4.0 EXHIBIT C – MILL PLAN (SEC 6.3.3)

4.1 BACKGROUND

The Mill (permitted under Calais Colorado Resources, Inc. Permit M1990-057) is scheduled to commence operations with mill closure to occur in 2040. The planned facility, with the reconstructed TSF (Section 4.3, Tailings Storage Facility), has sufficient capacity to operate approximately ~~1 year at 160t/d~~ 0.5 years at 200tpd.

Leadville Mining and Milling, Inc. constructed the mill in 1989 to process ore from the Hopemore Mine located 8mi east of the Mill. The mine and mill commenced production in 1989 and operated sporadically for ~~less than two~~ approximately 10 years. A building permit was obtained in December 1987 and certificates of occupancy (Sec. 7.0, Exhibit F) were issued for the crusher building on October 5, 1990 and the mill building on November 9, 1990. The Mill was originally selected-to:

- Locate the tailings storage facility.
- Mitigate the generation of airborne migration of dust from the TSF disposal area;
- Isolate milling activities from neighbors and heavy traffic.
- Locate in close proximity to electric power, water, and natural gas; and,
- Minimize haulage distance within the mining district.

The mill site is located in a heavily wooded area on the lee side of an east-west trending hill which affords maximum protection from the normal prevailing wind from the northwest. The mill maintains a minimum cleared area to afford a good firebreak distance around the buildings, roads and tailings storage area.

The nearest inhabited buildings to the mill permit boundary is a structure ~~(Mellott)~~ (Benson) located about ~~550ft~~ (190ft) northwest, a house ~~(Mellott)~~ (Fowler) located approximately 800ft west and a house ~~(Wibbenmeyer~~) (Wood) located approximately 550ft west.

Sec. 13, Exhibit L describes and illustrates the location of "Permanent Man-Made Structures" within 200ft of the permit boundary.

The Mill and associated facilities are illustrated on Figure 6-2.

~~Figure 4-1 through Figure~~ The current facility includes 2 separate metal buildings:

- Mill Building. The mill building contains the fine ore bin, reagent storage area, ball mill circuit, flotation circuit, concentrate thickener, laboratory, mill office, safety/training/change room, concentrate storage room, and restroom; and
- Crushing Building. The crushing building contains the RoM grizzly, primary, and secondary crushers. It is connected to the mill building via an enclosed conveyor crossover bridge.

Upgrades proposed include:

- Truck scale.
- RoM storage pad.
- New crusher building.
- Conveyor connecting new crusher to main building
- Leach tank and detox tank pad

Other facilities include:

- 2 primary water monitoring wells.
- 1 shallow monitoring well in mostly dry perched aquifer.
- Electric utility line.
- Trailer foundation.
- Sewage lift station.
- Upper and lower gravel mill access roads.
- 3 ore stockpiles, 1 topsoil stockpile, 1 TSF overburden stockpile, a TSF redesigned to meet CDRMS performance standards, as summarized in (See Section 4.3, Tailings Storage Facility and geotechnical analysis (Sec. 15.0, Geotechnical Stability 6.5).

The property boundary is surrounded by a 4-strand animal-friendly fence, as prescribed by CDOW (Appendix 7-9).

The facility can be accessed by either an upper (north) or lower (south) road. Within the permit area, these roads connect to a 24ft-wide gravel access road connecting to US Highway 24. RoM ore haulage will access the grizzly on the upper mill road. Concentrate shipments, will use the lower mill road.

The fine ore feed bin, chemicals and reagents are contained in the Mill Building (Figure). Reagents and chemicals used in ore processing will be stored in over-pack drums or within secondary containment structures. Any leakage, or containment issues with the stored chemicals or reagents will be directed to the mill sump and then to the TSF (Figure 4-) or collected and disposed in an approved disposal facility. Waste management activities are discussed in greater detail in Sec. 14, Exhibit U, Designated Mining Operation Environmental Protection Plan.

The ~~concentrate~~ reagent storage room is a 24ft by 20ft extension located at the southwest corner of the Mill Building immediately adjacent to the mill sump. ~~The concentrates will be placed in 2- ton "supersacks" or 55 gallon drums, or client-specified shipping containers for offsite shipment~~.

~~A new crushing facility, which will allow for selective ore handling and storage, is scheduled for construction in the next expansion phase. The crushing facility will include;~~

- ~~Truck scales;~~
- ~~Multiple RoM concrete storage bunkers;~~
- ~~An enclosed crushing and screening building; and~~
- ~~A conveyor system connecting to the Mill Building.~~

4.2 Mill Management Activities (Sec 6.3.3(2)(a))

The mill will be reconfigured to use conventional agitated leaching, using sodium cyanide from low-grade vein dumps (RoM) located nearby. Each area supplying RoM will operate on an independent Reclamation Permit to be issued by CDRMS.

~~The Mill uses conventional technology via a combination of crushing, grinding, classification, flotation, gravity concentration and filtration. Design of the mill is such that either oxide or sulfide ores may be concentrated. The process flow sheet is shown in Figure 4-.~~[4]

4.2.1 Process Flowsheet

Figure 4-1 shows a simplified process flowsheet and material balance. Design criteria used to develop this flowsheet are based on metallurgical test work completed in January 2021. Key design parameters are summarized in Table 4-1.

[4] A1AR1Q6

TABLE 4-1: LEADVILLE MILL, DESIGN CRITERIA

Item	Design Parameter	Value	Unit
Physical Parameters			
1	RoM Moisture	4%	-
2	Plant Capacity	400	dstpd
3	Plant Availability	92%	-
4	Calculated Capacity	453	dstpd
Crushing Circuit			
5	Operating Hours	8	hr/day
6	Availability	75%	-
7	Trommel Fines	50%	-
8	Feed Rate	50% 277.8 31.7	% stpd stph
9	RoM Feed, F_{80}	102	mm
10	Crusher Product, P_{80}	12.5	mm
11	Fine Ore in Capacity	280	stpd
Mill Circuit			
12	Ball Mill Work Index (BWi)	15.45	-
13	Mill Feed, F_{80}	12,500	micron
14	Mill Product, P_{80} (cyclone O/F)	104	micron
Leach Circuit			
15	Thickener Feed	30%	solids
16	Leach Feed	40%	solids
17	Leach Time	18/24	hours
18	Feed Solids, Pressure Filter	40%	solids
19	Filtration Rate	500	lb/ft^2-hr
20	Filtration Product	80%	solids
21	Repulp Tank	50%	solids
22	Detox Tank	50% 4	solids hours
23	Vacuum Filter, Drum	100	lb/ft^2-hr

TROMMEL & CRUSHING CIRCUIT

A new crushing building will house the trommel, crusher and screens. Basis of crusher design includes the following:

- **The RoM ore delivered by trucks, weighed, and stored in a ~~35t~~** 200st **capacity coarse ore bin, (~~Figure~~) will be crushed in a two-stage operation to a final size of about -3/8". A conveyor will move the ore to the 200t fine ore bin located in the mill building**.[5]

[5] A1AR1Q7/Q26

- RoM will first go through a trommel where fines will be washed and sent directly to the ball mill circuit. Coarse material will report to the crusher.
- The trommel/crusher will operate 8-hours per day during day shift. This will also mitigate noise during nighttime hours.

Trommel and crusher circuit equipment performance criteria are shown in Table 4-2.

TABLE 4-2: TROMMEL & CRUSHER PERFORMANCE CRITERIA

Equipment Performance	Value	Unit
Trommel		
Operating Time	8	hr/day
	54.3	dstph
Residue Time	5	min
Pulp Density	30%	-
Primary Crusher		
Feed	27.2	stph
F_{80}	50	mm
P_{80}	18	mm
Screen Aperture	18	mm
Secondary Crusher		
Feed	13.6	stph
F_{80}	18	mm
P_{80}	12.5	mm

GRINDING CIRCUIT

Since the trommel/crusher will only operate 8-hrs/day, an operating philosophy was developed for steady state plant operation. This results in the ball mill processing 13.58stph fines and 5stph coarse material during the 8-hours of trommel/crusher operation and 11.95stph coarse material only during the remaining 16 operating hours.

The thickener will stabilize the operation, providing a steady 20stph feed to the leach circuit.

Trommel and crusher circuit equipment performance criteria are shown in Table 4-3.

TABLE 4-3: GRINDING PERFORMANCE CRITERIA

Equipment Performance	Value	Unit
Fine Ore Bin		
Capacity	200	stpd
Ball Mill		
F_{80}	12,500	micron
P_{80}	104	micron
BWi	15.45	-
Operating Hours	20	hr/day
Rate (8-hr/day)	18.58	hr/day
Rate (16-hr/day)	11.9	Hr/day
Horsepower	200-250	hp
Horsepower. Max	300	hp
Ball Mill Sump		
Flowrate	600	gpm
Residue Time	4	min
Sump Capacity (@90% capacity)	2,670	gal
Cyclone		
Operating Units	2	units
Standby Units	1	units
Flowrate, total	600	gpm
Flowrate, per unit	300	gpm
Thickener		
Feed	25%	solids
Unit Area	0.12	ft^2/tpd
Underflow	40	solids
Diameter	10	feet

LEACH & MERRILL CROWE CIRCUIT

Dissolution of gold (Au) and siler (Ag) using cyanide (CN) was developed in the late-19th century. Dissolution occurs as:

$$4Au + 8NaCN + O_2 + 2H_2O \rightarrow 4NaAu(CN)_2 + 4NaOH$$

Merrill Crowe is a process which uses zinc to precipitate Au and Ag from cyanide solution using direct reduction reactions as:

$$2Au(CN)2 + Zn \rightarrow 2Au + Zn(Cl)4\text{-}2$$
$$2Au(CN)2 + Zn + 3OH\text{-}1 \rightarrow 2Au + HZnO2\text{-}1 + CN\text{-}1 + H2O$$

Trommel and crusher circuit equipment performance criteria are shown in Table 4-4.

TABLE 4-4: LEACH & MERRILL CROWE PERFORMANCE CRITERIA

Leach Circuit		
Feed	40%	solids
Leach Time	18-Hr/24-Hr	hours
Volume (w/ 10% freeboard)	26,400/35,200	ft^3
Tanks	4	no. of units
Tanks Size, 12-hour leach	16 x 32	ft dia. x ft height
Tank Size, 24-hour leach	18 x 36	ft dia. x ft height
Holding Tank		
Feed	40%	solids
Residue Time	2	hrs
Residence Time	10	hrs
Filter Cake	12 x 24	ft dia. x ft height
Pressure Filter		
Feed	40%	solids
Filtration Rate	500	lb/ft^2-hr
Area Required	80	ft^2
Filter Cake	80%	solids
Repulp Tank		
Residence Time	5	min
Volume	600	ft^3
Solids	50%	solids
Tank Size	9 x 9	ft dia. X ft height
Detox		
Feed	50%	solids
Residence Time	4	Min.
Volume	3,947	ft^3
Tank size	18 x 18	ft dia. x ft height
Drum Filter		
Feed	50%	solids
Filtration Rate	100	lb/ft^2-hr
Filter Cake	75	solids
Area Required	400	ft^2

4.2.2 PROCESS MATERIAL BALANCE

The material balance for the Mill was developed in concurrence with the process flowsheet and is shown in Table 4-5. The stream number shown correspond with the orange-colored numbers in the Figure 4-1 flowsheet. Note the operational changes when the trommel/crusher is not operating (green shading).

TABLE 4-5: PROCESS MATERIAL BALANCE

Stream	Description	Solids (%)	TPH		Slurry (gpm)
			Solids	Water	
1	RoM Ore	96.0%	54.30	2.26	-
2	Trommel Oversize	95.0%	27.15	1.43	-
3	Trommel Fines	18.0%	27.15	123.01	537.57
4	Primary Crusher Product	95.0%	27.15	1.43	-
5	Feed to Screen	95.0%	33.94	1.79	-
6	Screen Oversize	95.0%	6.79	0.36	-
7	Secondar Crusher Product	95.0%	6.79	0.36	-
8	Feed to Storage Bin	95.0%	27.15	1.43	-
9	Fine Ore Bin discharge	95.0%	5.00	0.26	-
9	Fine Ore Bin discharge	95.0%	11.90	0.63	-
10	Ball Mill Feed	57.0%	18.58	13.84	83.98
10	Ball Mill Feed	95.0%	11.90	0.63	-
11	Ball Mill Discharge	57.0%	18.58	13.84	83.98
11	Ball Mill Discharge	65.0%	23.80	12.82	86.87
12	Cyclone Feed	25.6%	45.73	136.35	591.29
12	Cyclone Feed	40.0%	23.80	35.70	178.95
13	Cyclone Underflow	50.0%	13.58	13.58	74.82
13	Cyclone Underflow	65.0%	11.90	6.40	43.43
14	Cyclone Overflow	20.7%	32.15	123.27	530.80
14	Cyclone Overflow	28.8%	11.90	29.30	134.83
14	Thickener Feed	18.2%	20.00	89.72	396.00
15	Thickener O/F	-	-	73.36	238.54
16	Thickener U/F	40.0%	20.00	30.00	150.40
17	Leach Circuit Feed	40.0%	20.00	30.00	150.40
18	Leach Circuit Discharge	40.0%	20.00	30.00	150.40
19	Holding Tank	40.0%	20.00	30.00	150.40
20	Pressure Filter Cake	80.0%	20.00	5.00	20.00
21	Pregnant Solution	-	-	30.00	120.00
22	Feed to Merrill Crowe	-	-	30.00	120.00
23	Barren Solution	-	-	30.00	120.00
24	Gold Precipitate	-	0.12	trace	-
25	Repulp Tank	50.0%	20.00	20.00	110.20
26	Drum Filter Feed	50.0%	20.00	20.00	110.20
27	Filtrate	-	-	13.33	53.32
28	Leach Residue	75.0%	20.00	6.67	55.20
29	Process Water	-	-	124.44	-
30	Process Water	-	-	5.75	-
31	Process Water to Sump	-	-	22.88	-
32	Wash Water	-	-	5.00	20.00
33	Barren Solution	-	-	15.00	-

Note: Non-shaded streams denote operation with crusher operation. Shaded streams replaced non-shaded streams when crusher is not operating

4.2.3 LABORATORY

Laboratory activities will include bulk density, screening, flotation, AA assaying and thickening testing. A Marcy bulk density scale will be used for bulk density testing. Both wet and dry screening will take place in the laboratory. Samples for screen test will be crushed and ground with laboratory scale equipment. Wet screen material will be dried in a microwave oven. Neither the bulk density nor screen tests require the use of reagents.

Flotation test will be conducted to optimize the flotation process. Samples ranging from 50-100g will be floated using small quantities of reagents already on site. After testing, float samples will be reintroduced into the process.

Thickening test will be conducted using small amounts of environmentally friendly polyacrylactes.

Sample preparation will also be performed in the laboratory.[6]

4.2.4 CHEMICAL REAGENT INVENTORY

TROMMEL & CRUSHING CIRCUIT

There are no chemicals or reagent associated with the trommel and crushing circuit.

GRINDING & AGITATED LEACH CIRCUIT

Unit consumption rates as well as daily and monthly reagent consumption is shown in Table 4-6. A small amount of copper sulfate will be kept on site for testing, although not required for the process

TABLE 4-6: REAGENT CONSUMPTION, GRINDING & AGITATED LEACH CIRCUIT

No.	Reagent	Consumption		
		Unit Rate (lbs./st)	Daily (lbs.)	Monthly (tons)
1	Water - H_2O (1)	0.33	133	4,058
2	Flocculant	0.02	8.00	0.12
3	Lime - CaO	8.00	3,200	49
4	Sodium Cyanide - NaCN	4.00	1,600	24
5	Sodium Bisulfite - $NaHSO_3$	0.50	200	3.0
6	Copper Sulfate - $CuSO_4$	0	0	0.025
7	Lead Nitrate - $Pb(NO_3)2$	0.01	4.00	0.06

(1) Water consumption is reported in tons.

[6] A1AR1Q16

Refinery

Unit consumption rates as well as daily and monthly reagent consumption is shown in Table 4-7.

Table 4-7: Reagent Consumption, Refinery

No.	Reagent	Consumption			
		Quantity	Units	Daily (lbs)	Monthly (lbs)
1	Zinc Oxide - ZnO	0.20	lbs/ton	79	2,414
2	Borax - $Na_2[B_4O_5(OH)_4]$	-	-	-	200
3	Soda Ash - Na_2O_3	-	-	-	100
4	Silica Sand - SiO_2	-	-	-	400
5	Potassium Nitrate - KNO_3	-	-	-	150
6	Fluorspar - CaF_2	-	-	-	5
7	Silicon Carbide Cement - SiC [(2)]	-	-	-	< 10

(1) These reagents are used during au-Ag pours, so only monthly values are reported.
(2) Silicon Carbide is used as needed for furnace repair.

Other Reagents

Other reagents and chemicals that will be on site are shown in Table 4-8.

Table 4-8: Reagent Consumption, Refinery

No.	Reagent	Consumption			
		Quantity	Units	Monthly Quantity	Units
1	Diesel Fuel	10	gal/day	304	gallons
2	Hydraulic Fluid	0.25	gal/day	8	gallons
3	Oil - Gear Boxes	0.01	gal/day	0.3	gallons
4	Gear lube - Ball Mill & others	0.001	gal/day	0.03	gallons

On-Site Inventory

On-site inventory is shown in Table 4-9. Reagents will be stored in a secured-access area in the Mill. Lubricants will be stored in flame-protected metal cabinets.

TABLE 4-9: ON-SITE REAGENT INVENTORY

No.	Reagent	Quantity	Units
1	Water - H_2O	30,000	gal
2	Flocculant	243	lbs.
3	Lime - CaO	24	tons
4	Sodium Cyanide - NaCN	6	tons
5	Sodium Bisulfite - $NaHSO_3$	3	tons
6	Copper Sulfate - $CuSO_4$	50	lbs.
7	Lead Nitrate - $Pb(NO_3)2$	0	lbs.
8	Zinc Oxide - ZnO	1	ton
9	Borax - $Na_2[B_4O_5(OH)_4]$	200	lbs.
10	Soda Ash - Na_2O_3	100	lbs.
11	Silica Sand - SiO_2	400	lbs.
12	Potassium Nitrate - KNO_3	150	lbs.
13	Flourspar - CaF_2	5	lbs.
14	Silicon Carbide Cement - SiC (1)	50	lbs.
15	Diesel Fuel	125	gallons
16	Hydraulic Fluid	10	gallons
17	Oil - Gear Boxes	1	gallon
18	Gear lube - Ball Mill & others	1	gallon

~~Lime, xanthate, pine oil, copper sulfate and DAF-30 are the chemicals/reagents stored within the mill. Lime, xanthate, copper sulfate and DAF-30 are dry reagents and the pine oil is a liquid reagent. Table 4-, summarizes the estimated reagent inventory, daily consumption and monthly inventory. Only one day's operating supply is in the reagent feeders at any one time.~~

~~Copper sulfate ($CuSO_4$) will be used in instances where polymetallic sulfide ores containing high lead and silver values exist. $CuSO_4$ is a reagent used in the flotation process to suppress zinc and increase lead recovery and lead concentrate grade. It is important to have the ability to split lead and zinc as lead smelters pay 95-96% for silver in the concentrates, whereas zinc smelters do not pay for silver.~~

~~When used, consumption rate will be between 0.05 - 0.10lb/(st) or 12lbs/day. The annual consumption is estimated to be 500lbs given that $CuSO_4$ will not be used all the time. $CuSO_4$ will be purchased in bulk dry form sold in 50lb bags. Two hundred and fifty pounds will be kept in inventory.~~[7]

~~**Table 4-5: Estimated Reagent Inventory**~~

~~Reagent~~	~~Chemical Symbol~~	~~Solution Shipped~~	~~Daily Use~~	~~Shipping Container~~	~~Inventory (monthly)~~
~~Hydrated Lime~~	~~$Ca(OH)_2$~~	~~100%~~	~~32 lb~~	~~50lb (bag)~~	~~40 bags~~

[7] A1AR1Q38

~~Xanthate~~	~~TBD~~	~~93%~~	~~11 lb~~	~~286 lb (drum)~~	~~2 drums~~
~~Pine Oil~~	~~n/a~~	~~100%~~	~~7 lb~~	~~286 lb (drum)~~	~~2 drums~~
~~Flocculent~~	~~n/a~~	~~95%~~	~~1.3 lb~~	~~286 lb (drum)~~	~~1 drums~~
~~Copper Sulfate~~	~~$CuSO_4$~~	~~100%~~	~~12 lb~~	~~50lb (bag)~~	~~5 bags~~

~~No less than 1ton of lime will be on site at any given time for purposes of detoxification or stabilization of all designated chemicals and toxic or acid forming materials.~~[8]

~~Secondary spill containment in the mill building is controlled by a sealed collection sump built into the concrete floor at the lower end of the mill . The containment sump holds approximately 1,000gal of liquids and/or sediments. Tertiary containment is the TSF facility.~~

4.2.5 SOLUTION MANAGEMENT

Spill containment in the mill building will be accomplished by; first localizing containment and clean-up, and second by directing any remaining spill to the sump build into the concrete floor and located at the lower end of the building. ~~In the sump, the walls are sealed to the base of the sump.~~

Liquid quantities of reagent in use at one time are small (see Table 4-) to minimize risk due to spillage and waste. Chemicals not needed immediately, will be stored in Over-pack Barrel containers. The reagent mixing area is at the fine ore bin level. Any spillage not cleaned up at the source will be washed down to the sump. If chemical laden water gets to the sump, it can be pumped up to the tailings trough which will flow to will be pumped to the TSF (see Figure 6-2) to mix and dilute with the water decanting from the tailings in-the TSF.[9]

Operation solution volumes are summarized in Table 4-11. Primary containment, representing tanks and facilities used in the operation, amounts to approximately ~~14,000~~ 328,900 gal. Secondary containment consists of the sump and is located at the lower level of the mill building. The sump area can hold about ~~69%~~ 5,000gal of the tanks and facilities located within the mill building. In the event of 100% primary containment failure, the TSF will serve as the tertiary containment facility. The maximum capacity of the TSF assumes a 3ft freeboard. The first 1ft of the freeboard ~~(500,000gal)~~ 425,000 gal represents the tertiary capacity of the TSF. Tertiary containment, therefore represents over 35 times all primary containment facilities.[10]

[8] A1AR1Q43
[9] A1AR1Q9
[10] A1AR1Q13

TABLE 4-10: OPERATION SOLUTION VOLUMES

Description	Primary Containment (gallons)	Secondary Containment (gallons)	Tertiary Containment (gallons)
Interior Mill Building			
Primary process water tank No. 1	5,000	-	-
Primary process water tank No. 2	5,500	-	-
Domestic water	2,000	-	-
Reclaim tank No. 1	1,650	-	-
Reclaim tank No. 2	2,250	-	-
Crushing/washing			
Trommel fines floor sump	200		
Grind thickener	900		
Overflow tank	100		
Wash area floor sump	200		
Grinding			
Ball Mill	150	-	-
Ball Mill sump	300		
Thickener	6,800		
Thickener feed tank	200		
Thickener overflow tank	400		
Grinding area floor sump	200		
Leaching			
Leach tank # 1	68,500		
Leach tank # 2	68,500		
Leach tank # 3	68,500		
Leach tank # 4	68,500		
Filter feed head tank	20,300		
Leach area floor sump	200		
Merrill Crowe			
Pregnant solution storage	1,000		
Clarifier	200		
Pre coat mix & storage tank	100		
D.E. slurry floor sump	200		
Vacuum tower	200		
Steady head tank	100		
Cooling bath	50		
CN Detox			
Re-pulp tank	1,900		
CN Destruct tank # 1	1,900		
CN Destruct tank # 2	1,900		
Wash solution holding tank	500		
Re-pulp area sump	200		
Reagents & Utilities			
CN mixing tank	200		
Ferric sulfite mixing tank	50		
Floc mixing tank	50		
Totals			
Total volume of solutions	328,900		
Main building Sump		5,000	-
Subtotal Interior Mill Building		5,000	0
TSF (1ft freeboard)		-	425,000
Total Containment		5,000	425,000

Ore will be geochemically characterized, and ore metal values will be evaluated prior to processing. Ore seller information and the characteristics of the ore as outlined in Section 4.6 will be determined prior to receiving or processing ore.

The plant is anticipated to operate at a rate of 8tph ore throughput using 3-8 hour shifts per day for a 20-shift cycle with the 21st shift reserved for maintenance. ~~With additional downtime and operational delays, the mill will operate at 160tpd or 56ktpy.~~

4.2.6 DUST CONTROL

Dust control within the Mill buildings will be accomplished utilizing a 4,000cfm UAS Dust Hawg horizontal cartridge dust collector. Dust will be managed in the crushing plant by use of a ducted exhaust air system which will draw air and dust down through the crusher and transfer points. Pollutants from the screening, primary and secondary crushing circuits, conveyance systems, and fine ore storage operations will be limited to fugitive particulate matter. Negative pressure ventilation will direct venting to the dust collector to control the flow of fugitive particulate matter during screening and crushing operations.

The unit is estimated to operate at air velocities of 3,500-4,500fpm based on demand and manual control dampers at each collection point. The dust collector is rated at 4,000cfm and upgradable to 6,000cfm. The dust control unit is designed to capture 28.2tpy crushed ore fugitive particulate matter and an additional 0.4tpy reagent fugitive particulate matter for a combined 165lb/day at a 99.8% at 0.5µm published design efficiency. The captured dust will be pulse-cleaned off the filters in the dirty air plenum and collected in drums and returned to the material flow in the grinding circuit.

The items below have been superseded in this Permit Amendment Application and are retained for reference and completeness.

4.2.1 Material Handling

Ore will be dumped directly from haul trucks into a 35t capacity coarse ore bin prior to feeding the crusher circuit (Figure). Upstream of the crusher is a vibratory screen designed to screen out 3/8" minus material bypassing the crushing circuit. The crushing circuit is composed of a 9"x15" jaw crusher, which discharges directly into a roll crusher (16"x10" face). Ore will report to the vibratory screen where oversize material will report to the primary and secondary crushers before being conveyed to the fine ore bin. Undersized material will by-pass the crushing circuit and will be conveyed directly to the fine ore bin.

The jaw crusher will be set to a closed side setting of approximately 0.5''. The product from the jaw crusher will report directly to the secondary roll crusher. Product from the roll crusher will join the screen undersize to be conveyed to the fine ore bin (Figure). The fine ore bin has a maximum capacity of 100t.

The Mill uses conventional technology via a combination of crushing, grinding, classification, flotation and gravity concentration and filtration. Design of the mill is such that either oxide or sulfide ores may be concentrated. The RoM ore delivered by trucks, weighed, and stored in a 35t capacity coarse ore bin, (Figure) will be crushed in a two-stage operation to a final size of about -3/8". A conveyor will move the ore to the 100t fine ore bin located in the mill building.

In the future, a new crushing/screening and storage receiving facility will be constructed which will allow RoM ore to be dumped directly from the trucks into bunkers prior to feeding the crusher circuit. RoM material from either the storage bunkers or directly from trucks will be fed through a grizzly into the coarse ore bin and then into the primary crusher. Undersized material will report to secondary crushing, while oversized material will be sent back to primary crushing. Undersized material from secondary crushing will report to the fine ore bin via belt conveyor. Oversized material will report back to secondary crushing.[11]

4.2.3 Grinding Circuit

[11] A1AR1Q7

Material from the fine ore bin will be conveyed to the wet grinding circuit via a belt feeder. Lime and water (approx. 8-10,000g/d) (Section 6.3.3(h)) will be added to the ore and adjusted for pH as necessary to maximize metal recovery (8-9) (9.5-11.5).

Maintaining a slight basic pH is critical to successful recovery in the milling process. Lime will be added to the ball mill via a feeder system to achieve the ore-type specific pH requirement, which is typically in the range of 8-9. pH will be tested in the conditioning tank, which is also part of the grinding circuit to assure proper pH prior to flotation. If necessary, additional lime can also be added at the conditioning tank. Once the desired pH is achieved all downstream process flows (concentrates and tailings) will maintain this pH level.

pH will be tested monthly in the TSF to assure that pH levels between 6.5 and 9 are maintained at all times. Lime will be added to the TSF should pH levels drop below 6.5. Given that only sulfide ores are processed, it is not anticipated that pH levels will exceed the pH 9 threshold limit. In the unlikely event of a pH greater than 9, UMC will reduce the amount of lime introduced into the process.

pH testing will be performed on the TSF to assure the proper pH range prior to final reclamation.[12]

The grinding circuit is comprised of 1 - 5ft dia. x 4ft long Marcy ball mill. The ball mill has a maximum processing throughput of 8tph.

The grinding system operates in closed circuit with a classifier to produce a final flotation feed. The oversize will report back to the ball mill resulting in an effective 8tph feed. The underflow may pass through a gravity circuit to recover free gold and silver. The remaining material will be fed to the conditioning tank then to the rougher flotation circuit.

Water will be added at the ball mill discharge trough. Reagents will be added at the ball mill and the conditioning tank through reagent feeders. As shown in Table, lime will be added at the grinding mill and/or the conditioning tank to control pH. Xanthate will be added as a promoter at the grinding mill for increased reagent reaction time. Lime will be added through a dry reagent feeder and the xanthate is a (1% solution), mixed on site.

Typical reagent usage added at the grinding circuit is presented in Table. Dust emissions are generated when the dry chemicals are added to the reagent mixers.

[12] A1AR1Q15

Negative pressure ventilation collects fugitive particulate matter emissions from the reagent mixing area. The same dust collector used in the crushing and conveying circuit captures the emissions.

TABLE 4-1: CHEMICAL USAGE, BALL MILL

Reagents	Lime	Xanthate	Water
Rate	0.2 lbs/ton [1]	0.07 lbs/ton	0.8 st H_2O/st ore
Amount used[2]	5.6 st/yr	1.9 st/yr	-
Amount used[3]	-	-	45,700 st H_2O/yr

[1] Reagents rated base on dry ore feed tonnage
[2] Dry tons of reagents per year
[3] Liquid tons of reagents per year

4.2.4 FLOTATION CIRCUIT

The comminution product reports to the rougher flotation circuit where it is mixed with water to achieve a density of 35% solids by weight, which is carried through to the scavenger and cleaner circuits.

The rougher flotation cell bank consists of six, 25"x24"x29" (60.4 ft^3) tank cells. Tails from rougher flotation will report to the scavenger flotation circuit which consists of six, 25"x24"x29" (60.4ft^3) tank cells. Tails from the scavenger flotation circuit report to the tails thickener.

The concentrates from the rougher and scavenger flotation cells report to the cleaner flotation circuit, which consists of two, 25"x 24"x29" (20.1ft^3) tank cells. The tailings from the cleaner flotation circuit report back to the scavenger flotation circuit for additional residence time.

The concentrates from the cleaner flotation circuit reports to the concentrate thickener.

Underflow from the classifier reports to the conditioning tank where additional xanthate may be added. As shown in Table, pine oil is added as frother. Pine oil is diluted from a 100% pine oil liquid solution.

Additional xanthate and pine oil may be added in limited amounts to the rougher, scavenger, and cleaner flotation cells, as needed to adjust concentrations for optimal recovery of metals.

TABLE 4-2: CHEMICAL USAGE, CONDITIONING TANK

Reagents	Pine Oil
Rate[1]	0.04 lb/st
Amount Used [2]	2,240 lb/yr
Amount Used [3]	-

1 Reagent rate on dry ore feed tonnage.
2 US gallons of reagents annual quantity.
3 Liquid US tons of reagents annual quantity.

4.2.5 CONCENTRATE CIRCUIT

The concentrate from the second flotation cleaner cell will report to a thickener to maximize process water recovery. The thickened concentrate, 65% solids, will go to the concentrate filter. The filter additionally recovers process water. The material is 65% solids entering the filter and 90% solids exiting the filter. Overflow from the concentrate thickener will be returned to the circuit as process water. The concentrate filter gravity discharges its concentrate cake onto a conveyor which transports the concentrate into a 4 ton bin from where it is loaded into super sacks or drums for shipment.

The sacks or drums will be stored within the facility until shipped. The super sacks or drums will be loaded on highway trucks for shipment. The concentrates will contain less than 10% moisture.

Reagents are added at the thickener through a reagent mixer, diluted with water and added through a chemical feed pump. As shown in Table , DAF-30 will be consumed at an estimated amount of 0.3lb/day for representative ore.

TABLE 4-3: CHEMICAL USAGE, CONCENTRATE THICKENER

Reagents	DAF-30
Rate[1]	0.008 lb/st
Concentrate Feed	6,150 st/yr
Amount Used [2]	50 lb/yr

1. Reagent rate based on dry concentrate feed tonnage (11% concentrate per ton)
2. Tons of reagent per year

4.2.6 TAILINGS CIRCUIT

Tailings from scavenger flotation will be sent to a tailings thickener. Thickened underflow will be sent to the tailing storage facility at 65%-70% solids in piping laid in an accessible concrete trough. The trough is shown in Figure 6-2 and a detailed drawing of the conveyance is shown in Figure 4-12.[13] Overflow ranging from 25 to 35% from the tailings thickener will be returned to the circuit as process water. Reclaim water from the TSF will also be used as process water.

[13] A1AR1Q8

~~Reagents are added at the thickener through a reagent mixer, diluted. As shown in Table , DAF-30 approximately 2.3lb/day will be added as a flocculent (same reagent as used in the concentrate thickener).~~

~~TABLE 4-4: CHEMICAL USAGE, TAILINGS THICKENER~~

~~Reagents~~	~~DAF-30~~
~~Rate[1]~~	~~0.008 lb/st~~
~~Tails feed~~	~~49,850 st/yr~~
~~Amount Used [2]~~	~~400 lb/yr~~

~~1 Reagent rate based on dry tailings feed tonnage – 11% concentrate per ton~~
~~2 Tons of reagents per year.~~

4.3 TAILINGS STORAGE FACILITY (TSF) (6.3.3(2)(b))

Note: TSF earthworks were completed in 2014. The remaining TSF construction will be completed in Spring 2021.

The current mill configuration, process and operations have been modified to treat an ore different than was processed during the last operational period, as described in Section 4.2. This necessitates rephrasing the initial TSF plan to provide tailings disposal capacity for a more efficient concentrating system and increased tails reporting to the TSF. The historical TSF embankment compaction was inadequate for current production requiring complete removal of the existing embankment and reconstruction of the TSF facility with a lined facility.

The reconstruction honors the original permit parameters as follows:

- The same 4.6ac TSF is utilized.
- The pond excavation at a maximum 21ft depth does not impact the known aquifers at 80-100ft below the surface.
- The TSF embankment will be constructed from available onsite soils borrowed from the tailings disposal area as outlined in the recommendation of CTL Thompson, Inc., *Permeability Study*, April 10, 1990, presented as Appendix 15-2, and *Slope Stability Evaluation*, July 8, 2011, presented as Appendix 15-5.
- The TSF will be constructed as a zero-discharge facility with 3ft of freeboard in accordance with the Probable Maximum Precipitation Estimates - United States between the Continental Divide and the 103rd Meridian.

- Non disturbed drainage is diverted around the TSF while disturbed area drainage from the mill area disturbance reports to the TSF.
- The observation well down gradient from the 4.6ac TSF area will be maintained in its current location and monitored.
- Topsoil, in accordance with the topsoil plan will be removed and stockpiled.

Additionally, the proposed TSF design will encompass:

- Stability analysis initiated by CTL Thompson, Inc. May 12, 2011, on samples collected from the existing compacted fill embankment, 2 additional holes drilled to compliment and confirm the 1990 permeability test hole data (Appendix 15-2), and the CTL Thompson Letter Report of July 8, 2011 (Appendix 15-5). Subsequently, CTL Thompson issued an update to the July 8, 2011 Report, presented as Appendix 15-6, *Response to CDRMS Slope Stability Evaluation*, dated September 1, 2011.
- A 2.5:1 (horizontal to vertical) outside face and a 2:1 interior face embankment dam with a berm 12ft wide at the crest.
- A geosynthetic clay liner of 1 x 10^{-6}cm/sec permeability (or less), or equivalent material liner.
- A seepage/leak detection drainage net system between the geosynthetic clay liner and the 45-mil polypropylene geomembrane with the collection sump located in the northwest corner of the impoundment, and the pond bottom sloping at 0.5% to the northwest.
- A synthetic pond liner of 45-mil polypropylene geomembrane or equivalent.
- Compaction testing during construction.

The TSF, as a 110(2) permit, was developed within the existing 4.6 ac. TSF area. The TSF 4.6ac area is shown on Figure 4- with the TSF located within the black line polygon area south of the mill. The TSF is shown on Figure 4- and the TSF cross-section is shown on Figure 4- . The leak detection system and sump design is shown on Figure 4-.

The facility is a cut and fill structure, requiring about 4,500yd^3 of fill from the existing TSF OB stockpile east of the existing pond. The 4,500yd^3 represents the excess cut material stockpiled from the original TSF construction. This material has been incorporated into the cut and fill balance for the new TSF construction. Table 4-11 presents the cut and fill balance for the structure. The net operating capacity is 54,000st. The total pond capacity is 22.4ac-ft. Additional expansion requires increasing the disturbance area beyond the 10ac 110 permit maximum disturbance and the conversion from a 110(2) permit to a 112 permit.

TABLE 4-11: TSF IMPOUNDMENT VOLUMES

Description	Volumes
Cut (yd^3)	18,000
Fill (yd^3)	23,000
Net Excess (yd^3)	(5,000)

TABLE 4-12: TSF CAPACITY

Tailings Storage Volume	Capacity
Total Volume (yd3)	43,000
Freeboard Volume (yd3)	6,790
Net Volume (yd3)	36,210
Net Volume (ft3)	977,670
Net Weight (st)	54,315
Production Rate (st/y)	56,000
Concentrate (11% mass pull)	6,160
Concentrate Shipped (wet st)	6,840
Tailings (89%) (st)	49,840
Solids (%)[14]	~~65%~~ 57%
Water (%)	~~35% 43%~~
Water Reclaim (%)	90%
Net Tailings Slurry (st)	52,524
Capacity (years)	1.03

4.3.1 TSF CONSTRUCTION PREPARATION (6.3.3(2)(b))

Construction of the TSF impoundment require~~s~~d the removal and replacement of approximately 950st of historic tailings and approximately 50st of magnetite, both currently contained within the unlined facility. The TSF overburden stockpile to the east of the existing impoundment will also be removed and incorporated into the fill construction of the lower access road to the concentrate storage, and fill for the impoundment.

4.3.2 SUBGRADE PREPARATION (6.3.3(2)(b))

Timbering, stump removal, and topsoil removal ~~will~~ has occurred prior ~~to disturbing additional lands~~. The timbering and stump removal ~~will~~ has been performed by local contractor ~~with~~ and the timber was removed from the site. The topsoil ~~will be~~

[14] Typographical error corrected in Version 2.0

was removed in accordance with the topsoil plan and stored in the existing topsoil storage pile.

The sub-grade preparation ~~through 45mil liner installation~~ for the TSF ~~is~~ was completed as follows:

- Clear cut/log trees. Clear and grub organic matter including tree roots, pine needles, dead wood and other deleterious materials.
- Clear topsoil and place in topsoil stockpile for reclamation.
- Cut and fill to design specifications using contractor selected equipment. Equipment can include track dozer(s), backhoe(s), scraper(s), front end loader(s), road grader(s), sheep foot compactor(s), or excavator(s).
- Fill material ~~will have~~ had a top size of 6in and contain approximately 50% silt and clay.
- Fill ~~will be~~ was placed in 10-12in level lifts and compacted by a self-propelled sheep foot roller.
- Fill ~~will be~~ was placed and compacted to 95% of Standard Proctor dry density (ASTM D 698).
- Fill ~~will be~~ was scarified between lifts.
- Fill ~~will be~~ was moisture conditioned to within 2% of optimum.
- Construction engineer ~~will be~~ was on site to provide testing during fill placement.

The following subgrade preparation will be completed in the Spring of 2021.

- Verify compaction of floor of pond by number of tests recommended by CTL Thompson.
- **Install Geocomposite Drainage Layer (GDL) between embankment and Geocomposite Clay Liner (GCL) to protect GCL during installation.**[15]
- Install Bentomat® DN geosynthetic clay liner or equivalent.
- Install TexDrain® TD 300 leak detection drainage net system, or equivalent, between the top of the geosynthetic clay liner and the bottom of the 45mil reinforced polypropylene capable of intercepting liquid within the leak detection zone and conveying the liquid to a collection sump for storage.

[15] A1AR1Q5

- Install leak collection sump and piping in pond corner and connect leak detection drainage net system to the sump.
- Lining contractor to install geosynthetic clay liner, leak detection drainage net system and 45mil reinforced polypropylene.
- Liner materials will be tested at intervals specified by manufacturer and contractor but not less than two tests will be performed.
- Materials or construction not meeting standards and design specifications will be removed and repaired.

4.3.3 TSF Stability & TSF Design (6.3.3(2)(b))

TSF stability and design activities described in this subsection were completed in 2014.

The existing tailings facility will be removed and the new TSF embankment will be reconstructed as shown in Figure 4-. The compacted fill embankment has a 2.5:1 (horizontal to vertical) outside face, and a 2:1 interior face. Fill material will have top size of 6in and contain approximately 50% silt and clay. Fill will be placed in 10-12in level lifts and compacted by a self-propelled sheep foot roller. Fill will be placed and compacted to 95% of Standard Proctor dry density (ASTM D 698). Fill will be scarified between lifts. Fill will be moisture conditioned to within 2% of optimum. Construction engineer will be on site to provide testing during fill placement and verify compaction of floor of pond by number of tests recommended by CTL Thompson. CTL Thompson, Inc. has conducted slope stability analysis on the TSF embankment as shown in Figure 4- and Figure 4-. Samples were collected from drilling two (2) additional holes to verify and confirm the 1990 permeability test hole data and additionally confirm the embankment materials and underlying soils.

Additionally, a sample of tailings materials generated from laboratory testing was analyzed. The embankment materials, native soils and tailings materials were tested for strength and classification, using direct shear tests for use in analyzing slope stability of the embankment. The results are presented in the July 8, 2011 Report (see Appendix 15-5). Subsequently, CTL Thompson issued an update to the July 8, 2011 Report (see Appendix 15-6).

4.3.4 Geocomposite Drainage Layer (6.3.3(2)(b))

The geocomposite drainage layer will be installed in the Spring of 2021.

A US Fabrics, Inc 220GN Geocomposite Drainage Layer, or equivalent, will be placed on the interior slopes and bottom where there are seeps to protect the GCL from premature hydration during the installation process. **The GDL will be installed concurrently with the GCL, leak detection system, and polypropylene geomembrane liner. GDL specifications and installation instructions are presented in Appendix 4-1.4, Geocomposite Drainage Layer.**[16]

4.3.5 Geosynthetic Clay Liner (6.3.3(2)(b))

The geocomposite drainage layer will be installed in the Spring of 2021.

A Bentomat® DN geosynthetic clay liner, or equivalent, will be placed on the interior slopes and impoundment bottom. The geosynthetic clay liner is installed concurrent with the leak detection drainage net system and the 45mil polypropylene geomembrane liner. Geosynthetic clay liner specifications are presented in Appendix 4-1.1, Geosynthetic Clay Liner.

4.3.6 Leak Detection System (6.3.3(2)(b))

The leak detection system will be installed in the Spring of 2021.

Concurrent with the installation of the geosynthetic clay liner, a seepage leak detection system will be placed between the geosynthetic clay layer and the synthetic liner with the collection system located in the northwest corner of the impoundment, and the impoundment bottom sloping at 0.5% to the northwest.

Figure 4- shows additional details on the leak collection system and sump. The leak detection system is concurrently installed between the top layer of the $1x10^{-6}$cm/s (or less) geosynthetic clay liner and the 45mil polypropylene geomembrane liner. The leak detection system is a composite drainage product, produced by thermally laminating a 6oz/yd^2 nonwoven geotextile to both sides of a polyethylene drainage net, capable of intercepting liquid within the leak detection zone and conveying the liquid to a collection sump for storage. The leak detection drainage net system is shown on Figure 4- and Figure 4-.

[16] A1AR1Q5

The volume of the collection system is limited to the sump and is approximately 90 gallons. The sump is accessed through a 4in PVC pipe to the top of the impoundment. Collected leachate will be returned to the TSF and then recycled to the mill through the impoundment decant pump(s). The leak detection system requires a manual inspection of the sump through the 4in PVC pipe. If leachate is detected (indicating a leak in the 45mil polypropylene), the level will be monitored, a small pump will be installed in the PVC pipe and the Division notified of fluids from the leak detection system. **If ground water is detected (indicating a leak in the GCL), the level will be monitored, a small pump will be installed in the PVC pipe, the ground water will be pumped to the impoundment, and the Division will be notified within 48 hours from first detection.** ~~If groundwater is detected (indicating a leak in the geosynthetic clay liner), the level will be monitored, a small pump will be installed in the PVC pipe, the groundwater pumped to the impoundment and the Division notified of fluids from the leak detection system.~~[17]

Leak detection drainage net system specifications are presented in Appendix 4-1.2, Leak Detection.

4.3.7 POLYPROPYLENE LINER (6.3.3(2)(b))

The polypropylene liner will be installed in the Spring of 2021.

Concurrent with the installation of the seepage/leak detection system, a synthetic pond liner of 45mil polypropylene geomembrane, or equivalent, will be installed as shown in Figure 4-. The hydrostatic head on the geomembrane liner will be less than 2ft. UMC will continuously decant the water for reuse in the mill to minimize makeup water requirements. Typically, tailings will be laid down in a bench, or splay within the impoundment and a barge mounted decant sump pump(s) located at the lowest level will pump the water back to the mill. This pump(s) will be pressure sensor activated (or float switch activated). UMC is incorporating a standard liner keying system. Typically, this is a trench 2ft wide, approximately 3ft or more from edge of the inside slope, 2ft deep. The liner is rolled down the trench wall, across the trench floor, and then the trench is backfilled and compacted to the specified embankment compaction standards. Details are presented in Figure 4-.

[17] A1AR1Q5

Geomembrane liner specifications are presented in Appendix 4-1.3, Geomembrane Liner.

4.3.8 INITIAL TSF LINER STABILIZATION (6.3.3(2)(b))

The initial TSF liner stabilization will be installed in the Spring of 2021.

The impoundment liner will initially be held in place with water (ballast) hauled into the site from the local construction water metering station. Next, the approximately 1,000st of historic tailings stored on the temporary storage pad will be moved to the edge of the TSF by front-end loader and washed down the slope of the TSF with water from the TSF.

UMC has committed to CDRMS to initiate removal of the existing onsite ore stockpiles within 60days following start-up. The material is currently stockpiled on the west side of the mill entrance road, at the "Y" for the lower access (south) road. With this in mind, the mill operation will use this material as initial feedstock to further secure the liner. Historic tailings, the existing ore stockpiles, water, or onsite soils will also be used in ballast pipes or sandbags to stabilize the liner on the TSF embankment slopes.

4.3.9 QA/QC (6.3.3(2)(b))

The QA/QC will be performed in the Spring of 2021.

The Quality Assurance/Quality Control *(QAQC)* Plan for the TSF is as follows.

ONSITE PERSONNEL

UMC's mill manager or qualified designate will be on site at all times construction activities are being conducted by UMC crews or by contractor crews. UMC has retained an Owner's Engineer, who is a Registered Professional Engineer and a Professional Land Surveyor in the State of Colorado, to monitor the contractors. UMC has contracted clearing and grubbing, topsoil removal and storage, impoundment excavation and embankment construction, clay material segregation, geosynthetic clay liner installation, leak detection installation sump construction, and impoundment liner installation. **UMC crews will place historic tails in the TSF,**

construct and place ballast tubes on the impoundment sides, install tailings slurry pipes to the impoundment, and install the decant water pumping station.[18]

The following activities were completed in 2014.

GENERAL SITE PREPARATION

- Stake tree clearing/topsoil removal limits for TSF.
- Stake grubbing limits for existing tailings storage pad.
- Slope stake storage pad for existing tailings.
- Oversee tailings storage pad layout and grading.

CLEARING, GRUBBING, TOPSOIL REMOVAL/STORAGE

- Performed by contractor, monitored by Mill Superintendent and/or Owner's Engineer.
- Quantity check between planned and actual material moved.

IMPOUNDMENT EXCAVATION AND EMBANKMENT CONSTRUCTION

- Performed by contractor, monitored by Mill Manager and/or Owner's Engineer.
- Slope stake exterior and interior embankment slopes.
- Red top embankment slopes as being constructed by contractor.
- Grade top of subbase on interior slope and bottom of impoundment (±1") on 50ft grid.
- Monitor compaction lifts, compaction equipment in conjunction with contract soils engineer.
- Compact to 95% standard proctor, within 2% optimum moisture.
- Soils engineer to observe, segregate suitable embankment material, and test placement of embankment fill during construction.

The following activities will be completed in the Spring 2021.

[18] A1AR1Q5

SUBBASE CONSTRUCTION, GDL AND GCL ~~AND GEOSYNTHETIC CLAY LINER INSTALLATION~~

- Finished surface shall be firm and unyielding, without abrupt elevation changes, voids, cracks, ice or standing water.
- The subbase will be constructed during a period of low flow to ensure that the GDL will protect the GCL from premature hydration.
- **Liner contractor will install and test the geocomposite drainage layer in accordance with manufacturer's recommendations. Installation of the GDL protecting the GCL from premature hydration is shown in Figure 4-**. [19]
- Liner material contractor will inspect the subbase prior to commencing installation.
- Liner material contractor will install and test the geosynthetic clay liner in accordance with manufacture's recommendations.
- The liner material contractor will inspect a known perched aquifer seep approximately 4ft above the bottom of the TSF floor and employ one of the techniques below, or equivalent, to minimize premature hydration when laying the geosynthetic clay liner over the seep area.
    - No special procedures:
        - Seep has minimal flow (damp, dry) or the seep flow is controllable with standard pumping techniques (minimizing standing water) and no additional liner installation techniques required.
    - Visqueen liner below seep:
        - Seep flow is controllable with standard pumping techniques (minimizing standing water), but flow from the seep may cause hydration of the geosynthetic clay liner below the seep faster than desired.
        - Visqueen or equivalent liner placed from the seep to the TSF floor, reducing hydration of the GCL material and directing seep flow to the TSF floor for control by standard pumping techniques.

[19] A1AR1Q5

- Subdrain along seep:
  - Seep flow is not controllable with standard pumping techniques (standing water).
  - Installation of subdrain along seep, directing water from seep to an infiltration area within the TSF structure as shown in Figure 4-, Subdrain Detail and Figure 4-12, Subdrain Location.
  - Following installation of the subdrain, compaction to 95% standard proctor, ±2% optimum moisture, and grading of sub base on interior slope ±1" on 50ft grid, then the geosynthetic clay liner is installed.

- If the geosynthetic clay liner is prematurely hydrated during installation, it may remain in place if the following conditions are met.
  - Geotextiles have not been separated, torn or otherwise damaged.
  - No evidence that needle punching between the geotextiles has been compromised.
  - Geosynthetic clay liner does not leave deep indentions when walked upon.
  - **Overlapped and bentonite-enhanced seams are intact.**[20]

Leak Detection and Sump Construction

- Performed by contractor, monitored by Mill Superintendent and/or Owner's Engineer.
- Layout and grade detection layer collection sump system.
- **Liner material contractor will install and test**[21] the leak detection drainage net system in accordance with manufacture's recommendations.

Impoundment Liner Installation

- Performed by contractor, monitored by Mill Manager and/or Owner's Engineer.
- Layout and grade anchor trench for geomembrane liner.

[20] A1AR1Q5
[21] A1AR1Q5

- Liner material contractor will inspect the substrate and anchor trenching prior to commencing installation.
- Panel installation will occur in reasonably clam weather conditions with ambient temperatures in excess of 40°F and no precipitation.
- Sample seams will be made on a daily basis to establish a proper film bond tear.
- Seaming crews will overlap the material ±6in and construct a minimum 2in wide fully bonded seam without wrinkles or voids.
- If wrinkles occur, the seam will be cut and patched accordingly, a minimum of 4in beyond the problem seam in all directions.
- Field seams will be tested by the air-lance method per ASTM Method D4437. Where visual or audible signs occur, the area will be repaired.
- Destructive samples will be taken every 1,000 liner-feet of seam from the material in the trench area. At least 2 samples will be taken if less than 2,000lf of seam installed.
- Destructive samples will be sent to a lab for testing (peel and shear). The test values will be a minimum of 80% of parent material strength.
- The liner contractor shall supply daily reports to the Owner.

Liner Stabilization, Historic Tailings Placement. Slope Ballast Installation

- Performed by Owner, monitored by Mill Superintendent and/or Owner's Engineer.

Tailings Slurry Piping. Decant Water Pumps

- Performed by Owner, monitored by Mill Superintendent and/or Owner's Engineer.

4.3.10 Construction Schedule (6.3.3(2)(b))

The following activities will be completed in the Spring 2021.

The proposed construction schedule for the TSF follows. Reference QA/QC plan for additional details on the listed activities. UMC will provide the Division 48hr notice on the CORMS inspections. UMC will also provide the Division 48hr notice on the optional inspections but will proceed if the Division elects not to inspect. The Division will be provided specific calendar dates following initiation of construction.

TABLE 4-13: CONSTRUCTION SCHEDULE

Activity	Duration	Inspection
General Site Preparation	2 days	No Inspection
Clearing, Grubbing, Topsoil Removal/Storage	10 days	CDRMS Optional
Impoundment Excavation/Embankment Construction	20 days	CDRMS Inspection
Geosynthetic Clay Liner Installation	5 days	CDRMS Inspection
Leak Detection Installation Sump Construction	"	Included with above
Impoundment Liner Installation	"	Included with above
Historic Tailings Placement, Slope Ballast Installation	5 days	CDRMS Optional
Tailings Slurry Piping, decant Water Pumps	5 days	No Inspection

4.3.11 GEOCHEMICAL CONSTITUENTS (6.3.3(2)(b))

The geochemical constituents of the tailings and the anticipated impacts to ground- and surface-waters are discussed in Section 14.7

4.3.12 PLANT FACILITIES (6.3.3(2)(a))

Chemical types and quantities to be used at the TSF, chemical storage and spill containment and emergency response plans are discussed in Section 14.7.[22]

4.3.13 DRAINAGE CONTROL (6.3.3(2)(c))

Drainage control is discussed in Appendix 14-1, Storm Water Management Plan.

~~Figure 6-2 show our planned upland diversion measures. In general, the design will handle a 200 year, 24-hr rainfall event (2.47 inches, per NOAA database), diverting runoff around disturbed areas, reporting in detention ponds in some areas, and onto natural existing drainages. Water within disturbed areas will report to the TSF.~~

~~There are two distinct portions of the Mill property. The northern portion of the property is a moderately steep south facing slope and drains to the south. The average grade of the northern slope is 25% and the hill slope on the property ranges from an elevation of 9,760ft to 9,730ft. The southern portion of the property is a gently sloping area that drains toward the southwest and west. The average grade of the southern slope is 3% and the hill slope on the southern portion of the property ranges from 9,730ft to 9,700ft at the southwest property corner.~~

[22] Texted added to support A1AR1Q12

An unnamed 1ft to 3ft wide drainage channel enters the property on the eastern boundary, adjacent to the northwest corner of the Leadville Sanitation District polishing pond. This channel generally flows to the southwest across the property, crossing under two access roads. The channel flows into what appears to be an old soil conservation drainage ditch in the southwest corner of the property and the water then flows along the contour to the northwest, exiting the property on the western boundary. Undisturbed area runoff water to the north of the unnamed drainage channel reports to the unnamed channel. The flows are limited and the culverts under the road are 12in culverts, with no evidence of overtopping or wash outs. The water exits the property into an existing road drainage network, flowing to the Highway 24 drainage network and then to California Gulch.

Undisturbed area runoff water south of the unnamed channel does not report to a drainage channel, and overland flows through trees, and vegetative cover, leaving the property along the southern boundary.

One type of soil classification exists within the property's drainage basin according to the Lake County Soil Survey. The soil series is Leadville sandy loam (LeE). This is a woodland soil. The predominate tree species on the property is Lodgepole Pine.

During operation, runoff and flow patterns in the property drainage basin are designed to generally follow the same paths as the historic basin. Soil characteristics are identical to those of the historic basin, except for impervious building, impoundment and road improvements. Vegetation characteristics will not change in the undisturbed area of the project. Swales and inlets are designed to handle the 100-year 24-hour peak flow.

During operation, a stormwater management plan and best management practices (BMPs) will be implemented and maintained. Disturbed area measures will include silt fence, erosion control logs, construction entrances, river rock (or on-site cobble) sediment traps as required in swales or diversions, and vegetative filters for overland flow discharges. All areas disturbed by construction will be temporarily re-vegetated or graveled and maintained as soon as practical.

(1) Nature of Milling Activities at the Site

The Mill is a custom ore processing facility. Ore will be routinely delivered to the facility. Ore will be processed at a maximum production rate of 200 tons per day. Ore will be conveyed to the crusher, then through a series of processes to produce concentrates. These concentrates will be shipped off site for further processing. The process tailings will be pumped to a CDRMS approved TSF. The TSF is located adjacent to the Mill. The Mill will be operated and or maintained 365 days a year-24 hours a day, 7 days a week.

(2) Design Parameters

Once the CDRMS permit is issued, the following construction activities will commence. Based on- Wilkes, S.G and Erke C. King, 1975. Procedures for Determining Peak Flows in Colorado– Soil Conservation Service:

- Install BMPs on access road from Highway 24;
- Install or repair other BMP structures;
- Improve or construct structures on the preexisting access road including berms, swales, debris basins, and ditches using the following design criteria and methods;
    - Drainage Area: 20.7 acres (entire property).
    - Runoff Coefficients. Undisturbed forest Runoff Coefficient Number (RCN) = 60.
    - 10-yr,and 100-yr 24hr Stormwater Events. The estimated peak flows are 0.54cfs and 3.0cfs for 10-year, 24-hour and 100 year, 24-hour storm events respectively. The peak flows were calculated assuming a RCN=60, a drainage area of 20.7ac, the disturbed area is internally drained, Lodgepole Pine vegetative coverage is approximately 40%.
    - Drainage Channel Configuration (Stormwater Diversion). Stormwater for the 100-year, 24-hour storm event of 4.25cfs will be conveyed around the disturbed area in a ditch that has 1:1 side slopes that is at least 1.25ft deep constructed on a slope less than 5%.

Existing 12in culverts will convey the peak flow from the 100-year -24-hour storm with a flow through velocity estimated to be approximately 8.0fps.

- Affected Area: Estimate of total affected area, and area/location expected to be disturbed by clearing, excavation, grading or other construction activities.
    - The mill permit area occupies approximately 10.0ac;

  - ~~The TSF occupies an area approximately 3.0ac;~~
  - ~~Pre-existing mill disturbance includes, topsoil, and historic ore stockpiles, access roads, tailings pond, mill building, culverts and fences;~~
  - ~~Pre-existing easements including Leadville Sanitation District sewer pipeline, Xcel Energy gas pipeline, and Xcel Energy transmission line.~~
- ~~Site Soil Information: Existing soils data for the drainage area within the permit and affected areas are provided through the National Resource Conservation Service Custom Soil Resource Report for the Lake County Area, Colorado. The soils are thin, well drained, well vegetated with the existing rocky slopes ranging from 3-35%. The soils are considered to be relatively stable to limit offsite erosion and sedimentation impacts.~~
- ~~Existing Vegetation: Coniferous trees cover the site, except the area where the Mill building is located. Lodge pole Pine is the predominant tree species. Approximately 1.7ac of trees and underlying vegetation was removed during construction of the TSF.~~
- ~~Potential Pollution Sources: The following provides a general description of each potential source:~~
  - ~~Chemical Storage~~

~~**Frequency**~~	~~**Activity**~~	~~**Containment**~~
~~Weekly~~	~~Load 55 gallon drum(s) or other suitable container of process ore concentrate into truck for offsite hauling~~	~~Diversion berms and a containment basin will be put in place to prevent sediment migration.~~
~~Monthly~~	~~Chemical delivery will be delivered to the Mill~~	~~Chemicals will be stored in the mill. Chemicals will be stored in 55 gallon drums or sacks. 55gallon drums will be placed in secondary containment vessels. Other chemicals to be used on site will include paints, aerosols, lubricant oils, and antifreeze. All chemicals will be stored and locked in the Mill Building.~~

- ~~Truck haulage - to control fugitive dust, speed limits of 15 miles per hour for haul trucks will be posted to limit road dust;~~
- ~~When necessary, roads will be periodically sprayed with water to control fugitive dust;~~
- ~~BMPs will be inspected twice a month and after significant precipitation during construction, and monthly thereafter during milling operations from April through November;~~
- ~~Road construction and maintenance will be routinely conducted to maintain BMP structures, road grades and sediment control structures; and~~
- ~~Regulated materials will be transported by CDOT and USDOT approved vendors.~~

o ~~Non-Stormwater Discharge Locations: Non-stormwater discharges are not anticipated to occur. No man-induced springs, landscape irrigation, construction dewatering or concrete washout exists.~~

o ~~Receiving Waters: The 10.0ac mill permit area is located approximately 850ft north of California Gulch, tributary to the Arkansas River. The unnamed ephemeral channel draining the mill site only flows in response to snow melt and thunderstorm runoff events.~~

o ~~Wetlands: There are no designated wetlands or riparian lands within the permit boundary.~~

Storm Water Management Plan data and BMP details are shown in Appendix 4-1. [23]

4.4 Existing Historic Ore Stockpiles

Existing ore stockpiles have been stored on site since 1991. The stockpiles, until they are reprocessed or disposed in the TSF, will be maintained in the following manner to mitigate the potential in generating acid rock drainage (ARD). The following measures will be implemented to mitigate potential surface or groundwater contamination impacts Stockpile ores will be reprocessed or disposed in the TSF prior to processing or disposal the stockpiles. The following measures will be maintained:

[23] A1AR1Q12

- Existing stockpile ore considered to be acid or toxic producing materials will be covered with reinforced visqueen or alternative impermeable material.
- Reinforced visqueen sheeting, approximately 40ft x 100ft sheets, will be placed over the piles, edges folded and pinned, and held in place by tires, blocks, rocks and/or other suitable ballast.
- The water runoff from the reinforced visqueen will be passed through a combination of erosion and sediment control measures including natural minor depressions, constructed berms, silt fence and vegetative filters.
- Reinforced visqueen will be maintained and replaced as needed.
- Stockpiled ore will be sampled and a TCLP analysis will be performed, as outlined in the Division's August 27, 2009 letter prior to removal and prior to milling or disposal.
- Provide CDRMS an ore stockpile removal schedule; and
- Weather permitting, historical stockpiled ore will be removed and disposed in the TSF within 60 days after the permit has been approved.

4.5 MILL UTILITIES & SERVICES

4.5.1 ELECTRICAL POWER

The mill receives electric power from Xcel Energy. The connected load is about 130kW. The power is delivered by a 25kV overhead line across the northern portion of the property, connecting to the northeast corner of the Mill Building. A portable generator will be available on site for emergency conditions.

In an emergency situation, ~~the generator~~ generator(s) will ~~only be~~ ~~deployed~~ be used for life/safety use. The generator will be ~~hand~~ manually **started~~.~~ No transfer switch will be used. The generator will not be used to run processing equipment and pumps**.[24]

4.5.2 COMMUNICATION

Mill site communications are by cell phone and VoIP phones. No land line communications are proposed. Internet communication is through a satellite internet service.

[24] A1AR1Q14

4.5.3 Sewage Disposal

~~The Lake County CUP stipulates that sewage disposal use the newly constructed sanitary sewage lift station, connecting the mill office/safety/training/change house facility to the Leadville Sanitation District sewage line that crosses the northern portion of the property. The existing septic tank now serves as the holding tank for the sanitary sewage lift station~~. The Mill is serviced by Leadville Sanitation. See Figure 6-2. ~~During any construction or repairs that render the sewage lift system inoperable, a chemical toilet will be rented.~~ The maximum number of employees expected to be in the mill operating crew at any given time is ~~five~~ six.

4.5.4 Solid Waste

Solid waste (debris, scrap, etc.), as well as biodegradable and recyclable material, will be stored in bins and periodically hauled to the Lake County Landfill.

4.5.5 Water

There are no permitted domestic or commercial wells on the property. Process water will be hauled to the property by contracted haulers until which time that water rights are purchased/leased.

Bottled water will be provided to employees. Water for domestic and milling needs will be purchased from Parkville Water District. No contract is required.

Water will be trucked to the site from a local construction water metering station located in Leadville. The mill will require approximately 30-40,000gal/day.

The mill maintains 4-water tanks (see Figure 6-2)within the plant, with a combined capacity of 40,000gal.

4.6 Ore Buying Acceptance Criteria

The toll ore buying program will fill mill capacity with high quality ores which will meet metallurgical criteria summarized in this section.

4.6.1 Contract with Supplier

The Ore buying process will generally adhere to the following but modified for each specific Supplier to account for ore processing requirements (within the operating parameters of the Mill).

1. Supplier and CJK agree to "Economic Terms". E.g. payment based on toll ore grade, process recovery, market prices, treatment costs, etc.
2. Batch of toll ore to be processed is identified. This may, for example, be a specific stope in a mine, or a stockpile on the surface.
3. The batch is surveyed to determine quantity and to collect a representative sample.
4. A representative ore sample is collected under established chain of custody protocols and laboratory tested for ore grade.
5. Economic or performance test will validate ore grades which will be used to determine toll ore purchase price.

4.6.2 ACCEPTANCE CRITERIA

Acceptance Criteria will also include:

- Bill of Lading documenting the ore has been analyzed and approved for mill processing.
- Truck and ore deliveries are pre-approved and scheduled.
- Truck and driver are CDOT certified.
- Insurance is current.
- Ore location is identified,
- Tarps are securely covering delivered ore.
- Ore is minus xx inches.
- Ore is free of organic debris.
- Ore is dumped in designated areas.
- Truck drivers are site safety trained in; communication protocols, noise and dust mitigation, scale and traffic management procedures, speed limits, emergency response, inclement weather operating procedures, site restrictions, and PPE.
- On- and off-site transportation activities conform with CDRMS, CDOT and Lake County regulations.

~~UMC's Leadville Mill's Ore Buying Program is designed to fill mill capacity with high quality ores. Ore must meet the metallurgical criteria summarized in section 4.6.1.~~

~~*4.6.1 General Information*~~

- ~~Ores must be amenable to conventional mill concentration methods~~

~~Ores (30-50lb sample) will be tested for grade, and deleterious substances prior to being accepted. If ores are not acceptable, no purchase contract will be offered to the supplier trace metals prior to accepting the ore for processing. The metals of interest include~~

~~Arsenic (As)equal to or less than 0.5 mg/l~~

~~Barium (Ba)-equal to or less than 2 mg/l~~

~~Cadmium (Cd)- equal to or less than 0.1 mg/l~~

~~Chromium (Cr)- equal to or less than 0.5 mg/l~~

~~Lead (Pb)- equal to or less than 0.5 mg/l~~

~~Mercury (Hg)- equal to or less than 0.001 mg/l~~

~~Selenium (Se)- equal to or less than 0.5 mg/l~~

~~Silver (Ag)-equal to or less than 0.05 mg/l~~

- ~~Initial sample testing will require a 30-50lb sample that is representative of the ore to be mined and shipped. This will be crushed, blended and fire assayed for precious metal values and a 40-element ICP analysis performed for other metals and contaminants. Assays and analyses will be reviewed to determine if the material meets the ore criteria and a report will be sent to the supplier.~~
- ~~If tests show ore does not meet purchase criteria, no further work will be performed.~~
- ~~If ore meets purchase criteria, metallurgical tests will be performed to determine process and general amenability to the Mill. A metallurgical report will be prepared and sent to the supplier, advising whether the ore is suitable for processing.~~
- ~~UMC will reserve the right to modify these requirements at any time.~~
- ~~Representative ore sample will be crushed, blended, and analyzed for metal values. In addition, a 40-element ICP geochemical analysis.~~

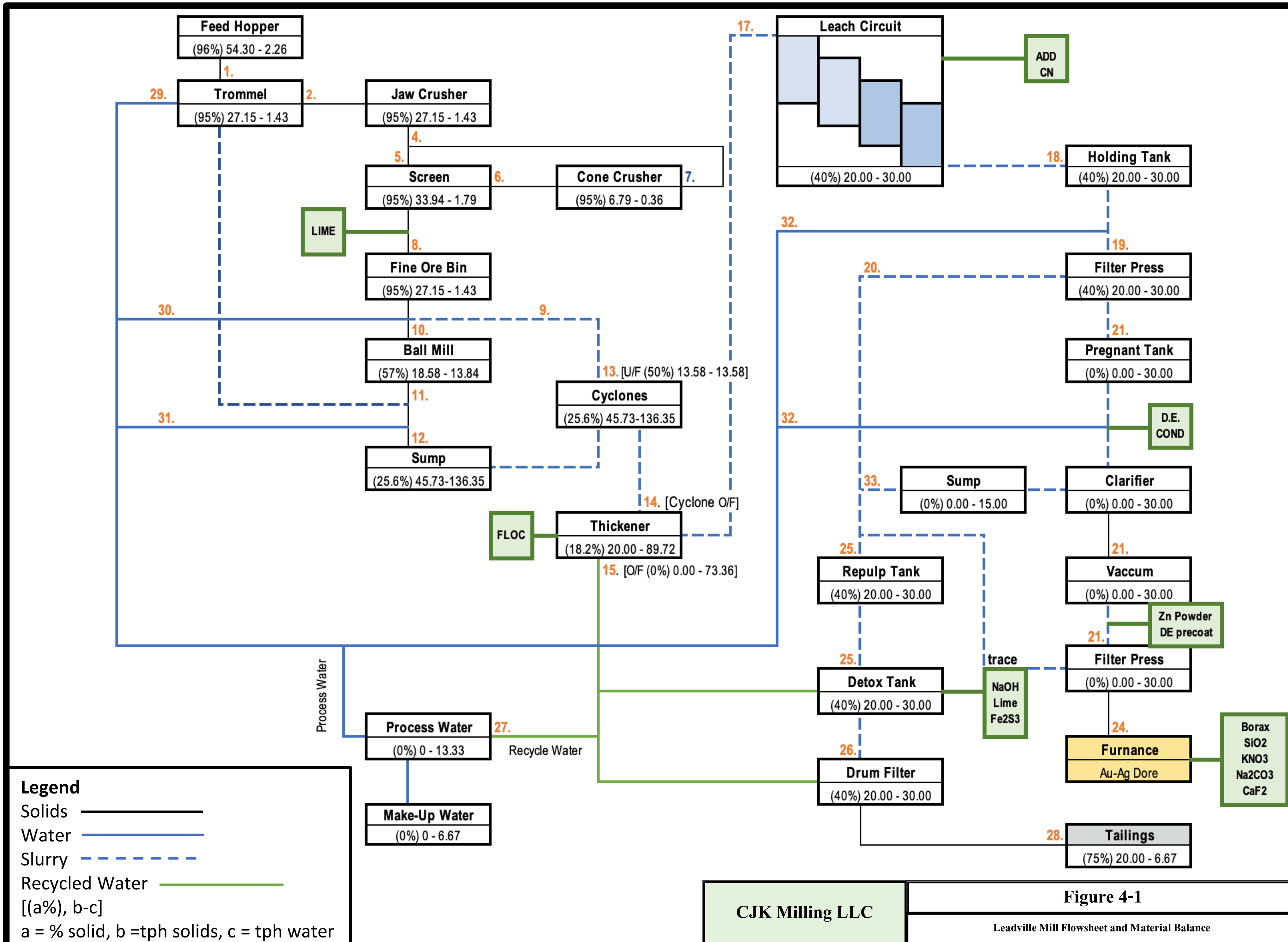
~~*4.6.2 Ore Baseline Analysis Limits*~~

~~Sampling tests are completed for each sample of custom ore brought to the Mill. An elemental scan (4 acid digestion ICP analyses) determines elemental concentration on~~

~~a range of metal and non-metals in the sample. Certain ores may be rejected based on metallurgical or environmental constraints.~~

Figure 4-1: Leadville Mill – Flowsheet & Material Balance

This was Figure 4-1 - Mill Building General Arrangement – Main Level Pre-Tailings Storage Facility Conditions in the 110(2) permit and has been replaced with the updated flowsheet and material balance figure.



CJK Milling LLC

Figure 4-1

Leadville Mill Flowsheet and Material Balance

Figure 4-2: Mill Building General Arrangement - Main Level Upper Level & Crusher Building

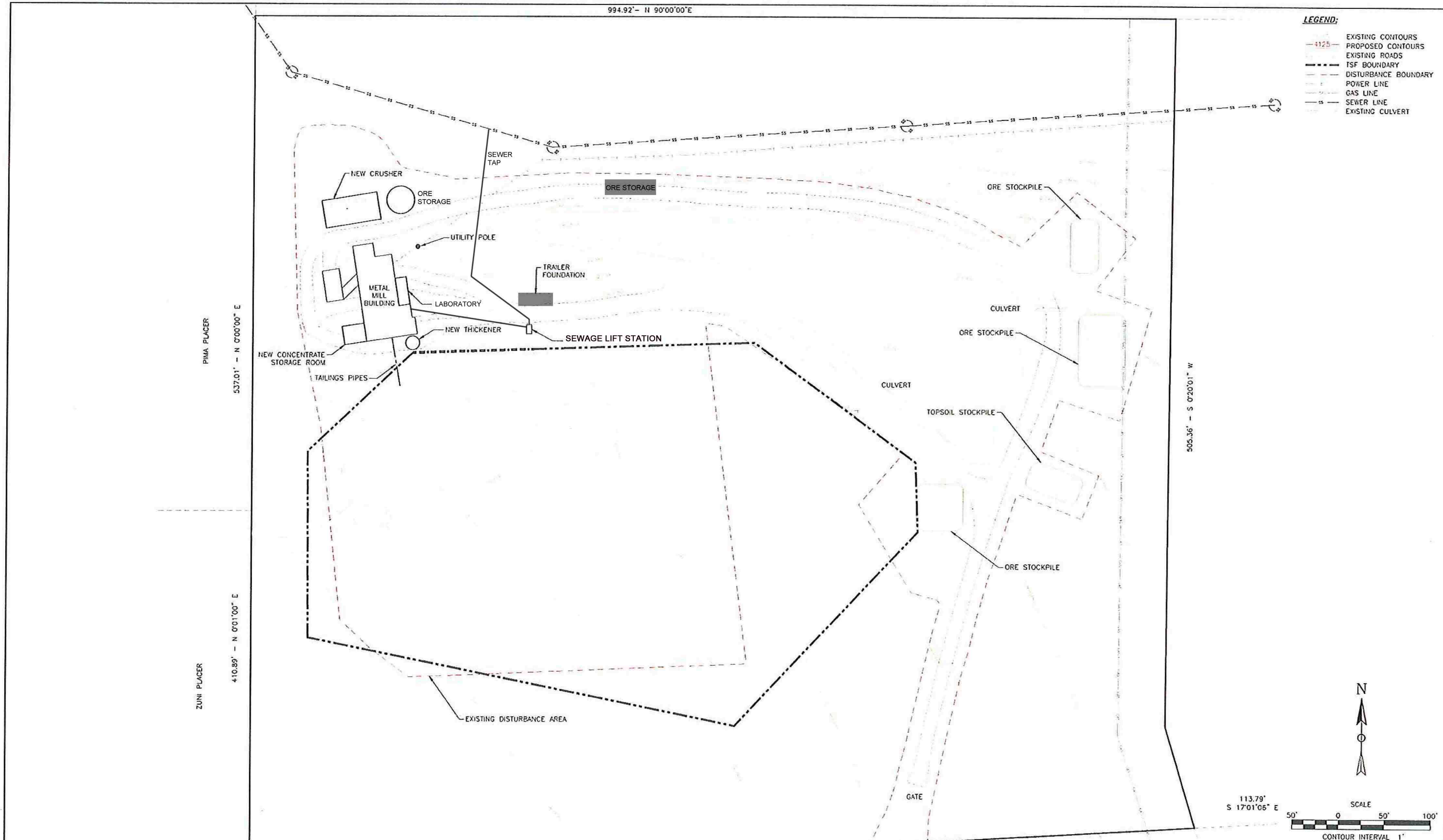
This figure is obsolete.

Figure 4-3: Mill Building General Arrangement - Upper Level & Crusher Building Longitudinal Section

This figure is obsolete.

Figure 4-4: Mill Building General Arrangement - Longitudinal Section

This figure is obsolete.



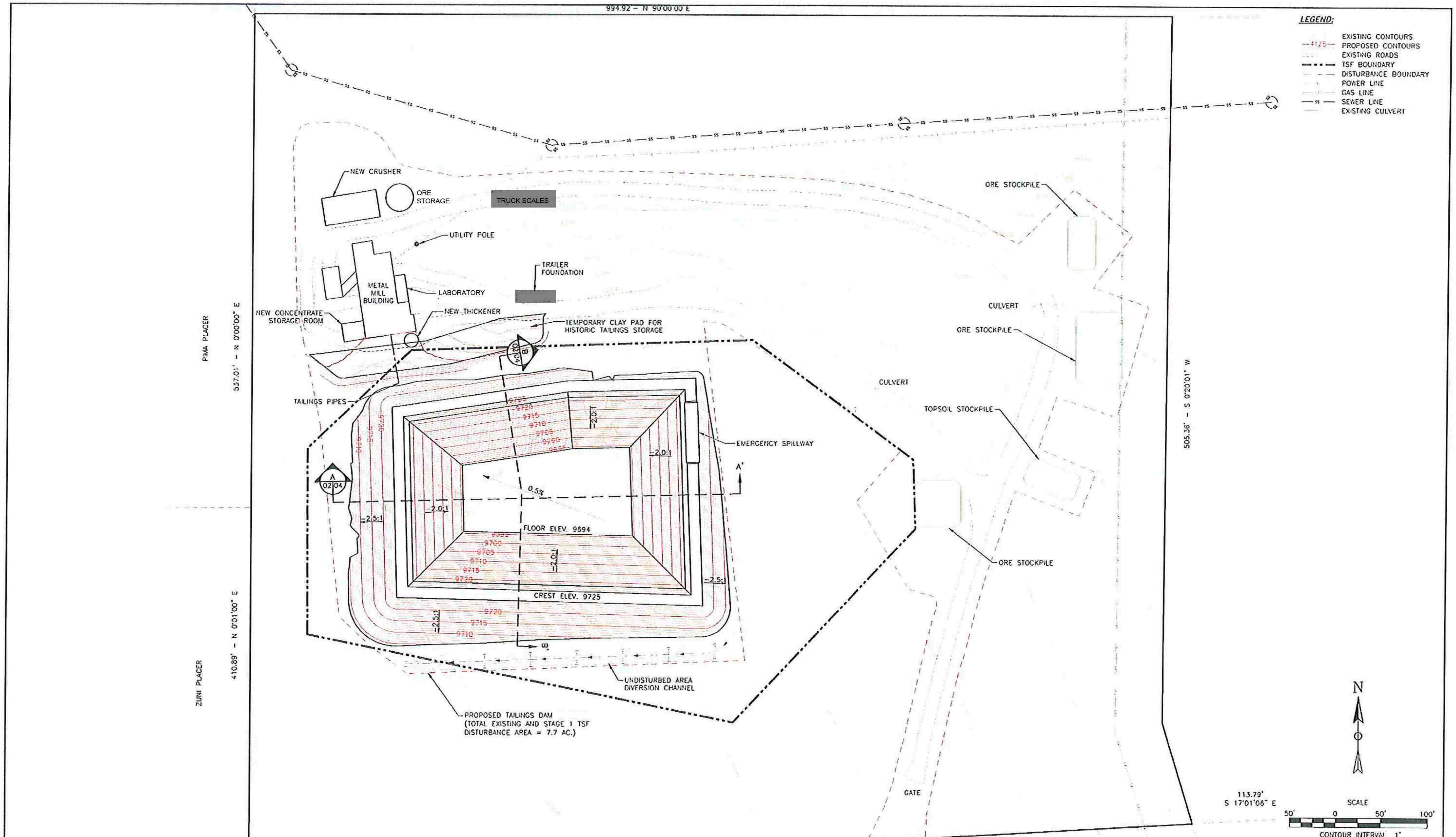
This document was prepared by me or under my direct supervision and the information presented is true and correct to the best of my knowledge and belief.

J. Michael Elder, PE
Colorado Registered Professional Engineer 15893

9/21/2011

Issued by:	Project: THE UNION MILLING COMPANY TAILINGS STORAGE FACILITY DESIGN	
THE UNION MILLING COMPANY	Title: GENERAL LOCATION EXHIBIT	
	Location: LAKE COUNTY, CO	FIGURE 4-5
	Date: 5/13/2011 Project no.:	REVISION A

C:\Civil 3D Projects\Union Milling\Dwg\Initial\Exh01 - Existing GFA.dwg, 9/14/2011 4:43:19 PM



This document was prepared by me or under my direct supervision and the information presented is true and correct to the best of my knowledge and belief.

J. Michael Elder, PE
Colorado Registered Professional Engineer 15303

9/27/2011

Issued by:

THE UNION MILLING COMPANY

Project: THE UNION MILLING COMPANY TAILINGS STORAGE FACILITY DESIGN

Title: TAILINGS STORAGE FACILITY - PLAN VIEW -

Location: LAKE COUNTY, CO

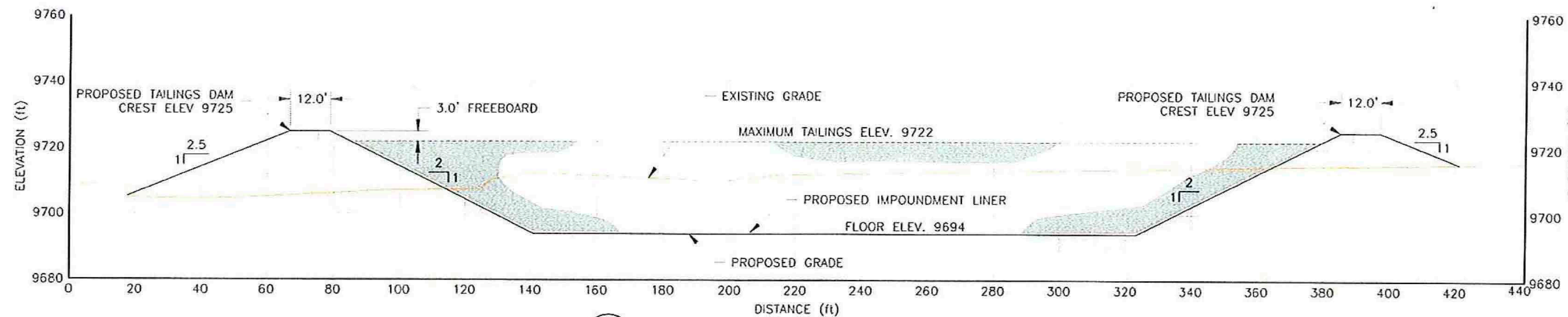
Date: 5/13/2011

Project no.:

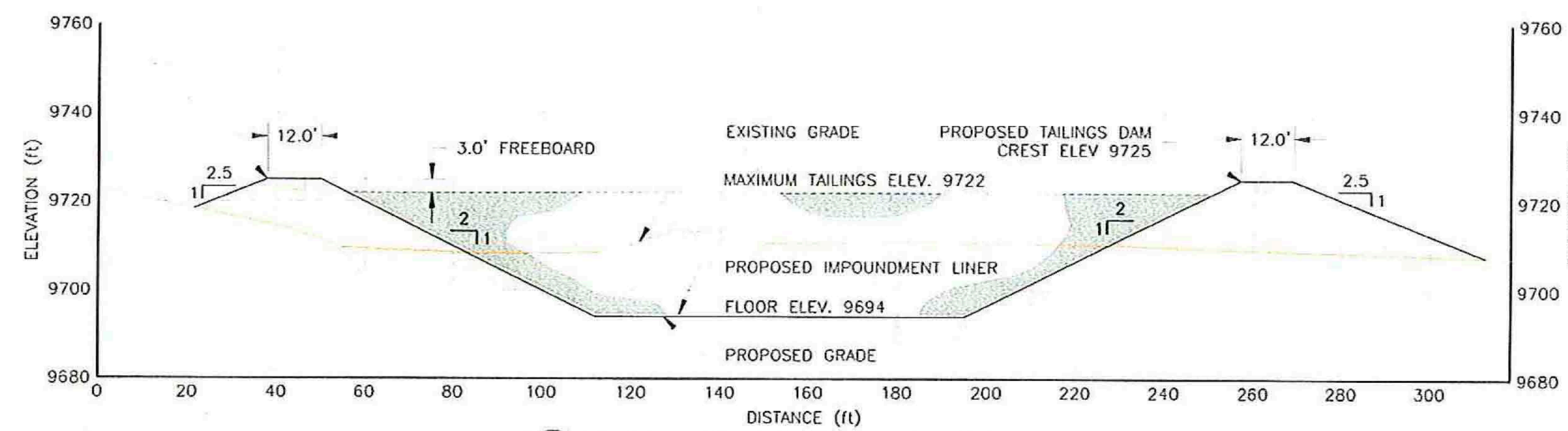
FIGURE 4-6

A REVISION

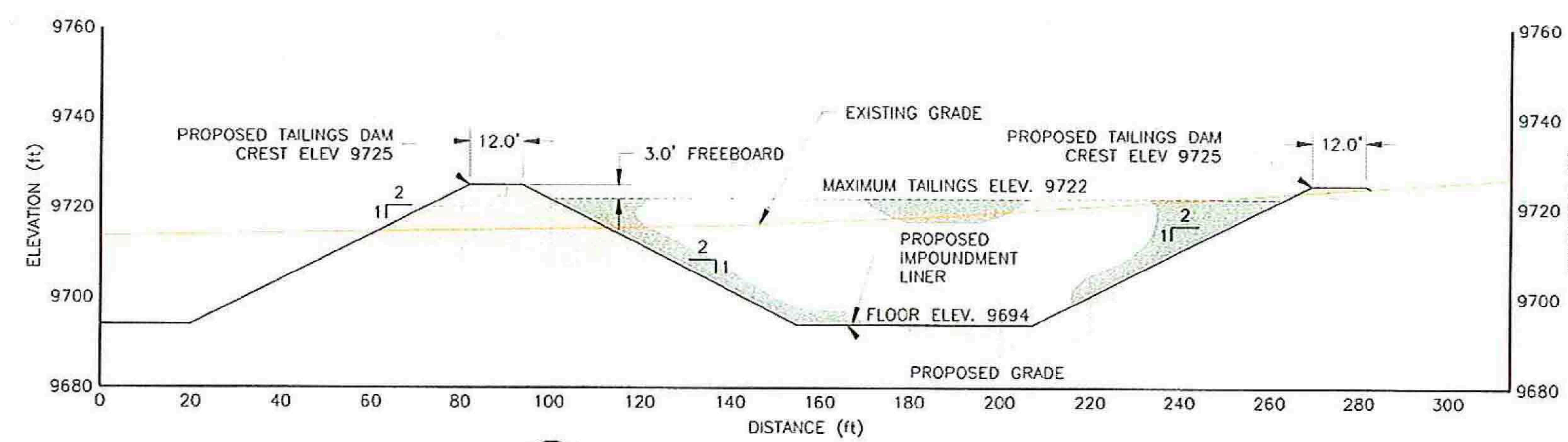
C:\Civil 3D Projects\Union Milling\Dwg\Initial\Lsa02 - Proposed Ph 1 (1)-rev1.dwg, 9/22/2011 1:49:35 PM



A 02|04 TAILINGS STORAGE FACILITY CROSS-SECTION



B 02|04 TAILINGS STORAGE FACILITY CROSS-SECTION



C 03|04 TAILINGS STORAGE FACILITY CROSS-SECTION

This document was prepared by me or under my direct supervision and the information presented is true and correct to the best of my knowledge and belief.

J. Michael Elder, PE
Colorado Registered Professional Engineer 35503

Issued by: THE UNION MILLING COMPANY

Project: THE UNION MILLING COMPANY TAILINGS STORAGE FACILITY DESIGN

Title: TAILINGS STORAGE FACILITY CROSS-SECTIONS

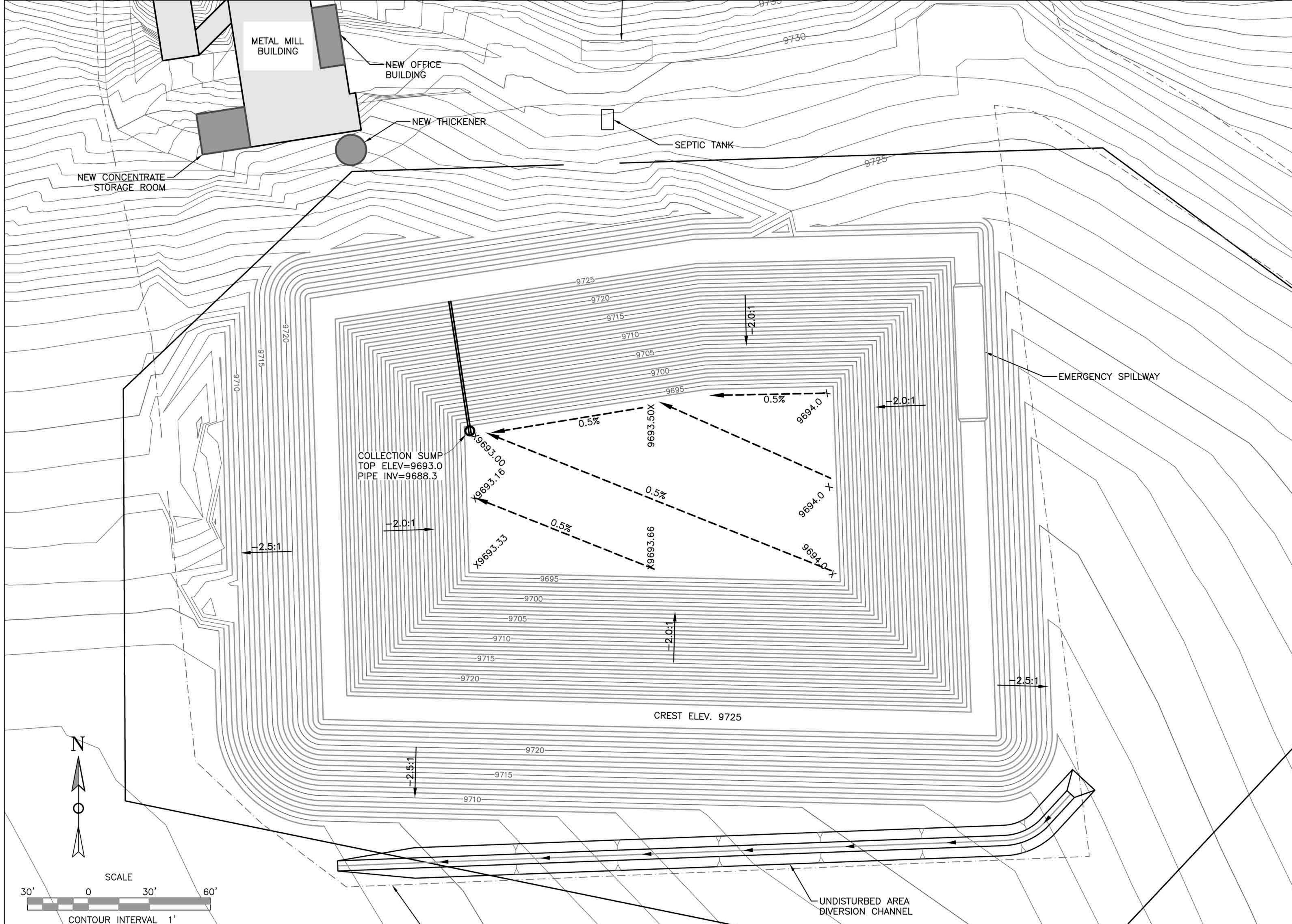
Location: LAKE COUNTY, CO

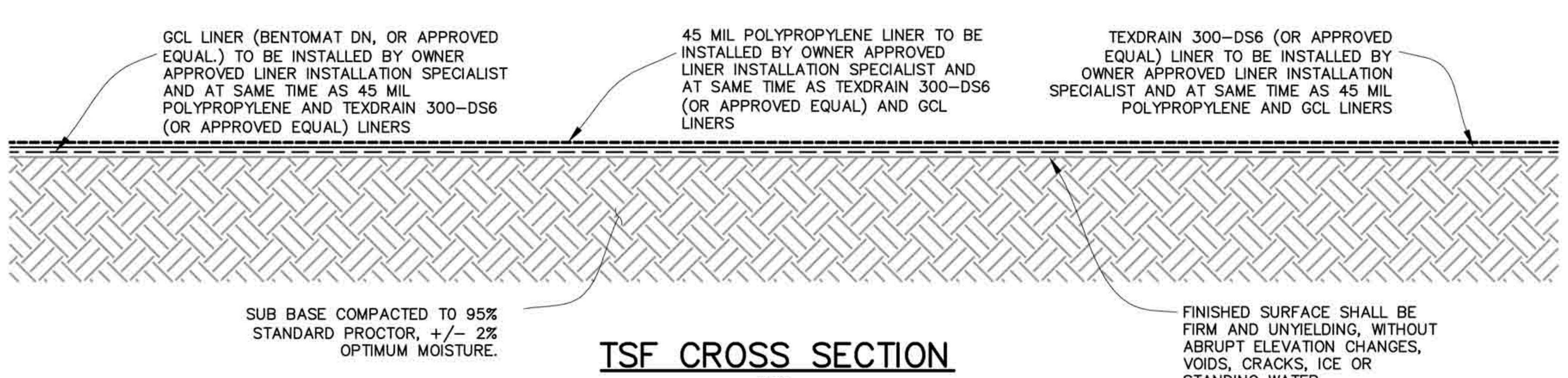
Date: 5/13/2011 | Project no.:

FIGURE 4-7

REVISION A

C:\Civil 3D Projects\Union Milling\Dwg\Installs\4 - Proposed TSF cross-sections.dwg, 9/14/2011 4:37:42 PM





TSF CROSS SECTION

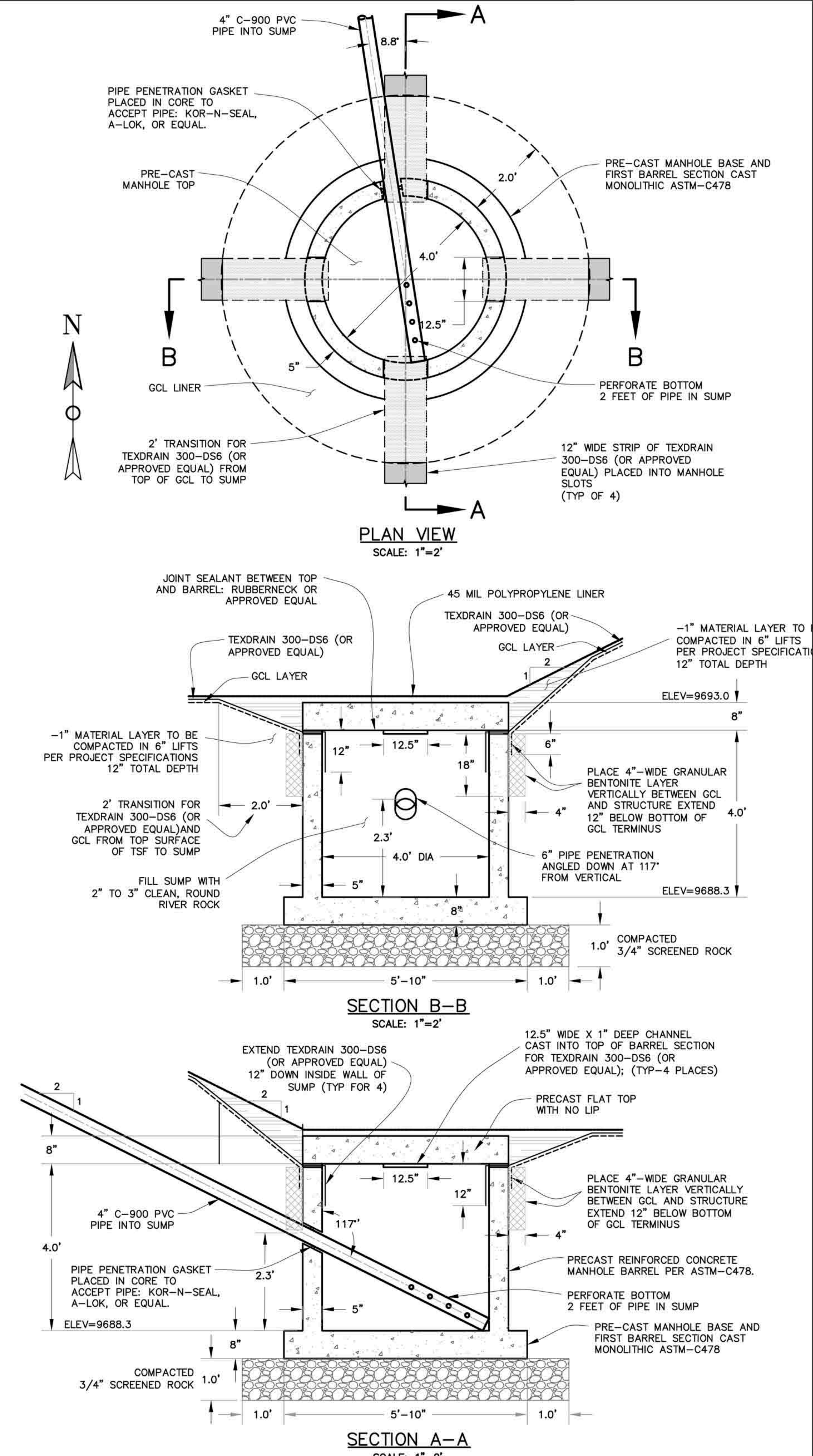
NTS

NOTES

1. SUBGRADE SURFACES CONSISTING OF GRANULAR SOILS OF GRAVEL ARE NOT ACCEPTABLE DUE TO THEIR LARGE VOID FRACTION AND PUNCTURE POTENTIAL.
2. SUBGRADE SURFACE SHALL BE SMOOTH AND FREE OF VEGETATION, SHARP-EDGED ROCKS, STONES, STICKS, CONSTRUCTION DEBRIS AND OTHER FOREIGN MATTER THAT COULD CONTACT THE GCL. THE SUBGRADE TO BE ROLLED WITH A SMOOTH-DRUM COMPACTOR TO REMOVE ANY WHEEL RUTS, FOOT PRINTS, OR OTHER ABRUPT GRADE CHANGES.
3. ALL PROTRUSIONS EXTENDING MORE THAN 1/2" FROM SUBGRADE SHALL BE REMOVED, CRUSHED, OR PUSHED INTO SUBGRADE WITH A SMOOTH-DRUM COMPACTOR.

NOTES

1. JOINT BETWEEN SUMP BARREL, TOP AND AROUND PIPE INTO SUMP SHALL BE WATERTIGHT.
2. ALL CONCRETE WORK SHALL COMPLY WITH LATEST ACI-318 SPECIFICATIONS.
3. ALL EXPOSED BARE CONCRETE SURFACES ON INSIDE AND OUTSIDE OF SUMP TO TO COATED WITH 2 APPLICATIONS OF SPRAY ON POLYUREA COATING.



DETECTION LAYER COLLECTION SUMP

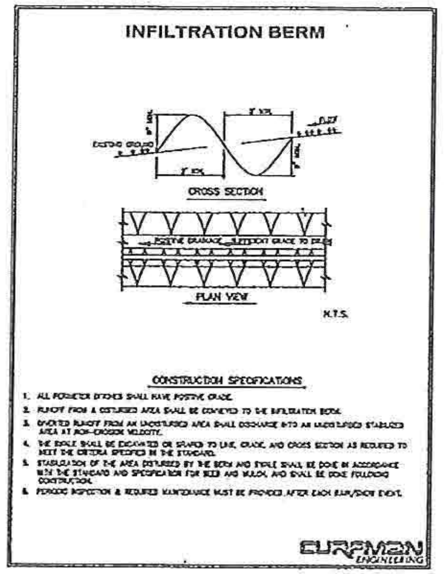
This document was prepared by me or under my direct supervision and the information presented is true and correct to the best of my knowledge and belief

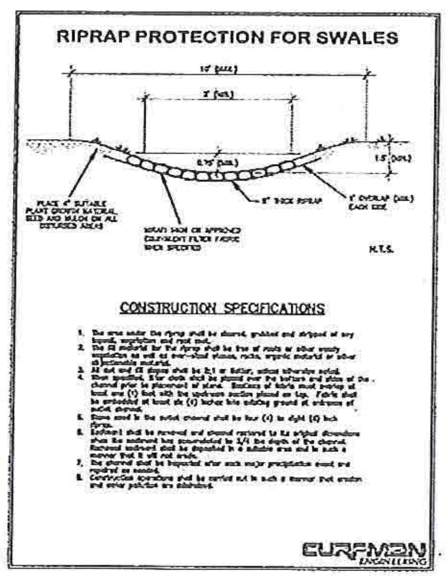
Kenneth W. Curfman
Colorado PE, PLS 25620

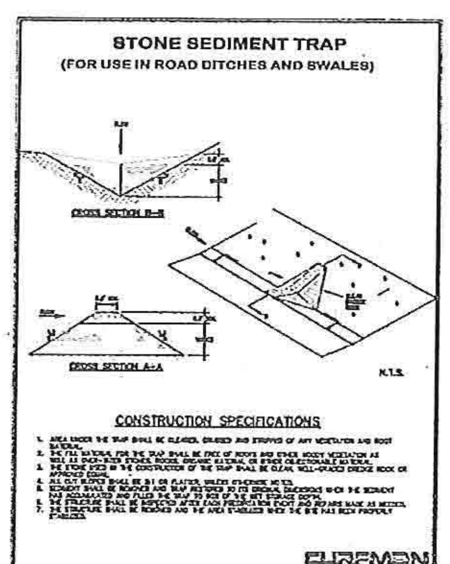
COLORADO REGISTERED KENNETH W. CURFMAN 25620 PE AND P.L.S.

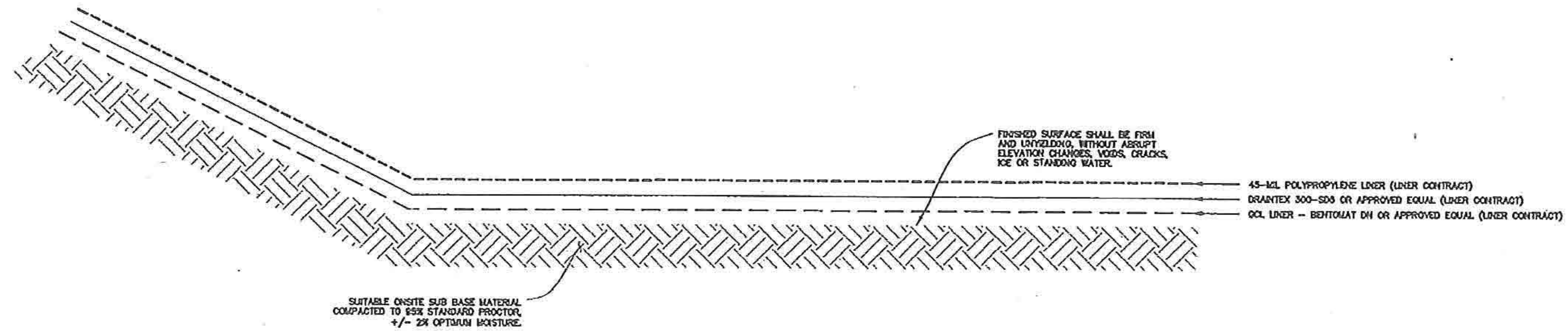
Issued by: THE UNION MILLING COMPANY	Project: THE UNION MILLING COMPANY TAILINGS STORAGE FACILITY DESIGN
	Title: TAILINGS STORAGE FACILITY LEAK DETECTION
	Location: LAKE COUNTY, CO — Exhibit: 4-8
	Date: 5/28/2012 — Project no.: — REVISION B

C:\Civil 3D Projects\Union Milling\Dwg\Initial\Exh05 - Leak Detection-rev-B.dwg, 5/29/2012 8:00:35 AM



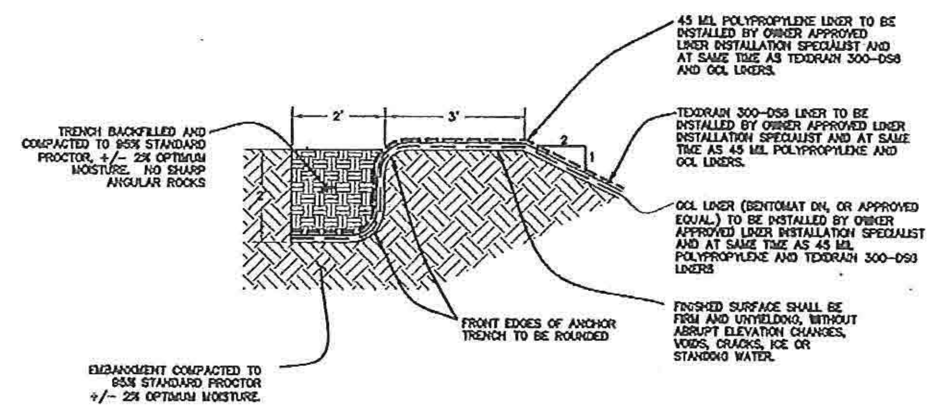






TAILINGS STORAGE FACILITY (TSF)

NTS



ANCHOR TRENCH DETAIL

NTS

NOTES

1. ALL LINERS SHALL BE PLACED IN THE ANCHOR TRENCH SUCH THAT THEY COVER THE ENTIRE TRENCH FLOOR BUT DO NOT EXTEND UP REAR WALL OF TRENCH
2. THE TOP AND BOTTOM FRONT EDGE OF TRENCH SHALL BE ROUNDED TO ELIMINATE ANY SHARP CORNERS THAT COULD CAUSE EXCESSIVE STRESS ON THE LINERS.
3. ALL PROTRUSIONS EXTENDING MORE THAN 1/2" FROM SUBGRADE SHALL BE REMOVED, CRUSHED, OR PUSHED INTO SUBGRADE.

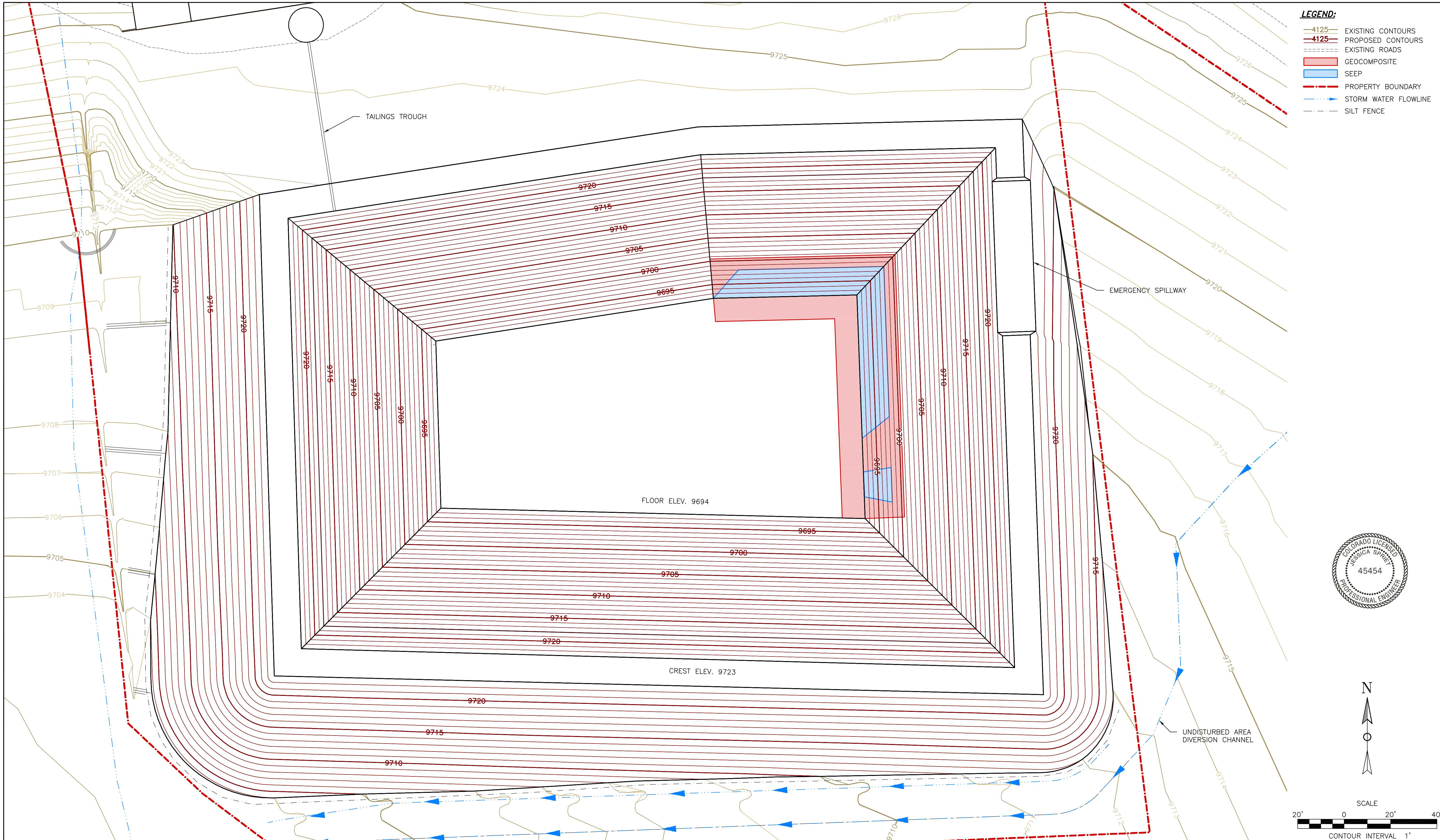
This document was prepared by me or under my direct supervision and the information presented is true and correct to the best of my knowledge and belief

Kenneth W. Curfman
Colorado PE, PLS 25620

Issued by:

THE UNION MILLING COMPANY

Project:	THE UNION MILLING COMPANY TAILINGS STORAGE FACILITY DESIGN
Title:	TAILINGS STORAGE FACILITY DETAILS
Location:	LAKE COUNTY, CO
Exhibit:	4-9
Date:	5/28/2012
Project no.:	
Revision	B



Issued by

THE UNION MILLING COMPANY

Project: THE UNION MILLING COMPANY
TAILINGS STORAGE FACILITY DESIGN

Title: GEOCOMPOSITE DRAINAGE LAYER INSTALLATION

Location: LAKE COUNTY, CO

Date: 10/8/2013

Project no.:

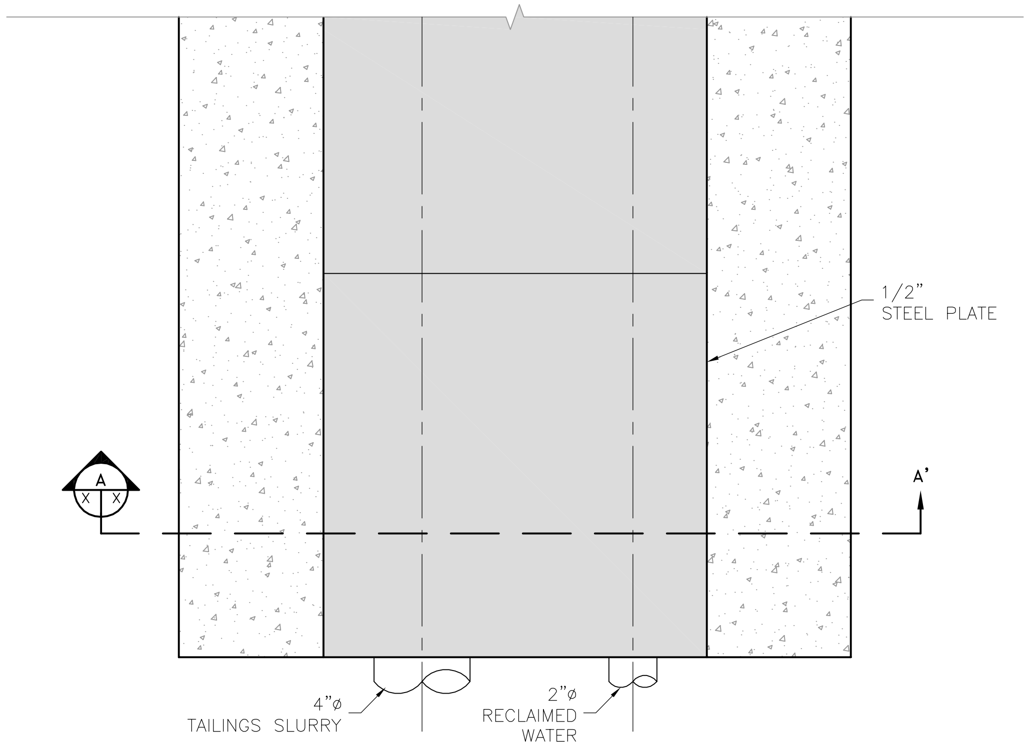
Exhibit: FIGURE 4–10

A REVISION

Troy Holm – C:\Troy\Union Milling\10-13 dwgs\Figure_4-10_GDL Installation (003th).dwg – 11/22/2013 11:02 AM

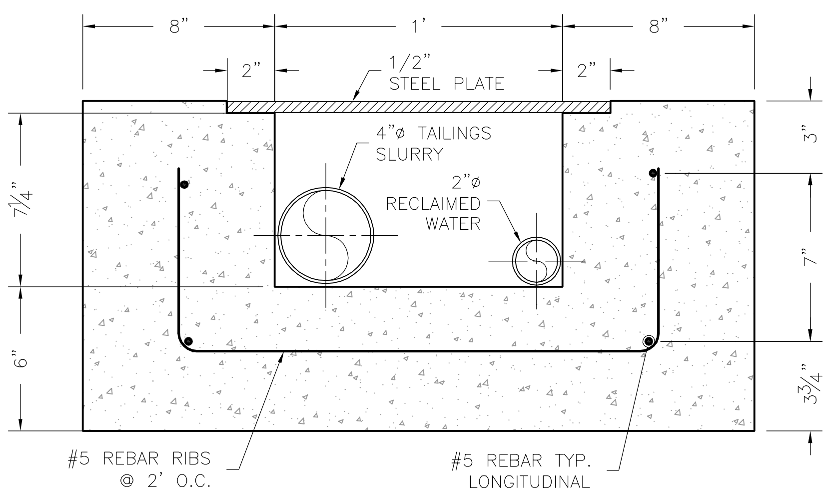
Figure 4-11: Process Flowsheet

This figure is obsolete.



PIPE TROUGH PLAN VIEW

1-1/2"=1'-0"



PIPE TROUGH CROSS SECTION

1-1/2"=1'-0"

Issued by

THE UNION MILLING COMPANY

Project: THE UNION MILLING COMPANY TAILINGS STORAGE FACILITY DESIGN

Title: TAILINGS STORAGE FACILITY TAILINGS CONVEYANCE

Location: LAKE COUNTY, CO

Date: 10/14/2013

Project no.:

FIGURE 4-12

A REVISION

Troy Holm - C:\Troy\Union Milling\10-13 dwgs\Figure_4-12_TSF Conveyance (001th).dwg - 10/31/2013 10:16 PM

The Tailings Storage Facility design was approved by CDRMS in 2014. This Appendix, shaded in gray, has been retained for completeness.

APPENDIX 4-1

TAILINGS STORAGE FACILITY
TECHNICAL SPECIFICATIONS & DATA SHEETS

4-1.1: Geosynthetic Clay Liner (Under-liner)

TECHNICAL REFERENCE 401-BMDN

BENTOMAT® DN
CERTIFIED PROPERTIES

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY	REQUIRED VALUES
Bentonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss[1]	ASTM D 5891	1 per 50 tonnes	18 mL max
Bentonite Mass/Area[2]	ASTM D 5993	40,000 ft^2 (4,000 m^2)	0.75 lb/ft^2 (3.6 kg/m^2) min.
GCL Tensile Strength[3]	ASTM D 6768	200,000 ft^2 (20,000 m^2)	50 lb/in (88 N/cm) MARV
GCL Peel Strength[3]	ASTM D 6496	40,000 ft^2 (4,000 m^2)	3.5 lbs/in (6.1 N/cm) min.
GCL Index Flux[4]	ASTM D 5887	Weekly	1×10^{-8} m^3/m^2/sec max.
GCL Hydraulic Conductivity[4]	ASTM D 5887	Weekly	5×10^{-9} cm/sec max.
GCL Hydrated Internal Shear Strength[5]	ASTM D 5321 ASTM D 6243	Periodic	500 psf (24 kPa) typical @200 psf

Bentomat DN is a reinforced GCL consisting of a layer of sodium bentonite between two nonwoven geotextiles, which are needlepunched together.

Notes

1 Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.
2 Bentonite mass/area reported at 0 percent moisture content.
3 All tensile strength testing is performed in the machine direction using ASTM D 6768. All peel strength testing is performed using ASTM D 6496. Upon request, tensile and peel results can be reported per modified ASTM D 4632 using 4 inch grips.
4 Index flux and permeability testing with deaired distilled/deionized water at 80 psi (551kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 925 gal/acre/day. This flux value is equivalent to a permeability of 5×10^{-9} cm/sec for typical GCL thickness. Actual flux values vary with field condition pressures. The last 20 weekly values prior the end of the production date of the supplied GCL may be provided.
5 Peak values measured at 200 psf (10 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

CETCO has developed an edge enhancement system that eliminates the need to use additional granular sodium bentonite within the overlap area of the seams. We call this edge enhancement, SUPERGROOVE™, and it comes standard on both longitudinal edges of BENTOMAT® DN. It should be noted that SUPERGROOVE™ does not appear on the end-of-roll overlaps and recommend the continued use of supplemental bentonite for all end-of-roll seams.

LAST UPDATED MAY 2007

IMPORTANT: The information contained herein supersedes all previous printed versions, and is believed to be accurate and reliable. For the most up-to-date information, please visit www.CETCO.com. CETCO accepts no responsibility for the results obtained throught application of this product. CETCO reserves the right to update information without notice.

CETCO®
www.CETCO.com
2870 Forbs Avenue Hoffman Estates, IL 60192
847.851.1800 | 800.527.9948

LINING TECHNOLOGIES | REMEDIATION TECHNOLOGIES | DRILLING SYSTEMS | BUILDING ENVELOPE

BENTOMAT® INSTALLATION GUIDELINES

GEOSYNTHETIC CLAY LINERS

CETCO®

BENTOMAT®

GEOSYNTHETIC CLAY LINERS

CONTENTS

NOTICE: THIS DOCUMENT IS INTENDED FOR USE AS A GENERAL GUIDELINE FOR THE INSTALLATION OF CETCO GCLS. THE INFORMATION AND DATA CONTAINED HEREIN ARE BELIEVED TO BE ACCURATE AND RELIABLE. CETCO MAKES NO WARRANTY OF ANY KIND AND ACCEPTS NO RESPONSIBILITY FOR THE RESULTS OBTAINED THROUGH APPLICATION OF THIS INFORMATION. INSTALLATION GUIDELINES ARE SUBJECT TO PERIODIC CHANGES. PLEASE CONSULT OUR WEBSITE @ WWW.CETCO.COM/LT FOR THE MOST RECENT VERSION.

SECTION 1
INTRODUCTION

1.1
This document provides procedures for the installation of CETCO GCLs in a manner that maximizes safety, efficiency, and the physical integrity of the GCL.

1.2
These guidelines are based upon many years of experience at a variety of sites and should be generally applicable to any type of lining project using CETCO GCLs. Variance from these guidelines is at the engineer's discretion.

1.3
The performance of the GCL is wholly dependent on the quality of its installation. It is the installer's responsibility to adhere to these guidelines, and to the project specifications and drawings as closely as possible. It is the engineer's and owner's responsibility to provide construction quality assurance (CQA) for the installation. This will ensure that the installation has been executed properly. This document covers only installation procedures.

1.4
For additional guidance, refer to ASTM D5888 (Standard Guide For Storage and Handling of Geosynthetic Clay Liners) and ASTM D 6102 (Standard Guide For Installation of Geosynthetic Clay Liners).

SECTION 2
EQUIPMENT REQUIREMENTS

2.1
CETCO GCLs are delivered in rolls typically 2,600-2,950 lbs (1180-1340 kg). Roll dimensions and weights will vary with the dimensions of the product ordered. It is necessary to support this weight using an appropriate core pipe, as indicated in Table 1. For any installation, the core pipe must not deflect more than 3 inches (75 mm), as measured from end to midpoint when a full GCL roll is lifted.

2.2
Lifting chains or straps appropriately rated should be used in combination with a spreader bar made from an I-beam, as shown in Figure 1.

2.3
The spreader bar ensures that lifting chains or straps do not chafe against the ends of the GCL roll, allowing it to rotate freely during installation. Spreader bar and core pipe kits are available through CETCO.

2.4
A front end loader, backhoe, dozer, or other equipment can be utilized with the spreader bar and core pipe or slings. Alternatively, a forklift with a "stinger" attachment may be used for on-site handling. A forklift without a stinger attachment should not be used to lift or handle the GCL rolls. Stinger attachments (Figures 2-4) are specially fabricated to fit various forklift makes and models.

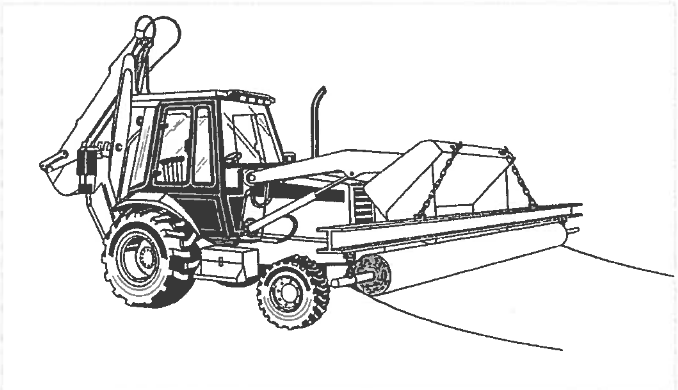
Table 1: Core Requirements

Product	Nominal GCL Roll Size Lenth X Diameter	Typical GCL Roll Weight	Interior Core Size	Core Pipe Length x Diameter	Minimum Core Pipe Strength
BENTOMAT DN, SDN	16' x 24" (4.9 m x 610 mm)	2,650 lbs. (1204 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH
BENTOMAT ST	16' x 24" (4.9 m x 610 mm)	2,650 lbs. (1204 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH
BENTOMAT STM	16' x 32" (4.9 m x 814 mm)	2,500 lbs. (1130 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH
BENTOMAT 200R	16' x 24" (4.9 m x 610 mm)	2,650 lbs. (1204 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH
BENTOMAT CLT	16' x 26" (4.9 m x 660 mm)	2,650 lbs. (1204 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH
BENTOMAT CL	16' x 25" (4.9 m x 635 mm)	2,650 lbs. (1204 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH
BENTOMAT 600 CL	16' x 25" (4.9 m x 635 mm)	2,700 lbs. (1227 kg)	3 3/4" (100 mm)	20' x 3.5" O.D. (6.1 m x 89 mm)	XXH

BENTOMAT®

GEOSYNTHETIC CLAY LINERS

FIGURE 1 -SPREADER BAR ASSEMBLY



2.5
When installing over certain geosynthetic materials, a 4 wheel, all-terrain vehicle (ATV) can be used to deploy the GCL. An ATV can be driven directly on the GCL provided that no sudden stops, starts, or turns are made.

2.6
Additional equipment needed for installation of CETCO GCLs includes:

- Utility knife and spare blades (for cutting the GCL)
- Granular bentonite for end-of-roll GCL seams and for sealing around structures and details
- Waterproof tarpaulins (for temporary cover on installed material as well as for stockpiled rolls)
- Optional flat-bladed vise grips (for positioning the GCL panel by hand)

2.7
The CETCO EASY ROLLER™ GCL Deployment System is a preferred method of installing geosynthetic clay liners. Use of the EASY ROLLER system eliminates the need for spreader bars and heavy core pipes. Installation speed and worker safety are also significantly increased. For further details, contact CETCO.

FIGURE 2 - HOOK MOUNT

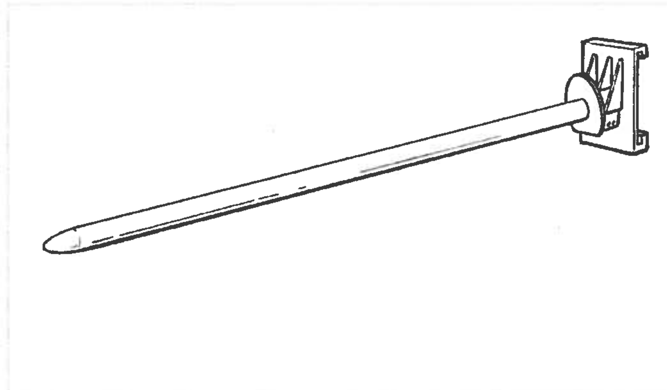


FIGURE 3 - FORK MOUNT (WITH FORK POCKETS)

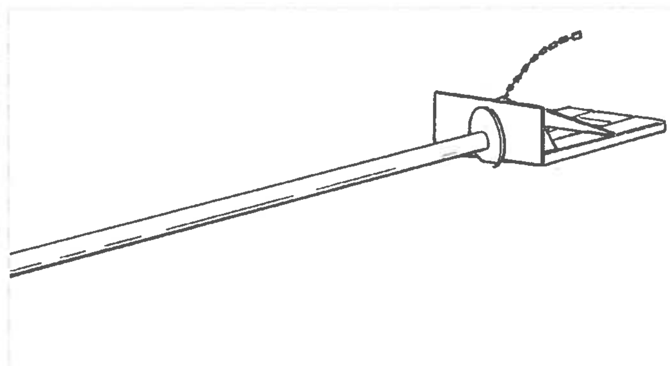
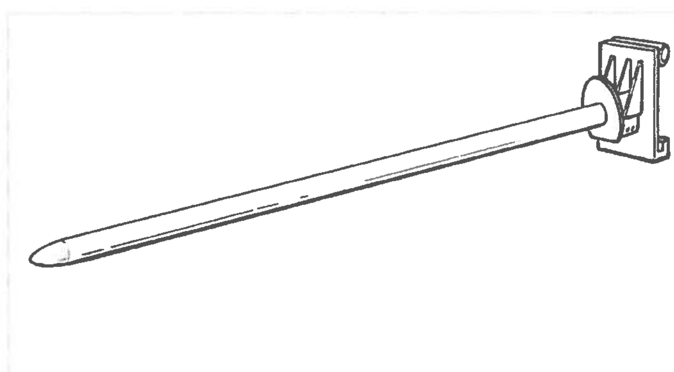


FIGURE 4 - PIN MOUNT



2870 Forbs Avenue Hoffman Estates, IL 60192
847.851.1800 | 800.527.9948

SECTION 3 SHIPPING, UNLOADING, & STORAGE

3.1
All lot and roll numbers should be recorded and compared to the packing list. Each roll of GCL should also be visually inspected during unloading to determine if any packaging has been damaged. Damage, whether obvious or suspected, should be recorded and the affected rolls marked.

3.2
Major damage suspected to have occurred during transit should be reported to the carrier and to CETCO immediately. The nature of the damage should also be indicated on the bill of lading, with specific lot and roll numbers noted. Accumulation of some moisture within roll packaging is normal and does not damage the product.

3.3
The party directly responsible for unloading the GCL should refer to this manual prior to shipment to ascertain the appropriateness of their unloading equipment and procedures. Unloading and on-site handling of the GCL should be supervised.

3.4
In most cases, CETCO GCLs are delivered on flatbed trucks. There are three methods of unloading: core pipe and spreader bar, slings, or stinger bar. To unload the rolls from the flat-bed using a core pipe and spreader bar, first insert the core pipe through the core tube. Secure the lifting chains or straps to each end of the core pipe and to the spreader bar mounted on the lifting equipment. Hoist the roll straight up and make sure its weight is evenly distributed so that it does not tilt or sway when lifted.

3.5
All CETCO GCLs are delivered with two 2'x 12' (50 mm x 3.65 mm) Type V polyester endless slings on each roll. Before lifting, check the position of the slings. Each sling should be tied off in the choke position, approximately one third (1/3) from the end of the roll. Hoist the roll straight up so that it does not tilt or sway when lifted.

3.6
In some cases, GCL rolls will be stacked in three pyramids on flatbed trucks. If slings are not used, rolls will require unloading with a stinger bar and extendible boom fork lift. Spreader bars will not work in this situation because of the limited access between the stacks of GCL. Three types of stingers are available from CETCO, a hook mount, fork mount and pin mount (Figures 2-4). To unload, guide the stinger through the core tube before lifting the GCL roll and removing the truck.

3.7
An extendable boom fork lift with a stinger bar is required for unloading vans. Rolls in the nose and center of the van should first be carefully pulled toward the door using the slings provided on the rolls.

3.8
Rolls should be stored at the job site away from high-traffic areas but sufficiently close to the active work area to minimize handling. The designated storage area should be flat, dry, and stable. Moisture protection of the GCL is provided by its packaging; however, based on expected weather conditions, an additional tarpaulin or plastic sheet may be required for added protection during prolonged outdoor storage.

3.9
Rolls should be stacked in a manner that prevents them from sliding or rolling. This can be accomplished by chocking the bottom layer of rolls. Rolls should be stacked no higher than the height at which they can be safely handled by laborers (typically no higher than four layers of rolls). Rolls should never be stacked on end.

SECTION 4 SUBGRADE PREPARATION

4.1
Subgrade surfaces consisting of granular soils or gravels are not acceptable due to their large void fraction and puncture potential. In applications where the GCL is the only barrier, subgrade soils should have a particle-size distribution of at least 80 percent finer than the #60 sieve (0.25 mm). In other applications, subgrade soils should range between fines and 1 inch (25 mm). In high-head applications (greater than 1 foot or 30.48 cm), CETCO recommends a membrane-laminated GCL (BENTOMAT CLT, BENTOMAT CL, or BENTOMAT 600 CL).

4.2
When the GCL is placed over an earthen subgrade, the subgrade surface must be prepared in accordance with the project specifications. The engineer's approval of the subgrade must be obtained prior to installation. The finished surface should be firm and unyielding, without abrupt elevation changes, voids, cracks, ice, or standing water.

BENTOMAT®

GEOSYNTHETIC CLAY LINERS

4.3

The subgrade surface must be smooth and free of vegetation, sharp-edged rocks, stones, sticks, construction debris, and other foreign matter that could contact the GCL. The subgrade should be rolled with a smooth-drum compactor to remove any wheel ruts greater than 1 inch in depth, footprints, or other abrupt grade changes. Furthermore, all protrusions extending more than 0.5 inch (12 mm) from the subgrade surface shall be removed, crushed, or pushed into the surface with a smooth-drum compactor. The GCL may be installed on a frozen subgrade, but the subgrade soil in the unfrozen state should meet the above requirements.

SECTION 5 INSTALLATION

5.1

GCL rolls should be taken to the work area of the site in their original packaging. The orientation of the GCL (i.e., which side faces up) may be important if the GCL has two different types of geosynthetics. Check with the project engineer to determine if there is a preferred installation orientation for the GCL. If no specific orientation is required, allow the roll to unwind from the bottom rather than pulling from the top (Figure 5A). The arrow sticker on the plastic sleeve indicates the direction that the GCL will naturally unroll when placed on the ground (Figure 6). Prior to deployment, the packaging should be carefully removed without damaging the GCL.

5.2

Equipment which could damage the GCL should not be allowed to travel directly on it. Therefore, acceptable installation may be accomplished whereby the GCL is unrolled in front of backwards-moving equipment (Figure 7). If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

5.3

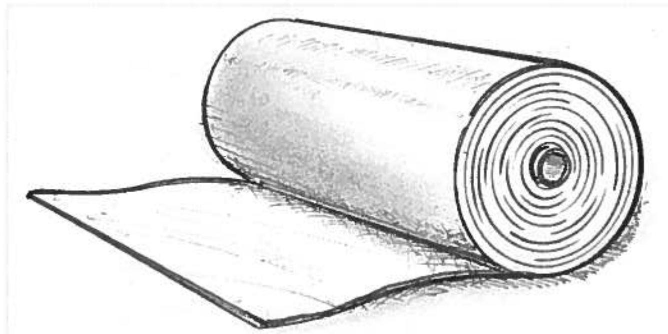
If sufficient access is available, GCL may be deployed by suspending the roll at the top of the slope, with a group of laborers pulling the material off of the roll, and down the slope (Figure 8).

5.4

GCL rolls should not be released on the slope and allowed to unroll freely by gravity.

FIGURE 5 A & B

"NATURAL' ORIENTATION (5A)



TOP OF THE ROLL (5B)

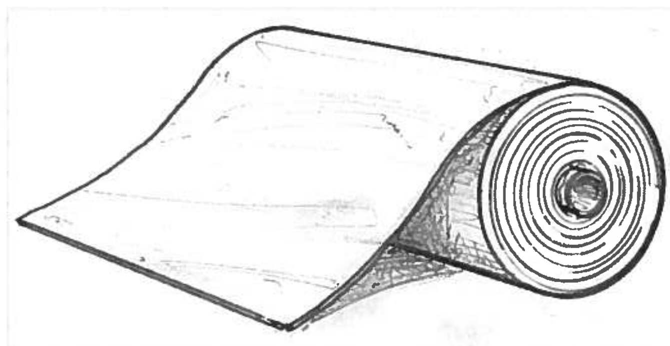


FIGURE 6 - DIRECTION TO UNROLL GCL ON GROUND PER FIGURE 5A

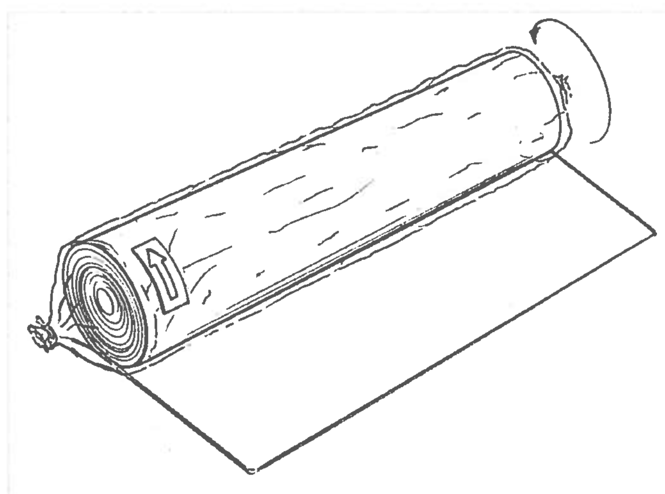


FIGURE 7 - TYPICAL BENTOMAT® INSTALLATION TECHNIQUE

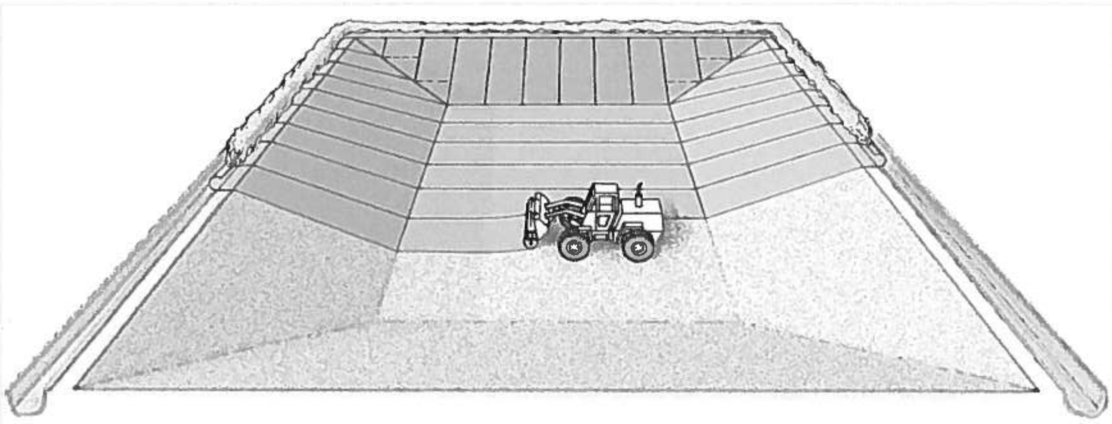
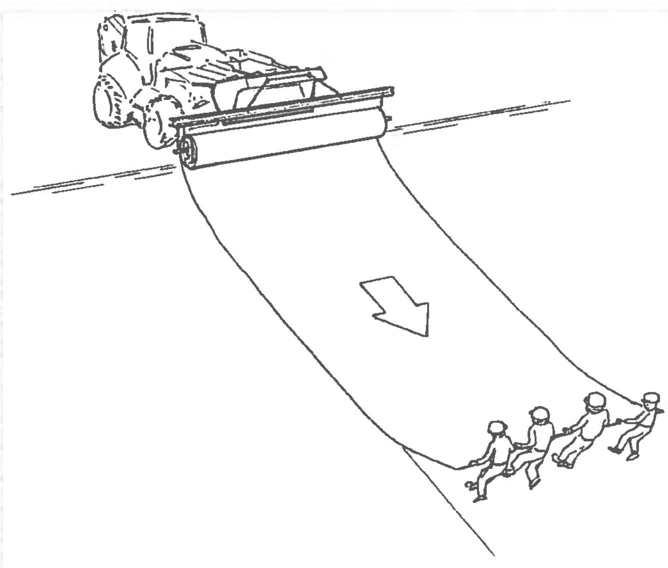


FIGURE 8 - UNROLLING BENTOMAT



5.5

Care must be taken to minimize the extent to which the GCL is dragged across the subgrade to avoid damage to the bottom surface of the GCL. Care must also be taken when adjusting BENTOMAT CLT panels to avoid damage to the geotextile surface of one panel of GCL by the textured sheet of another panel of GCL. A temporary geosynthetic subgrade cover commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

5.6

The GCL should be placed so that seams are parallel to the direction of the slope. End-of-panel seams should also be located at least 3 ft (1 m) from the toe and crest of slopes steeper than 4H:1V. End-of-roll seams on slopes should be used only if the liner is not expected to be in tension.

5.7

All GCL panels should lie flat, with no wrinkles or folds, especially at the exposed edges of the panels. When BENTOMAT geosynthetic clay liners with SUPERGROOVE® is repositioned, it should be gripped inside the SUPERGROOVE by folding the edge.

5.8

The GCL should not be installed in standing water or during rainy weather. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. CETCO recommends that premature hydration be evaluated on a case-by-case basis. The project engineer, CQA inspector, and CETCO TR-312 should be consulted for specific guidance if premature hydration occurs. The type of GCL, duration of exposure, degree of hydration, location in the liner system, and expected bearing loads should all be considered.

BENTOMAT®

GEOSYNTHETIC CLAY LINERS

In many instances, a needlepunch reinforced GCL may not require removal/replacement if the following are true:

- The geotextiles have not been separated, torn, or otherwise damaged
- There is no evidence that the needlepunching between the two geotextiles has been compromised
- The GCL does not leave deep indentations when stepped upon
- Overlapped seams with bentonite enhancement (see Section 7) are intact

5.9

For the convenience of the installer, hash marks are placed on BENTOMAT goesynthetic clay liners every 5' (1.5 m) of length.

SECTION 6 ANCHORAGE

6.1

If required by the project drawings, the end of the GCL roll should be placed in an anchor trench at the top of a slope. The front edge of the trench should be rounded to eliminate any sharp corners that could cause excessive stress on the GCL. Loose soil should be removed or compacted into the floor of the trench.

6.2

If a trench is used for anchoring the end of the GCL, soil backfill should be placed in the trench to provide resistance against pullout. The size and shape of the trench, as well as the appropriate backfill procedures should be in accordance with the project drawings and specifications. Typical dimensions are shown in Figure 9.

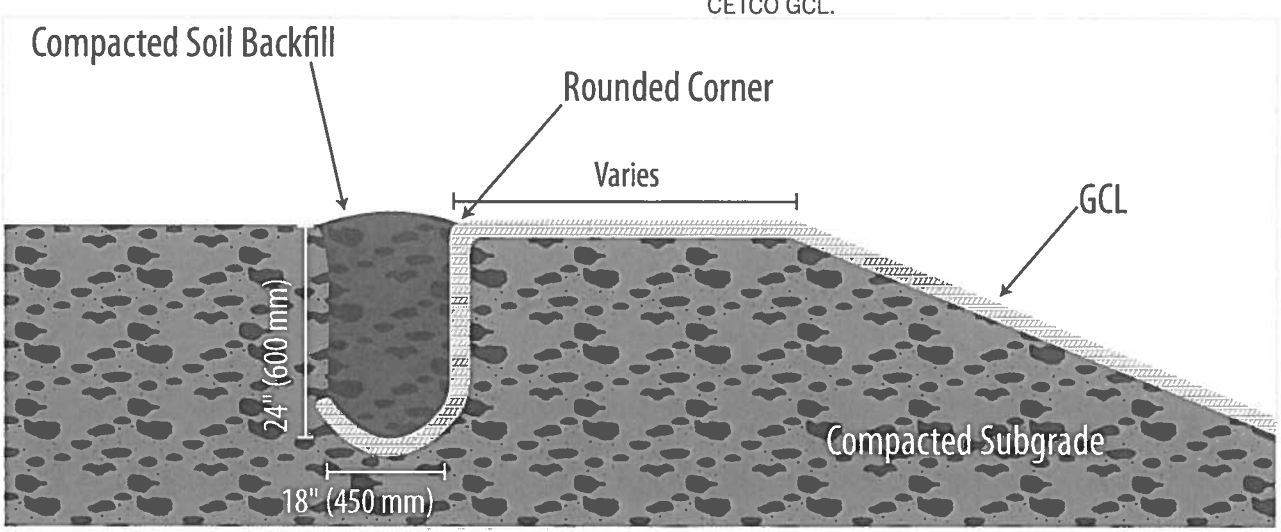
6.3

The GCL should be placed in the anchor trench such that it covers the entire trench floor but does not extend up the rear trench wall.

6.4

Sufficient anchorage may alternately be obtained by extending the end of the GCL roll back from the crest of the slope, and placing cover soil. The length of this "runout" anchor should be prepared in accordance with project drawings and specifications.

FIGURE 9 - TYPICAL ANCHOR TRENCH DESIGN

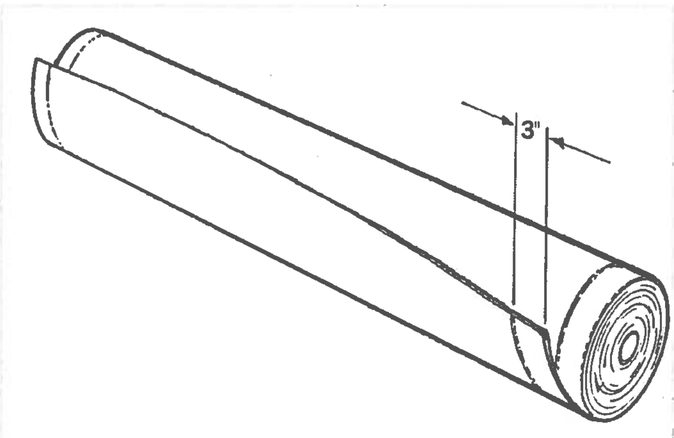


SECTION 7 SEAMING

7.1

GCL seams are constructed by overlapping adjacent panel edges and ends. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. BENTOMAT 200R, BENTOMAT ST, BENTOMAT DN, and BENTOMAT SDN have SUPERGROOVE® which provides self-seaming capabilities in their longitudinal overlaps, and therefore do not require supplemental bentonite. However, for pond applications, supplemental bentonite must be used in longitudinal seams, regardless of the CETCO GCL.

FIGURE 10 - SUPERGROOVE®



7.2
Longitudinal seams should be overlapped a minimum of 6 inches (150 mm) for BENTOMAT geosynthetic clay liners. For high-head applications (greater than 1 foot or 20.48 cm) involving BENTOMAT CL, BENTOMAT CLT, or BENTOMAT 600 CL, a minimum longitudinal seam overlap of 12 inches (300 mm) and supplemental bentonite (per Section 7.6) is recommended.

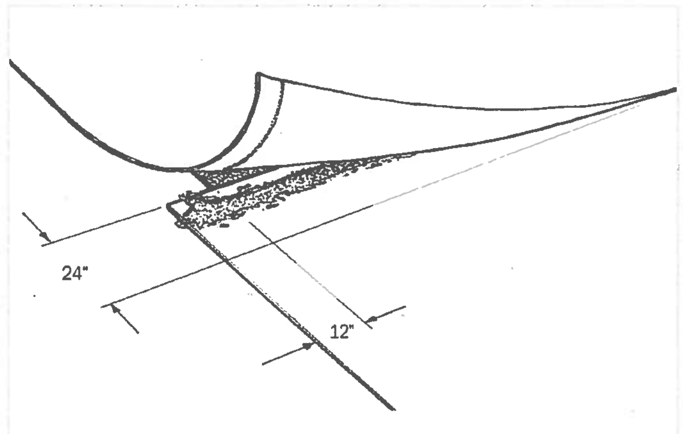
7.3
End-of-panel overlapped seams should be overlapped 24 inches (600 mm) for BENTOMAT geosynthetic clay liners.

7.4
End-of-panel overlapped seams are constructed such that they are shingled in the direction of the grade to prevent runoff from entering the overlap zone. End-of-panel seams on slopes are permissible, provided adequate slope stability analysis has been conducted (i.e., the GCL is not expected to be in tension). Bentonite-enhanced seams are required for all BENTOMAT end-of-panel overlapped seams.

7.5
BENTOMAT end-of-panel, bentonite-enhanced, overlapped seams are constructed first by overlapping the adjacent panels, exposing the underlying panel, and then applying a continuous bead or fillet of granular sodium bentonite 12" from the edge of the underlying panel (Figure 11). The minimum application rate at which the bentonite is applied is one-quarter pound per linear foot (0.4 kg/m).

7.6
If longitudinal bentonite enhanced seams are required for BENTOMAT 200R, BENTOMAT ST, BENTOMAT DN, or BENTOMAT SDN, they are constructed by overlapping the adjacent panels a minimum 6 inches (150 mm), exposing the underlying edge, and applying a continuous bead of granular bentonite approximately 3 inches (75 mm) from the edge. For pond applications involving BENTOMAT CL or BENTOMAT CLT, longitudinal seams are constructed by overlapping adjacent panels by 12 inches (300 mm), exposing the underlying edge, and applying a continuous bead of bentonite approximately 6 inches (150 mm) from the edge. The minimum application rate for the granular bentonite is one quarter pound per linear foot (0.4 kg/m).

FIGURE 11
BENTOMAT END-OF-PANEL OVERLAPPED SEAM



SECTION 8
SEALING AROUND PENETRATIONS AND STRUCTURES

8.1
Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid irregular tearing of the geotextile components of the GCL during the cutting process.

8.2
The GCL should be sealed around penetrations and structures embedded in the subgrade in accordance with Figures 12 through 14. Granular bentonite shall be used liberally (approximately 0.25 lbs/ln. ft. or 0.4 kg/m) to seal the GCL to these structures.

BENTOMAT®

GEOSYNTHETIC CLAY LINERS

FIGURE 12 A CROSS-SECTION OF A HORIZONTAL PIPE PENETRATION

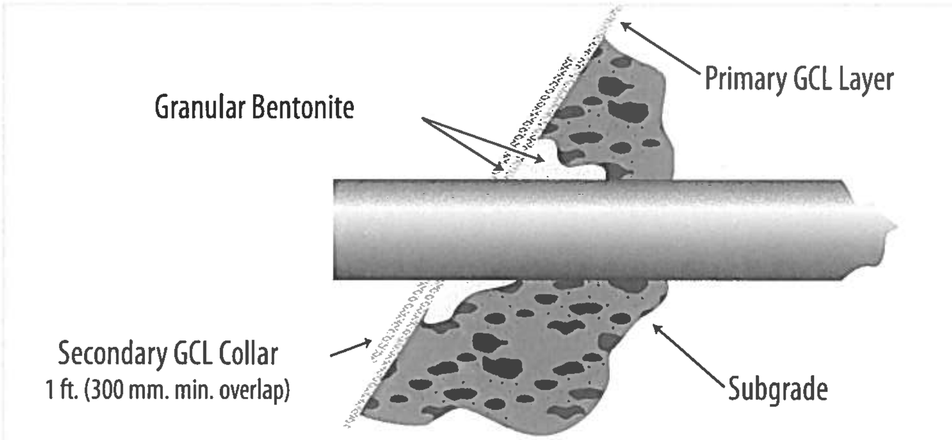


FIGURE 12 B ISOMETRIC VIEW OF A COMPLETED HORIZONTAL PIPE PENETRATION

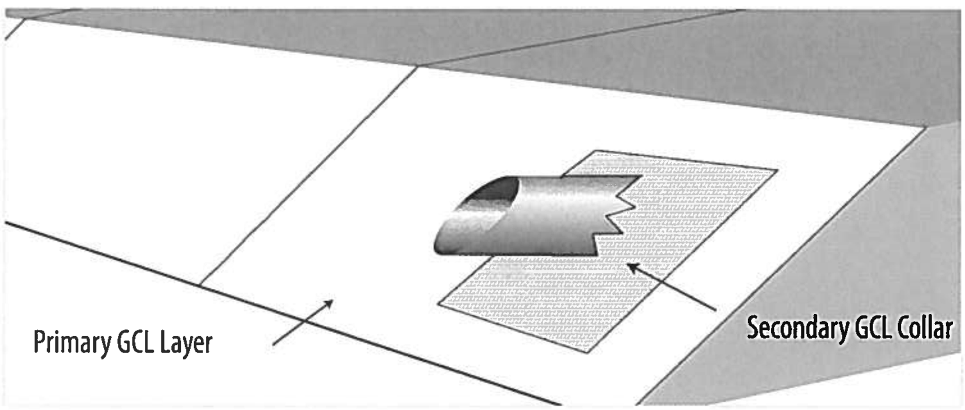


FIGURE 13 A CROSS-SECTION OF A VERTICAL PENETRATION

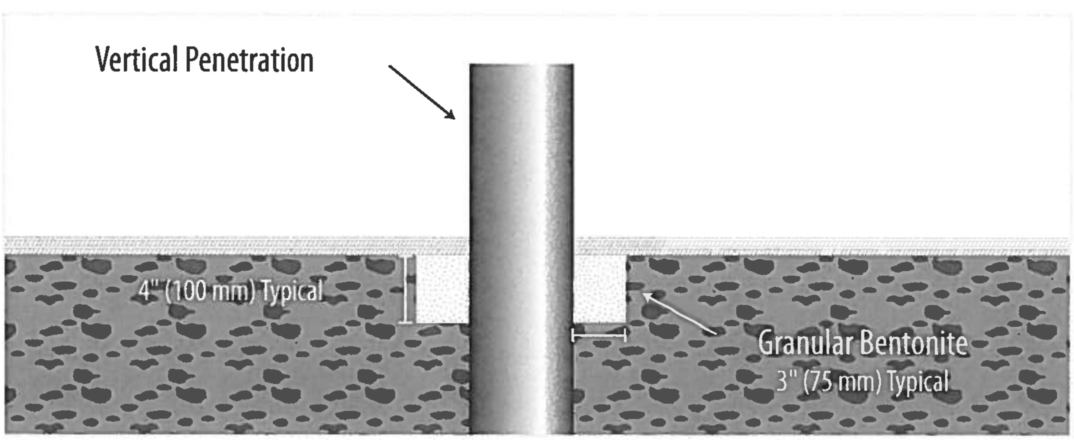


FIGURE 13B ISOMETRIC VIEW OF THE COMPLETED VERTICAL PENETRATION

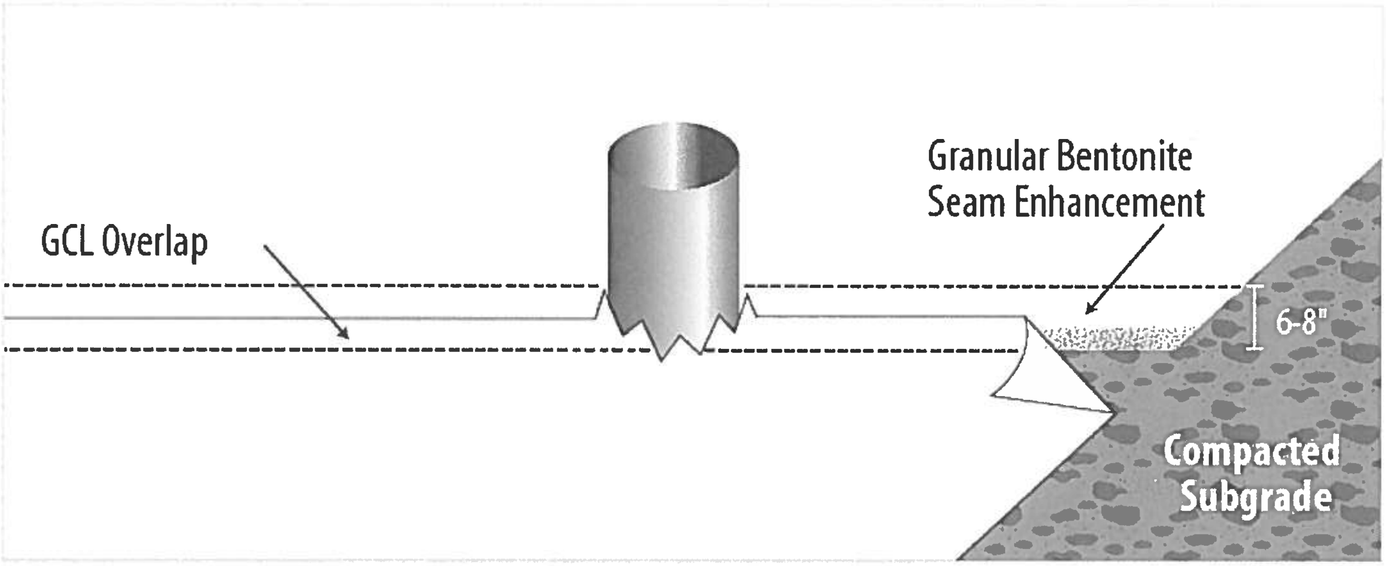
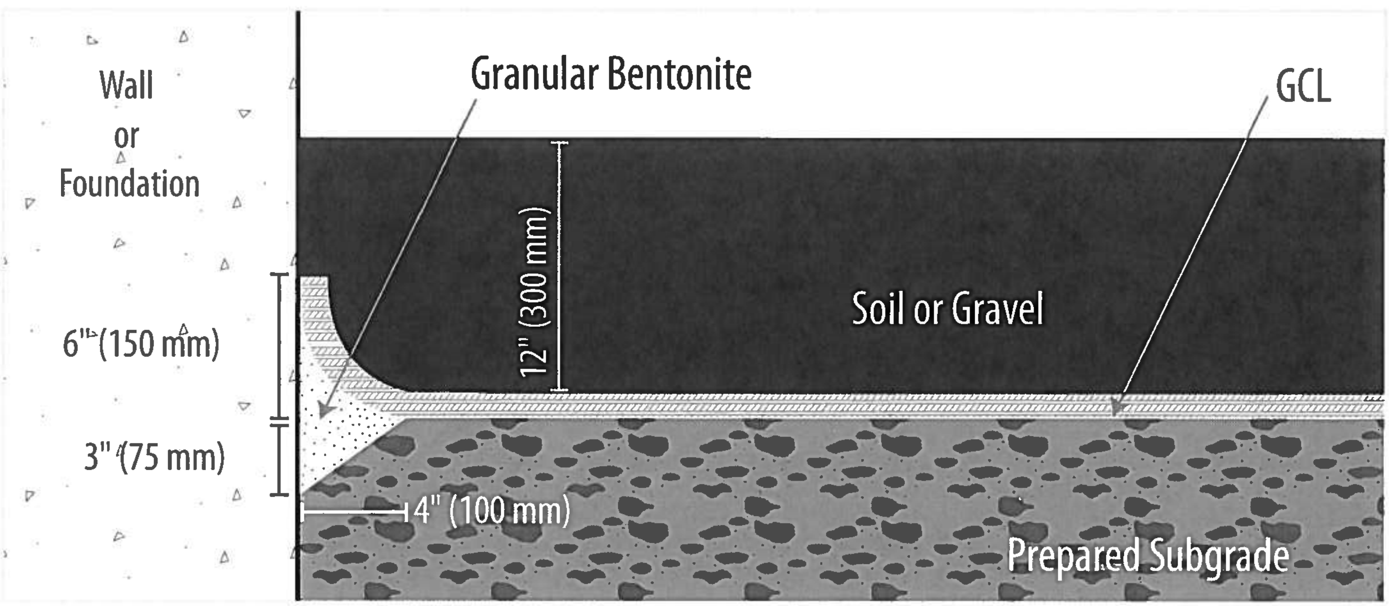


FIGURE 14 CROSS-SECTION OF GCL SEAL AGAINST AN EMBEDDED STRUCTURE OR WALL



BENTOMAT®

GEOSYNTHETIC CLAY LINERS

8.3
When the GCL is placed over a horizontal pipe penetration, a "notch" should be excavated into the subgrade around the penetration (Figure 12a). The notch should then be backfilled with granular bentonite. A secondary collar of GCL should be placed around the penetration, as shown in Figure 12b. It is helpful to first trace an outline of the penetration on the GCL and then cut a "star" pattern in the collar to enhance the collar's fit to the penetration. Granular bentonite should be applied between the primary GCL layer and the secondary GCL collar.

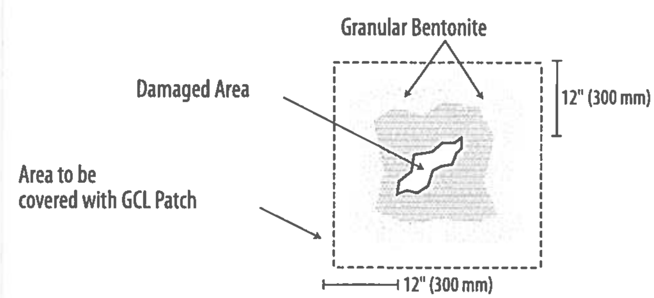
8.4
Vertical penetrations are prepared by notching into the subgrade as shown in Figure 13a. The penetration can be completed with two separate pieces of GCL as shown in Figure 13b. Alternatively, a secondary collar can be placed as shown in Figure 12a or 12b.

8.5
When the GCL is terminated at a structure or wall that is embedded into the subgrade on the floor of the containment area, the subgrade should be notched, as described in Sections 8.3 and 8.4. The notch is filled with granular bentonite; the GCL should be placed over the notch and up against the structure (Figure 14). Connection to the structure can be accomplished by placement of soil or stone backfill in this area. When structures or walls are at the top of a slope, additional detailing may be required. Contact CETCO for specific guidance.

SECTION 9
DAMAGE REPAIR

9.1
If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area (Figure 15). The patch should be cut to size such that a minimum overlap of 12 inches (300 mm) is achieved around all parts of the damaged area. Granular bentonite should be applied around the damaged area prior to placement of the patch. It may be necessary to use an adhesive such as wood glue to affix the patch in place so that it is not displaced during cover placement. Smaller patches may be tucked under the damaged area to prevent patch movement.

FIGURE 15 DAMAGE REPAIR BY PATCHING



SECTION 10
COVER PLACEMENT

10.1
The final thickness of soil cover on the GCL varies with the application. A minimum cover layer must be at least 1 foot (300 mm) thick to provide confining stress to the GCL, eliminate the potential for seam separation and prevent damage by equipment, erosion, etc.

10.2
Cover soils should be free of angular stones or other foreign matter that could damage the GCL. Cover soils should be approved by the engineer with respect to particle size, uniformity, and chemical compatibility. Consult CETCO if cover soils have high concentrations of calcium (e.g. limestone, dolomite, gypsum, seashell fragments).

10.3
Recommended cover soils should have a particle size distribution ranging between fines and 1 inch (25 mm), unless a cushioning geotextile is specified.

10.4
Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of 1 foot (300 mm) of cover soil should be maintained between the equipment tires/tracks and the GCL at all times during the covering process. In high-traffic areas such as on roadways, a minimum thickness of 2 feet (600 mm) is required.

10.5
Soil cover should be placed in a manner that prevents the soil from entering the GCL overlap zones. Soil cover should be pushed up on slopes, not down slopes, to minimize tensile forces on the GCL.

10.6
When a textured geomembrane is installed over the GCL, a temporary geosynthetic covering known as a slip sheet or rub sheet should be used to minimize friction during placement and to allow the textured geomembranes to be more easily moved into its final position.

10.7
Cyclical wetting and drying of GCL covered only with geomembrane can cause overlap separation. Soil cover should be placed promptly whenever possible. Geomembranes should be covered with a white geotextile and/or operations layer without delay to minimize the intensity of wet-dry cycling. If there is the potential for unconfined cyclic wetting and drying over an extended period of time, the longitudinal seam overlaps should be increased based on the project engineer's recommendation.

10.8
To avoid seam separation, the GCL should not be put in excessive tension by the weight or movement of textured geomembrane on steep slopes. If there is the potential for unconfined geomembrane expansion and contraction over an extended period of time, the longitudinal seam overlaps should be increased based upon the project engineer's recommendation.

SECTION 11
HYDRATION

11.1
Hydration is usually accomplished by natural rainfall and/ or absorption of moisture from soil. However, in cases where the containment of non-aqueous liquid is required, it may be necessary to hydrate the covered GCL with water prior to use.

11.2
If manual hydration is necessary, water can be introduced by flooding the covered lined area or using a sprinkler system. If flooding, care must be taken to diffuse the energy of the water discharge so that the cover material is not displaced.

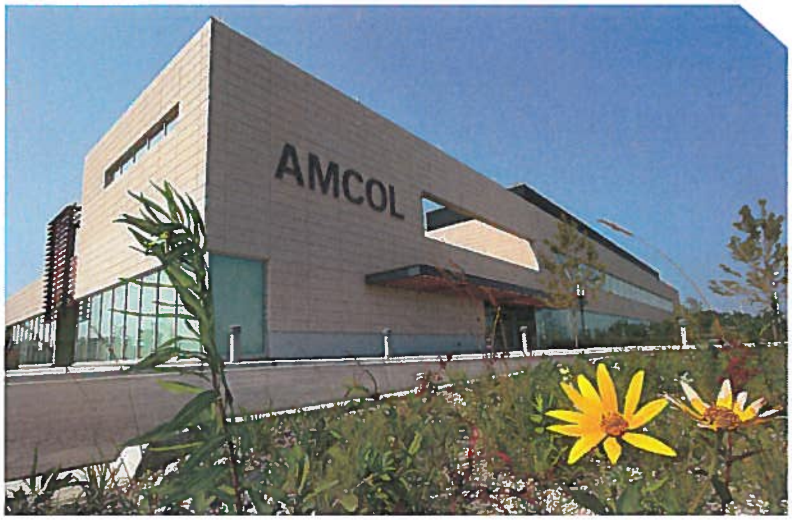
11.3
If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material.

As discussed in Section 5.8, in many instances a needlepunch reinforced GCL may not require removal/replacement if the following are true:

- The geotextiles have not been separated, torn or otherwise damaged
- There is no evidence that the needlepunching between the two geotextiles has been compromised
- The GCL does not leave deep indentations when stepped upon
- Any overlapped seams with bentonite enhancement (see Section 7) are intact

BENTOMAT®

GEOSYNTHETIC CLAY LINERS



AMCOL® INTERNATIONAL HEADQUARTERS

AMCOL INTERNATIONAL
amcol.com

Headquartered in Hoffman Estates, IL, AMCOL International Corporation (AMCOL) operates over 68 facilities in Africa, Asia, Australia, Europe, North America and South America. AMCOL employs more than 1,750 employees in 26 countries. The company, established in 1927, currently trades on the New York Stock Exchange under the symbol "ACO". AMCOL produces and markets a wide range of specialty mineral products used for industrial, environmental and consumer-related applications. With more than 68 world-wide locations, AMCOL manages a global supply chain to deliver world-class quality. Our full range of products and services allow us to bring value to our customers, but ultimately, our commitment to understanding customer's needs is what sets us apart in our industry.

DECEMBER 2010

IMPORTANT: The information contained herein is believed to be accurate and reliable. This document supersedes all previous printed versions. For the most up-to-date information, please visit www.CETCO.com. CETCO accepts no responsibility for the results obtained throughout application of this product. CETCO reserves the right to update information without notice.

2870 Forbs Avenue, Hoffman Estates, IL 60192
847.851.1800 | 800.527.9948 | cetco.com

CETCO®
CETCO, a wholly owned subsidiary of AMCOL International Corp.

THE "PREMATURE HYDRATION" OF GCLs

It is often asked whether "premature hydration" affects GCLs to the extent where it should be "removed and replaced". The term "premature" is used because excessive hydration is only a concern when the GCL is uncovered. Once a modest confining cover (12 inches of soil) is applied over the GCL, the bentonite cannot exert enough swelling force to delaminate the product, nor can it absorb enough water to become overly plastic. A few years ago, specifiers began to include provisions requiring the removal and replacement of all GCL that was hydrated before being covered. However, this "remove and replace" practice is not always necessary.

Bentomat® is a needlepunched GCL in that it is held together with needlepunched fibers. The needlepunched construction of Bentomat provides a mechanical bond that cannot be overcome by the swelling bentonite. In other words, Bentomat can withstand unconfined hydration without losing its integrity. This is why Bentomat can be successfully deployed even in standing water for short periods without adverse impacts. However, this does not mean that CETCO recommends such installation practices. CETCO's guidance is that these instances should be evaluated on a case-by-case basis. For example, the duration that the material was exposed, the degree of its hydration, the location of Bentomat within the liner system, and the bearing loads it will be subjected to during construction are all factored into a recommendation.

When assessing whether to remove and replace any prematurely hydrated Bentomat, an examination of the hydrated areas should be conducted in order to verify that:

1. The geotextiles have not been separated, torn, or otherwise damaged.

2. There is no evidence that the needlepunching between the geotextiles has been compromised.

3. The Bentomat does not leave deep indentations when it is walked upon.

4. The overlapped and bentonite-enhanced seams are intact.

If these conditions are met, then the Bentomat probably may remain in place. Although it may contain more water than it would have under soil or geosynthetic cover, this water will be drained from the Bentomat when consolidation occurs as normal loads are applied. The end result will be a water content in the formerly unconfined areas that is equivalent to that in the confined areas. Even if the Bentomat is hydrated to the extent that bentonite is displaced under foot, it may be possible to allow the material to air-dry such that bentonite is no longer displaced by point load. This is why it is not necessary to specify an absolute numerical moisture content criterion to decide whether to remove and replace the Bentomat. Again, removal and replacement would not be necessary, provided there is no visible evidence of damage.

Premature hydration is an extremely common occurrence, and Bentomat was designed to sustain it without requiring removal and replacement. In CETCO's experience, such cases are a rare exception and occur only as a result of prolonged hydration followed by direct vehicular contact. For this reason, CETCO estimates that over 99% of prematurely hydrated Bentomat does not require removal.

TR-312
Revised 12/00

4-1.2: Leak Detection System

CETCO®

Product Data Sheet

TexDrain® TD 300

TD 300 series is a composite drainage product produced by thermally laminating a 6 oz/yd² or 8 oz/yd² nonwoven geotextile to both sides of a polyethylene drainage net. TD 300 and its individual components conform to the physical property values listed below.

Geocomposite(3)			Minimum Average Roll Value	
Property	Test Method	Test Frequency	6 oz/yd² geotextile	8 oz/yd² geotextile
Transmissivity (1), m²/s	ASTM D 4716	500,000 ft²	9×10^{-4}	9×10^{-4}
Peel Adhesion, lbs/in	ASTM D 7005	50,000 ft²	1	1

2 Sided 300 mil Geonet Component			Minimum Average Roll Value	
Property	Test Method	Test Frequency	6 oz/yd² geotextile	8 oz/yd² geotextile
Thickness, mils	ASTM D5199	Per 50,000 ft²	300	300
Peak Tensile Strength, lbs/in (MD)	ASTM D5035	Per 50,000 ft²	75	75
Melt Flow Index, g/10 minutes	ASTM D1238	Per resin lot	≤1.0	≤1.0
Density, g/cm³	ASTM D792, B	Per 50,000 ft²	0.94	0.94
Carbon Black Content, %	ASTM D4218	Per 50,000 ft²	2-3	2-3
Transmissivity(1), m²/sec	ASTM D4716	Per 500,000 ft²	8×10^{-3}	8×10^{-3}

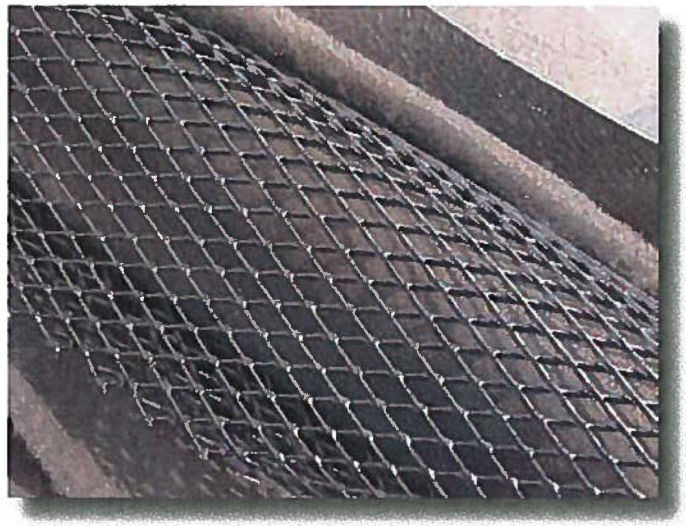
Geotextile Component(2)			Minimum Average Roll Value	
Property	Test Method	Test Frequency	6 oz/yd² geotextile	8 oz/yd² geotextile
Mass per Unit Area, oz/yd²	ASTM D5261	Per 100,000 ft²	6.0	8.0
Grab Tensile Strength, lbs	ASTM D4632	Per 100,000 ft²	170	225
Grab Elongation, %	ASTM D4632	Per 100,000 ft²	50	50
Trapezoidal Tear, lbs	ASTM D4533	Per 100,000 ft²	70	90
Puncture, lbs	ASTM D4833	Per 100,000 ft²	95	140
Permittivity, sec $^{-1}$	ASTM D4491	Per 100,000 ft²	1.60	1.26
Water Flow, gpm/ft²	ASTM D4491	Per 100,000 ft²	125	90
AOS, US Standard Sieve Size (max)	ASTM D4751	Per 100,000 ft²	70	80
UV resistance after 500 hours, % Strength Retained	ASTM D4355	Per resin formulation	70	70

1. Geonet and geocomposite transmissivity measured in the machine direction using water at 21 degrees C, gradient of 0.1, load of 10,000 psf, and seating time of 15 minutes between steel plates. Values may vary based on dimension of the transmissivity specimen and specific laboratory.
2. Prior to lamination to geonet core. Thermal lamination may alter these properties. Geotextile properties are Minimum Average Roll Values, except for AOS, which is Maximum Average Roll Value.
3. Component Properties are prior to lamination to geonet core. Thermal lamination may alter these properties.

TR-709
Revised 08/09

FUNCTION

TEXDRAIN drainage geocomposites consist of a polyethylene geonet core with nonwoven geotextiles bonded to one or both sides. They serve as a cost-effective substitute for granular soils in various drainage and gas venting applications. The biplanar geonet core provides a high flow capacity and is also available in different thicknesses to meet a wide range of performance requirements. The nonwoven geotextiles serve as a separation layer between the geonet and adjacent soils, preventing soil intrusion and clogging of the geonet core. In addition, nonwoven geotextiles provide good interface shear strength with adjacent geomembranes and soil.



APPLICATIONS

In landfill cover systems TEXDRAIN geocomposites are used to drain surface water away from the barrier layer decreasing percolation of water into the waste. TEXDRAIN geocomposites may also be used as a gas venting layer below the barrier layer to prevent the build-up of gases generated by degrading waste or underlying soils.

In landfill bottom liner systems TEXDRAIN geocomposites are used above the primary liner for leachate drainage and as a leak detection layer between the primary and secondary liners.

Similarly, in liquid impoundments TEXDRAIN may be used underneath the primary liner as the leak detection layer.

FEATURES AND BENEFITS

- Cost-effective substitute for thick layers of coarse-grained soil in drainage applications, providing savings on materials, transportation, installation and airspace.
- Preserves aggregate resources for structural applications where alternative materials can't be used.
- Three functions in one unit: filtration, drainage and protection.
- Rapid installation in comparison to conventional soil drainage layers.
- Wide range of product combinations allows performance driven product selection at an economical price.
- Chemically resistant polyethylene geonet and polypropylene geotextile construction provides long life in harsh environments.
- Exhibits good interface shear strength with adjacent geomembranes and soil, allowing a high factor of safety against sliding.

CETCO®

PRODUCTS

PRODUCT SELECTIONS

TEXDRAIN Geonets can be combined with a broad range of nonwoven geotextiles, thermally bonded to either one or two sides to achieve a wide range of product performance. The charts below illustrate typical transmissivity data for several common products. For more complete data, refer to the TEXDRAIN Certified Properties Sheets.

TEXDRAIN 200 GEONET

PROPERTY	TEST	UNITS	TYPICAL VALUE
Thickness	ASTM D 5199	Mil	200
Density, min.	ASTM D 1505	g/cc	0.94
Carbon Black Content, min.	ASTM D 1603	%	2-3
Tensile Strength	ASTM D 5035 MOD	lbs/inch	45
Transmissivity* (MD)	ASTM D 4716	m^2/sec	2×10^{-3}

* Tested between two metal plates at 10,000 lb/ft² with a hydraulic gradient of 0.1 for 15 minutes.

TEXDRAIN 250 GEONET

PROPERTY	TEST	UNITS	TYPICAL VALUE
Thickness	ASTM D 5199	Mil	250
Density, min.	ASTM D 1505	g/cc	0.94
Carbon Black Content, min.	ASTM D 1603	%	2-3
Tensile Strength	ASTM D 5035 MOD	lbs/inch	55
Transmissivity* (MD)	ASTM D 4716	m^2/sec	3×10^{-3}

* Tested between two metal plates at 10,000 lb/ft² with a hydraulic gradient of 0.1 for 15 minutes.

TEXDRAIN DRAINAGE GEOCOMPOSITE Typical Transmissivity

PRODUCT	TRANSMISSIVITY (gal/min. ft)	TRANSMISSIVITY (m^2/sec)
TEXDRAIN 200 DS 6	0.48	1×10^{-4}
TEXDRAIN 200 DS 8	0.48	1×10^{-4}
TEXDRAIN 250 DS 6	1.69	3.5×10^{-4}
TEXDRAIN 250 DS 8	1.69	3.5×10^{-4}

The above values, unless otherwise specified, are the minimum acceptable average test results for any roll based on the specified test methods and do not refer to an individual test specimen. The data provided is for informational purposes only and is not intended as a warranty or guarantee. Values are subject to change without notice.

4-1.3: Geomembrane Liner (Over-liner)

Lange Containment Systems Inc.

45-mil Polypropylene Geomembrane – Physical Properties

Physical Property	Test Method	Property Of Unaged Sheet	Property After Aging 672 hrs (28 days) @ 240°F (116°C)
Tolerance on nominal thickness, %	ASTM 0 5199 ASTMD 751	0.045" ± 10	
Thickness over scrim, in. (mm)	ASTM D4637 Optical Method	0.013 (0.330) min.	
Mass per unit area, lb/ft^2 (g/ft^2) (kg/m^2)	ASTM D 5261	0.21 (95) (1.03) typical	
Breaking strength, lbf (kN) (grab tensile at strain rate of 12 in./min.)	ASTM D 751 Grab Method A	250 (1.1) min. 300 typ.	250 (1.1) min. 300 typ.
Elongation at break of fabric, %	ASTM D 751	25 typical	25 typical
Tearing strength, lbf (N) (2 in./min. strain rate)	ASTM D5884 (max. load)	100 (445) min. 160 (712) typ.	
Low temperature flexibility, °F (°C)	ASTM D 2135 1/8 in. mandrel 4 hour @ temp.	-40 (-40) max. -50 (-46) typical	
Linear Dimensional Change (Shrinkage), %	ASTM D 1204		+/- 1.0 max -0.5 typical
Ozone resistance, 100 pphm, 168 hours	ASTM D 1149	No cracks	No cracks
Resistance to water (distilled absorption after 30 days immersion 122 °F (50°C) Change in mass, %	ASTM D 471 (coating compound only)	1.0 max 0.5 typical	
Hydrostatic resistance, lbfr/in. 2 or psi (MPA) (Mullen burst)	ASTN D 751 Procedure A	350 (2.4) min. 450 (3.1) typical	350 (2.4) min. 450 (3.1) typical
Field Seam strength, lbf/in. (kN/m) Seam tested in peel after weld Factory Seams, bonded seam strength, lbf (kN), if applicable	ASTM D 4437 1 in. wide ASTM D 751 Grab Method A	30 (5.3) min. 60 (10.5) typical peak value 200 (0.9) min	
Water Vapor permeance, Perms	ASTM E 96	0.10 max. 0.05 typical	
Puncture resistance, lbf (N)	ASTM D4833 (index puncture)	85 (378) min 110 (489) typical	
Resistance to xenon-arc weathering[1] Xenon-arc, 15,120 kJ/m^2 total radiant exposure, visual condition at 10X	ASTM G 155 0.70 W/m^2 80 °C B.P.T.	No cracks No loss of breaking or tearing strength	

[1]Equivalent to 12,000 hours exposure at 0.35 W/m^2 irradiance B.P.T. is black panel temperature.
Note: Factory seams are not a normal condition of the supplied sheet described in this chart.

Polypropylene Installation Guide

1. Handling and Storage:

A. Polypropylene panels are shipped in palletized boxes, which are inspected before leaving the factory. Any visible damage to the shipment should be noted on the freight receipt and project records.

B. The Polypropylene should remain packaged in dry storage until ready for use.

C. The pallets should not be stacked.

2. Panel Placement and Seaming.

A. The area to be lined should be smooth and free of sharp objects that could puncture the membrane. All vegetation, roots and grasses should be removed. Any cracks or voids should be filled.

B. The panels should not be unfolded under extreme cold or windy conditions.

C. Care must be taken when the Polypropylene panels are deployed. Sharp objects, hard bottom shoes, vehicles and equipment should not come in contact with the material.

D. The Polypropylene liner should be placed in a relaxed condition, free of stress or tension. The panels should be positioned so that there is a nominal 4-inch seam overlap.

E. The contact surfaces of the two sheets should be wiped clean to remove all dirt, dust, moisture or other foreign materials.

F. Field seams are made by thermal fusion bonding. The welding machine should be set to the pre-determined temperature and speed. A trial seam should then be made and tested to verify these settings. The machine settings should be adjusted accordingly. Throughout the seaming operation occasional adjustments of temperature or speed as the result of changing ambient conditions may be necessary to maintain a consistent seam. A 1.5 inch nominal seam width is required for single-track welds. Dual track weld should have two 0.5-inch nominal seams separated by an air test channel.

3. Repairs to Liner:

A. Any cuts, rips or tears in the Polypropylene membrane should be patched with a piece of the same membrane material. Patches should be cut with rounded corners and should overlap the damaged area a minimum of 3 inches

B. Patches are applied with a hand held heat gun and roller. The patch and damaged membrane area should be clean and dry. The heat gun should be inserted between the patch and the membrane liner, heating the surfaces of each to a molten state. Steel roller pressure over a hard surface should be applied during the heating process in such a way as to smooth out any wrinkles while mating both surfaces.

Back To Polypropylene Table Of Contents
Back To Geomembranes Page
Back To Products Page

Pond Liner Calculator

[HOME | PRODUCTS | SPECIALS | RELATED INFORMATION]
[CONTACT US! | WHAT'S NEW | ABOUT]

Visit Often for Our Latest Page Developments And Updates! Last Updated: 05/10/06 03:47:28 PM

4-1.4: Geocomposite Drainage Layer[25]

Table 1: GDL Properties

PROPERTY	TEST METHOD	UNITS	VALUE
Geonet			
Structure	Biaxial		
Thickness (min.)	ASTM D 5199	inches	0.200
Tensile Strength (min.)	ASTM D 5035	lb/ in	45
Density (min.)	ASTM D 1505	g/cm^3	0.94
Melt Flow Index (max.)	ASTM D 1238	g/10 min	1.0
Carbon Black Content	ASTM D 4218	%	2-3
Transmissivity	ASTM D-4716	m^2/s	2×10^{-3}
Geocomposite			
Ply Adhesion (min.)	ASTM D 904	lb/inch	1.0
Transmissivity[2] — Machine Direction MD (min.)	ASTM D 4716 GRI-GC8	(m^2/sec)	1.8E-03

Table 2: Geotextile Properties

PROPERTY	TEST METHOD	UNITS	VALUE
Weight (MARV)	ASTM D3776	Oz/sy	6
AOS (MaxARV)	ASTM D4751	US Sieve (mm)	70 (0.21)
Permitivity (MARV)	ASTM D4491	sec^{-1}	0.5
Grab Tensile Strength (MARV)	ASTM D4632	lbs	157
Trapezoid Tear (MARV)	ASTM D4533	lbs	56
Puncture Strength (MARV)	ASTM D4833	lbs	56
UV Resistance @500 Hours (MIN)	ASTM G154	%	95
Weight (AVE)	ASTM D3776	oz/sy	6
Grab Tensile Strength (MARV)	ASTM D4632	lbs	157
UV Resistance @500 Hours (MIN)	ASTM G154	%	95

Installation:

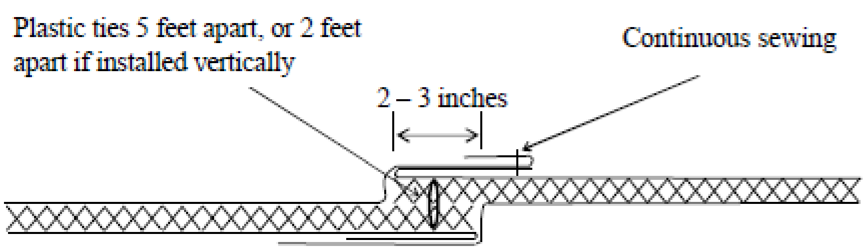
- Handling & Placement
  - The surface shall be cleaned and free of excess dirt and debris.
  - The Installer shall handle all GDL material in such a manner as to ensure it is not damaged in any way. Precautions shall also be taken to prevent damage to underlying layers during placement.
  - For slopes, special care shall be taken so that only full-length rolls are used at the top of the slope.

[25] A1AR1Q5

- If necessary, the material shall be positioned by hand after being unrolled to minimize wrinkles.

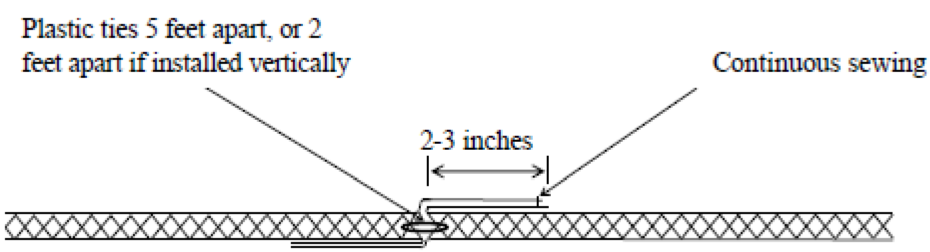
- Seams & Overlaps
    - The geonet shall be secured or seamed at overlaps.
- Geonet Component
    - Adjacent edges of geonet along the length of the geocomposite, shall be overlapped 2-3 inches, see Diagram 1, or if approved by the Engineer based on the site specific conditions, placed with the edges of each geonet butted against each other, see Diagram 2. These overlaps shall be joined by tying the geonet cores together with white or yellow cable ties or plastic fasteners. These ties shall be spaced at a maximum of every 5ft along the roll length.

Diagram 1: Overlap Along Roll Length (Overlap)



(a) Geonet Overlapped

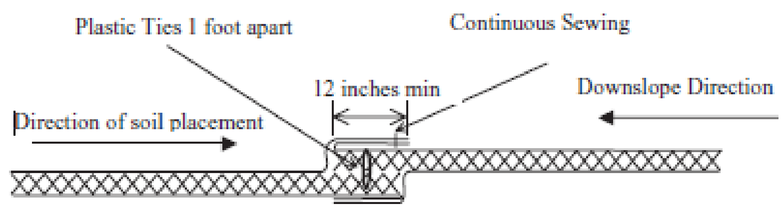
Diagram 2: Overlap Along Roll Length (Butted)



(b) Geonet Ends Butted

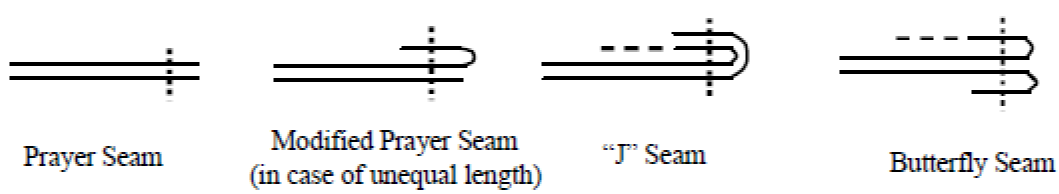
- Adjoining geocomposite rolls (end to end) along the roll width shall be shingled down in the direction of the slope, with the geonet portion of the top geocomposite overlapping the geonet portion of the bottom geocomposite a minimum of 12in across the roll width as shown in Diagram 3. Geonet shall be tied every 12in across the roll width and every 6in in the anchor trench or as specified by the Engineer.

Diagram 3: Adjoining Geocomposite Rolls



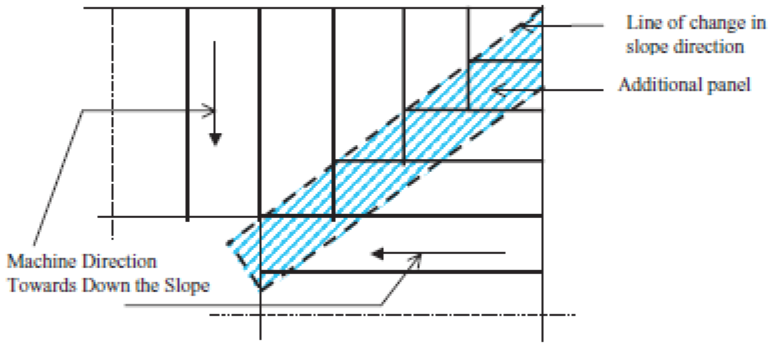
- Geotextile Component
  - The bottom layer of geotextile shall be overlapped.
  - The top layers of geotextile shall be sewn together, or at the discretion of the Engineer may be heat bonded or wedge weld. Geotextiles shall be overlapped a minimum of 4in prior to seaming or heat bonding, geotextile sewing seams to be used are Prayer, "J", or Butterfly, see details in Diagram 4. The seam shall be a two-thread, double-lock stitch, or a double row of single-thread, chain stitch. If heat bonding is to be used, care must be taken to avoid burn through of the geotextile. It is important that the geotextiles be joined continuously along to the roll as to prevent any fugitive particle migration into the geonet core flow channels.

Diagram 4: Geotextile Sewing Seam Details



- Slope Corners
  - In the slope corners, the direction of the slope changes at the corner diagonal line, as illustrated in Diagram 5. Installation will first place an additional panel along the corner diagonal line of the adjacent slope. The panels from the opposite slope will be placed to extend on top of the additional panel. Then, the panel for the slope which contains the additional panel will be placed to butt up to the opposite slope panels.

Diagram 5: Slope Corner Detail



- Repair
  - o The GDL shall be inspected for damage resulting from construction prior to covering.
  - o Any rips, tears or damaged areas on geotextile component of the deployed geocomposite shall be removed and patched. The patch for damaged geonet shall be secured to the original geonet by tying every 6in with white or yellow plastic fasteners or polymeric braid. The patch shall be extended 12in beyond the edges of the damaged area.

~~Appendix 4-2~~[26][16]

~~Storm Water Management Plan~~
~~Data Sheets & BMP Sketches~~

Note to Reviewer: Appendix 4-2 is superseded by Appendix 14-1. Hence, Amendment 1, Adequacy Response 1 Questions referenced in footnotes cannot be reconciled in this appendix.

[26] A1AR1Q12

This page intentionally left blank.