
SITE LOCATION

CONSULTANT
Golder Associates

YYYY-MM-DD	2014-08-22
PREPARED	JWT
DESIGN	DGC
REVIEW	DGC
APPROVED	FSS

PROJECT No.	CONTROL	Rev.	FIGURE
13-02086	1302086G001.mxd	0	1

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1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI B

LEGEND

🟥 Approximate Class 2 Landfill Extent

▭ Exide Site

▭ Undeveloped Buffer Property

NOTES

1. THE CELL LAYOUT IS APPROXIMATE AND IS FOR CONCEPTUAL PURPOSES ONLY.

REFERENCE

1. SITE FEATURES - GOLDER, 2014
2. LANDFILL CELLS - TITAN ENGINEERING, INC. 2000. INTERIM/FINAL COVER CONCEPTUAL MODEL; LANDFILL LAYOUT DRAWINGS. PROVIDED TO EXIDE TECHNOLOGIES, PROJECT NUMBER 13-04 ON NOVEMBER 21, 2000.
3. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

100 50 0 100
Feet

CLIENT
EXIDE TECHNOLOGIES

PROJECT
LANDFILL EVALUATION REPORT

TITLE
LAYOUT OF LANDFILL CELLS

CONSULTANT

Golder Associates

YYYY-MM-DD 2014-08-22
PREPARED JWT
DESIGN DGC
REVIEW DGC
APPROVED FSS

PROJECT No. 13-02086
CONTROL 1302086G002.mxd
Rev. 0
FIGURE **2**

1 in
0
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI B

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LEGEND

✚	Soil Sample Location
🟥	Approximate Class 2 Landfill Extent
▭	Exide Site
▭	Undeveloped Buffer Property

LMW-9 **<0.002900**	Location Code Lead Result (mg/L)

REFERENCE

1. SITE FEATURES - GOLDER, 2014
2. AERIAL IMAGERY - SOURCE: ESRI, DIGITALGLOBE, GEOEYE, I-CUBED, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEX, GETMAPPING, AEROGRID, IGN, IGP, SWISSTOPO, AND THE GIS USER COMMUNITY

100 50 0 100
Feet

CLIENT
EXIDE TECHNOLOGIES

PROJECT
LANDFILL EVALUATION REPORT

TITLE
SOIL SAMPLE LOCATIONS NEAR THE CLASS II LANDFILL

CONSULTANT
Golder Associates

YYYY-MM-DD	2014-08-22
PREPARED	JWT
DESIGN	DGC
REVIEW	DGC
APPROVED	FSS

PROJECT No.	CONTROL	Rev.	FIGURE
13-02086	1302086G005.mxd	0	**3**

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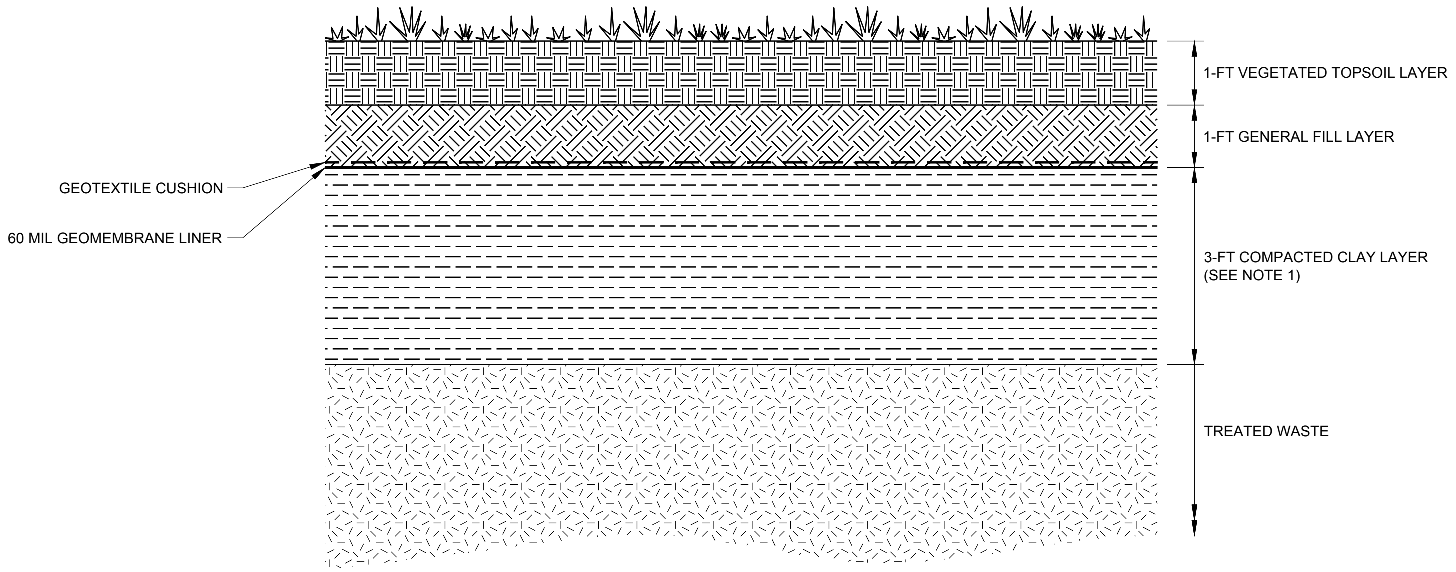
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ANSI B

1 in
0

NOTES

1. ALTERNATIVELY, THE 3-FT COMPACTED CLAY LAYER COULD BE REPLACED WITH A 1-FT COMPACTED CLAY LAYER, OVERLAIN BY A GEOSYNTHETIC CLAY LINER (GCL).



REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW

PROJECT

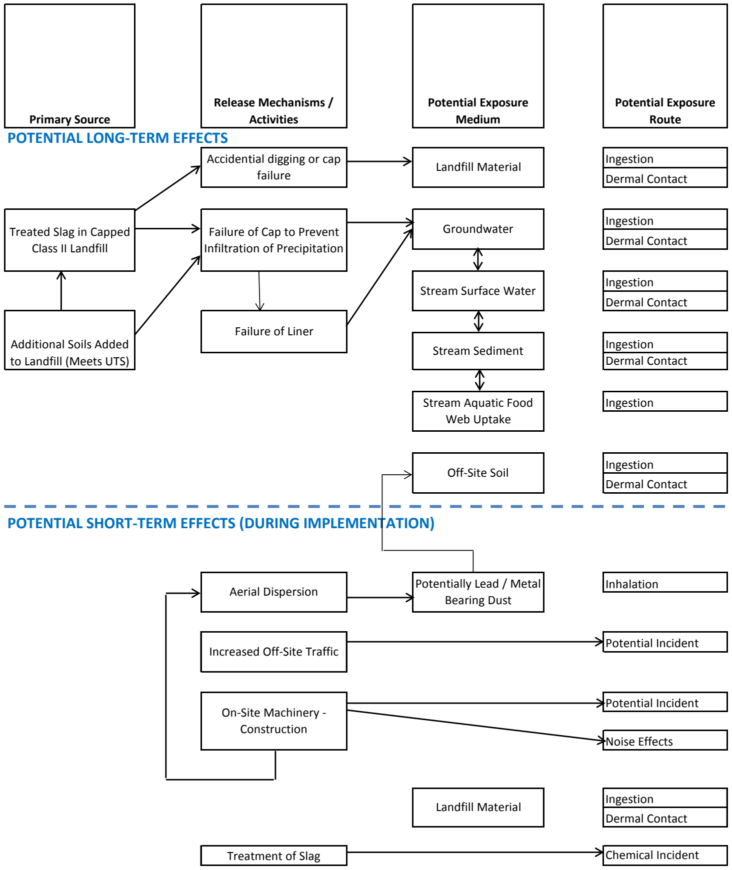
EXIDE TECHNOLOGIES
LANDFILL EVALUATION REPORT

TITLE

FINAL COVER CROSS SECTION FOR ALTERNATIVES 1 AND 2

Golder Associates

PROJECT No.		130-02086.1012	FILE No.	130-2086.1012_Final Cover Cross Section
DESIGN	VMR	2014-05-15	SCALE	NTS
CADD	ACF	2014-08-22	FIGURE	
CHECK	FSS	2014-05-15		4
REVIEW	DC	2014-05-15		



Potential Exposure Medium	Potential Exposure Route	Likelihood					Consequence						CSM Risk Values				
							A	B	C	D	E		A	B	C	D	E
		Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms	Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms	Cell Reference	Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms
POTENTIAL LONG-TERM EFFECTS																	
Landfill Material	Ingestion	5	NA	4	4	5	4	NA	4	4	4	1	20	NA	16	16	20
	Dermal Contact	5	NA	4	4	5	4	NA	5	4	5	2	20	NA	20	16	25
Groundwater	Ingestion	4	NA	5	5	5	4	NA	4	4	4	3	16	NA	20	20	20
	Dermal Contact	4	NA	5	5	5	5	NA	5	5	5	4	20	NA	25	25	25
Stream Surface Water	Ingestion	4	NA	5	4	5	4	NA	4	4	3	5	16	NA	20	16	15
	Dermal Contact	4	NA	5	4	5	5	NA	5	5	5	6	20	NA	25	20	25
Stream Sediment	Ingestion	4	NA	5	4	5	4	NA	4	4	3	7	16	NA	20	16	15
	Dermal Contact	4	NA	5	4	5	5	NA	5	5	5	8	20	NA	25	20	25
Stream Aquatic Food Web Uptake	Ingestion	NA	NA	NA	4	5	NA	NA	NA	4	3	9	NA	NA	NA	16	15
Off-Site Soil	Ingestion	5	NA	NA	5	5	5	NA	NA	5	5	10	25	NA	NA	25	25
	Dermal Contact	5	NA	NA	5	5	5	NA	NA	5	5	11	25	NA	NA	25	25
POTENTIAL SHORT-TERM EFFECTS (DURING IMPLEMENTATION)																	
Potentially Lead / Metal Bearing Dust	Inhalation	5	4	NA	5	5	5	5	NA	5	5	12	25	20	NA	25	25
	Potential Incident	5	NA	NA	5	5	3	NA	NA	3	4	13	15	NA	NA	15	20
	Potential Incident	NA	4	NA	NA	NA	NA	4	NA	NA	NA	14	NA	16	NA	NA	NA
	Noise Effects	5	4	NA	4	5	4	4	NA	4	5	15	20	16	NA	16	25
Landfill Material	Ingestion	NA	5	NA	5	5	NA	4	NA	4	5	16	NA	20	NA	20	25
	Dermal Contact	NA	5	NA	5	5	NA	4	NA	4	5	17	NA	20	NA	20	25
	Chemical Incident	NA	5	NA	NA	NA	NA	5	NA	NA	NA	18	NA	25	NA	NA	NA

Risk Analysis Matrix

Likelihood	Score	Consequence				
		Minimal	Minor	Medium	Major	Critical
		5	4	3	2	1
Rare	5	25	20	15	10	5
Unlikely	4	20	16	12	8	4
Possible	3	15	12	9	6	3
Likely	2	10	8	6	4	2
Almost Certain	1	5	4	3	2	1

Risk Rating

Risk Rating	Risk Score
Minimal Risk	19.6 - 25.0
Minor Risk	14.6 - 19.5
Medium Risk	7.6 - 14.5
Major Risk	3.6 - 7.5
Critical Risk	0.0 - 3.5

Potential exposures or hazards potentially are related to remedial activites at the Class 2 landfill

L = Long Term
S = Short Term

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CONCEPTUAL SITE MODEL FOR THE CLASS II LANDFILL: ALTERNATIVE 1 - CLOSE IN PLACE

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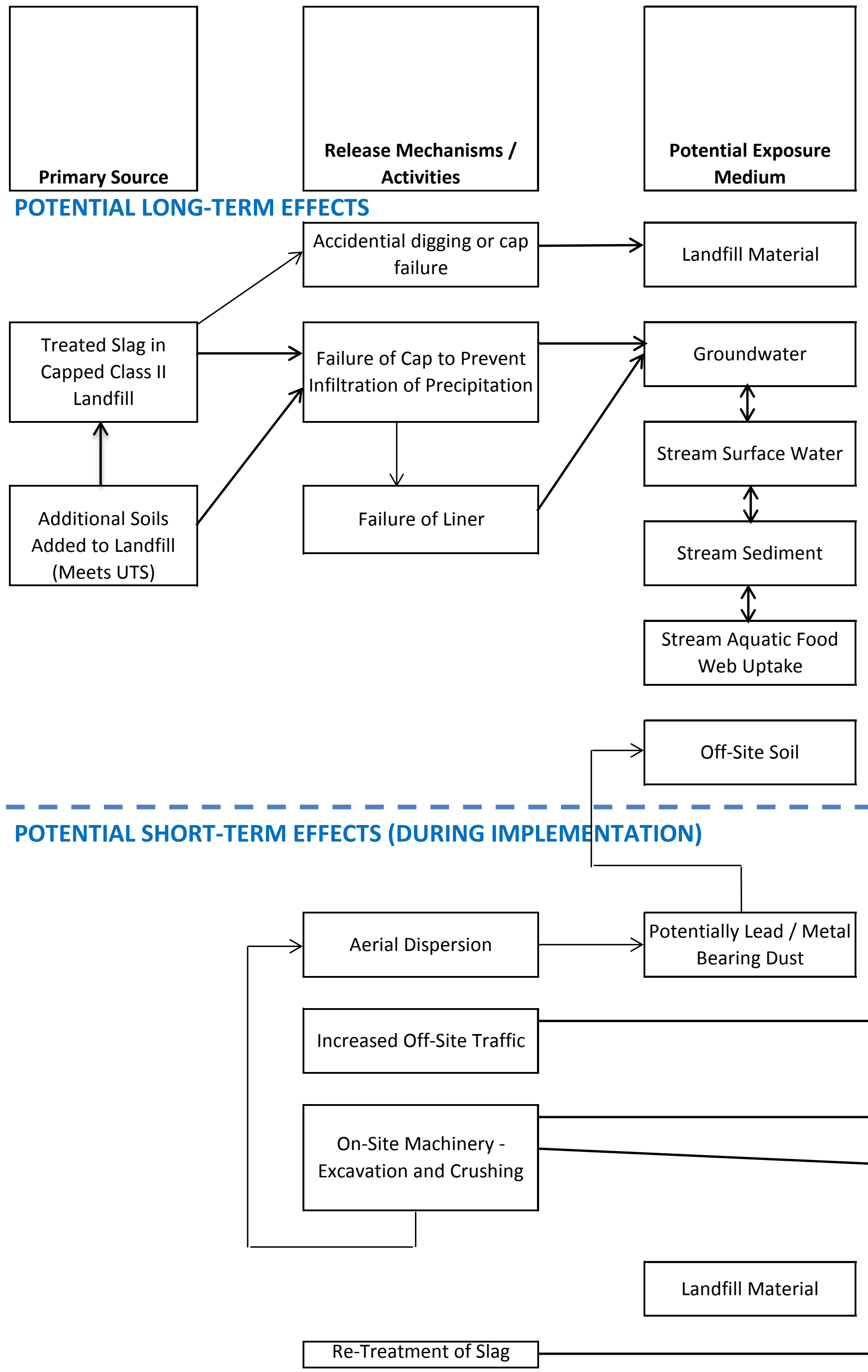
FIGURE
5



POTENTIAL LONG-TERM EFFECTS

Potential Exposure Medium	Potential Exposure Route	Likelihood					Consequence					CSM Risk Values					
													A	B	C	D	E
		Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms	Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms	Cell Reference	Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms
Landfill Material	Ingestion	5	NA	4	5	5	4	NA	5	4	4	1	20	NA	20	20	20
	Dermal Contact	5	NA	4	5	5	4	NA	5	4	5	2	20	NA	20	20	25
Groundwater	Ingestion	5	NA	5	5	5	4	NA	4	4	4	3	20	NA	20	20	20
	Dermal Contact	5	NA	5	5	5	5	NA	5	5	5	4	25	NA	25	25	25
Stream Surface Water	Ingestion	5	NA	5	5	5	4	NA	4	4	3	5	20	NA	20	20	15
	Dermal Contact	5	NA	5	5	5	5	NA	5	5	5	6	25	NA	25	25	25
Stream Sediment	Ingestion	5	NA	5	5	5	4	NA	4	4	3	7	20	NA	20	20	15
	Dermal Contact	5	NA	5	5	5	5	NA	5	5	5	8	25	NA	25	25	25
Stream Aquatic Food Web Uptake	Ingestion	NA	NA	NA	5	5	NA	NA	NA	4	3	9	NA	NA	NA	20	15
Off-Site Soil	Ingestion	3	NA	NA	4	4	4	NA	NA	4	4	10	12	NA	NA	16	16
	Dermal Contact	3	NA	NA	4	4	5	NA	NA	4	5	11	15	NA	NA	16	20

POTENTIAL SHORT-TERM EFFECTS (DURING IMPLEMENTATION)

Potential Exposure Medium	Potential Exposure Route	Likelihood					Consequence					CSM Risk Values					
													A	B	C	D	E
		Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms	Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms	Cell Reference	Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms
Potentially Lead / Metal Bearing Dust	Inhalation	3	2	NA	3	4	4	3	NA	4	4	12	12	6	NA	12	16
	Potential Incident	4	NA	NA	4	5	3	NA	NA	3	4	13	12	NA	NA	12	20
	Potential Incident	NA	3	NA	NA	NA	NA	2	NA	NA	NA	14	NA	6	NA	NA	NA
	Noise Effects	3	2	NA	3	4	3	2	NA	3	5	15	9	4	NA	9	20
Landfill Material	Ingestion	NA	3	NA	3	5	NA	4	NA	4	5	16	NA	12	NA	12	25
	Dermal Effects	NA	3	NA	3	5	NA	4	NA	4	5	17	NA	12	NA	12	25
	Chemical Incident	NA	3	NA	NA	NA	NA	3	NA	NA	NA	18	NA	9	NA	NA	NA

Potential exposures or hazards potentially are related to remedial activites at the Class 2 landfill

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CONCEPTUAL SITE MODEL FOR THE CLASS II LANDFILL: ALTERNATIVE 2 - EX SITU ON-SITE TREATMENT

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FIGURE 6

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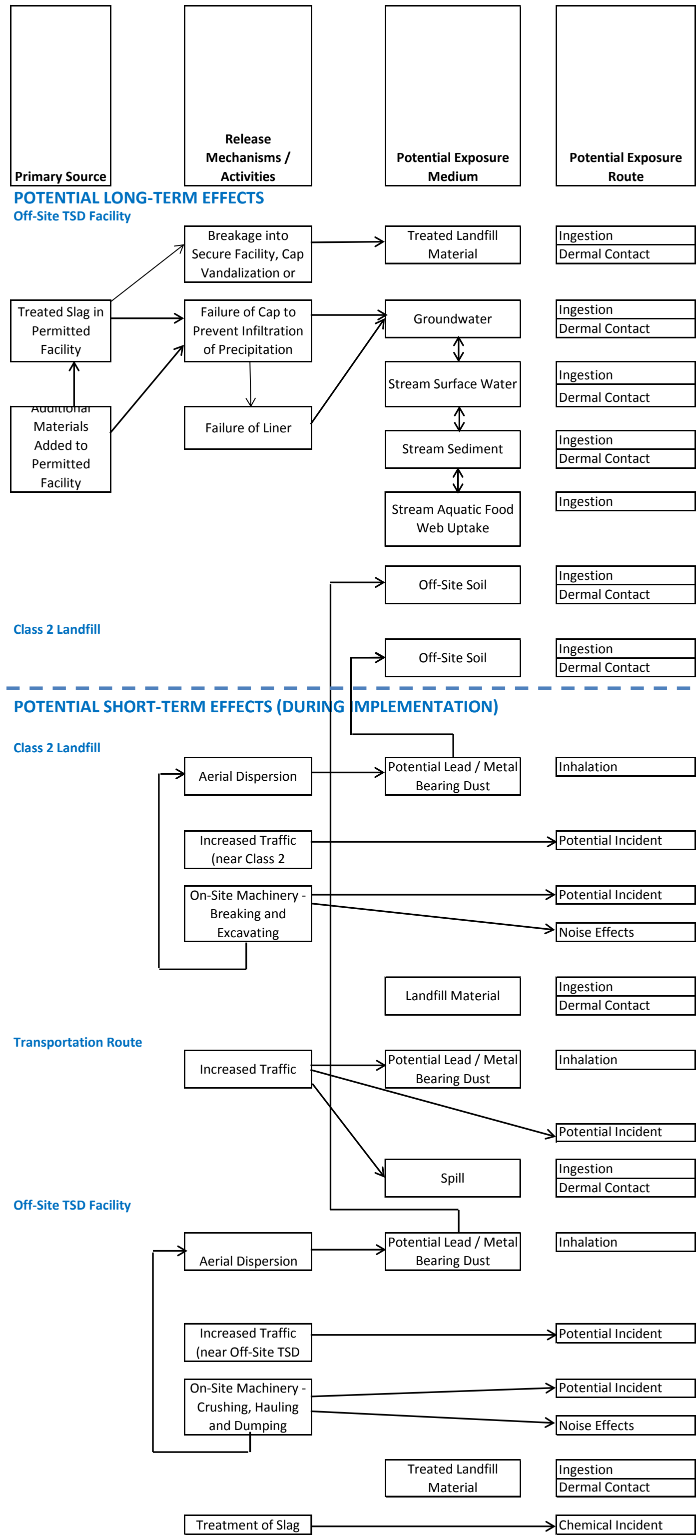

Likelihood

Potential Exposure Route	Class 2 Landfill and Vicinity				Transportation Route			Off-Site TSD Facility				
	Off-Site Residents	Remediation Workers	Terrestrial Organisms	Aquatic/Riparian Organisms	Off-Site Residents	Terrestrial Organisms	Aquatic/Riparian Organisms	Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms
Ingestion	NA	NA	NA	NA	NA	NA	NA	5	NA	5	5	5
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	5	NA	5	5	5
Ingestion	NA	NA	NA	NA	NA	NA	NA	5	NA	5	5	5
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	5	NA	5	5	5
Ingestion	NA	NA	NA	NA	NA	NA	NA	5	NA	5	5	5
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	5	NA	5	5	5
Ingestion	NA	NA	NA	NA	NA	NA	NA	5	NA	5	5	5
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	5	NA	5	5	5
Ingestion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5	5
Ingestion	NA	NA	NA	NA	NA	NA	NA	5	NA	NA	5	5
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	5	NA	NA	5	5
Ingestion	4	NA	4	4	NA	NA	NA	NA	NA	NA	NA	NA
Dermal Contact	4	NA	4	4	NA	NA	NA	NA	NA	NA	NA	NA
Inhalation	3	3	3	4	NA	NA	NA	NA	NA	NA	NA	NA
Potential Incident	3	NA	3	5	NA	NA	NA	NA	NA	NA	NA	NA
Potential Incident	NA	3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Noise Effects	4	3	3	4	NA	NA	NA	NA	NA	NA	NA	NA
Ingestion	NA	3	4	5	NA	NA	NA	NA	NA	NA	NA	NA
Dermal Contact	NA	3	4	5	NA	NA	NA	NA	NA	NA	NA	NA
Inhalation	NA	NA	NA	NA	4	4	4	NA	NA	NA	NA	NA
Potential Incident	NA	NA	NA	NA	4	4	5	NA	NA	NA	NA	NA
Ingestion	NA	NA	NA	NA	4	4	4	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	4	4	4	NA	NA	NA	NA	NA
Inhalation	NA	NA	NA	NA	NA	NA	NA	5	4	NA	4	4
Potential Incident	NA	NA	NA	NA	NA	NA	NA	5	NA	NA	5	5
Potential Incident	NA	NA	NA	NA	NA	NA	NA	NA	4	NA	NA	NA
Noise Effects	NA	NA	NA	NA	NA	NA	NA	5	3	NA	4	4
Ingestion	NA	NA	NA	NA	NA	NA	NA	NA	4	NA	4	5
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	NA	4	NA	4	5
Chemical Incident	NA	NA	NA	NA	NA	NA	NA	NA	4	NA	NA	NA

Consequence

Potential Exposure Route	Class 2 Landfill and Vicinity				Transportation Route			Off-Site TSD Facility				
	Off-Site Residents	Remediation Workers	Terrestrial Organisms	Aquatic/Riparian Organisms	Off-Site Residents	Terrestrial Organisms	Aquatic/Riparian Organisms	Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms
Ingestion	NA	NA	NA	NA	NA	NA	NA	5	NA	5	4	4
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	5	NA	5	4	5
Ingestion	NA	NA	NA	NA	NA	NA	NA	5	NA	4	4	4
Dermal Contact	NA		NA	NA	NA	NA	NA	5	NA	5	5	5
Ingestion	NA	NA	NA	NA	NA	NA	NA	5	NA	4	4	4
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	5	NA	5	5	5
Ingestion	NA	NA	NA	NA	NA	NA	NA	5	NA	4	4	4
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	5	NA	5	5	5
Ingestion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4	4
Ingestion	NA	NA	NA	NA	NA	NA	NA	5	NA	NA	4	4
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	5	NA	NA	4	5
Ingestion	4	NA	4	4	NA	NA	NA	NA	NA	NA	NA	NA
Dermal Contact	5	NA	4	5	NA	NA	NA	NA	NA	NA	NA	NA
Inhalation	4	3	4	4	NA	NA	NA	NA	NA	NA	NA	NA
Potential Incident	2	NA	3	4	NA	NA	NA	NA	NA	NA	NA	NA
Potential Incident	NA	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Noise Effects	3	2	3	5	NA	NA	NA	NA	NA	NA	NA	NA
Ingestion	NA	4	4	5	NA	NA	NA	NA	NA	NA	NA	NA
Dermal Contact	NA	4	4	5	NA	NA	NA	NA	NA	NA	NA	NA
Inhalation	NA	NA	NA	NA	4	4	5	NA	NA	NA	NA	NA
Potential Incident	NA	NA	NA	NA	2	2	3	NA	NA	NA	NA	NA
Ingestion	NA	NA	NA	NA	4	4	4	NA	NA	NA	NA	NA
Dermal Contact	NA	NA	NA	NA	4	4	4	NA	NA	NA	NA	NA
Inhalation	NA	NA	NA	NA	NA	NA	NA	5	3	NA	4	4
Potential Incident	NA	NA	NA	NA	NA	NA	NA	4	NA	NA	3	4
Potential Incident	NA	NA	NA	NA	NA	NA	NA	NA	3	NA	NA	NA
Noise Effects	NA	NA	NA	NA	NA	NA	NA	5	3	NA	4	5
Ingestion	NA	NA	NA	NA	NA	NA	NA	NA	4	NA	4	5
Dermal Contact	NA	NA	NA	NA	NA	NA	NA	NA	4	NA	4	5
Chemical Incident	NA	NA	NA	NA	NA	NA	NA	NA	4	NA	NA	NA

CSM Risk Values

	A	B	C	D	E	F	G	H	I	J	K	L
	Class 2 Landfill and Vicinity				Transportation Route			Off-Site TSD Facility				
Cell Reference	Off-Site Residents	Remediation Workers	Terrestrial Organisms	Aquatic/Riparian Organisms	Off-Site Residents	Terrestrial Organisms	Aquatic/Riparian Organisms	Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms
1	NA	NA	NA	NA	NA	NA	NA	25	NA	25	20	20
2	NA	NA	NA	NA	NA	NA	NA	25	NA	25	20	25
3	NA	NA	NA	NA	NA	NA	NA	25	NA	20	20	20
4	NA	NA	NA	NA	NA	NA	NA	25	NA	25	25	25
5	NA	NA	NA	NA	NA	NA	NA	25	NA	20	20	20
6	NA	NA	NA	NA	NA	NA	NA	25	NA	25	25	25
7	NA	NA	NA	NA	NA	NA	NA	25	NA	20	20	20
8	NA	NA	NA	NA	NA	NA	NA	25	NA	25	25	25
9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	20	20
10	NA	NA	NA	NA	NA	NA	NA	25	NA	NA	20	20
11	NA	NA	NA	NA	NA	NA	NA	25	NA	NA	20	25
12	16	NA	16	16	NA	NA	NA	NA	NA	NA	NA	NA
13	20	NA	16	20	NA	NA	NA	NA	NA	NA	NA	NA
14	12	9	12	16	NA	NA	NA	NA	NA	NA	NA	NA
15	6	NA	9	20	NA	NA	NA	NA	NA	NA	NA	NA
16	NA	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
17	12	6	9	20	NA	NA	NA	NA	NA	NA	NA	NA
18	NA	12	16	25	NA	NA	NA	NA	NA	NA	NA	NA
19	NA	12	16	25	NA	NA	NA	NA	NA	NA	NA	NA
20	NA	NA	NA	NA	16	16	20	NA	NA	NA	NA	NA
21	NA	NA	NA	NA	8	8	15	NA	NA	NA	NA	NA
22	NA	NA	NA	NA	16	16	16	NA	NA	NA	NA	NA
23	NA	NA	NA	NA	16	16	16	NA	NA	NA	NA	NA
24	NA	NA	NA	NA	NA	NA	NA	25	12	NA	16	16
25	NA	NA	NA	NA	NA	NA	NA	20	NA	NA	15	20
26	NA	NA	NA	NA	NA	NA	NA	NA	12	NA	NA	NA
27	NA	NA	NA	NA	NA	NA	NA	25	9	NA	16	20
28	NA	NA	NA	NA	NA	NA	NA	NA	16	NA	16	25
29	NA	NA	NA	NA	NA	NA	NA	NA	16	NA	16	25
30	NA	NA	NA	NA	NA	NA	NA	NA	16	NA	NA	NA

Potential exposures or hazards are assigned to the locations where they have the potential to occur
Class 2 Landfill - Landfill and vicinity where landfill material currently is located
Transportation Route - the route between the Class 2 Landfill and the TSD along which landfill material would be hauled
TSD (Treatment. Storage, and Disposal) Facility - Off-site permitted facility where the landfill material from the Class 2 landfill would be transported for treatment and disposal

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CONCEPTUAL SITE MODEL FOR THE CLASS II LANDFILL: ALTERNATIVE 3 - EXCAVATE AND HAUL

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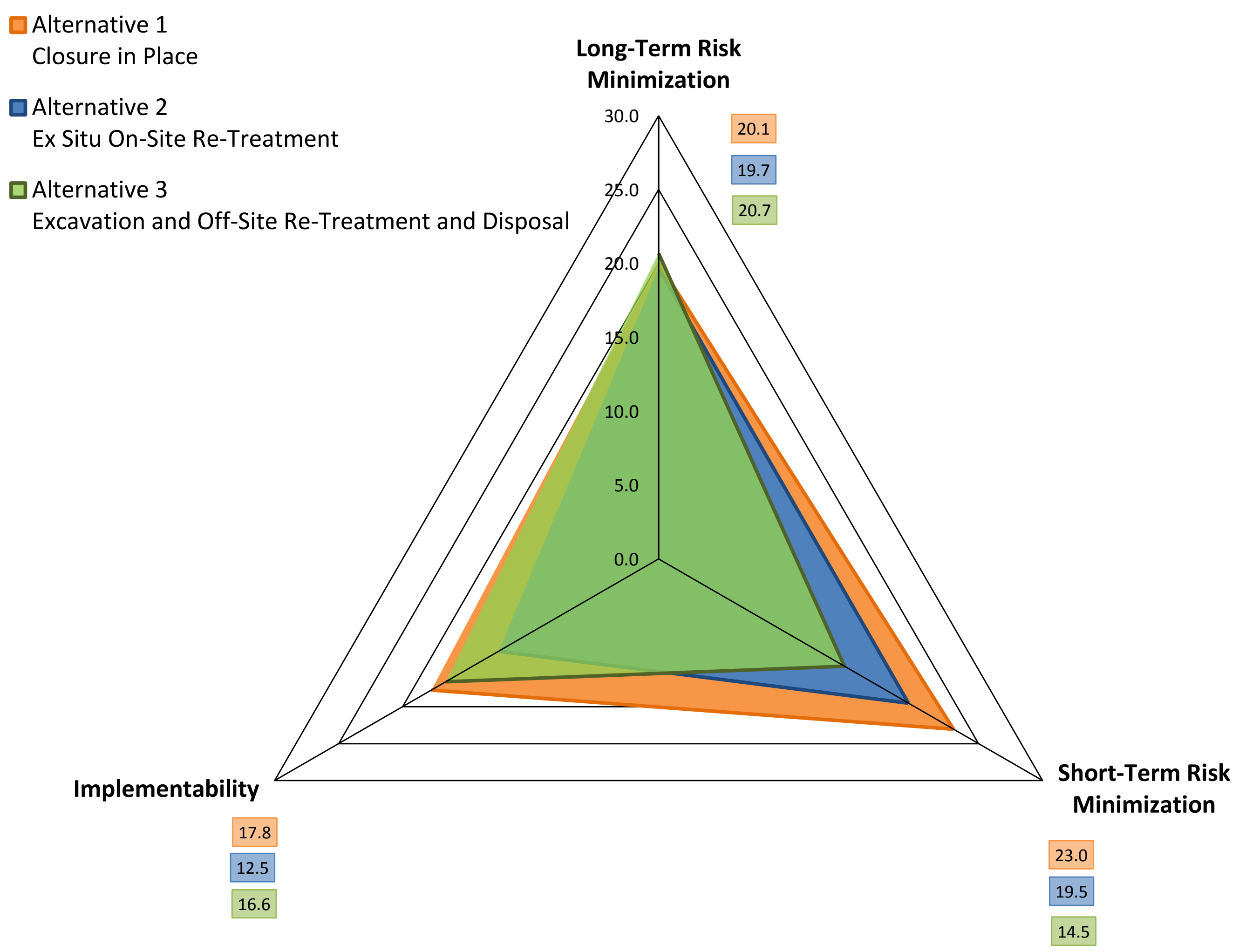
FIGURE
7

Diamond Chart of Weighted Average Scores for the Three Remedial Alternatives



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DIAMOND CHART OF WEIGHTED AVERAGE SCORES FOR THE THREE REMEDIAL ALTERNATIVES

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FIGURE
8

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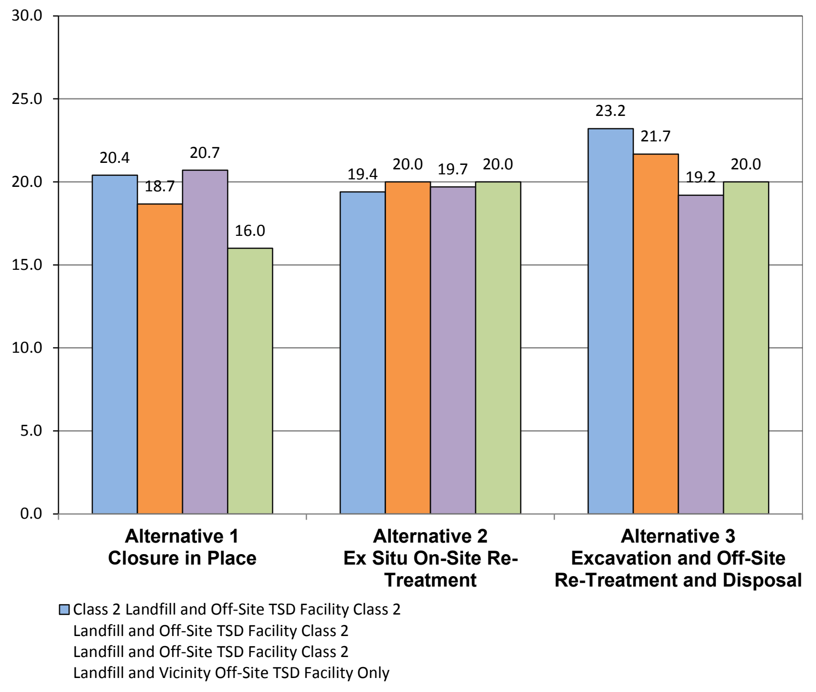
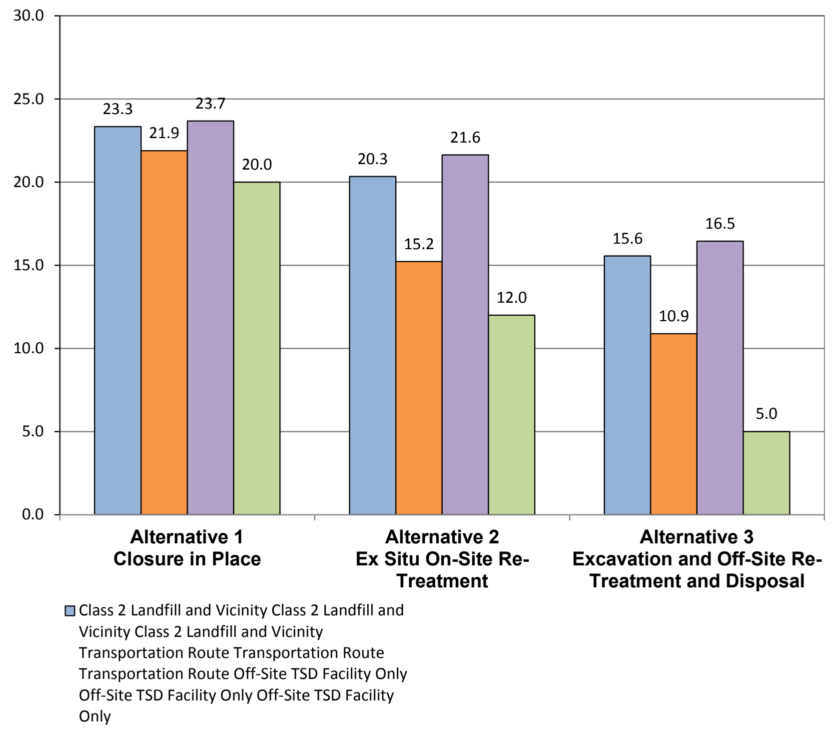
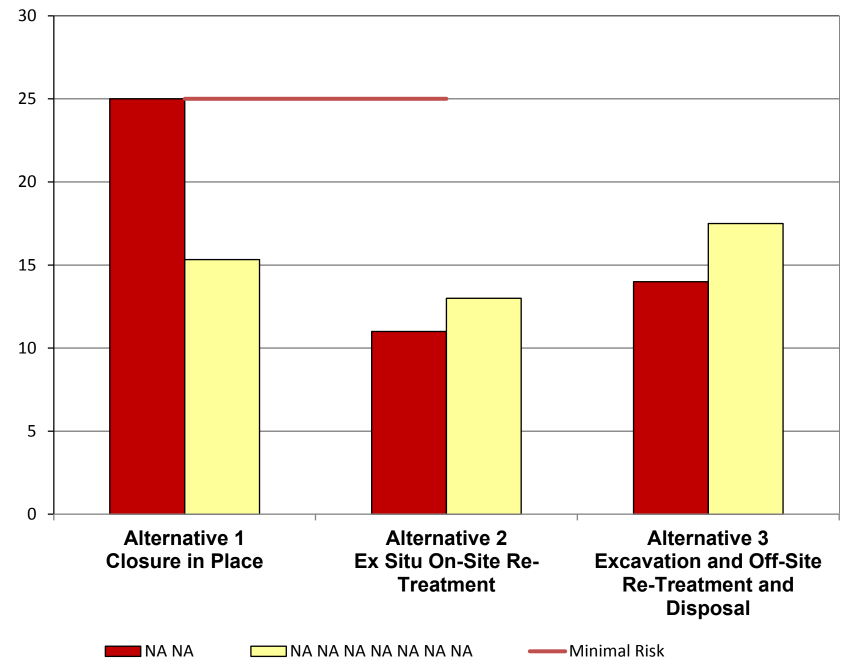
Long-Term Risk Minimization



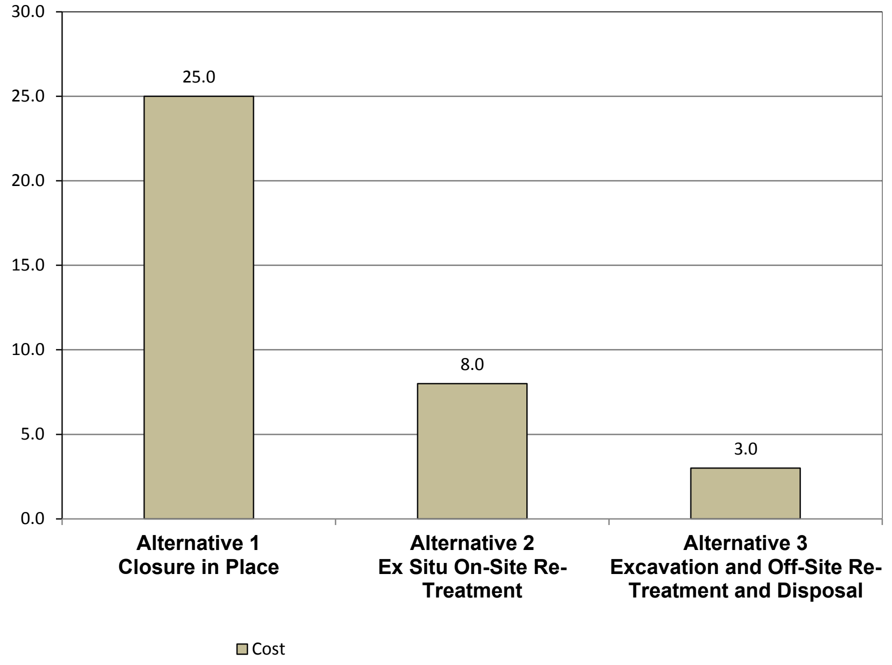
Short-Term Risk Minimization



Implementability



Cost Control



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LANDFILL EVALUATION PROJECT

TITLE

BAR CHARTS FOR COMPARING REMEDIAL ALTERNATIVES FOR THE CLASS 2 LANDFILL

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FIGURE
9

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LANDFILL EVALUATION PROJECT

TITLE

BAR CHART COMPARING INDICATORS FOR REMEDIAL ALTERNATIVES FOR THE CLASS 2 LANDFILL

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13-02086

FIGURE
10

ATTACHMENT A
READERS' GUIDE TO RISK EVALUATION SCORING

Attachment A: Readers' Guide to Risk Evaluation Scoring

The Exide Class 2 Landfill Risk Evaluation of Remedial Alternatives evaluates each of the three remediation alternatives against three major categories called "criteria." The criteria evaluated in the report are Long-term Risk, Short-term Risk, and Implementability. The heart of this evaluation is presented in Table 1, Risk Evaluation of Remedial Alternatives, which incorporates information from the three Conceptual Site Models ("CSM") contained in Figures 5, 6 and 7. For each remediation alternative, the report assesses various potential scenarios of concern, called "Indicators" and calculates scores for these Indicators based on the Indicator's likelihood of occurrence and its projected consequence. These scores are contained in both Table 1 and in Figures 5, 6 and 7.

Given the high level of detail in the report, however, it is easiest to guide the reader through Figures 5, 6 and 7 and Table 1 using a specific example. Included with this guide are an Example Figure 5 and an Example Table 1, which have annotated circles corresponding to the sections of the tables and figures discussed below.

Conceptual Site Models (Figures 5, 6 and 7) – Source of Scores on Table 1

For the Long-term Risk and Short-term Risk criteria presented in Table 1, Figures 5, 6 and 7 (the "Figures") are the sources of the "Indicator Scores." Each Figure presents one of the three alternatives evaluated. Each of the Figures includes columns identifying the source of contamination that might be released ("Primary Source"), the potential manner in which the contamination might be released ("Release Mechanism/Activities"), the impacted material to which there might be exposure ("Potential Exposure Media"), and the manner in which the exposure might occur ("Potential Exposure Route"). These columns are indicated in Circle 1 on Example Figure 5.

For the Long-term Risk and Short-term risk criteria, Indicator Scores are obtained by following the Conceptual Site Model for each alternative. These Indicator Scores are calculated by multiplying two scores: a score reflecting the likelihood that the Indictor will occur (see Example Figure 5, Circle 2), and a score reflecting the consequence of the Indicator occurring (see Example Figure 5, Circle 3).

The Likelihood and Consequence sections of the CSM are subdivided into five categories of humans or organisms that might be exposed (potential receptors). Based on best professional judgment, scores from 1 to 5 are assigned to each potential receptor/exposure or receptor/hazard scenario to denote the likelihoods and consequences of each scenario. Those two scores are multiplied to obtain a risk value (the "CSM Risk Value"), as shown in Circle 4 in Example Figure 5. Table A-1, below, explains the scores: the lowest level of risk receives the highest score, with a maximum/best score of 25.

On Table 1, each non-exposure/hazard-related indicator also receives a score up to 25, with a higher score indicating fewer or less significant challenges to Implementability. Table A-1, below, explains the implementability scores.

Table A-1: Risk Analysis Matrix

Likelihood	Score	Consequence				
		Minimal	**Minor**	**Medium**	**Major**	**Critical**
		5	**4**	**3**	**2**	**1**
Rare	**5**	25	20	15	10	5
Unlikely	**4**	20	16	12	8	4
Possible	**3**	15	12	9	6	3
Likely	**2**	10	8	6	4	2
Almost Certain	**1**	5	4	3	2	1

Risk Rating	Risk Score
Minimal Risk	19.6 - 25
Minor Risk	14.6 - 19.5
Medium Risk	7.6 - 14.5
Major Risk	3.6 - 7.5
Critical Risk	0.0 - 3.5

Table A-2: Implementability Matrix

Implementability Rating	Implementability Score
Very High	19.6 - 25
High	14.6 - 19.5
Medium	7.6 - 14.5
Low	3.6 - 7.5
Very Low or Negligible	0.0 - 3.5

Risk Evaluation of Remedial Alternatives (Table 1) – Summary of Evaluation

A comprehensive view of the evaluation is captured in Table 1. The three alternatives evaluated are located in four columns, as shown in Example Table 1, Circle 1. For each alternative, many potential scenarios or “Indicators” are identified and evaluated. The Indicators are given a number and a name, as shown in Example Table 1, Circles 2 and 3.

The Indicators are placed into one of three major categories (“Criteria”), and under those umbrellas the Indicators are also placed in smaller categories (“Sub-groups”). The Criteria and Sub-groups are shown in Example Table 1, Circles 4 and 5.

For each remedial alternative, scores are calculated for individual Indicators. Indicator Scores are then averaged to calculate subgroup scores and averaged to calculate criteria scores for that alternative. The Indicator, Sub-group, and Criteria scores are located in right-hand columns of Example Table 1. The scores are used to draw conclusions from the evaluation.

Example: What are the potential short-term effects to an off-site resident (the receptor) in the vicinity of the Class 2 landfill from inhalation (the potential exposure route) of potentially lead/metal-bearing dust (the potential exposure medium) caused by construction activities that create aerial dust dispersion at the landfill during implementation of an alternative remedy?

The Potential Exposure Mechanism

Figures 5, 6 and 7 show there are potential short-term effects associated with implementation of the alternative remedies. During implementation, on-site machinery are used for construction activities and the potential resultant aerial dispersion of dust is a potential “release mechanism” that can result in the potential exposure medium of construction dust, including in some circumstances potentially lead/metal-bearing dust (see Example Figure 5, Circle 5). Although there would be appropriate dust suppression and monitoring plans in place, these measures may not eliminate the risk that the construction dust could be inhaled (the potential exposure route) by off-site residents (the receptor) in some circumstances.

For illustration, provided below is a step wise narrative discussion of the evaluation process for Alternatives 1 and 3.

Alternative 1: Closure in Place

To determine the risk of an off-site resident inhaling dust, including potentially lead/metal-bearing dust, caused by construction activities, look at Example Figure 5. On Example Table 1, this scenario corresponds to Indicator 20, "Off-site resident exposure to construction dust," as shown in Example Table 1, Circle 6.

Example Figure 5, Circle 6 shows that the likelihood for inhalation by off-site residents of construction dust scores a "5," the score for "Rare." As explained in Example Table 1, Circle 7, this is because, under Alternative 1, the material will remain in-place and undisturbed and the entire landfill will have a multi-layer cap so there is not expected to be dust generating activity. Further, any general construction dust would be expected to be associated with uncontaminated material. In addition, appropriate controls such as watering and perimeter air monitoring would further mitigate off-site dust exposure.

Looking again at Example Figure 5, proceeding right to the next set of columns (Example Figure 5, Circle 7), the consequences if off-site residents are exposed to construction dust scored a "5." This indicates that, if an off-site resident inhaled dust caused by construction activities at the landfill, under Alternative 1, the potential effects would be expected to be minimal. This is because the dust generated by activities in this Alternative would be expected to be from uncontaminated, non-lead/metal-bearing materials such as clean fill.

The final column cluster in Example Figure 5 gives the "CSM Risk Values" (see Example Figure 5, Circle 8). The risk to off-site residents from inhaling construction dust scored a 25, minimal risk, which was obtained by multiplying 5 (rare likelihood) by 5 (minimal consequence). Thus, based on this assessment, there is expected to be minimal potential risk to off-site residents associated with inhaling construction dust, including potentially lead/metal-bearing dust, if Alternative 1 is the selected remedy.

Example Table 1 uses the CSM Risk Value from Example Figure 5 as the Indicator Score. The row for Indicator 20 (see Example Table 1, Circle 6) provides both the Indicator Score and the rationale behind that score. In Example Table 1, the cell that describes Indicator 20 under Alternative 1 (Example Table 1, Circle 7) also cross-references the location of the CSM Risk Value on Example Figure 5 at A15 (see Example Figure 5, Circle 8). Where an Indicator Score is risk-based, the CSM Risk Value was placed in the Indicator Score column. Thus, here, under the column labeled "#1" for Alternative 1 (Example Table 1, Circle 8), the risk score is shown as 25. The report averages the Indicator Score for Indicator 20 with other Indicator Scores from the Community Hazard Sub-group to obtain a Sub-group score of 23.3 for Alternative 1. This Sub-group score is then averaged with other Sub-group scores under the Short-term Risk criterion to obtain a criterion score of 23.0 for Alternative 1.

Alternative 3: Excavation and Off-Site Retreatment and Disposal

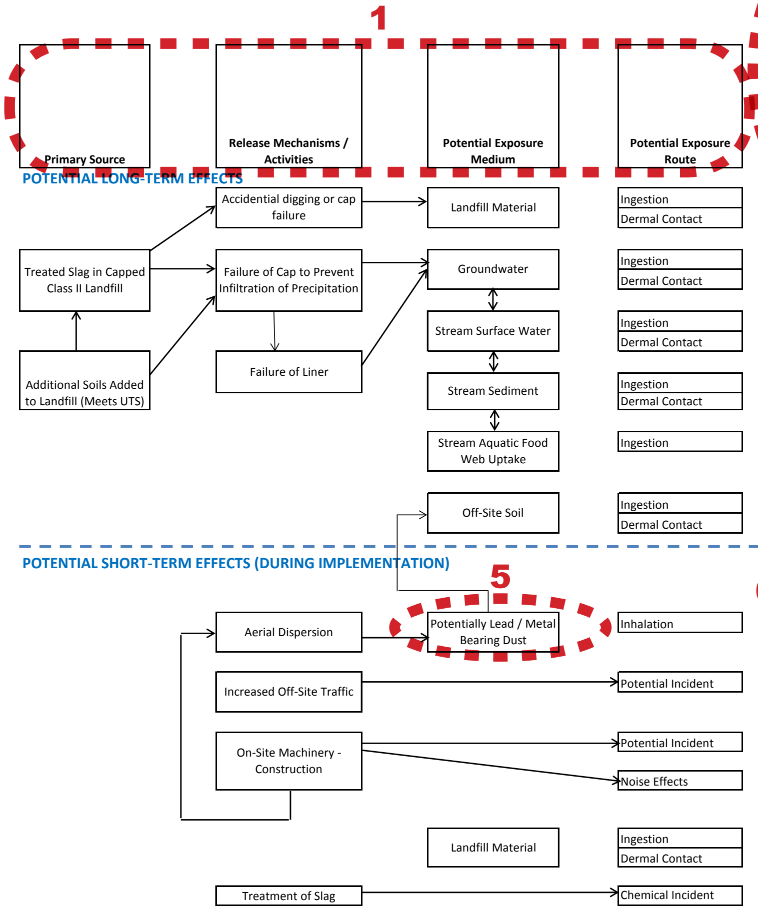
The CSM for Alternative 3 is shown in Figure 7, which can be read in the same manner as Example Figure 5. To determine the risk of an off-site resident inhaling dust, including potentially lead/metal-bearing dust, caused by construction activities, look at Figure 7.

For Alternative 3, the likelihood of off-site residents in the vicinity of the Class 2 landfill inhaling construction dust scored a "3," the score for "Possible." As explained in Example Table 1, Indicator 20, Alternative 3a, this is because Alternative 3 requires that landfill material be broken and, to a limited extent, crushed into manageable pieces to facilitate excavation, loading and off-site transport. In contrast to Alternative 2, Alternative 3 would not require the landfill material to be crushed into fine particles for retreatment at the Class 2 landfill. For this reason, Alternative 3 would result in less likelihood of aerial dispersion of potentially lead/metal-bearing dust in the vicinity of the Class 2 landfill than Alternative 2. The impacts of crushing for retreatment that would occur at the off-site TSD facility are evaluated under Indicator 26. Dust suppression measures would be put in place at both facilities to minimize dust generation.

Looking again at Figure 7 and proceeding right to the next set of columns, the consequences of an off-site resident in the vicinity of the Class 2 landfill inhaling construction dust scored a “4,” indicating “Minor” consequence. This is the same consequence score as in Alternative 2, but it is a worse score than in Alternative 1. This is because, under both Alternatives 2 and 3, the construction dust may potentially include lead/metal-bearing dust due to the breaking, excavating, crushing, loading, and hauling of treated slag material in the landfill.

The final column cluster in Figure 7 gives the “CSM Risk Values.” The risk to off-site residents in the vicinity of the Class 2 landfill from inhaling dust during Alternative 3 construction activities scored a 12, obtained by multiplying 3 (possible likelihood) by 4 (minor consequence). This cell is color-coded yellow to indicate that this scenario poses a medium potential risk. Because the breaking, excavation, crushing, and loading of treated slag material in the landfill has the potential to generate potentially lead/metal-bearing dust, which may be inhaled by off-site residents, Alternative 3, like Alternative 2, receives a worse risk score than Alternative 1.

Example Table 1 also contains some of this information. The CSM Risk Value is also shown in Example Table 1, in the row for Indicator 20, under the columns labeled “Indicator Scores” under “#3a On-site.” The cell in Example Table 1 that describes Indicator 20, Alternative 3a also cross-references the location of the CSM Risk Value on Figure 7 at A14.



Potential Exposure Medium	Potential Exposure Route	2 Likelihood					3 Consequence					4	CSM Risk Values				
							A	B	C	D	E		A	B	C	D	E
		Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms	Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms	Cell Reference	Off-Site Residents	Remediation Workers	Future Industrial Workers	Terrestrial Organisms	Aquatic/Riparian Organisms
POTENTIAL LONG-TERM EFFECTS																	
Landfill Material	Ingestion	5	NA	4	4	5	4	NA	4	4	4	1	20	NA	16	16	20
	Dermal Contact	5	NA	4	4	5	4	NA	5	4	5	2	20	NA	20	16	25
Groundwater	Ingestion	4	NA	5	5	5	4	NA	4	4	4	3	16	NA	20	20	20
	Dermal Contact	4	NA	5	5	5	5	NA	5	5	5	4	20	NA	25	25	25
Stream Surface Water	Ingestion	4	NA	5	4	5	4	NA	4	4	3	5	16	NA	20	16	15
	Dermal Contact	4	NA	5	4	5	5	NA	5	5	5	6	20	NA	25	20	25
Stream Sediment	Ingestion	4	NA	5	4	5	4	NA	4	4	3	7	16	NA	20	16	15
	Dermal Contact	4	NA	5	4	5	5	NA	5	5	5	8	20	NA	25	20	25
Stream Aquatic Food Web Uptake	Ingestion	NA	NA	NA	4	5	NA	NA	NA	4	3	9	NA	NA	NA	16	15
Off-Site Soil	Ingestion	5	NA	NA	5	5	5	NA	NA	5	5	10	25	NA	NA	25	25
	Dermal Contact	5	NA	NA	5	5	5	NA	NA	5	5	11	25	NA	NA	25	25
POTENTIAL SHORT-TERM EFFECTS (DURING IMPLEMENTATION)		6					7					8					
Potentially Lead / Metal Bearing Dust	Inhalation	5	4	NA	5	5	5	5	NA	5	5	12	25	20	NA	25	25
	Potential Incident	5	NA	NA	5	5	3	NA	NA	3	4	13	15	NA	NA	15	20
	Potential Incident	NA	4	NA	NA	NA	NA	4	NA	NA	NA	14	NA	16	NA	NA	NA
	Noise Effects	5	4	NA	4	5	4	4	NA	4	5	15	20	16	NA	16	25
Landfill Material	Ingestion	NA	5	NA	5	5	NA	4	NA	4	5	16	NA	20	NA	20	25
	Dermal Contact	NA	5	NA	5	5	NA	4	NA	4	5	17	NA	20	NA	20	25
	Chemical Incident	NA	5	NA	NA	NA	NA	5	NA	NA	NA	18	NA	25	NA	NA	NA

Risk Analysis Matrix

Likelihood	Score	Consequence				
		Minimal	Minor	Medium	Major	Critical
		5	4	3	2	1
Rare	5	25	20	15	10	5
Unlikely	4	20	16	12	8	4
Possible	3	15	12	9	6	3
Likely	2	10	8	6	4	2
Almost Certain	1	5	4	3	2	1

Risk Rating

Risk Rating	Risk Score
Minimal Risk	19.6 - 25.0
Minor Risk	14.6 - 19.5
Medium Risk	7.6 - 14.5
Major Risk	3.6 - 7.5
Critical Risk	0.0 - 3.5

Potential exposures or hazards potentially are related to remedial activites at the Class 2 landfill

L = Long Term
S = Short Term

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CONSULTANT
Golder Associates

YYYY-MM-DD	2014-08-22
PREPARED	A.PARKIN
DESIGN	D.C.
REVIEW	D.C.
APPROVED	F.S.

PROJECT
LANDFILL EVALUATION PROJECT

TITLE
CONCEPTUAL SITE MODEL FOR THE CLASS II LANDFILL: ALTERNATIVE 1 - CLOSE IN PLACE

PROJECT No.
13-02086

FIGURE
EXAMPLE FIGURE 5

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Criterion	Subgroup	Receptors	Indicator Number	Means of Potential Exposure	Location	Indicator Names	Alternative 1: Closure In Place (with cell reference from CSM Figure 5)	Alternative 2: Ex Situ On-Site Re-Treatment (with cell reference from CSM Figure 6)	Alternative 3a: Excavation and Off-Site Re-Treatment and Disposal): FRC Facility and Vicinity Only (with cell reference from CSM Figure 7)	Alternative 3b: Excavation and Off-Site Re-Treatment and Disposal: Off-Site TSD Facility and Vicinity Only (with cell reference from CSM Figure 7)	Scoring Criteria	Indicator Scores					Subgroup Scores			Criterion Scores		
												1	2	3a On-Site	3b Off-Site	3	1	2	3	1	2	3
Short-Term Risk Minimization	Community Hazard Minimization	Off-Site Residents	20	Construction Activities	Class 2 Landfill and Vicinity	Off-Site Resident Exposure to Construction Dust (Class 2 Landfill and Vicinity)	A12 Minimal - material will remain undisturbed in situ and the entire landfill will have a multi-layer cap. Construction dust would be from clean materials. Appropriate controls, such as watering, will minimize dust generation.	A12 Medium - landfill material will be excavated, loaded into trucks, and crushed on-site to a fine particle size, creating potential lead/metal-bearing dust which may become airborne and travel off-site. Appropriate controls such as watering can minimize dust generation.	A14 Medium - landfill material will be broken to manageable pieces (to a lesser extent than the crushing activities in Alternative 2), loaded into trucks, and transported off site for disposal, creating lead/metal-bearing dust which may become airborne and travel off-site. Appropriate controls such as watering can minimize dust generation.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	25	12	12		12	23.3	20.3	15.6	23.0	19.5	14.5
		Off-Site Residents	21	Construction Activities	Class 2 Landfill and Vicinity	Off-Site Resident Exposure to Increased Truck Traffic (Class 2 Landfill and Vicinity)	A13 Minor - some increased truck traffic in the vicinity of the site when importing cover materials.	A13 Medium - increased operations in the vicinity of the site for excavation, crushing, loading, treatment, and hauling over an approximate 2.5-year period.	A15 Major - very high volume of truck traffic into and out of the site to transport material for a 1.5- to 3-year period.	NA - this indicator applies to the Class 2 landfill only	Truck traffic minimized 1 High traffic 25 Low traffic	15	12	6		6						
		Off-Site Residents	22	Construction Activities	Class 2 Landfill and Vicinity	Off-Site Resident Exposure to Increased Noise (Class 2 Landfill and Vicinity)	A15 Minimal - some increased noise during cover construction from standard earth moving equipment.	A15 Medium - increased noise due to crushing, excavation, loading, and hauling.	A17 Medium - increased noise due to truck traffic, breakage, excavation, loading, and hauling.	NA - this indicator applies to the Class 2 landfill only	Noise levels minimized 1 High noise levels 25 Low noise levels	20	9	12		12						
		Off-Site Residents	23	Transportation	Transportation Route	Off-Site Resident Exposure to Construction Dust (Transportation Route)	No off-site transportation	No off-site transportation	NA - off-site transportation is scored under Alternative 3b	E20 Minor - approximately 15,500 truck loads will haul the landfill material 250 miles one way to move the material to the off-site TSD facility. Lead/metal-bearing dust could potentially be generated from transport of landfill material. Appropriate controls, such as covering truck loads, will minimize dust generation. However, any dust dispersion would likely be spread over a wide area, minimizing localized exposures.	Probability minimized 1 High probability 25 Low probability	25	25		16	16						
		Off-Site Residents	24	Transportation	Transportation Route	Off-Site Resident Exposure to Increased Traffic (Transportation Route)	No off-site transportation	No off-site transportation	NA - off-site transportation is scored under Alternative 3b	E21 Medium - approximately 15,500 truck loads will haul the landfill material 250 miles each way for a total of 7,750,000 miles of increased truck traffic to move the material to the off-site TSD facility.	Probability minimized 1 High probability 25 Low probability	25	25		8	8						
		Off-Site Residents	25	Transportation	Transportation Route	Off-Site Resident Effects from Accidental Spill (Transportation Route)	No off-site transportation	No off-site transportation	NA - off-site transportation is scored under Alternative 3b	E22, E23 Minor - approximately 15,500 truck loads will haul the landfill material 250 miles one way to move the material to the off-site TSD facility, with the attendant the risk of spillage or accidents.	Probability minimized 1 High probability 25 Low probability	25	25		16	16						
		Off-Site Residents	26	Construction Activities	Off-Site TSD Facility Only	Off-Site Resident Exposure to Construction Dust (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	H24 Minimal - landfill material crushed on-site, creating potential lead/metal-bearing dust which may become airborne and travel off-site. However, the off-site TSD facility is expected to be located in remote area, which minimizes potential exposures.	Probability minimized 1 High probability 25 Low probability	25	25		25	25						
		Off-Site Residents	27	Transportation	Off-Site TSD Facility Only	Off-Site Resident Exposure to Increased Truck Traffic (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	H25 Minor - approximately 15,500 truck loads of landfill material will enter and exit the off-site TSD facility to deliver material. However, the facility is expected to be remote from residential areas.	Truck traffic minimized 1 High traffic 25 Low traffic	25	25		20	20						
		Off-Site Residents	28	Construction Activities	Off-Site TSD Facility Only	Off-Site Resident Exposure to Noise (Off-Site TSD Facility)	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	NA - this indicator applies to the Off-site TSD only	H27 Minimal - an estimated 15,500 truckloads of material from the Class 2 landfill will be received at the off-site facility. However, the facility is expected to be remote, which minimizes noise exposure to residents in the vicinity.	Probability minimized 1 High probability 25 Low probability	25	25		25	25						
	Occupational Hazard Minimization	Site Remediation Worker	29	Construction Activities	Class 2 Landfill and Vicinity	Site Remediation Worker Exposure to Construction Dust (Class 2 Landfill and Vicinity)	B12 Minimal - operations will involve moving clean material for cover over a 3 to 4 month period.	B12 Major - increased operations for crushing, excavation, loading, and hauling over an approximate 2.5-year period will result in increased potentailly lead/metal-bearing dust. Appropriate controls, such as watering, will minimize exposure.	B14 Medium - Increased operations for breakage and excavation of landfill material and loading into trucks for off site disposal over a 1.5- to 3-year period will generate potential lead/metal-bearing dust.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	20	6	9		9	21.9	15.2	10.9			
		Site Remediation Worker	30	Construction Activities	Class 2 Landfill and Vicinity	Site Remediation Worker Occupational Hazards (Class 2 Landfill and Vicinity)	B14 Minor - operations will involve standard earth moving equipment over a 3 to 4 month period.	B14 Major - landfill materials crushing, excavation, loading, and hauling operations will occur over an approximate 2.5-year period.	B16 Major - significant increased truck traffic; landfill material breakage, excavation, loading, and hauling will occur over a 1.5- to 3-year period.	NA - this indicator applies to the Class 2 landfill only	Probability minimized 1 High probability 25 Low probability	16	6	6		6						

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PREPARED A.PARKIN

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REVIEW D.C.

APPROVED F.S.

PROJECT

LANDFILL EVALUATION PROJECT

TITLE

RISK EVALUATION OF REMEDIAL ALTERNATIVES

PROJECT No. 13-02086

FIGURE EXAMPLE TABLE 1

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

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Engineering Earth's Development, Preserving Earth's Integrity