

Slag Pile Cover Concepts

PREPARED FOR: Montana Environmental Custodial Trust

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DATE: December 22, 2016

PROJECT NUMBER: 671189.64.04.02

This technical memorandum (TM) provides an update to the original Slag Pile Cover Concepts technical memorandum of September 16, 2016 (Attachment 3) with a recommended cover concept for the slag pile at the former ASARCO Smelter (former Smelter site). This work is being performed as part of the Corrective Measures Study (CMS) remedy evaluation being performed by the Montana Environmental Custodial Trust (Custodial Trust) under Resource Conservation and Recovery Act (RCRA).

Purpose

The focus of this scope is to develop cover concept alternatives and associated rough order of magnitude cost estimates that address to varying degrees long-term stability and environmental performance issues that have been identified for the slag pile. The slag pile cover concepts will be evaluated as a final remedy as part of the Corrective Measures Study process being performed by the Custodial Trust.

Background

The previous TM summarized three concept alternatives along with estimated costs for a cover system at the slag pile. The alternatives resulted from a series of team meetings and discussions with the Custodial Trust during the summer of 2016. Subsequent review sessions by the Custodial Trust and the USEPA of the initial three alternatives lead to refinement of the conceptual options resulting in the recommended alternative presented here.

Conceptual Cover Objectives

The key objectives of the conceptual cover design elements remain as presented in the original TM (Attachment 3).

Approach

The approach to the recommended alternative presented here, in addition to those listed in the original TM, addressed the following issues based on client and stakeholder comments:

- Develop an alternative that integrates covering the upper unfumed slag pile as an environmental action by the Custodial Trust, in conjunction with ongoing fumed slag removal/regrading by others (i.e., Ash Grove or other commercial entities utilizing slag)
- Minimize regrading of the unfumed slag (evaluation of cost estimates identified lower cost overall to cover slag as opposed to moving it)

- Use the more effective ET Cover for the unfumed slag (thickness of the cover can be reevaluated when the project gets to formal design stage to further optimize amount of cover material required)
- Leave slag overlaying the Chemet property in-place (until and if an agreement is worked out with them in the future)

Recommended Alternative

The recommended alternative is a modification of the minimum alternative presented in the original TM. As with the preliminary alternatives, the recommended concept includes removing the million-gallon water storage tanks and associated system components, consolidation of the unfumed slag, reshaping of the pile, and placing a soil cover over the unfumed slag.

The tank foundations would remain in place but would be broken up and covered with unfumed slag. Demolition debris other than concrete would be hauled offsite for either disposal or recycling.

The following modifications to the minimum alternative are incorporated in the recommended approach:

- Instead of moving all the upper unfumed slag overlaying the fumed slag in the north portion, only move a portion and consolidate over a smaller footprint.
- Cover the tank foundations using unfumed slag resulting from grading/smoothing the south area of the pile to eliminate high and low spots as well as eliminating one area of overhang on the east side.
- Leave grading of the north portion of the pile, including the steep slopes along the creek, to others as part of removing the fumed slag in this area for commercial purposes.
- Establish access to the north areas of fumed slag for future removal operations using the existing roads.
- Cover the fumed slag with an ET cover (similar to that used over the main facility footprint; 3 feet thick, comprised of soil assumed available from Custodial Trust-owned property east of Highway 518, and seeded)

Approximately 182,000 yd³ of slag would be moved in this alternative (vs. 269,000 yd³ in the minimum alternative); 160,000 yd³ of unfumed slag in the upper lift would be moved from the north to the south, about 16,000 yd³ moved to grade the south plateau, and another 6,000 yd³ to grade the unfumed north end.

The ET cover would encompass approximately 20 acres (96,700 yd³) (compared to approximately 17.5 acres (28,000 yd³) of 12" thick soil cover in the minimum alternative).

Figures 9, 10, and 11 in Attachment 1 show the grading plan and sections.

Cost Estimate

Costs for the recommended alternative were estimated similarly to those of the minimum alternative using the same assumptions, except that unit prices for grading the unfumed slag were reduced slightly to reflect a shorter haul distance. See Attachment 2 for cost estimate details.

Cost Summary Comparison

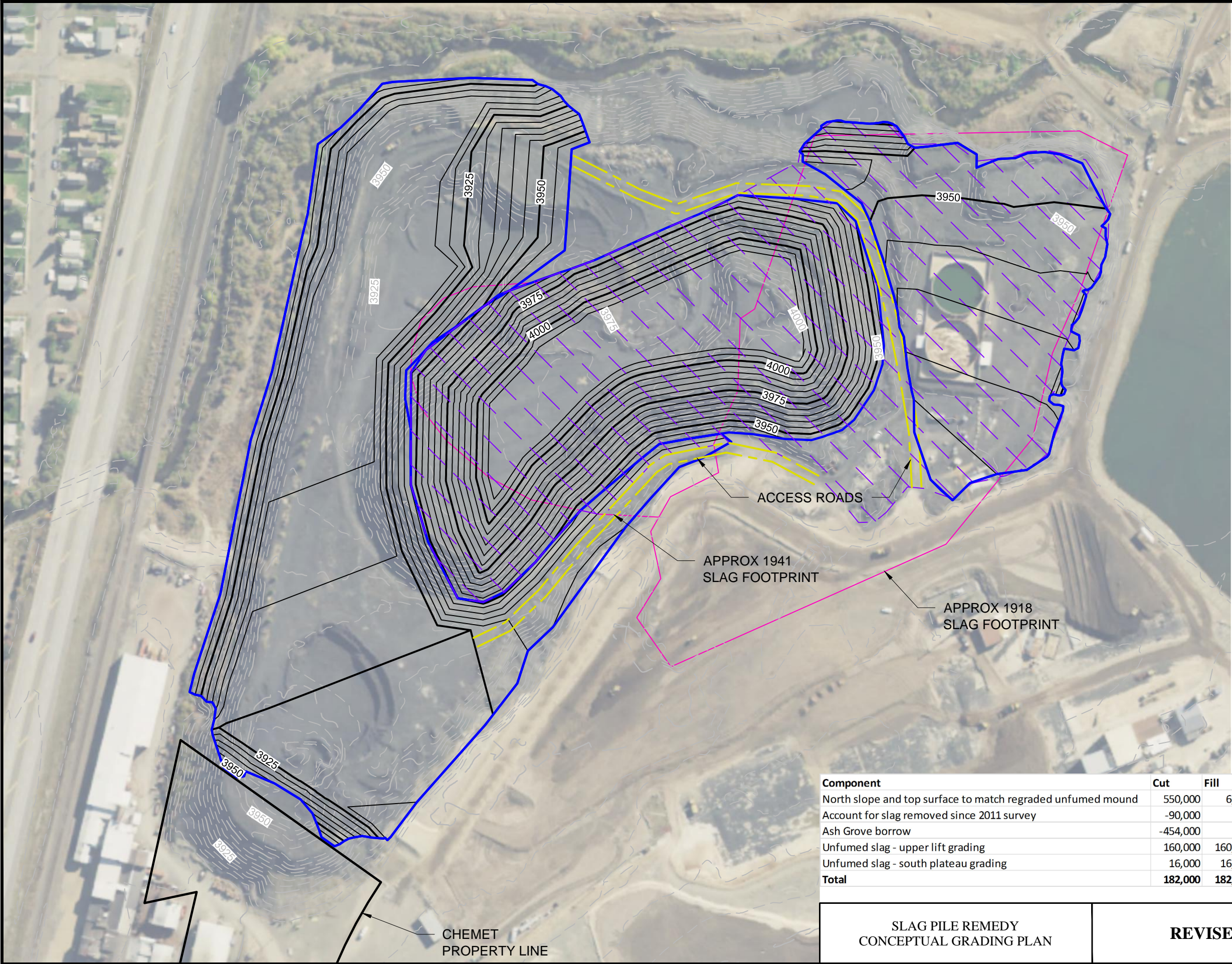
Table 1. Cost* Summary

	Units	Minimum	Intermediate	Maximum	Recommended
Slag Moved	yd ³	269,000	519,300	620,300	182,000
Soil Cover	Acre (yd ³)	17.5 (28,200)	25 (39,900)	28.2 (47,300)	-
ET Cover	Acre (yd ³)	-	-	9.3 (45,000)	20 (96,700)
Estimated Cost		\$4,536,000	\$8,063,000	\$9,863,000	\$3,700,000
Estimated Cost Range		\$3.18M to \$6.80M	\$5.64M to \$12.09M	\$6.90M to \$14.79M	\$2.59M to \$5.55M

* Estimated costs are based on a conceptual level of detail with anticipated accuracy range of -30 percent to +50 percent

Attachment 1

Plans and Sections Figures



SCALE
(In Feet)
0 200

LEGEND

- SOIL COVER
- NO HATCH: NO SOIL COVER
- GRADING LIMITS

CONTOURS

- EXISTING (5' & 25')
- PROPOSED (5' & 25')

SOIL COVER:
UNFUMED MOUND SURFACE AREA:
506,000 SF
REMAINING SOIL COVER AREA:
364,000
REQD SOIL VOLUME, 3-FT ET COVER:
96,700 CY

ADDITIONAL NOTES:
2.5:1 SLOPES ALONG REGRADED SLOPES
3:1 TO 3.5:1 NEAR NORTHEAST CORNER
6:1 SLOPE ON EAST RAMP
2% - 5% SLOPES FOR DRAINAGE

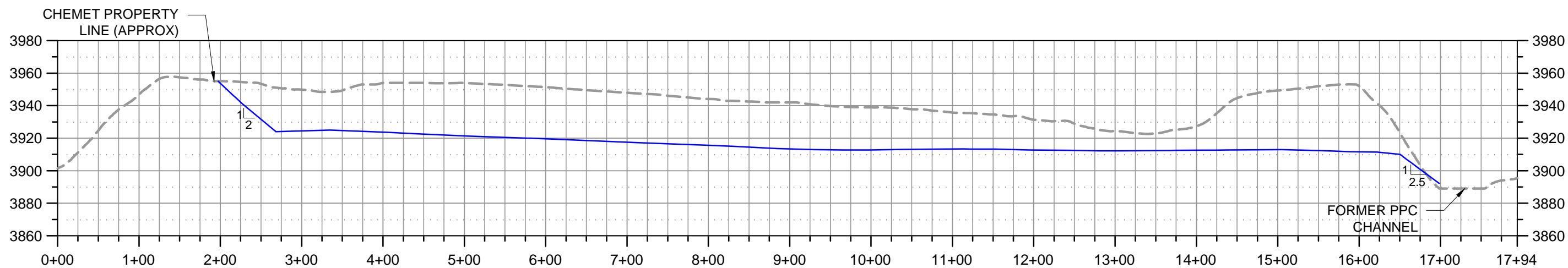
Component	Cut	Fill	Net
North slope and top surface to match regraded unfumed mound	550,000	6,000	544,000
Account for slag removed since 2011 survey	-90,000	0	-90,000
Ash Grove borrow	-454,000	0	-454,000
Unfumed slag - upper lift grading	160,000	160,000	0
Unfumed slag - south plateau grading	16,000	16,000	0
Total	182,000	182,000	0

SLAG PILE REMEDY
CONCEPTUAL GRADING PLAN

REVISED ALTERNATIVE

FIGURE

9

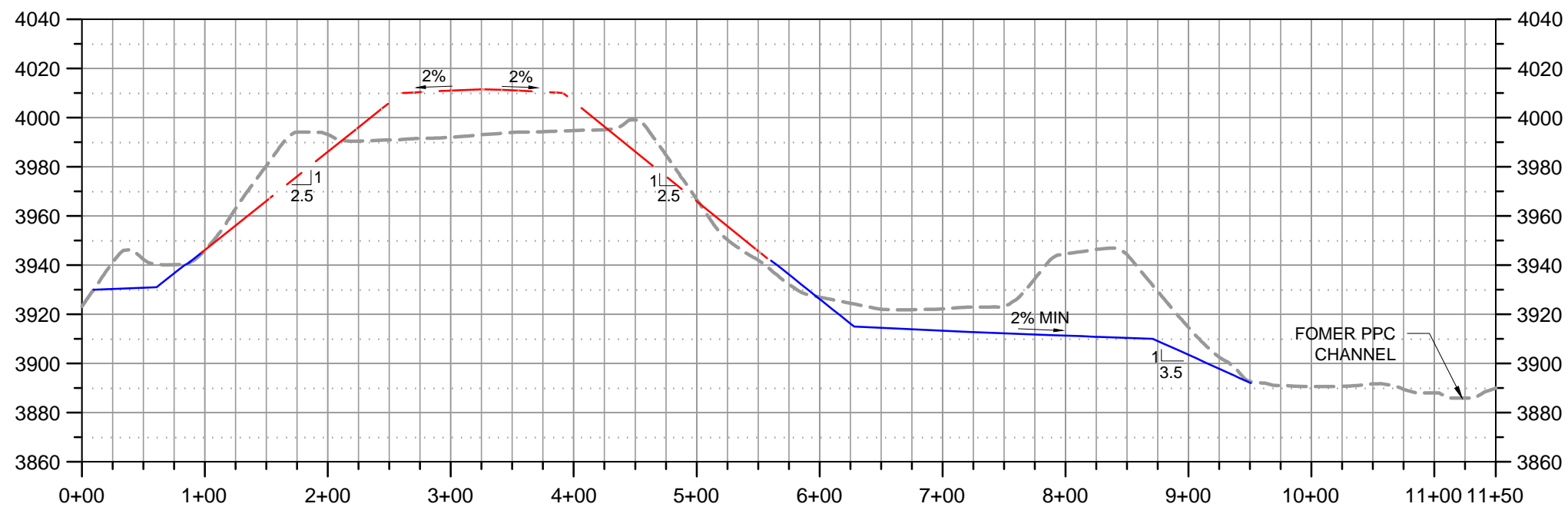
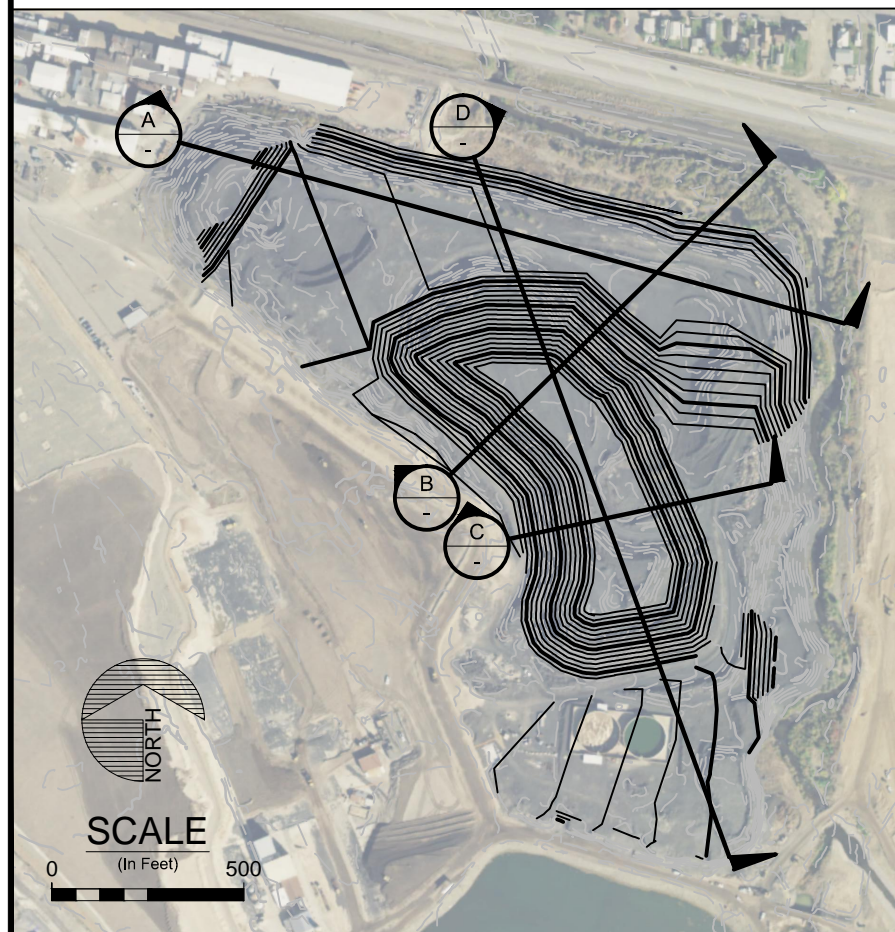


LEGEND

- EXISTING SURFACE
- PROPOSED TOP OF FUMED SLAG
- PROPOSED TOP OF UNFUMED SLAG

SCALE
(In Feet)
0 130

A SECTION
2X VERTICAL EXAGGERATION



SCALE
(In Feet)
0 120

B SECTION
2X VERTICAL EXAGGERATION

SLAG PILE REMEDY
CONCEPTUAL GRADING PLAN

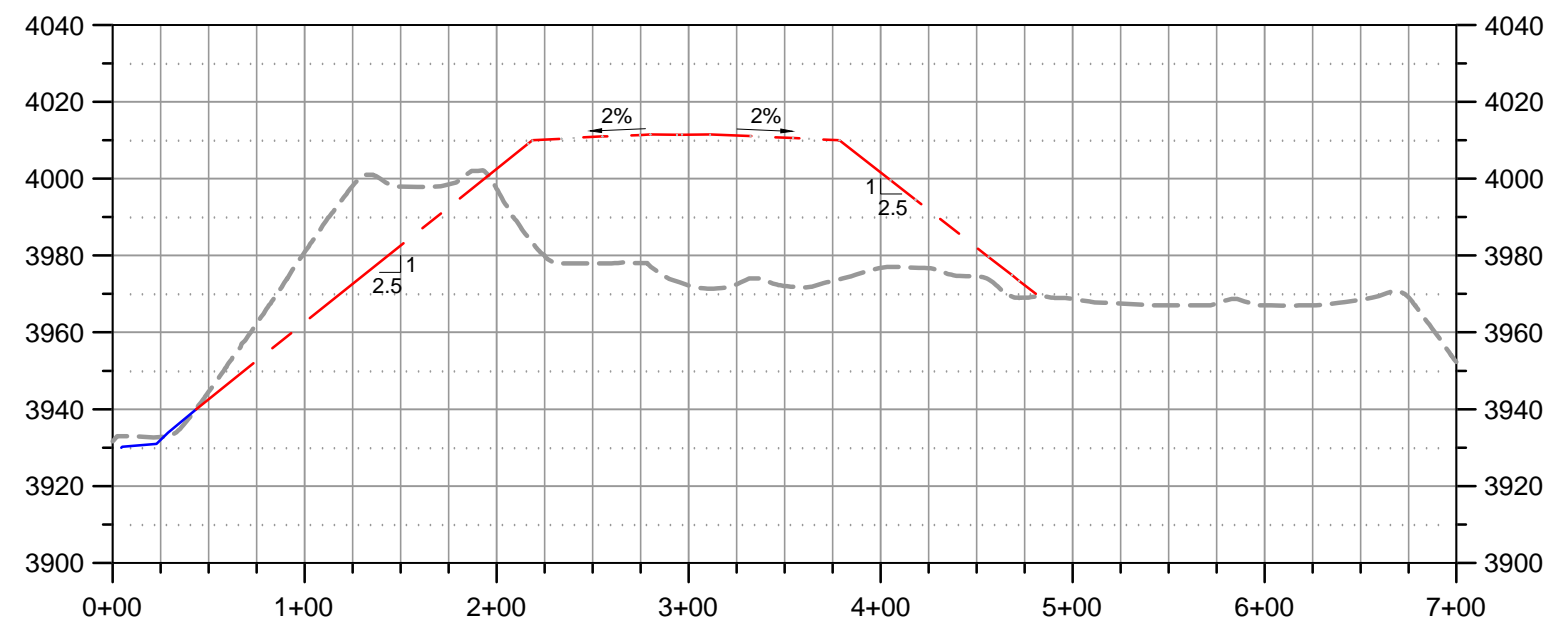
REVISED ALTERNATIVE

FIGURE

10

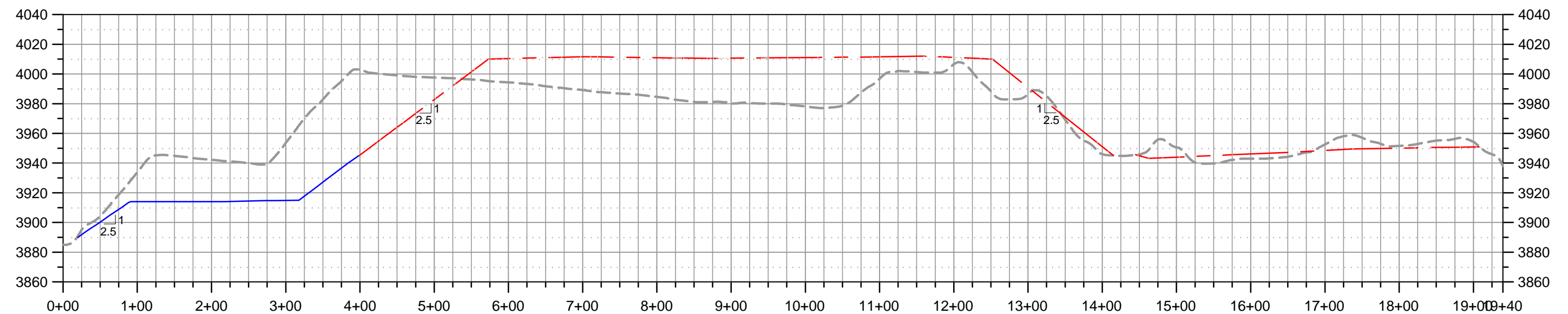
LEGEND

- EXISTING SURFACE
- PROPOSED TOP OF FUMED SLAG
- - - PROPOSED TOP OF UNFUMED SLAG



SCALE
(In Feet)
0 100

SECTION
C
2X VERTICAL EXAGGERATION



SCALE
(In Feet)
0 140

SECTION
D
2X VERTICAL EXAGGERATION

SLAG PILE REMEDY
CONCEPTUAL GRADING PLAN

REVISED ALTERNATIVE

FIGURE

11

Attachment 2
Cost Estimate Recommended
Alternative

Slag Pile Cover Concept- Recommended Alternative

Conceptual Cost Estimate

Item	Description	Qty	Units	Unit Rate	Cost	Notes
1	Demolition	1	LS	\$ 30,000.00	\$ 30,000	Demo scope includes removal of the million gallon tanks system, assume concrete is broken and left in place, covered with slag
2	Waste Disposal	910	CY	\$ 35.00	\$ 31,850	Assume .5% of slag volume is waste requiring offsite disposal, \$35/cy, dispose at local landfill
3	Slag Grading	182,000	CY	\$ 8.50	\$ 1,547,000	Unit prices from PPC Realignment range 4.50 to 10.50/cy. Use 8.50. Assume reduction in haul distance for unfumed and fewer steep slopes to grade compared to previous alternatives.
4	Cover Soil		CY	\$ 6.00	\$ -	No cover soil in this alternative
5	ET Cover	96,700	CY	\$ 7.00	\$ 676,900	Rates from ET/ICS2 are \$6.25/cy (35,700/ac), w/o seed maintenance. Use 7.00. Assumes 3ft thick
6	Hydroseeding	20	AC	\$ 2,400.00	\$ 48,000	Rates from PPC Realignment range from 1600 to 2900/acre, use 2400
Subtotal items 1-6					\$ 2,333,750	
7	Mobilization	1	LS	9.00%	\$ 210,038	Rates from ET/ICS2 cover and TPA/ICS1 range from 9.0 to 9.2% of major items total costs. Use 9%
8	Submittals, permits	1	LS	1.00%	\$ 23,338	Rates from ET/ICS2 cover and TPA/ICS1 range from 1.4 to 5.4% of major items total costs. Use 1% assuming minimal requirements
9	Surveying	1	LS	2.50%	\$ 58,344	Rates from ET/ICS2 cover and TPA/ICS1 range from 2.5 to 6.1 of major items total costs. Use 2.5%
10	Site Preparation	1	LS	2.00%	\$ 46,675	Rates from ET/ICS2 cover and TPA/ICS1 range from 1.0 to 4.8% of major items total costs. Use 2%
11	Road Maintenance	1	LS	4.00%	\$ 93,350	Rates from ET/ICS2 cover are 7.2% of major items total costs. Use 4% since most work is on slag, requiring minimal maint.
12	Stormwater Controls	1	LS	10.00%	\$ 233,375	Rates from ET/ICS2 cover and TPA/ICS1 range from 13.3 to 15.3% of major items total costs. Use 10% as work is on the slag pile w/ min impact from storm water
13	Demobilization, restoration, cleanup	1	LS	1.50%	\$ 35,006	Rates from ET/ICS2 cover and TPA/ICS1 range from 1.5 to 3.1% of major items total costs. Use 1.5%
14	Closeout	1	LS	0.50%	\$ 11,669	Rates from ET/ICS2 cover and TPA/ICS1 range from 0.4 to 1.4% of major items total costs. Use .5% assuming minimal effort required.
Subtotal Items 7-14					23.4% \$ 711,794	
Subtotal Items 1-14					\$ 3,045,544	
15	Bonds	3,045,544	LS	1.25%	\$ 38,069	
Subtotal					\$ 3,083,613	
16	Contingency	3,083,613	LS	20.00%	\$ 616,723	
Total					\$ 3,700,336	
					\$ 3,700,000	Use

Attachment 3
Original Slag Pile Technical Memo

Slag Pile Cover Concepts

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DATE: September 16, 2016

PROJECT NUMBER: 671189.64.04.02

This technical memorandum summarizes cover concepts developed for the slag pile at the former ASARCO Smelter (former Smelter site), as part of the corrective measures remedy evaluation being performed by the Montana Environmental Custodial Trust (Custodial Trust) as defined by the Resource Conservation and Recovery Act.

Purpose

The focus of this scope is to develop cover concept alternatives and associated rough order of magnitude cost estimates for the slag pile that address to varying degrees long-term stability and environmental performance issues that have been identified for the slag pile. The slag pile cover concepts developed and presented in this technical memorandum will be evaluated as a final remedy as part of the Corrective Measures Study process being performed by the Custodial Trust.

Background

Slag is a byproduct of the metal smelting process and was produced and placed onsite at the former Smelter site from 1888 when the smelter began operation until 2001 when the smelter shut down. The slag pile is approximately 45 acres in size and contains about 3,560,000 cubic yards (yd³) of slag. The pre-1940s unfumed slag is located at the south end of the pile and is overlain in part by newer fumed slag. Post-1982 unfumed slag is restricted to an upper lift on top of the pile, about 585,000 yd³ in volume. A review of historical maps and aerial photos shows that the slag pile is underlain by a number of former creek channels and ditches that could act as preferential flow pathways, especially during periods of high surface water and groundwater levels.

The pile topography includes steep side slopes (1.5H:1V or steeper) with the top of the pile generally flat. Along the eastern edge of the pile, undercutting and sloughing into Prickly Pear Creek has occurred over several decades. The flat topography across much of the pile reduces stormwater runoff and increases infiltration into the pile.

Groundwater beneath the slag pile shows apparent impacts from infiltration through the pile. Leaching analyses of slag suggest that the unfumed slag has the potential to leach constituents of concern (primarily metals) to groundwater. Studies to date indicate that the unfumed slag is the most likely source of contaminants entering the groundwater as a result of stormwater percolating through the pile. The available information suggests that additional action at the slag pile may reduce potential contaminant loading to groundwater and improve downgradient groundwater quality.

Conceptual Cover Objectives

The key objectives of the conceptual cover design elements are to:

- Reduce infiltration of stormwater through the slag, with particular focus on the unfumed material.
- Reduce the potential for human and ecological receptor contact with slag, with particular focus on unfumed slag.
- Develop and evaluate alternatives that allow continued asset recovery from the slag pile.
- Reduce, to the extent practicable, the potential for groundwater impacts from slag through the beneficial use of slag.
- Stabilize the steep sloped edges of the pile.
- Reduce the potential for slag to slough into Prickly Pear Creek.

Approach

Because studies indicate that water percolating through the pile may be leaching contaminants into the underlying groundwater, potential remedies have focused on reducing infiltration. Based on current information, the unfumed slag (particularly the post-1982 material) is believed to have the highest potential for impacts to the groundwater from stormwater runoff and infiltration. Capping the pile with a cover will reduce infiltration and promote stormwater runoff.

On July 8, 2016, a slag pile cover concept workshop was held with the technical team (Hydrometrics and CH2M) and the Custodial Trust to discuss cover elements that could potentially apply to the cover concept development. Cover elements discussed included:

- Grading elements – considering extent of slag material regrade, side slope regrading, and cover runoff drainage approaches.
- Cover types – considering final cover types such as soil, evapotranspiration (ET), and geosynthetic covers; a soil cover is the most economical cap.
- Cover area – considering where final cover would be applied on the slag pile.

Key discussion points from the workshop included:

- There is some measure of technical benefit to most of the remedy elements identified; however, cost has not yet been quantified for any of them, and cost will influence decisions on the benefit of implementation.
- Want to be conservative evaluating when concepts and their associated costs so that decisions can be made with confidence so that resources will be available within the Custodial Trust fund to cover adequately.
- The technical team will need to work together to evaluate the effectiveness of remedy elements. Given the complexity and size of the slag pile, detailed/extensive performance modeling is neither appropriate nor necessary to support the final remedy recommendations.

Three conceptual cover alternatives were discussed to look at a range of alternatives for the purposes of cost and performance evaluations. The alternatives are as follows:

- A minimum alternative consisting of regrading/consolidating the unfumed slag over the pre-1950 unfumed slag footprint, and covering the unfumed slag with a soil cover.

- An intermediate alternative consisting of regrading and covering the unfumed slag as above, coupled with selective regrading of the east slope to address overhang/stability issues. This alternative also includes “sculpted” grading of the north slope to blend the slope with the existing Ash Grove fumed slag borrow pit and covering the slope to blend with the unfumed slag cover.
- A maximum alternative consisting of regrading and covering the unfumed slag as above, coupled with regrading the east, north, and west slopes of the slag pile (flattening the slopes) to support soil cover placement in those locations. Soil cover would be placed over both fumed and unfumed slag areas.

These preliminary conceptual alternatives are described below and will be evaluated further, along with other potential alternatives that may be developed through the Corrective Measures Study and final remedy evaluation process.

Alternatives

All three preliminary alternatives include removing the million-gallon water storage tanks and associated system components, along with consolidating the unfumed slag toward the south end of the pile. The tank foundations would remain in place but would be broken up and covered with unfumed slag. Demolition debris other than concrete would be hauled offsite for either disposal or recycling. Each alternative includes various amounts of regrading and covering of the slag as described in more detail in the sections below.

Minimum Alternative

The minimum alternative would remove the tanks and consolidate the unfumed slag by moving newer unfumed slag from the upper north end of the pile (located outside the underlying, older, unfumed slag) and placing it over the older unfumed areas at the south end of the pile. Existing surfaces at the south end would be regraded to provide positive drainage. The consolidated unfumed slag would then be covered with soil and hydroseeded. One foot has been recommended as a minimum soil cover thickness to support good plant growth. Soil for the cover layer is assumed available from Custodial Trust-owned property east of Highway 518 (the East Fields).

Approximately 166,000 yd³ of unfumed slag would be moved from the north to the south, and approximately 103,000 yd³ would be moved for the remainder of the unfumed slag regrading, for a total of 269,000 yd³ moved. The soil cover would encompass approximately 17.5 acres (28,000 yd³). Figure A in Attachment 1 shows the relative area of cover for the minimum alternative. Figures 1 and 2 in Attachment 2 show the grading plan and sections.

Intermediate Alternative

The intermediate alternative includes the work outlined in the minimum alternative and adds removal of slag from the Chemet property (by request of the Custodial Trust) along with additional regraded slope areas. Slope regrading would be limited to the existing near-vertical or overhang portions of the east and south sides along with the entire north side between the Chemet removal point and new northeast corner established by the Prickly Pear Creek Realignment work. Slopes would be graded to a maximum steepness of 2.5H:1V to promote stability and facilitate a soil cover.

The existing Ash Grove borrow pit would be filled in with material resulting from the flattening of the north slopes. Future removal operations of fumed slag would then occur in the northwest area of the pile encompassing slag relocated from the Chemet property, as well as that from the area uncovered by removal of the unfumed slag west of the current pit.

Approximately 144,000 yd³ of slag would be removed from the Chemet property to fill in the existing borrow pit and create a mounded stockpile for future recovery. An additional 106,000 yd³ of slag would be moved in regrading the north slope and steeper slopes to the east and south. Including the

269,000 yd³ from the minimum alternative, a total of 519,300 yd³ of slag would be moved under the intermediate alternative.

A 1-foot-thick soil cover would be placed over the regraded areas and hydroseeded; approximately 25 acres (39,900 yd³) of soil cover would be placed in this alternative. Figure B in Attachment 1 shows the relative area of cover for the intermediate alternative. Figures 3, 4, and 5 in Attachment 2 show the grading plan and sections.

Maximum Alternative

The maximum alternative carries on from the intermediate alternative by including grading of all remaining steep side slopes, providing a 3-foot-thick ET cover over the unfumed slag area, and covering the remaining fumed slag areas with a soil cover. The soil cover would not be placed over access roads, stockpiles, and other areas designated for fumed slag removal operations. The ET cover would not be placed on the unfumed slopes; instead, the 1-foot soil cover would be used because infiltration would be reduced on the side slopes as a result of the steeper grades. All soil-covered areas would be hydroseeded.

Grading the remaining slopes would add an additional 100,000 yd³ to that of the intermediate alternative, resulting in approximately 620,300 yd³ of slag to be moved. Cover soil extent would increase to 28.2 acres (47,300 yd³) and an ET cover of 9.2 acres (45,000 yd³). Figure C in Attachment 1 shows the relative area of cover for the maximum alternative. Figures 6, 7, and 8 in Attachment 2 show the grading plan and sections.

Cost Estimate

Estimated costs (at a concept level) for each alternative were prepared using rates developed from recent Custodial Trust projects, including the Prickly Pear Creek Realignment, Tito Park Area Removal/Interim Cover System (ICS) 1 Area Construction, and ET Cover/ICS 2/Demolition Phase 3 Construction Projects. Table 1 provides a cost summary. See Attachment 3 for cost estimate details.

Costing Assumptions

- The estimate is based on conceptual designs and therefore contains uncertainties and variables, with an anticipated accuracy range of -30 percent to +50 percent (concept level). The estimate is intended to place an order of magnitude on costs and provide a means of comparing the alternatives.
- The concrete containment at the million-gallon tanks will be broken but remain in place.
- Some demolition debris exists in the slag pile that will need to be hauled offsite to the local landfill; estimated at 0.5 percent of slag moved.
- The unfumed slag will be more difficult to move and will be harder on equipment relative to the fumed slag.
- Working the steep side slopes, especially those adjacent to the existing railroad right-of-way and above the existing creek, will decrease productivity.
- Cover soil, including that for ET cover, will come from the east fields.
- ET cover is 3 feet thick, similar to that placed on the former Smelter site .
- Unit pricing for the intermediate and maximum alternatives can be reduced based on better efficiencies due to the larger overall quantities and higher percentage of fumed slag handled.

Cost Summary

Table 1. Cost Summary

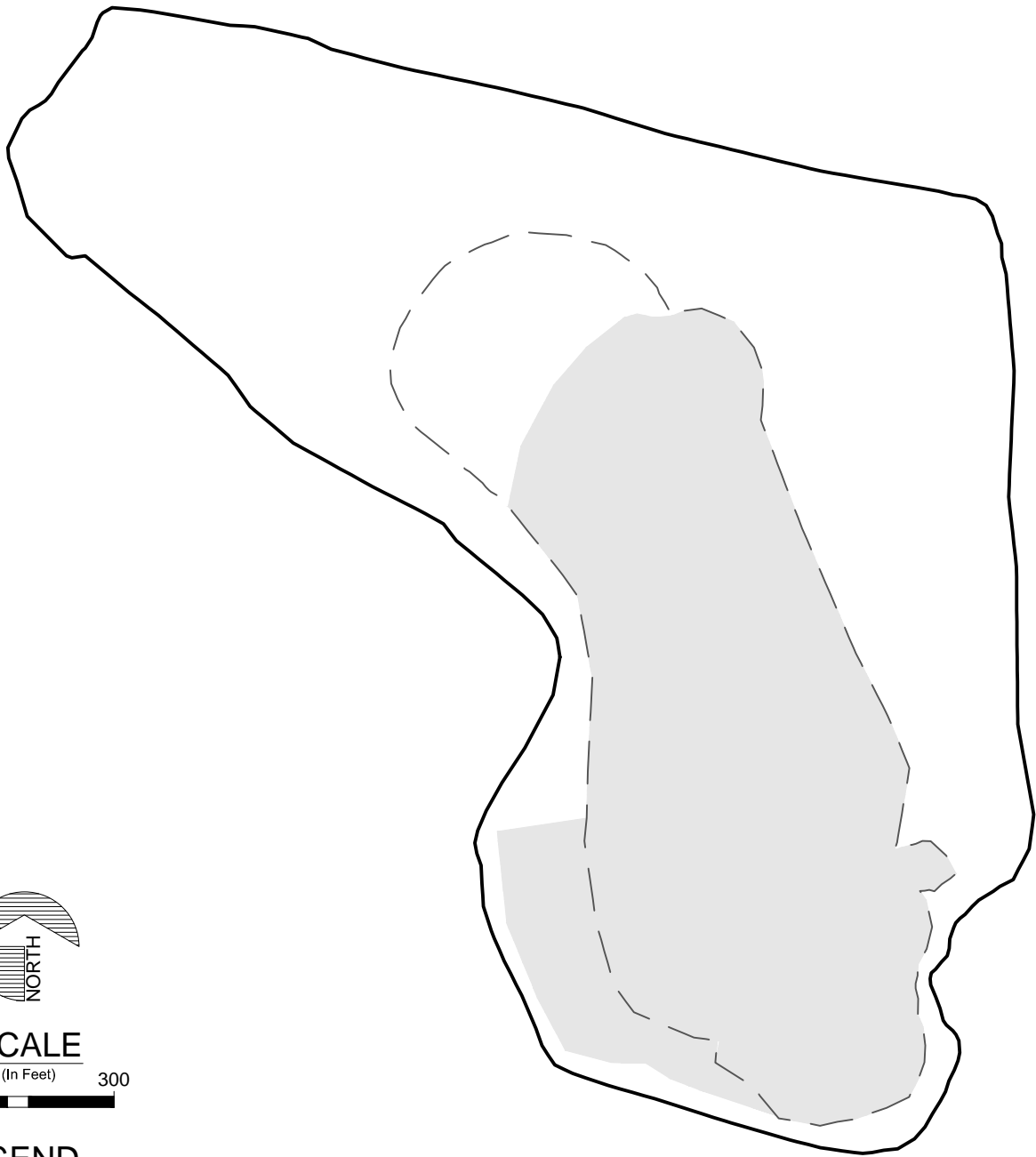
	Units	Minimum	Intermediate	Maximum
Slag Moved	yd ³	269,000	519,300	620,300
Soil Cover	Acre (yd ³)	17.5 (28,200)	25 (39,900)	28.2 (47,300)
ET Cover	Acre (yd ³)	-	-	9.3 (45,000)
Cost		\$4,536,000	\$8,063,000	\$9,863,000*
Cost Range		\$3.18M to \$6.80M	\$5.64M to \$12.09M	\$6.90M to \$14.79M**

* Addition of the ET cover represents an \$375,000 increase in total cost over that of a 12-inch soil cover on the same area.

** Addition of the ET cover represents a \$263,000 to \$563,000 increase in total cost over that of a 12-inch soil cover on the same area.

Attachment 1

Cover Figures



SCALE
(In Feet)
0 300

LEGEND

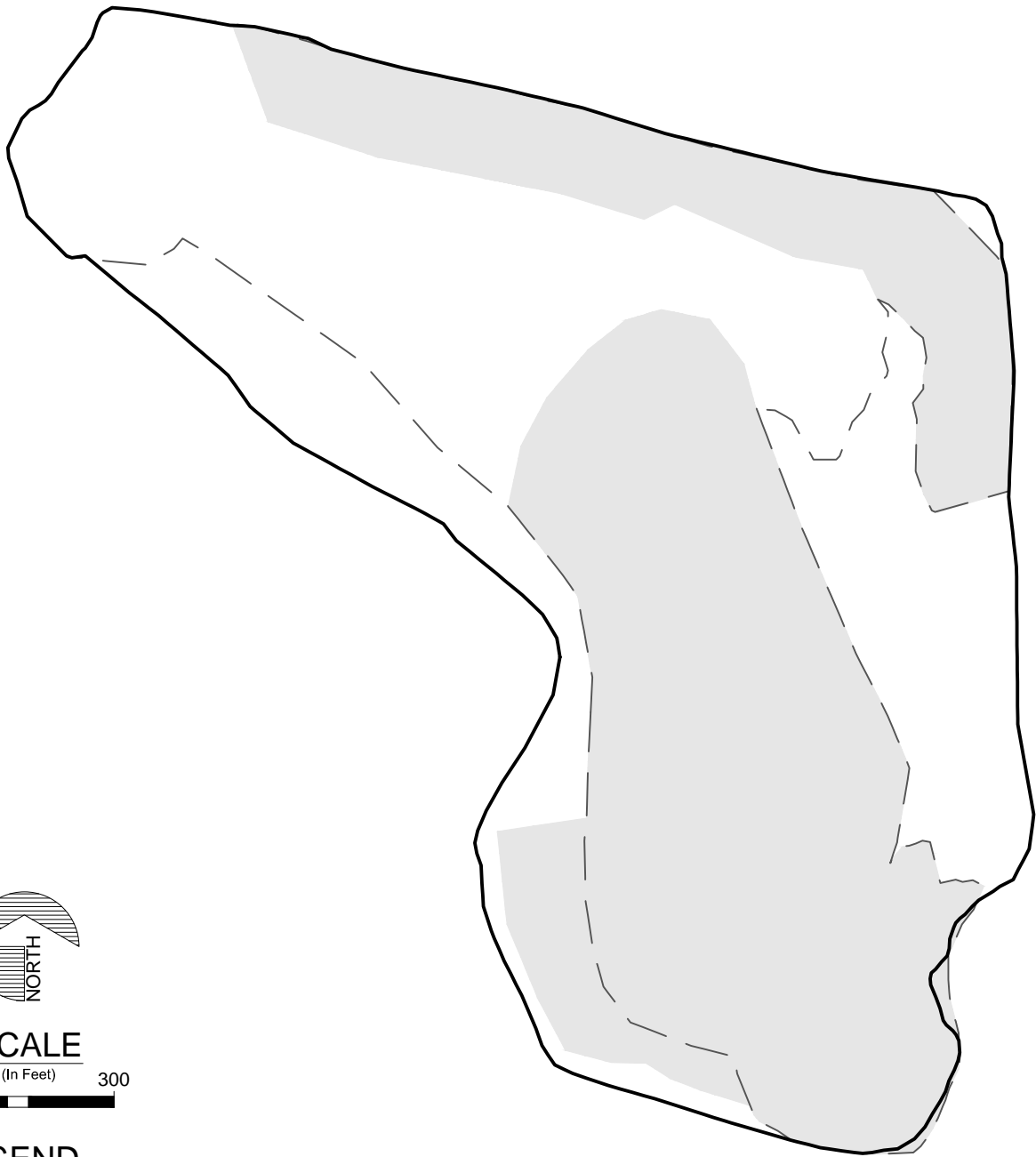
- 1-FOOT SOIL COVER
- EXISTING SLAG PILE FOOTPRINT (APPROX)
- GRADING LIMITS

METG East Helena Facility
Slag Pile Cover Concept

**Minimum Alternative
Covered Areas**

FIGURE

A



SCALE
(In Feet)
0 300

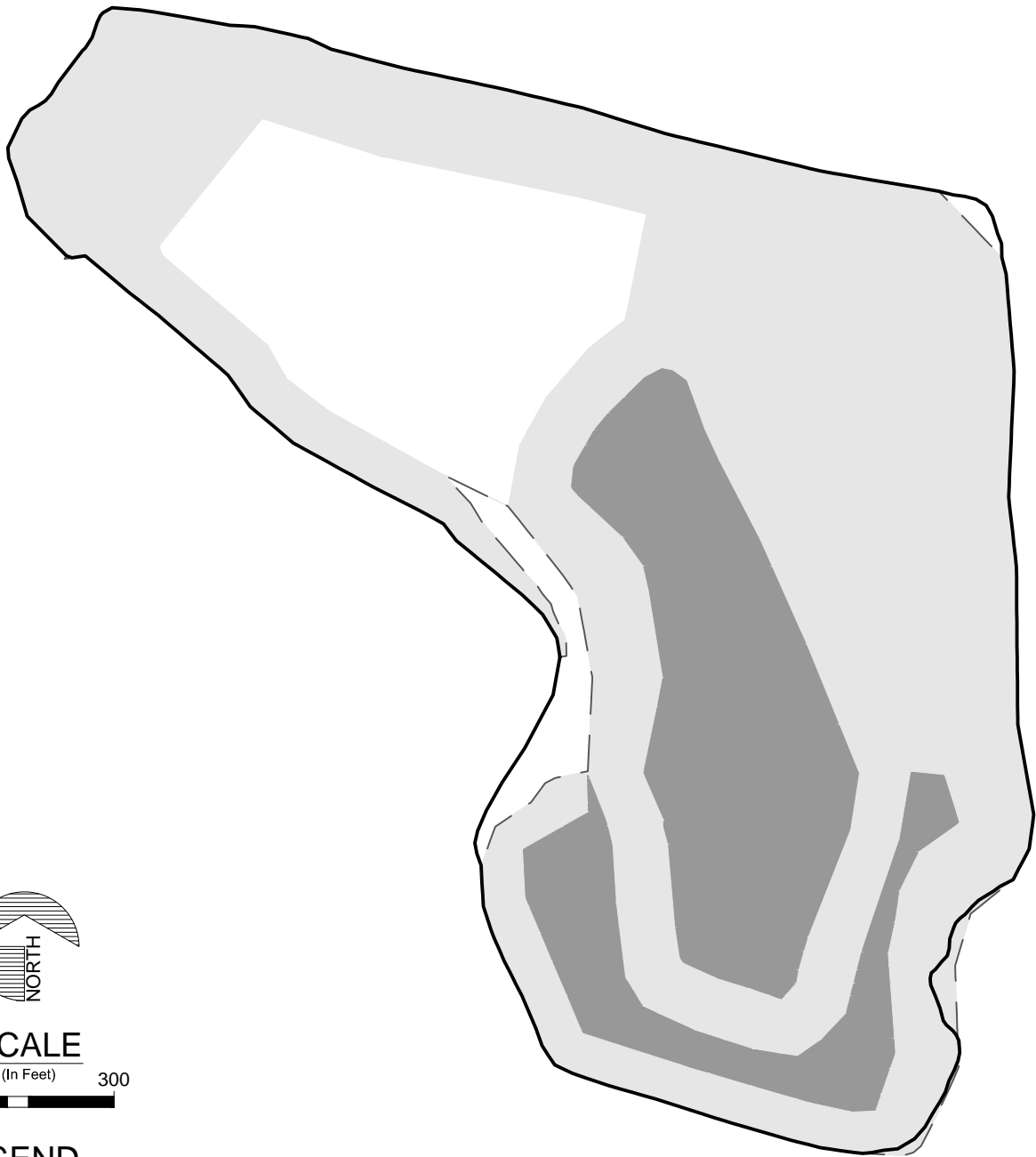
LEGEND

- 1-FOOT SOIL COVER
- EXISTING SLAG PILE FOOTPRINT (APPROX)
- GRADING LIMITS

METG East Helena Facility
Slag Pile Cover Concept

**Intermediate Alternative
Covered Areas**

FIGURE
B



LEGEND

- 3-FOOT ET COVER
- 1-FOOT SOIL COVER
- EXISTING SLAG PILE FOOTPRINT (APPROX)
- GRADING LIMITS

METG East Helena Facility
Slag Pile Cover Concept

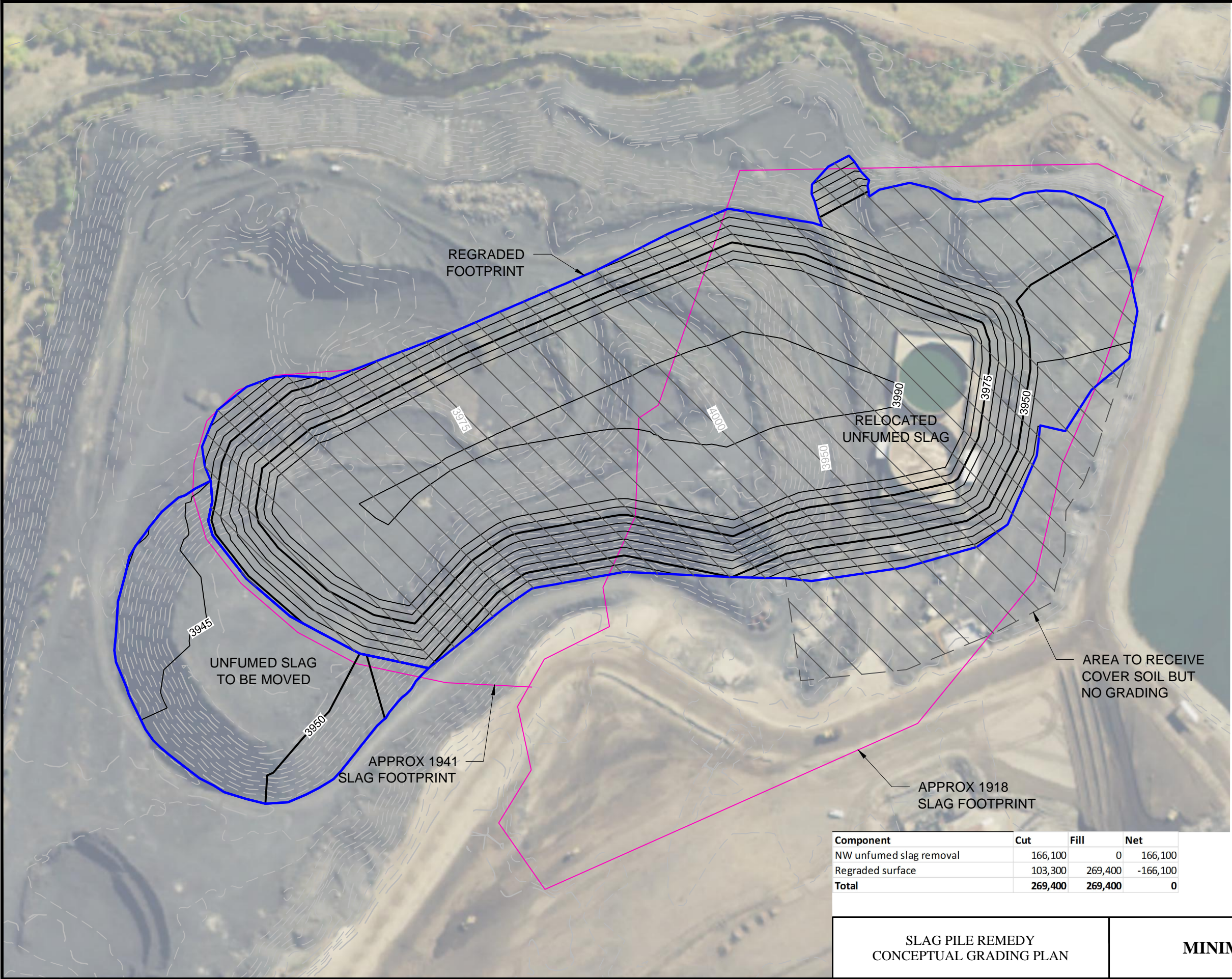
**Maximum Alternative
Covered Areas**

FIGURE

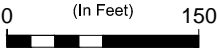
C

Attachment 2

Plans and Sections Figures



SCALE



LEGEND

- 1-FOOT SOIL COVER
- NO HATCH: NO SOIL COVER
- GRADING LIMITS

CONTOURS

- EXISTING (5' & 25')
- PROPOSED (5' & 25')

SOIL COVER:
SOIL COVER SURFACE AREA:
762,000 SF
REQD SOIL VOLUME, 1-FT COVER:
28,200 CY

ADDITIONAL NOTES:
2.5:1 SLOPES ALONG GRADED SLOPES
2% - 5% SLOPES FOR DRAINAGE

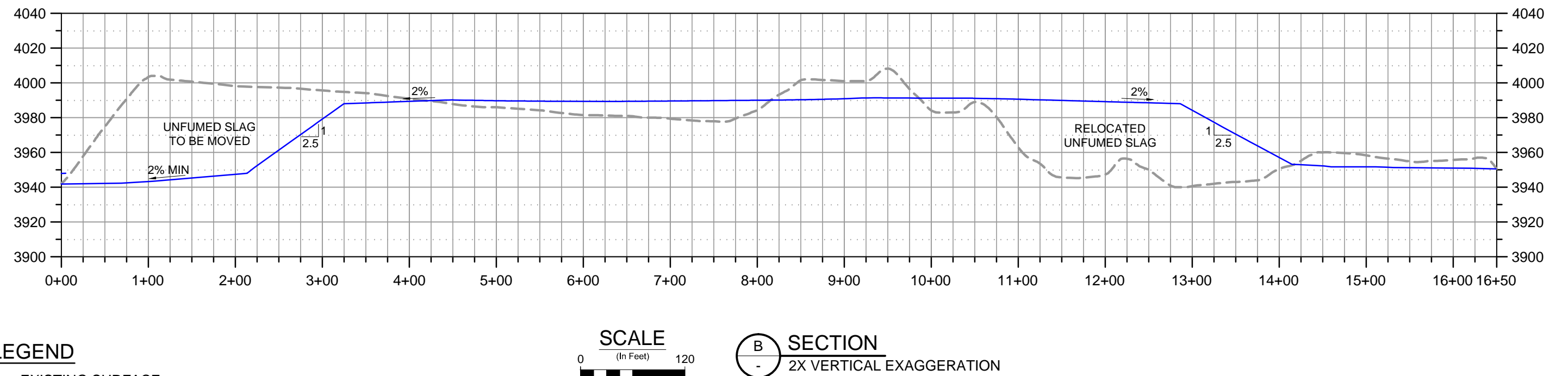
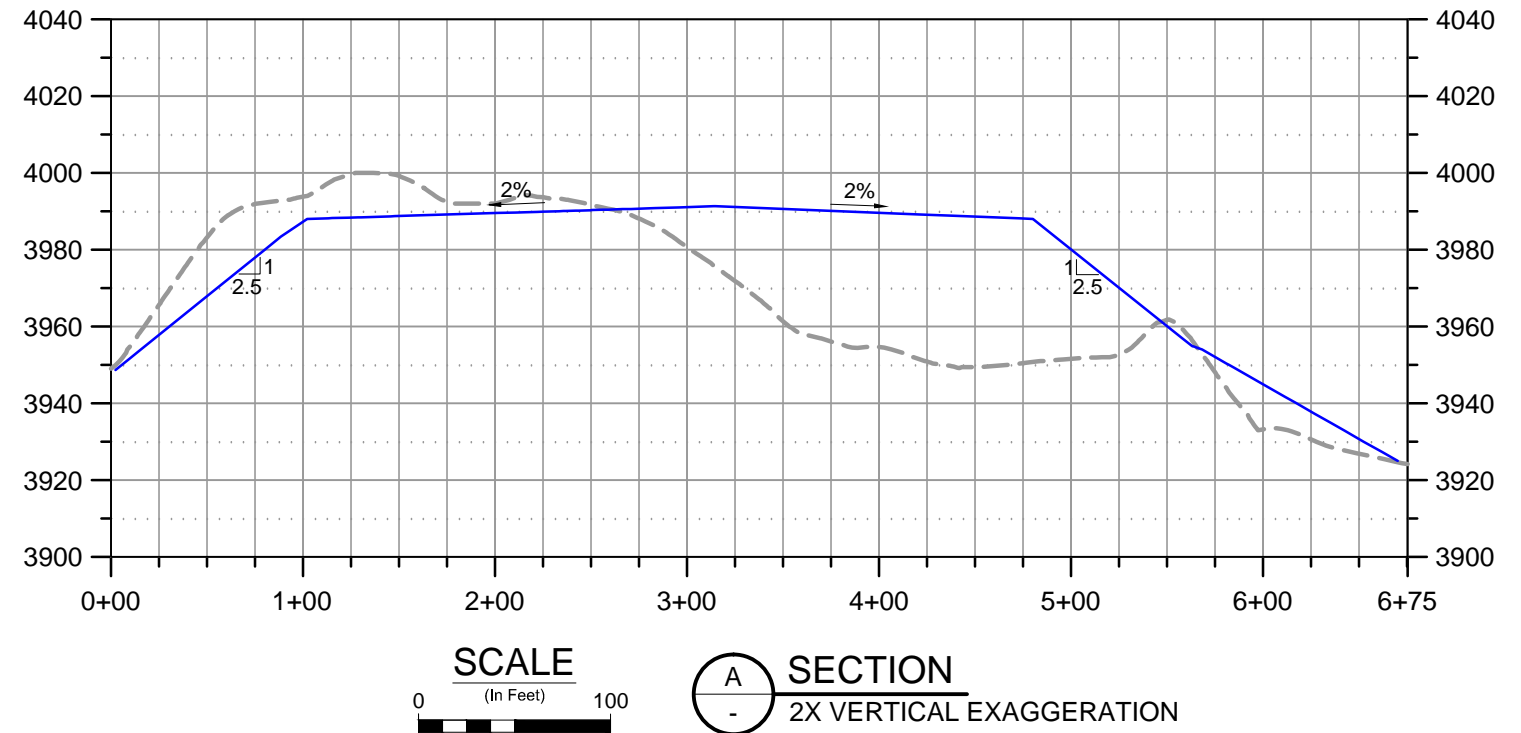
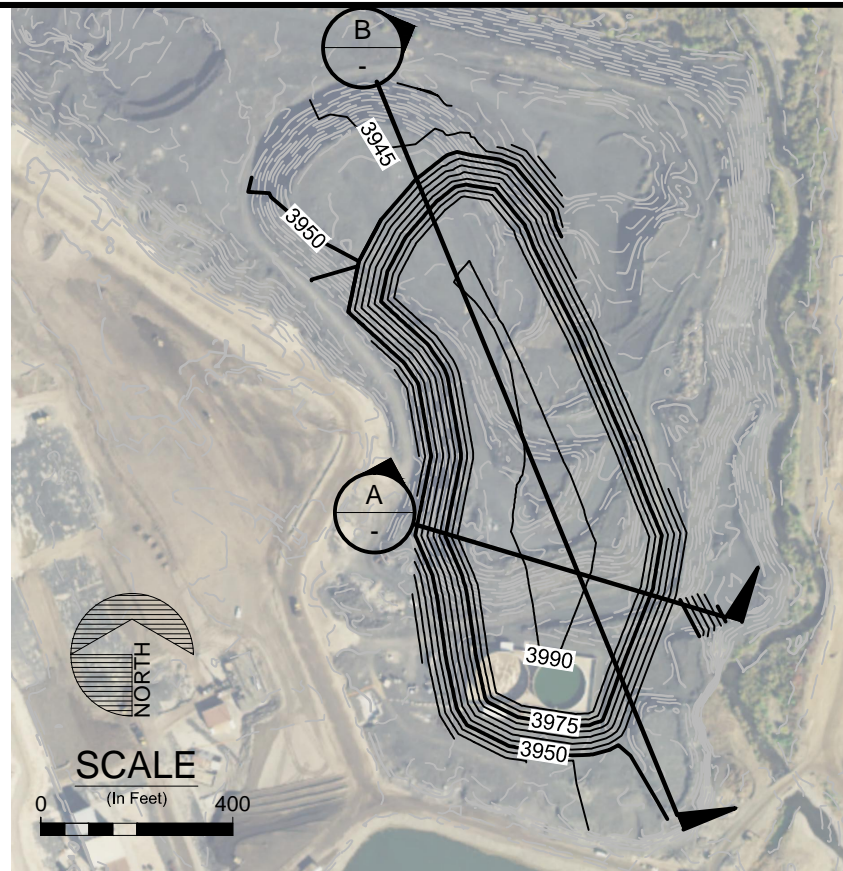
MOUND GRADED TO MATCH EXISTING
ELEVATIONS ALONG WEST AND SOUTH
EDGES; SOME CUT/FILL ALONG EAST AND
NORTH EDGES ASSUMING SMOOTHING OF
ADJACENT SLAG

Component	Cut	Fill	Net
NW unfumed slag removal	166,100	0	166,100
Regraded surface	103,300	269,400	-166,100
Total	269,400	269,400	0

SLAG PILE REMEDY
CONCEPTUAL GRADING PLAN

MINIMUM ALTERNATIVE

FIGURE
1

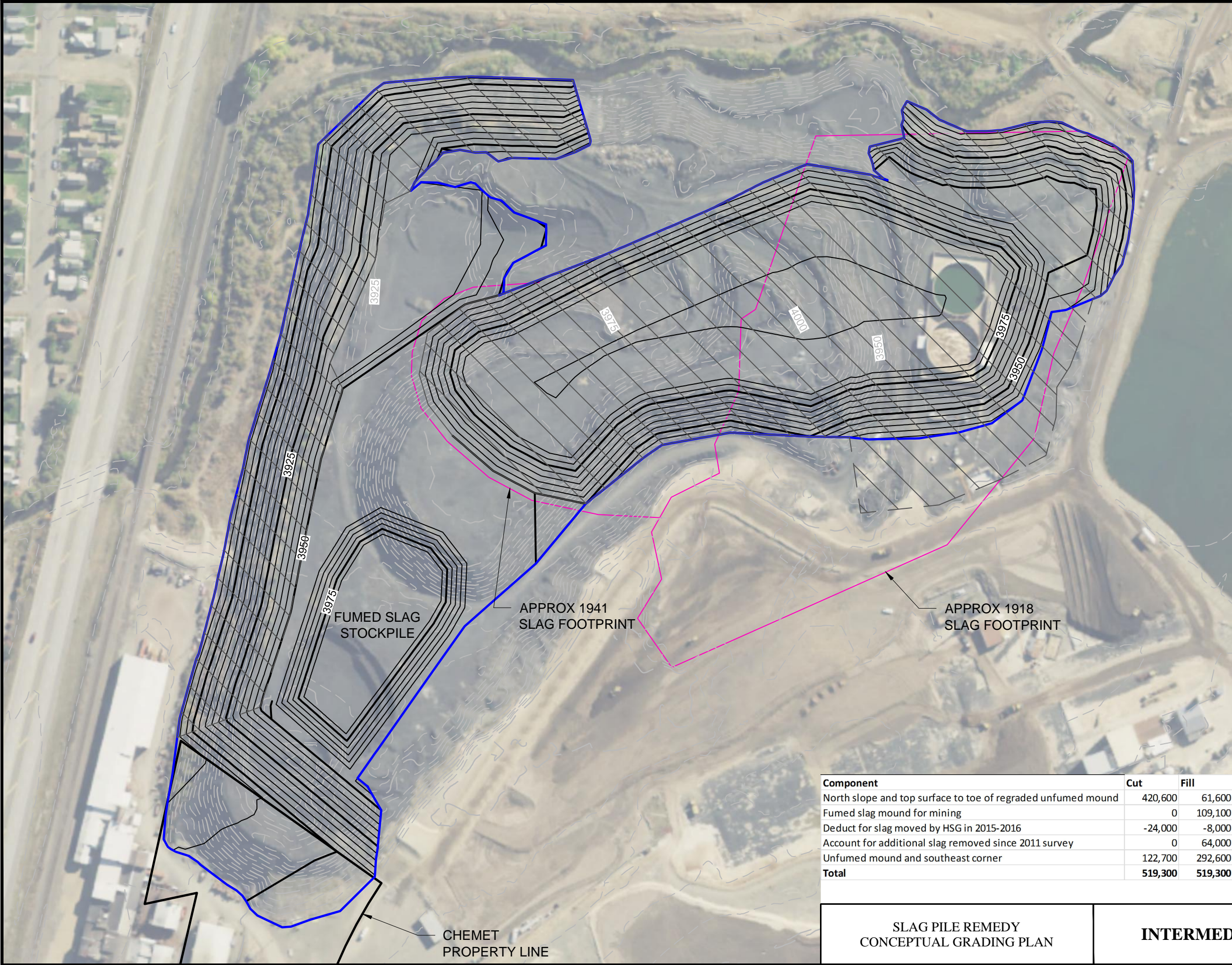


SLAG PILE REMEDY
CONCEPTUAL GRADING PLAN

MINIMUM ALTERNATIVE

FIGURE

2



LEGEND

1-FOOT SOIL COVER
NO HATCH: NO SOIL COVER
GRADING LIMITS

CONTOURS
EXISTING (5' & 25')
PROPOSED (5' & 25')

SOIL COVER:
UNFUMED SLAG SURFACE AREA:
801,000 SF
REQD SOIL VOLUME, 1-FT COVER:
29,700 CY

REMAINDER OF COVERED AREA
276,000 SF
REQD SOIL VOLUME, 1-FT COVER:
10,200 CY

ADDITIONAL NOTES:
2.5:1 SLOPES ALONG GRADED SLOPES
3.5:1 NEAR NORTHEAST CORNER
2:1 SLOPES ON FUMED SLAG MOUND
2% - 5% SLOPES FOR DRAINAGE

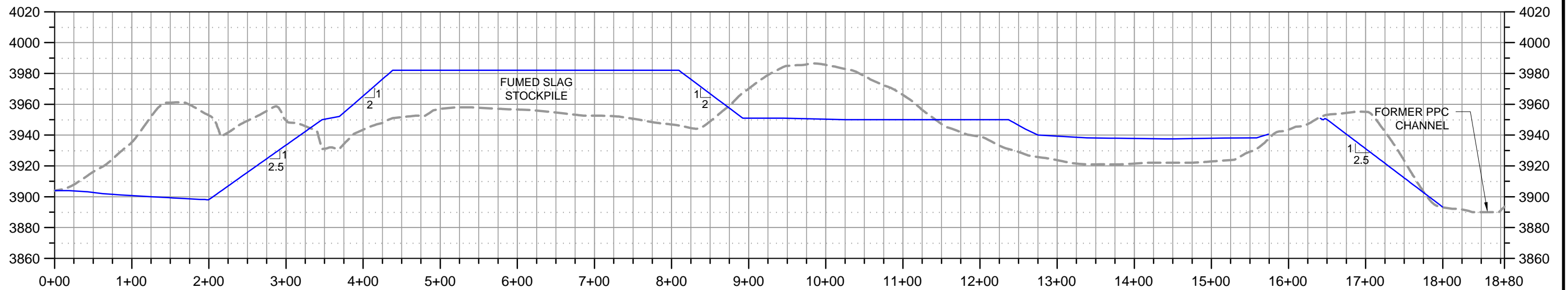
APPROX 144,000 CY CUT FROM CHEMET
PROPERTY LINE AND ADJACENT SLOPE

Component	Cut	Fill	Net
North slope and top surface to toe of regraded unfumed mound	420,600	61,600	359,000
Fumed slag mound for mining	0	109,100	-109,100
Deduct for slag moved by HSG in 2015-2016	-24,000	-8,000	-16,000
Account for additional slag removed since 2011 survey	0	64,000	-64,000
Unfumed mound and southeast corner	122,700	292,600	-169,900
Total	519,300	519,300	0

SLAG PILE REMEDY
CONCEPTUAL GRADING PLAN

INTERMEDIATE ALTERNATIVE

FIGURE
3

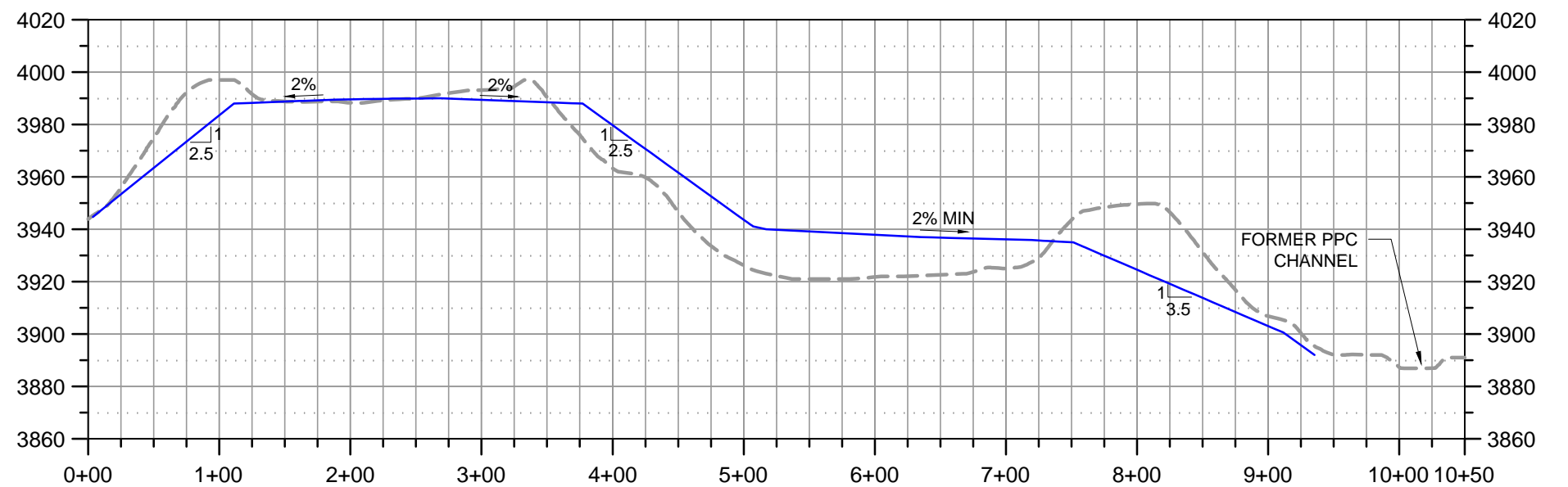
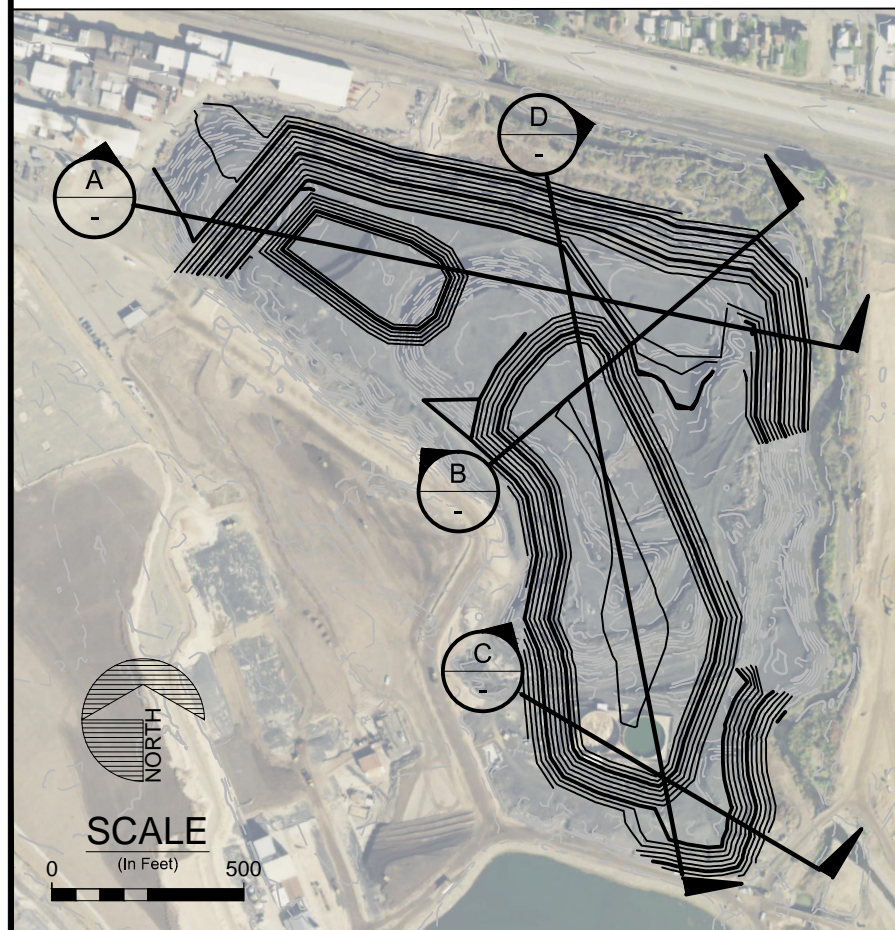


LEGEND

- EXISTING SURFACE
- PROPOSED TOP OF SLAG

SCALE
(In Feet)
0 130

SECTION A
2X VERTICAL EXAGGERATION



SCALE
(In Feet)
0 120

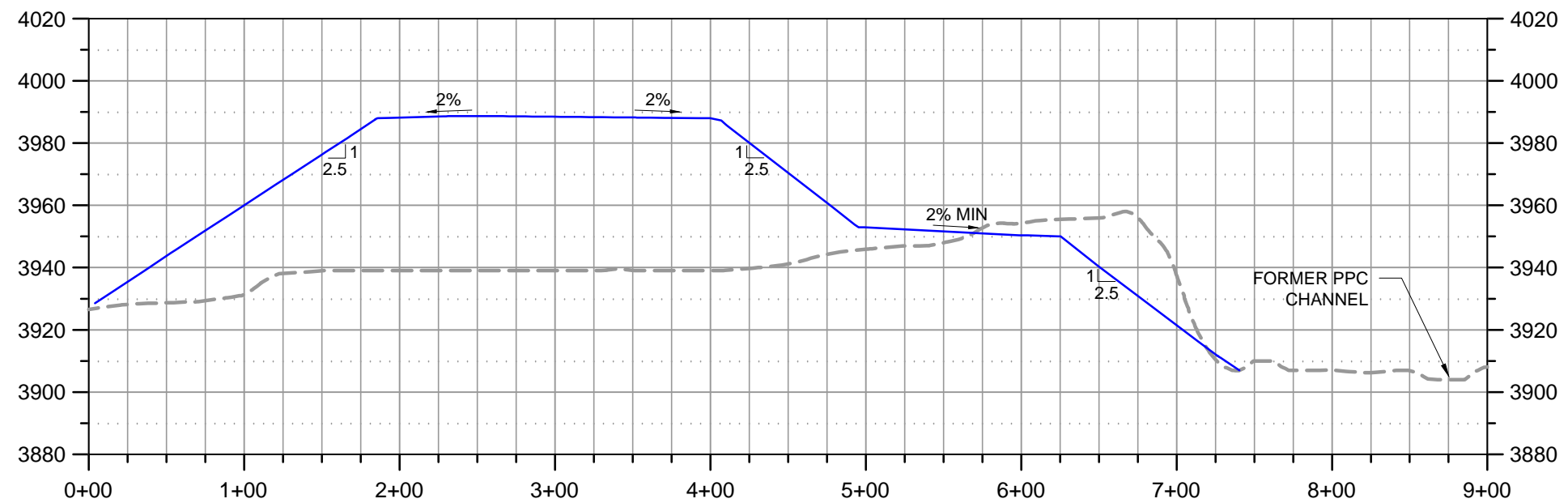
SECTION B
2X VERTICAL EXAGGERATION

SLAG PILE REMEDY
CONCEPTUAL GRADING PLAN

INTERMEDIATE ALTERNATIVE

FIGURE

4

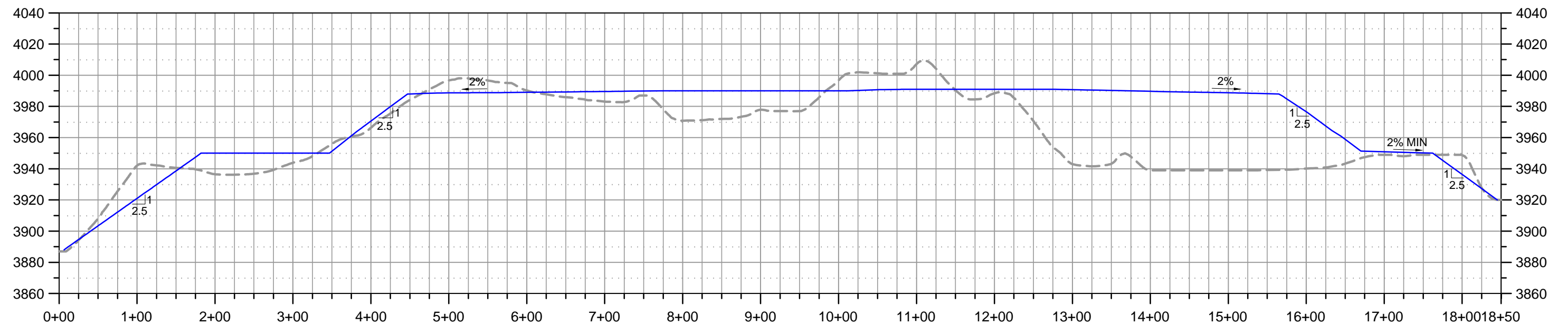


LEGEND

- EXISTING SURFACE
- PROPOSED TOP OF SLAG

SCALE
(In Feet)
0 100

SECTION
C
2X VERTICAL EXAGGERATION



SCALE
(In Feet)
0 130

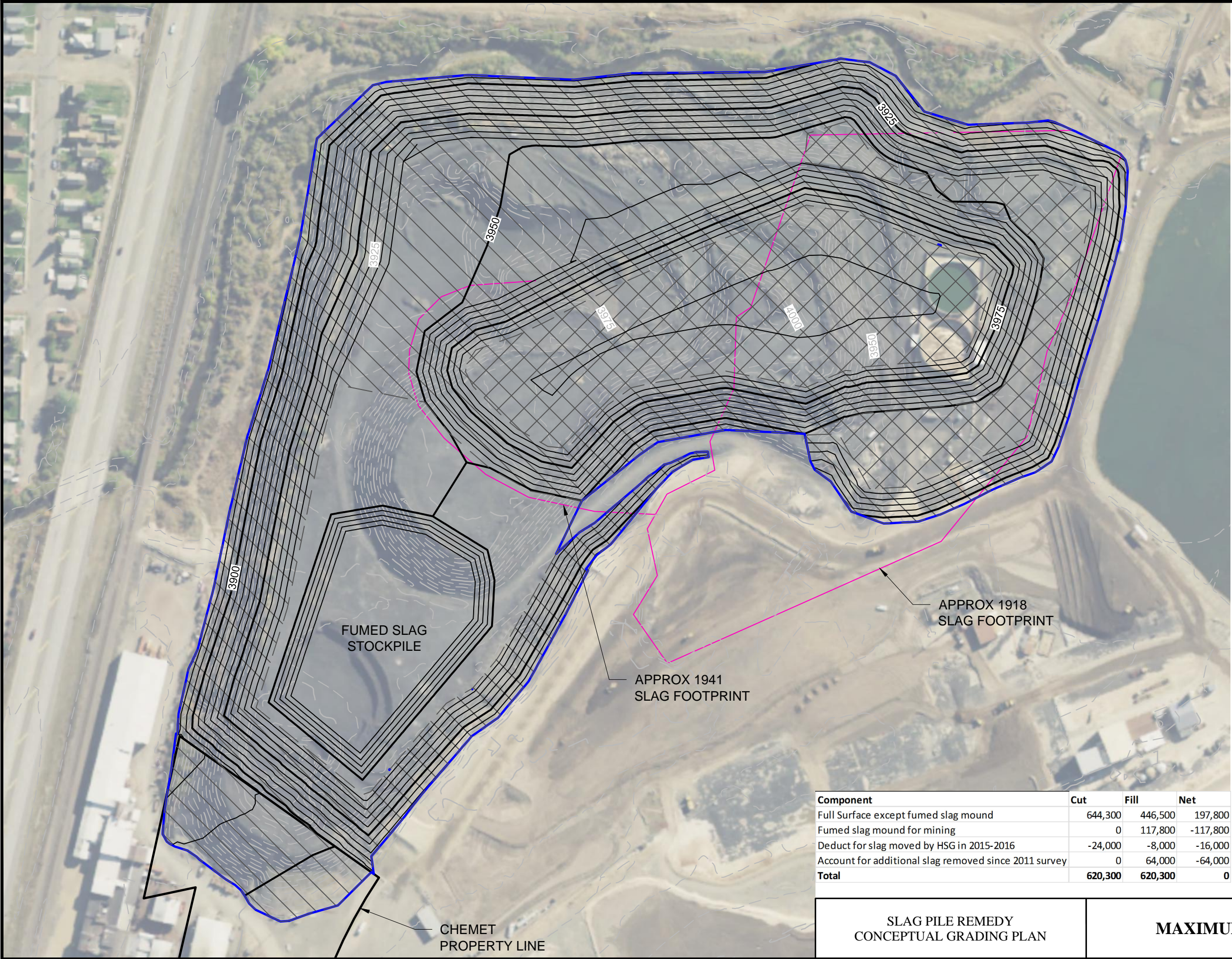
SECTION
D
2X VERTICAL EXAGGERATION

SLAG PILE REMEDY
CONCEPTUAL GRADING PLAN

INTERMEDIATE ALTERNATIVE

FIGURE

5



SCALE
(In Feet)
0 200

LEGEND

3-FOOT ET COVER
 1-FOOT SOIL COVER
NO HATCH: NO SOIL COVER
 GRADING LIMITS

CONTOURS
 EXISTING (5' & 25')
 PROPOSED (5' & 25')

SOIL COVER:
ET COVER SURFACE AREA:
405,000 SF
REQD SOIL VOLUME ASSUMING 3-FT ET COVER:
45,000 CY

REMAINDER OF COVERED AREA
1,277,000 SF
REQD SOIL VOLUME ASSUMING 1-FT COVER
47,300 CY

ADDITIONAL NOTES:
2.5:1 SLOPES ALONG GRADED SLOPES
3.5:1 NEAR NORTHEAST CORNER
2:1 SLOPES ON FUMED SLAG MOUND
2% - 5% SLOPES FOR DRAINAGE

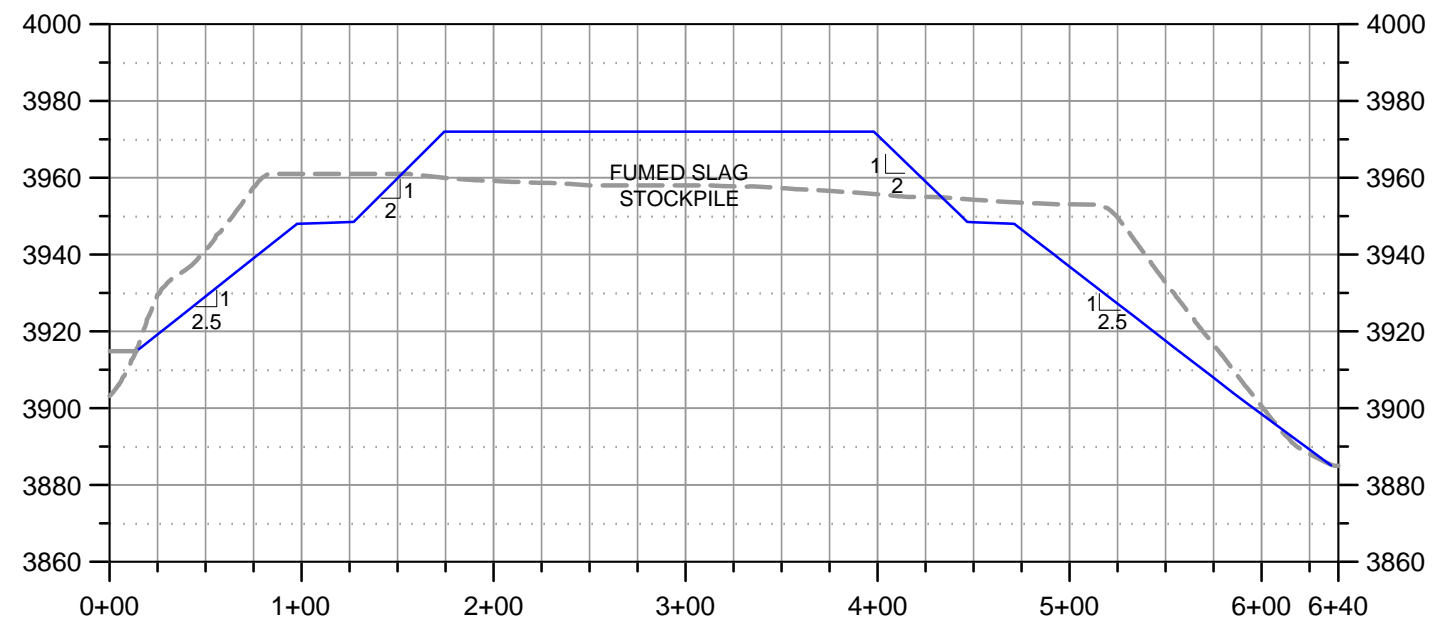
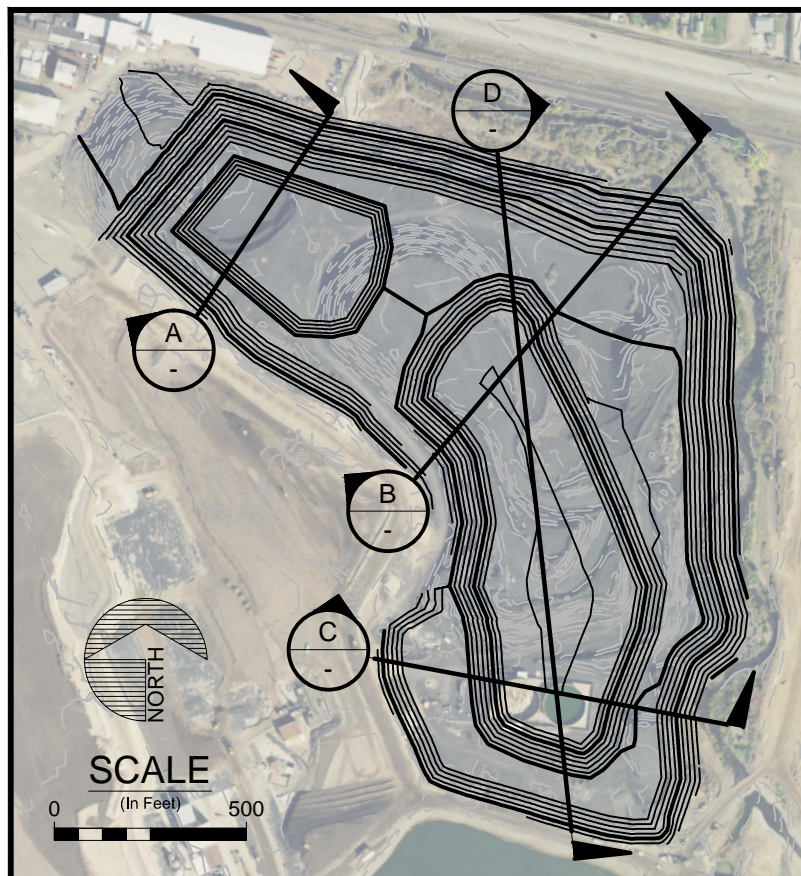
APPROX 144,000 CY CUT FROM CHEMET
PROPERTY LINE AND ADJACENT SLOPE

Component	Cut	Fill	Net
Full Surface except fumed slag mound	644,300	446,500	197,800
Fumed slag mound for mining	0	117,800	-117,800
Deduct for slag moved by HSG in 2015-2016	-24,000	-8,000	-16,000
Account for additional slag removed since 2011 survey	0	64,000	-64,000
Total	620,300	620,300	0

SLAG PILE REMEDY
CONCEPTUAL GRADING PLAN

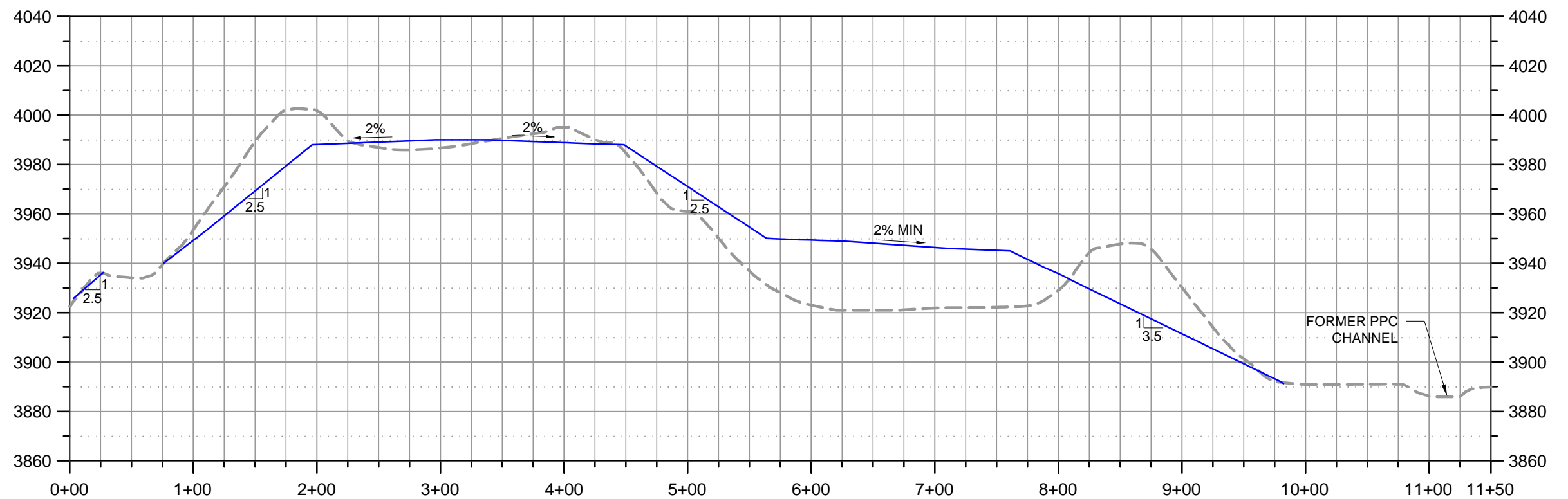
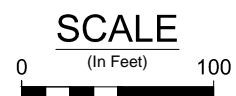
MAXIMUM ALTERNATIVE

FIGURE
6



LEGEND

- EXISTING SURFACE
- PROPOSED TOP OF SLAG



SLAG PILE REMEDY
CONCEPTUAL GRADING PLAN

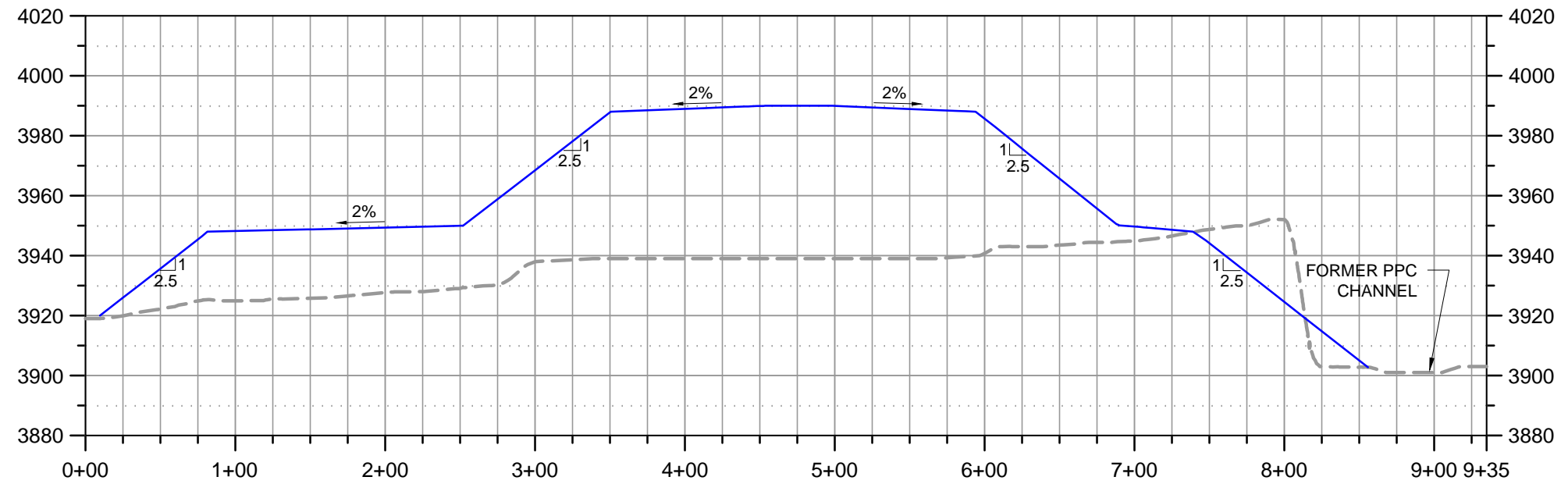
MAXIMUM ALTERNATIVE

FIGURE

7

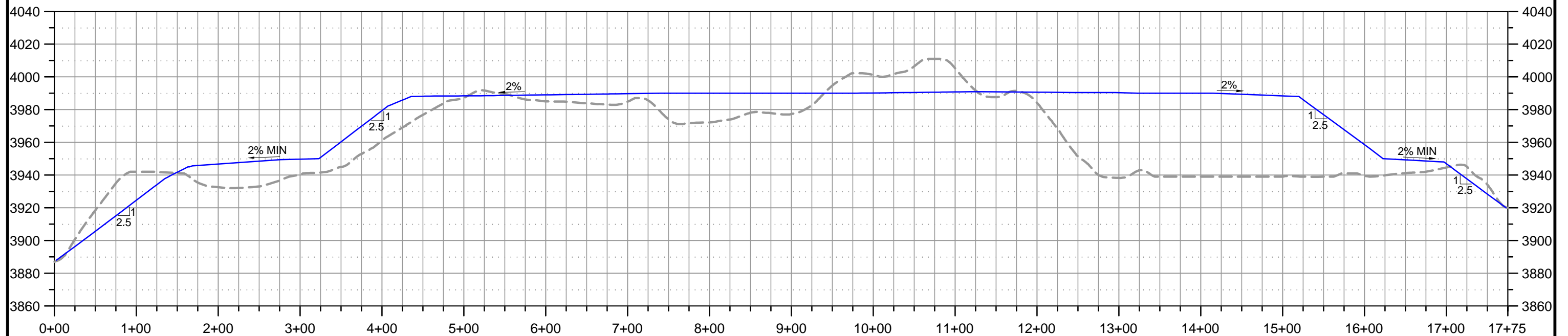
LEGEND

- EXISTING SURFACE
- PROPOSED TOP OF SLAG



SCALE
(In Feet) 0 100

SECTION C
2X VERTICAL EXAGGERATION



SCALE
(In Feet) 0 120

SECTION D
2X VERTICAL EXAGGERATION

SLAG PILE REMEDY
CONCEPTUAL GRADING PLAN

MAXIMUM ALTERNATIVE

FIGURE

8

Attachment 3

Cost Estimate

Slag Pile Cover Concept- Minimum Alternative

Conceptual Cost Estimate

Item	Description	Qty	Units	Unit Rate	Cost	Notes
1	Demolition	1	LS	\$ 30,000.00	\$ 30,000	Demo scope includes removal of the million gallon tanks system, assume concrete is broken and left in place, covered with slag
2	Waste Disposal	1,347	CY	\$ 35.00	\$ 47,145	Assume .5% of slag volume is waste requiring offsite disposal, \$35/cy, dispose at local landfill
3	Slag Grading	269,400	CY	\$ 9.00	\$ 2,424,600	Unit prices from PPC Realignment range 4.50 to 10.50/cy. Use 9.00 based on observed difficulties working in the slag.
4	Cover Soil	28,200	CY	\$ 6.00	\$ 169,200	Rate from TPA/ICS is 4.26/cy (from west fields). Use 6.00 to adjust for inflation and increased haul distance. Assume material comes from east fields area, 1ft thick
5	ET Cover	-	CY	\$ 7.00	-	Rates from ET/ICS2 are \$6.25/cy (35,700/ac), w/o seed maintenance. Use 7.00. Assumes 3ft thick
6	Hydroseeding	17.5	AC	\$ 2,400.00	\$ 41,983	Rates from PPC Realignment range from 1600 to 2900/acre, use 2400
Subtotal items 1-6					\$ 2,712,928	
7	Mobilization	1	LS	9.00%	\$ 244,164	Rates from ET/ICS2 cover and TPA/ICS1 range from 9.0 to 9.2% of major items total costs. Use 9%
8	Submittals, permits	1	LS	2.00%	\$ 54,259	Rates from ET/ICS2 cover and TPA/ICS1 range from 1.4 to 5.4% of major items total costs. Use 2%
9	Surveying	1	LS	3.00%	\$ 81,388	Rates from ET/ICS2 cover and TPA/ICS1 range from 2.5 to 6.1 of major items total costs. Use 3.0%
10	Site Preparation	1	LS	2.00%	\$ 54,259	Rates from ET/ICS2 cover and TPA/ICS1 range from 1.0 to 4.8% of major items total costs. Use 2%
11	Road Maintenance	1	LS	7.00%	\$ 189,905	Rates from ET/ICS2 cover are 7.2% of major items total costs. Use 7%
12	Stormwater Controls	1	LS	12.00%	\$ 325,551	Rates from ET/ICS2 cover and TPA/ICS1 range from 13.3 to 15.3% of major items total costs. Use 12%
13	Demobilization, restoration, cleanup	1	LS	2.00%	\$ 54,259	Rates from ET/ICS2 cover and TPA/ICS1 range from 1.5 to 3.1% of major items total costs. Use 2%
14	Closeout	1	LS	0.60%	\$ 16,278	Rates from ET/ICS2 cover and TPA/ICS1 range from 0.4 to 1.4% of major items total costs. Use .6%
Subtotal Items 7-14					27.3% \$ 1,020,061	
Subtotal Items 1-14					\$ 3,732,990	
15	Bonds	3,732,990	%	1.25%	\$ 46,662	
Subtotal					\$ 3,779,652	
16	Contingency	3,779,652	%	20.00%	\$ 755,930	
Total					\$ 4,535,582	
					\$ 4,536,000	Use

Slag Pile Cover Concept- Intermediate Alternative

Conceptual Cost Estimate

Item	Description	Qty	Units	Unit Rate	Cost	Notes
1	Demolition	1	LS	\$ 30,000.00	\$ 30,000	Demo scope includes removal of the million gallon tanks system, assume concrete is broken and left in place, covered with slag
2	Waste Disposal	2,597	CY	\$ 35.00	\$ 90,878	Assume .5% of slag volume is waste requiring offsite disposal, \$35/cy, dispose at local landfill
3	Slag Grading	519,300	CY	\$ 8.50	\$ 4,414,050	Unit prices from PPC Realignment range 4.50 to 10.50/cy. Use 8.50 based on increased total quantity and increased amount of unfumed slag over the minimum alternative (economy of scale).
4	Cover Soil	39,900	CY	\$ 6.00	\$ 239,400	Rate from TPA/ICS is 4.26/cy (from west fields). Use 6.00 to adjust for inflation and increased haul distance. Assume material comes from east fields area, 1ft thick
5	ET Cover	-	CY	\$ 7.00	-	Rates from ET/ICS2 are \$6.25/cy (35,700/ac), w/o seed maintenance. Use 7.00. Assumes 3ft thick
6	Hydroseeding	25	AC	\$ 2,400.00	\$ 59,339	Rates from PPC Realignment range from 1600 to 2900/acre, use 2400
Subtotal items 1-6					\$ 4,833,666	
7	Mobilization	1	LS	9.00%	\$ 435,030	Rates from ET/ICS2 cover and TPA/ICS1 range from 9.0 to 9.2% of major items total costs. Use 9%
8	Submittals, permits	1	LS	1.70%	\$ 82,172	Rates from ET/ICS2 cover and TPA/ICS1 range from 1.4 to 5.4% of major items total costs. Use 1.7%
9	Surveying	1	LS	3.00%	\$ 145,010	Rates from ET/ICS2 cover and TPA/ICS1 range from 2.5 to 6.1 of major items total costs. Use 3.0%
10	Site Preparation	1	LS	2.00%	\$ 96,673	Rates from ET/ICS2 cover and TPA/ICS1 range from 1.0 to 4.8% of major items total costs. Use 2%
11	Road Maintenance	1	LS	7.00%	\$ 338,357	Rates from ET/ICS2 cover are 7.2% of major items total costs. Use 7%
12	Stormwater Controls	1	LS	12.00%	\$ 580,040	Rates from ET/ICS2 cover and TPA/ICS1 range from 13.3 to 15.3% of major items total costs. Use 12%
13	Demobilization, restoration, cleanup	1	LS	2.00%	\$ 96,673	Rates from ET/ICS2 cover and TPA/ICS1 range from 1.5 to 3.1% of major items total costs. Use 2%
14	Closeout	1	LS	0.60%	\$ 29,002	Rates from ET/ICS2 cover and TPA/ICS1 range from 0.4 to 1.4% of major items total costs. Use .6%
Subtotal Items 7-14					27.2% \$ 1,802,958	
Subtotal Items 1-14					\$ 6,636,624	
15	Bonds	6,636,624	%	1.25%	\$ 82,958	
Subtotal					\$ 6,719,582	
16	Contingency	6,719,582	%	20.00%	\$ 1,343,916	
Total					\$ 8,063,498	
					\$ 8,063,000	Use

Slag Pile Cover Concept- Maximum Alternative

Conceptual Cost Estimate

Item	Description	Qty	Units	Unit Rate	Cost	Notes
1	Demolition	1	LS	\$ 30,000.00	\$ 30,000	Demo scope includes removal of the million gallon tanks system, assume concrete is broken and left in place, covered with slag
2	Waste Disposal	3,102	CY	\$ 35.00	\$ 108,553	Assume .5% of slag volume is waste requiring offsite disposal, \$35/cy, dispose at local landfill
3	Slag Grading	620,300	CY	\$ 8.20	\$ 5,086,460	Unit prices from PPC Realignment range 4.50 to 10.50/cy. Use 8.20 based on increased total quantity and increased amount of unfumed slag over the minimum alternative (economy of scale).
4	Cover Soil	47,300	CY	\$ 6.00	\$ 283,800	Rate from TPA/ICS is 4.26/cy (from west fields). Use 6.00 to adjust for inflation and increased haul distance. Assume material comes from east fields area, 1ft thick
5	ET Cover	45,000	CY	\$ 7.00	\$ 315,000	Rates from ET/ICS2 are \$6.25/cy (35,700/ac), w/o seed maintenance. Use 7.00. Assumes 3ft thick
6	Hydroseeding	39	AC	\$ 2,400.00	\$ 92,672	Rates from PPC Realignment range from 1600 to 2900/acre, use 2400
Subtotal items 1-6					\$ 5,916,485	
7	Mobilization	1	LS	9.00%	\$ 532,484	Rates from ET/ICS2 cover and TPA/ICS1 range from 9.0 to 9.2% of major items total costs. Use 9%
8	Submittals, permits	1	LS	1.60%	\$ 94,664	Rates from ET/ICS2 cover and TPA/ICS1 range from 1.4 to 5.4% of major items total costs. Use 1.6%
9	Surveying	1	LS	3.00%	\$ 177,495	Rates from ET/ICS2 cover and TPA/ICS1 range from 2.5 to 6.1 of major items total costs. Use 3.0%
10	Site Preparation	1	LS	2.00%	\$ 118,330	Rates from ET/ICS2 cover and TPA/ICS1 range from 1.0 to 4.8% of major items total costs. Use 2%
11	Road Maintenance	1	LS	7.00%	\$ 414,154	Rates from ET/ICS2 cover are 7.2% of major items total costs. Use 7%
12	Stormwater Controls	1	LS	12.00%	\$ 709,978	Rates from ET/ICS2 cover and TPA/ICS1 range from 13.3 to 15.3% of major items total costs. Use 12%
13	Demobilization, restoration, cleanup	1	LS	2.00%	\$ 118,330	Rates from ET/ICS2 cover and TPA/ICS1 range from 1.5 to 3.1% of major items total costs. Use 2%
14	Closeout	1	LS	0.60%	\$ 35,499	Rates from ET/ICS2 cover and TPA/ICS1 range from 0.4 to 1.4% of major items total costs. Use .6%
Subtotal Items 7-14					27.1% \$ 2,200,932	
Subtotal Items 1-14					\$ 8,117,417	
15	Bonds	8,117,417	LS	1.25%	\$ 101,468	
Subtotal					\$ 8,218,885	
16	Contingency	8,218,885	LS	20.00%	\$ 1,643,777	
Total					\$ 9,862,662	
					\$ 9,863,000	Use