Appendix A
Logan Wash Mine
Pond Facility Relining Project Summary Report

Garfield County, Colorado

Prepared for:

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Glenn Springs Holdings, Inc.
A Subsidiary of Occidental Petroleum Corporation
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Project No. 10202.01

March 27, 2019

Western Water & Land, Inc.

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1.0 INTRODUCTION

This report summarizes the as-built relining design and construction activities for the Logan Wash Mine Settling Pond and Evaporation Pond (pond facility) that is owned and operated by Occidental Oil Shale, Inc. (OOSI). Logan Wash Mine is an inactive oil shale mine permitted under the Colorado Division of Reclamation, Mining and Safety (DRMS) (permit number M-1977-424). The pond facility is located on U.S. Bureau of Land Management (BLM) land located in the SE ¼, of the SW ¼, of Section 29, Township 7 South, Range 97 West, 6th Principal Meridian (See Figure 1). The mine site is located at N ½, Township 7 South, Range 97 West, 6th Principal Meridian.

The pond facility consists of a 0.14-acre Settling Pond and 4-acre Evaporation Pond. Retort water draining from the inactive Logan Wash Mine (oil shale mine) is delivered to the facility by way of a 4-inch diameter buried polyvinyl chloride (PVC) pipeline. The pipeline discharges to the Settling Pond at a rate of approximately 2.5 gallons per minute (gpm). The water is detained in the Settling Pond to allow any settling of solids prior to flowing into the Evaporation Pond. The water delivered to the facility may contain small amounts of oil and light petroleum hydrocarbons.

The pond facility was originally constructed in 1984. In 2018, under a renewed BLM right-of-way grant, the ponds were relined with new high density polyethylene (HDPE) geomembrane liners.

This report summarizes the original pond facility design and the new design and construction that took place in 2018. Specifically, the report highlights the project background, investigative activities requested by the BLM, the technical approach and new lining construction that occurred in 2018.

The onsite project management contractor at Logan Wash Mine is Western Water & Land, Inc. (WWL) located in Grand Junction, CO. WWL reports directly to Glenn Springs Holdings, Inc. (GSH). GSH and OOSI are wholly owned subsidiaries of Occidental Petroleum Corporation (Oxy). GSH manages legacy environmental projects on behalf of Oxy.

2.0 BACKGROUND

Occidental Oil Shale, Inc. (OOSI) began exploration and research of oil shale extraction at the Logan Wash Mine, in Garfield County, Colorado in 1974. The research expanded to pilot-scale operations of the Modified In Situ Retorting process that culminated in the underground burning (retorting) of rubblized oil shale zones (retorts) in 1982. Over 200,000 barrels of shale oil was produced from the main two commercial sized retorts (245 feet high by 165 feet square).

In 1983, retort operations were terminated by quenching the commercial-size retorts with injected water. Mining activities were suspended. Flushing/cleaning of the retorts were completed in 1987. Water draining from the retorts was captured in sumps and was at first treated near the mine site using oil/water separators and other methods. It was realized that the retorts were also capturing ambient groundwater causing a persistent drainage of contaminated retort water. In 1984, to treat the drainage of retort water, a 4-acre evaporation pond was constructed on U.S. Bureau of Land Management (BLM) land, located approximately 6 miles west of the mine site. The BLM granted a 10 acre right-of-way for pond construction at the site. The retort water was conveyed to the evaporation pond through a buried 4-inch and 6-inch PVC pipe, located adjacent to Logan Wash Road.

Retort water discharge rates initially were high, at times greater than 10 gallons per minute (gpm). Overtime, discharge rates subsided and are currently approximately 2.5 gpm. This rate appears to represent ambient groundwater drainage rates to Retorts 7 and 8, the retorts that produce the bulk of retort water.

Underground retort water plumbing was redesigned and constructed in 2003 before the mine portals were plugged shut with earth-plug seals in 2004. Two-inch HDPE thick-walled coiled pipe was used to convey retort water from the bulkheads of Retorts 4, 6, 7 & 8 to the L-700 Drift where a single two-inch HDPE pipe conveys the water to the Lower Bench Vault. Valves in the vault allow for the shut-off and sampling of retort water as well as the ambient mine water (water that does not come in contact with retorted areas) that also exists in the mine. The discharge point for ambient mine water (referred to as LW-001) is a buried infiltration trench located on the Lower Bench.

Retort water is managed by discharging to the 0.14 acre Settling Pond. The Settling Pond allows for the settling of oil and related sediment or sludge before the water drains to the main Evaporation Pond, where the water is evaporated. No discharge occurs from the pond facility. The ponds were constructed on compacted native soils (weathered Wasatch Formation) in excavated and HDPE-lined impoundments.

Annually, the Evaporation Pond achieves virtually complete dry-up between mid-June to late September or longer. Only a small pool of water is present near the pond inlet during this 3 to 4 month period. Over the 34-year life of the pond facility, the Evaporation Pond accumulated some sediment from the retort water, wind-blown sediment, and precipitated salt deposits from evaporation of the retort water (typical retort water has a total dissolved solid concentration of approximately 6,000 mg/L). With exception of a few high spots on the pond bottom, the total accumulation of solids varied from 0 to 10 inches in the

Settling Pond and 0 to 6 inches in the Evaporation Pond; salt deposits were up to 4–inches thick in the Evaporation Pond.

The original 60-mil HDPE liner used at the Settling Pond and Evaporation Pond was in good condition based on limited observations of the exposed portion of the liner. However, in the last 10 years, some small patch repairs were made to the Evaporation Pond liner in a few areas on the upper slope. In 2011, the Leak Detection Vault for the Evaporation Pond began to receive leakage from the Pond, and the leakage occurred intermittently through 2017. In 2018, the Settling Pond liner had two seams separate just above and slightly below the water line; these were also repaired. Because of the intermittent occurrence of leakage to the leak detection vault, the periodic need of liner repair, and the overall age of the liners, OOSI began plans to replace the pond liners as they applied for a BLM right-of-way renewal in 2017.

3.0 ORIGINAL POND DESIGN

The original pond facility for the Logan Wash Mine was constructed in 1984. The dimensions of the Settling Pond and Evaporation Pond are as follows:

Settling Pond:

Length:	115 ft.
Width:	54 ft.
Depth:	5 ft.
Slope:	4 ft. H: 1 ft. V
Perimeter of liner:	300 ft.
Area of liner:	~6,000 $ft.^2$
Area of water surface:	~2,700 $ft.^2$
Volume of wastewater:	~65,000 gallons (1,550 bbls)

Evaporation Pond:

Footprint Length:	435 ft.
Footprint Width:	435 ft.
Bottom:	393 ft. square
Depth:	5 ft.
Slope:	4 ft. H: 1 ft. V
Area of liner:	4.3 acres
Area of water surface:	3.5 acres
Volume of wastewater:	3.5 MM gallons (82,500 bbls)

The original construction design of the Settling and Evaporation Ponds is indicated in drawings located in project files (see Attachment A). It is apparent that the ponds were constructed by site leveling and excavation of the pond impoundments, likely followed by soil compaction, installation of leak detection drains and vault, and installation of 60 mil HDPE geosynthetic liner. Drawings in Attachment A show details of the 1984 As-Built construction design.

The Evaporation Pond was constructed with an underlying leak detection system. The leak detection system consisted of three main 2-inch diameter, perforated PVC leak gathering pipes that were aligned east to west and equally spaced across the bottom of the pond within excavated channels in the pond subgrade soils. Each pipe was set within a gravel envelope and also had four gravel drain channels that extended perpendicular from the pipe alignment on both sides of the pipe. These gravel drains acted as the main means to capture leakage from the overlying 60-mil HDPE liner. The three main leak conveyance pipes are connected to a common 2-inch vent pipe that trends north-south on the bottom of the east quarter of the pond. The pond bottom was constructed flat, but the intended slope of the leak detection drains and pipes was indicated to be 0.30% or 0.3 feet of vertical drop per 100 feet of horizontal distance. This slope represents a potential drop of approximately 1 foot across the bottom of the pond from east to west (see Drawing Sheet 4 of 8, Attachment A).

In the case of a leak through the HDPE 60-mil liner, the leak detection system is designed to convey leakage to the Leak Detection Vault on the west side of the Evaporation Pond. Leakage water was first discovered in 2011 and has occurred intermittently since that time (see Figure 2). Any water present in the Leak Detection Vault was pumped back into the pond using an automated, solar-powered pump system. Water level within the Leak Detection Vault is continuously monitored with an automated pressure transducer.

4.0 BLM INVESTIGATIONS

The pond facility is located on public lands. The original right-of-way (ROW) was granted by the BLM on August 27, 1984 (COC38492). The renewed ROW was made effective in 2014 (the date of termination of the initial ROW) and terminates on December, 31, 2044. Under the renewed ROW, BLM verbally requested the following stipulations:

1. Conduct soil sampling under the existing 60-mil HDPE liner and analyze for potential contamination and moisture content.
2. Excavate and inspect the north and south leak detection conveyance pipes that extend from beneath the pond to the west side of the pond and connect to the Leak Detection Vault.

In addition, OOSI is required to comply with written stipulations provided within the ROW grant document which included the installation of bird netting on the Settling Pond and Evaporation Pond. On September 22, 2017, BLM approved of installing netting only on the Settling Pond with the requirement to conduct biannual sampling of the Evaporation Pond water. Netting may be required on the Evaporation Pond at a later date, depending on salinity levels in the Pond.

WWL conducted soil sampling under the Evaporation Pond liner at 8 locations. A summary of this work is in Attachment B. Results of this sampling showed no hydrocarbon compounds were detected, and moisture content and salt concentrations were comparable to reference soil samples collected outside of the pond liner area.

Excavation and inspection of the north and south detection pipes included inspection with a video camera. The video revealed that both pipes contained local areas with fluid present. This indicated that the sections of pipe outside of the pond footprint were not consistently sloped to provide positive drainage to the leak detection vault. The pipes were cut at the 90-degree bends where the pipes trend east under the pond and video conducted in the east-trending sections exhibited similar conditions in places. Some salt deposits were present at the 90-degree elbow on the north detection pipe; these salt materials were removed. The pipe camera could not be advanced in the detection pipes the entire distance underneath the pond due to excessive frictional forces; a distance of approximately 250 feet. The BLM found the observed conditions to be acceptable and approved OOSI's plans to reline the ponds as described in Section 5.

5.0 POND RELINING DESIGN

Several designs were considered for relining the Settling Pond and Evaporation Pond. Through consultation with a geomembrane installation company (H & H Lining, Inc.), and BLM approval, it was determined that new liner geomembranes could be placed directly on top of the old liner and existing salt and sediment deposits. The final design included a three layer system consistent with a modern leak detection system design for liquid impoundments under Colorado Department of Public Health and Environment (CDPHE) regulations. This was not required as the Logan Wash Mine is administered by DRMS, not by CDPHE. However, a robust design was needed to account for the underlying uneven surface due to the extremely dense salt materials.

The relining design included a secondary liner (bottom liner) of 60-mil HDPE, an overlying layer of geocomposite that consisted of 200-mil HDPE geonet bonded to 6-oz nonwoven geotextile, and a primary (top) liner of 80-mil HDPE. Even though the Evaporation Pond is flat-bottomed, two leak detection sumps were constructed on the east and west sides of the pond to monitor for potential pond leakage through the primary liner. The geocomposite material provides for a transmissive layer that would allow for leakage from the primary liner to potentially be detected at the sump locations. Each sump has a leak detection pipe installed from the bottom of the sump (located at the toe of the pond slope) to the top of the pond slope. The leak detection pipe can be monitored for the presence of retort water, which would indicate a leak in the primary liner. The same design was constructed at the Settling Pond where one leak detection sump and pipe was constructed on the west end of the pond. Figure 3 is a schematic of the pond lining system that was constructed at the pond facility.

6.0 CONSTRUCTION

Pond relining construction involved three main phases: 1) site preparation, 2) pond relining, and 3) site reclamation.

6.1 Site Preparation

The site preparation phase consisted mostly of earthwork conducted by Johnson Construction Inc. (JCI) from Rifle, Colorado. JCI provided various construction services throughout the entire construction process including the following:

- Grading of the pond access road
- Removal of plugged culvert and construction of low-water swale on pond access road
- Widening and grading of the pond perimeter road
- Placement of road base on the pond perimeter road
- Enhancement of stormwater ditches and drainage features at the pond site and access road
- Installation of stormwater BMPs (silt fence, gravel/rock channels)
- Removal of old cinder blocks and debris from original pond liner surface
- Excavation and backfilling of Settling Pond and Evaporation Pond anchor trenches
- Unloading and transporting liner materials from stage area (Logan Wash Road) to pond site
- Trash removal
- Preparation of slopes for seeding reclamation
- Coordination with pond lining and waste water hauling subcontractors

JCI began widening the pond perimeter road and deck on July 30, 2018 and remained active in preparing the pond access and perimeter road through mid –September, 2018. JCI equipment remained onsite and was used throughout the project by JCI and H & H Lining personnel until November 28, 2018 when all site earthwork was completed.

6.2 Water Management

Management of the retort water was necessary during pond relining construction. Blac-Frac Tanks, Inc. (BFT) was subcontracted to provide storage tanks on site and transport services of retort water to a licensed disposal facility (Greenleaf Environmental Services, LLC). Four, 400-barrel (bbl) upright tanks were place on the widened perimeter road adjacent to the Settling Pond. WWL, through the use of JCI, excavated and installed a T-valve fitting on the retort water line just upstream from the No. 1 Manhole. The retort water could then be diverted at elevation above the storage tanks and flow to the tanks under gravity conditions.

The Settling Pond waste water and sediment/sludge was then removed by BFT and transported to the Greenleaf disposal facility. The Settling Pond liner was power-washed to remove all existing debris materials.

Retort water was first diverted to the storage tanks on September 15, 2018. BFT typically conducted two site visits a week to transport retort water from the tanks to the Greenleaf disposal facility. Each site visit resulted in 4 to 7 bobtail truck loads to Greenleaf. One bobtail load is 80 bbls. Retort water production of approximately 2.5 gpm is equivalent to 86 bbls/day. BFT completed all work and demobilized tanks on November 20, 2018. A total of 8,208 bbls of settling pond retort water and sludge was hauled to Greenleaf during pond relining construction.

6.3 Lining Installation

The geosynthetic materials were purchased by GSHI directly from the manufacturers as indicated below.

Vendor	Product	Description	Quantity (sq. ft.)
Solmax	HDS-080NE-BBB-B-00	80-mil HDPE smooth liner	232,650
Solmax	HDS-060NE-BBB-B-00	60-mil HDPE smooth liner	240,975
Skapps	TN220-1-6	Geocomposite	239,250

Materials were unloaded and staged on Logan Wash Road on a section of road that is paved for a chain-up area. This stage area is only a hundred feet or so from the Logan Wash Mine Evaporation Pond Access Road. The 60-mil and 80-mil HDPE liner began arriving on site on September 27, 2018. Geonet was delivered on September 28 and 29, 2018. All ordered materials were delivered by end of day September 29, 2018.

H & H Lining, Inc. (H & H), the subcontractor used to conduct installation of all geosynthetic materials (liners and geonet) arrived on site on September 26, 2018. They filled and distributed sand bags to be used for ballast during liner installation. The following shows work conducted by H & H.

September 27: H & H lines Settling Pond with 60-mil HDPE secondary liner; begins lining of the Evaporation Pond with 60-mil HDPE (secondary) liner.

September 29: Completed lining of Evaporation Pond with 60-mil HDPE liner.

September 30 – October 1: Start liner testing of 60-mil liner. Testing consists of 1) double wedge seam air test at 40 psi; 2) extrusion weld tests using vacuum; and 3) destructible tests where 3 ft. section of a seam is cut out and tested by peel test and shear tests; one destruct test per 500 linear ft. of liner.

October 1: Continue liner testing and begin placing geocomposite material.

October 2: Light rain begins. H & H is not done air testing seams on 60-mil on north end of Evaporation Pond; they leave open holes in 60-mil liner. H& H leaves site because of wet working conditions.

October 3: Liner has ½ to 1-inch of water on 60-mil liner on Evaporation Pond. There are 2-3 inches of water in the Settling Pond. WWL directs H & H to patch open holes in 60-mil liner left open for air testing to prevent additional water from getting under new liner.

October 4: At WWL’s direction, H & H patches open air test holes to reduce leakage of rain water to underlying salt deposits under the new 60-mil liner. Heavy rain today and more rain expected.

October 5: H & H finishes temporary patches of all test holes on new 60-mil liner. Also fixed geocomposite that was picked-up by wind the previous day and blown out of position.

October 8 – 18: No liner work performed. Pond is flooded by rain water and heavy rains continue during this time. WWL commences and continues on a daily basis to pump off accumulated rain water on and below the new 60-mil liner. BFT on site periodically to transport retort water to Greenleaf.

October 19: H & H returns to site and does batten work (60-mil liner to Settling Pond Spillway); also trams geocomposite to pond site.

October 20: H & H installs 80-mil HDPE liner on Settling Pond; set leak detection pipe; begin testing of 80-mil liner; conducts vacuum tests; finished with Settling Pond. This work was done so that WWL can use the Settling Pond for storage of salt-laden water (rain water) that needs to be pumped from underneath the 60-mil liner on the Evaporation Pond.

October 22 – 26: Continue to dewater rain water on Evaporation Pond and cut holes in 60-mil liner of Evaporation Pond and pump underlying salt water to Settling Pond. BFT pumped salt water from Settling Pond and transporting to Greenleaf, also transporting retort water from storage tanks. JCI backfills anchor trench on Settling Pond.

October 29 – 30: H & H repairs cut holes for salt water pumping and conducts destructible tests on 60-mil liner.

November 1-2: H & H installs geocomposite on Evaporation Pond. JCI trams 80-mil liner to pond site from staging area.

November 5: H & H constructs west and east sumps on Evaporation Pond.

November 6: H & H repairs holes in 60-mil HDPE and installs geocomposite on Evaporation Pond; WWL pumping salt water out from underneath 60-mil liner on Evaporation Pond.

November 8-10: H & H installs 80-mil HDPE on Evaporation Pond.

November 12- 16: H & H begins and completes liner testing on 80-mil HDPE on Evaporation Pond. WWL inspects and witnesses liner testing and conducts liner integrity inspections, marks defects and damaged liner locations. H & H and WWL conduct liner inspection walkthrough; Pond good to receive retort water. WWL turns retort water into Settling Pond on November 16, 2018. H & H Settling Pond and Evaporation Pond liner installation is complete.

An As-Built drawing from the 2018 Pond Reline Project is shown in Figure 4.

6.4 Settling Pond Bird Netting Installation

HRL Compliance Services, Inc. was subcontracted to design and install protective bird netting over the Settling Pond in accordance with BLM stipulations.

The bird netting structure consists of 22 vertical steel support poles installed at a height of 6.5 feet above grade around the pond perimeter. Netting consists of woven polyethylene cord with 1 1/2 –inch openings. The netting is supported by high-tensile steel cables that extend across the pond from one support pole to another. Netting is also installed vertically from pole to pole, forming a perimeter fence. Two access gates were installed; one the south side at the Settling Pond Spillway and one on the north side. A safety cable is attached to the inside of the support poles and can be used by personnel to clip on to while inside the netted area. Snow accumulation may occur on the netting and heavy accumulations should be removed. WWL will monitor for this condition and remove snow as necessary.

HRL began site work on January 27th, 2018. Work included drilling support pole holes with remote control CME 55 drill auger rig, and placing gravel and poles; 13 poles were placed. This work continued and was finished on the 28th. On January 30th, concrete was placed in the pole hole annulus to support poles, and HRL painted all support poles, installed ratchets and perimeter cable, and dug holes for man access gates. On February 1st, WWL approved gate locations and HRL cemented the gate poles in place and installed overtop cables for netting support. Warm wet weather delayed the second round of concrete to top off support poles. The concrete work was completed on February 8th. Net installation began on February 19th and concluded on February 26th. HRL will return to the site in the Spring to regrade pond perimeter road and Settling Pond area

7.0 RECLAMATION

WWL conducted site revegetation work at the pond facility. This work included directing JCI to scarify the barren dirt slope above the pond perimeter road cut that extends from the northwest corner to the northeast corner of the Evaporation Pond. A BLM and DRMS-approved seed mix was hand broadcast and raked into the scarified soil surface. Biodegradable erosion control blanket (WintersChoice BIO™) was then installed on the slope and stapled in place. The blanket consists of 70% straw and 30% coconut fiber. This work was also conducted on the exposed soil fill area that had been established on the southwest corner of the pond site during site grading for stormwater drainage. WWL conducted the revegetation work from November 26 to 28, 2018.

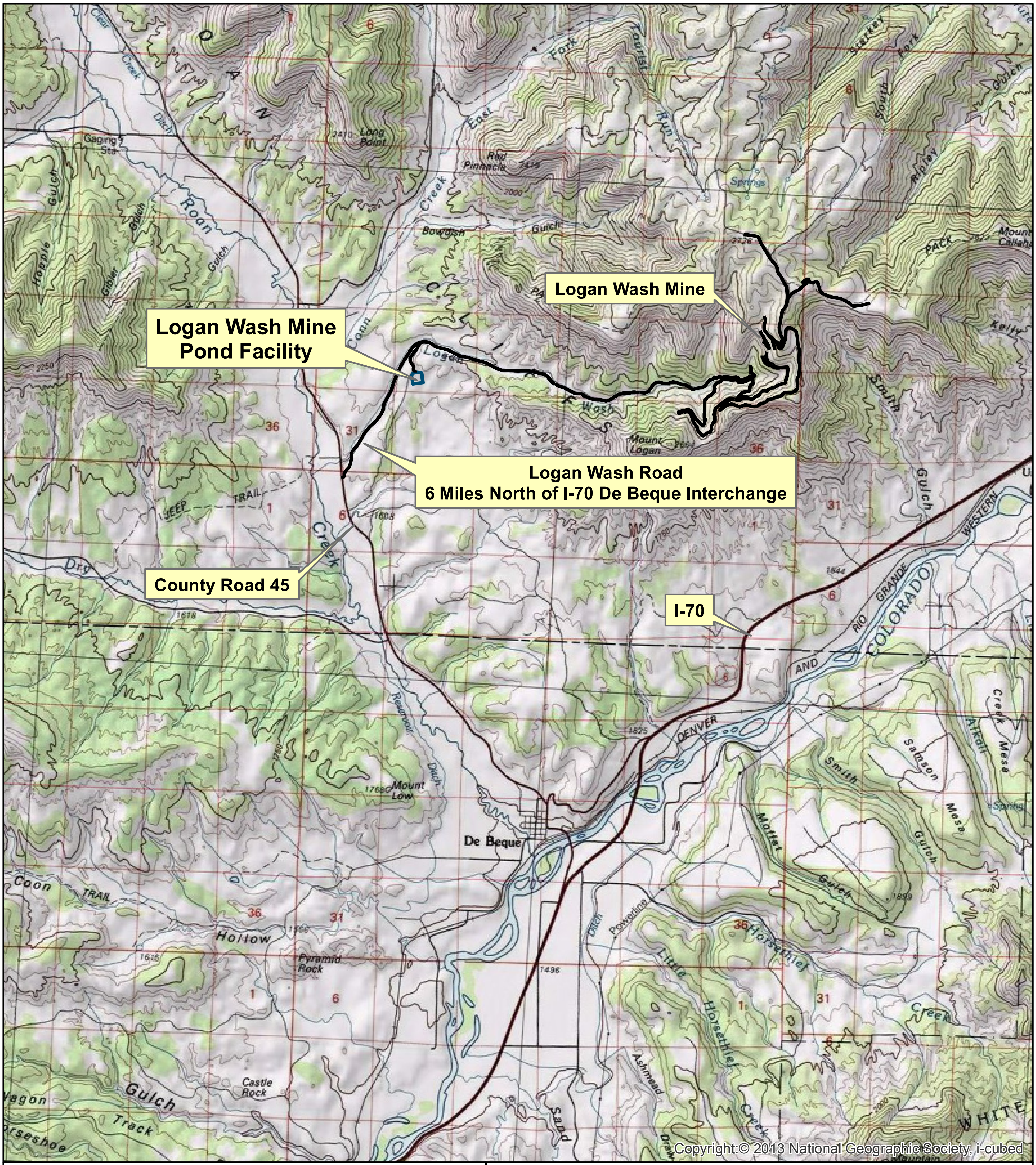


Figure 1. Logan Wash Mine Location Map

Garfield County, Colorado

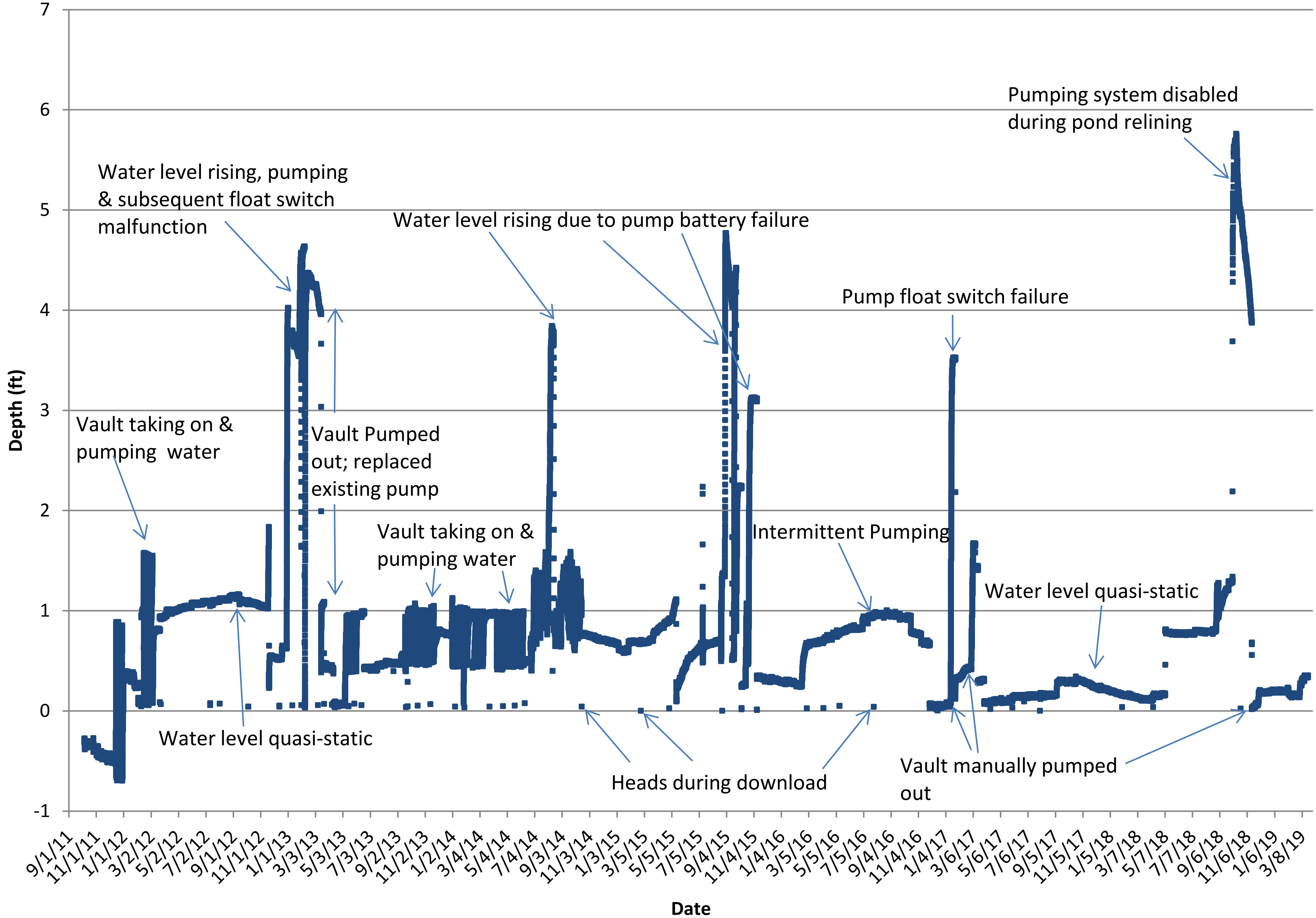
N

0 1 2 4 Miles

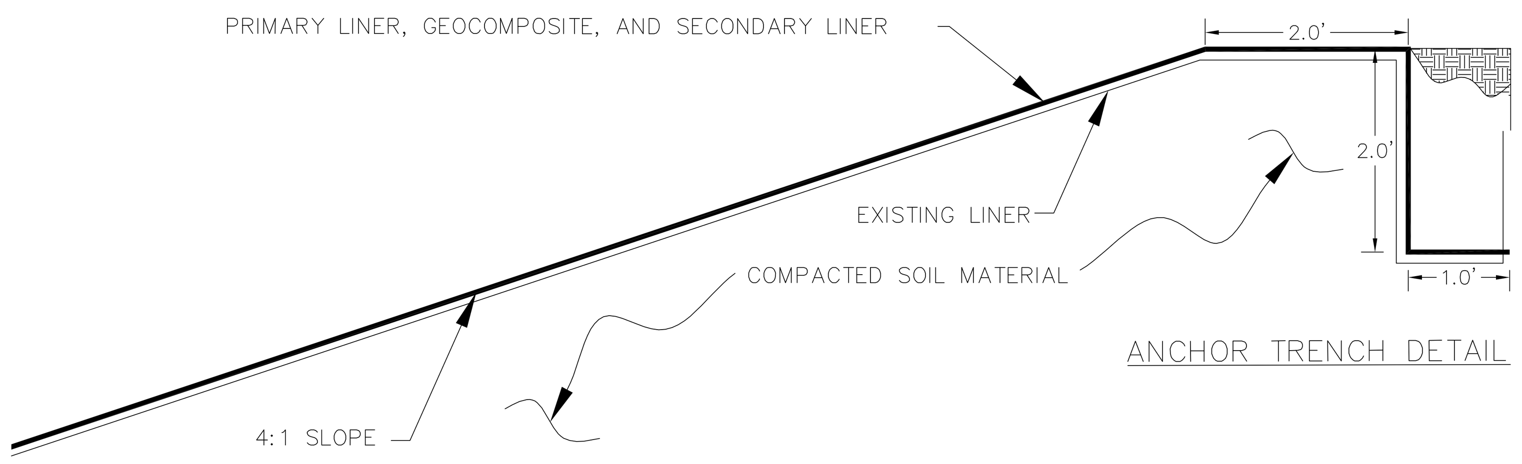
1:100,000

Western Water & Land, Inc.
Applications in Earth Science

Figure 2. Logan Wash Mine Evaporation Pond Leak Detection Vault Water Levels

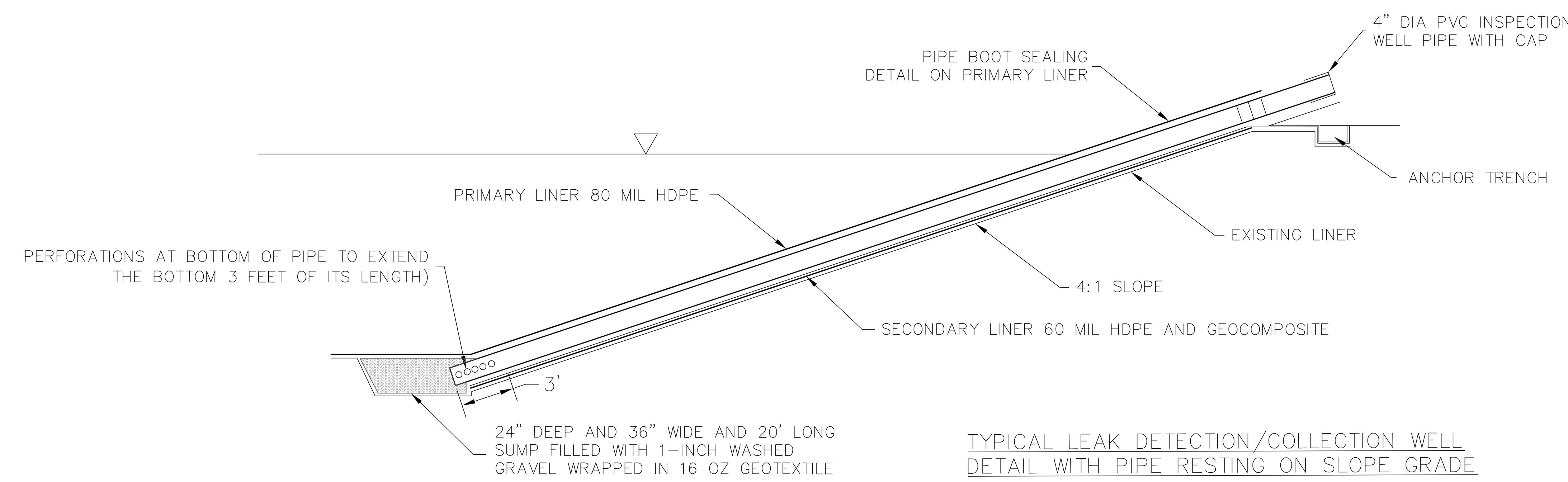


UTILITY NOTIFICATION CENTER
OF COLORADO
CALL 811
THREE WORKING DAYS BEFORE YOU DIG, GRADE OR
EXCAVATE FOR THE MARKING OF UNDERGROUND UTILITIES.



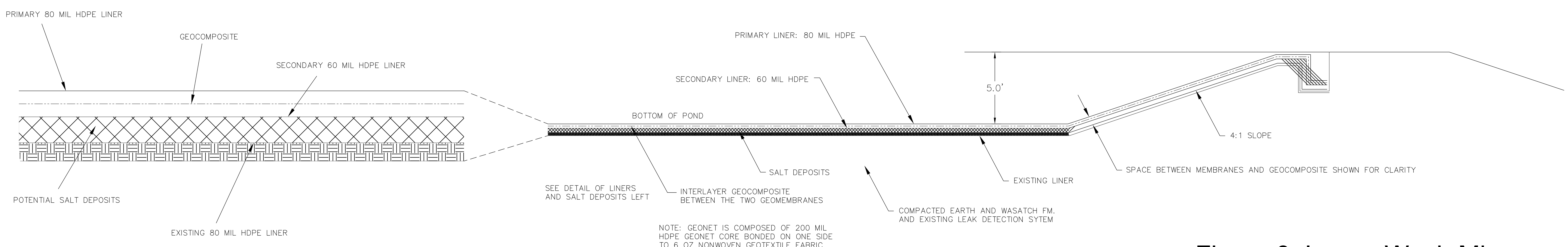
ANCHOR TRENCH DETAIL

NO SCALE



TYPICAL LEAK DETECTION/COLLECTION WELL
DETAIL WITH PIPE RESTING ON SLOPE GRADE

NO SCALE



NOTE: GEONET IS COMPOSED OF 200 MIL
HDPE GEONET CORE BONDED ON ONE SIDE
TO 6 OZ NONWOVEN GEOTEXTILE FABRIC.

MEMBRANE LINERS AND GEOCOMPOSITE DETAILS

NO SCALE

Figure 3. Logan Wash Mine Settling Pond and Evaporation Pond Lining Design

PREPARED BY JEK
REVIEWED BY JEK
DATE 06-26-2018
SCALE NO SCALE
JOB NO. 18020.02

DATE	DESCRIPTION	BY	CK
09-11-18	CHANGED SECONDARY 80 MIL LINER TO 60 MIL LINER	JEK	JEK

LOGAN WASH MINE
EVAPORATION POND RELINING PROJECT
OCCIDENTAL OIL SHALE, INC.

Rhino Engineering
Rhino Engineering, Inc.
PO Box 810
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COLORADO LICENSED PROFESSIONAL ENGINEER
33064
06-06-18

SHEET

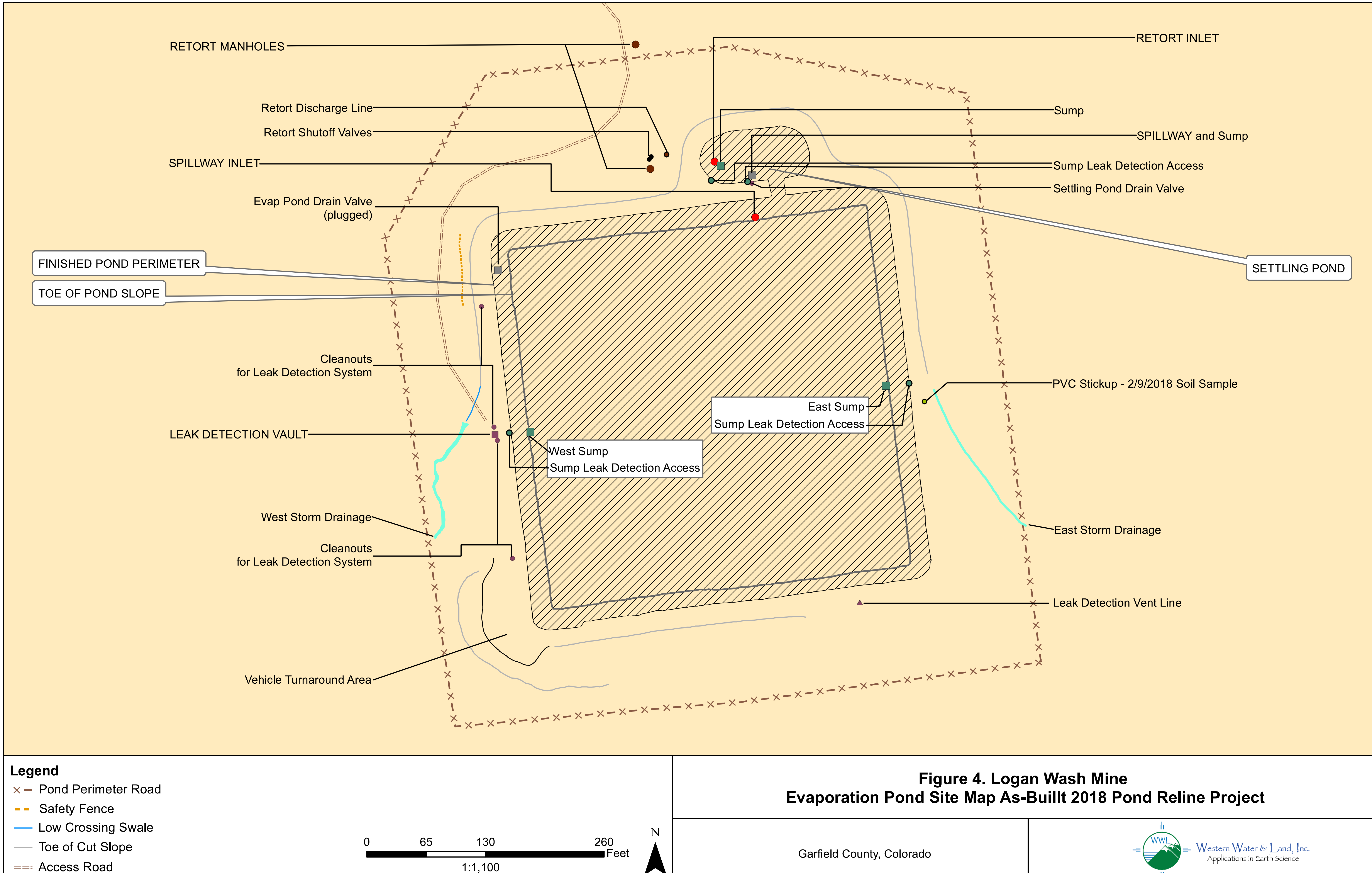


Figure 4. Logan Wash Mine
Evaporation Pond Site Map As-Buillt 2018 Pond Reline Project

Garfield County, Colorado

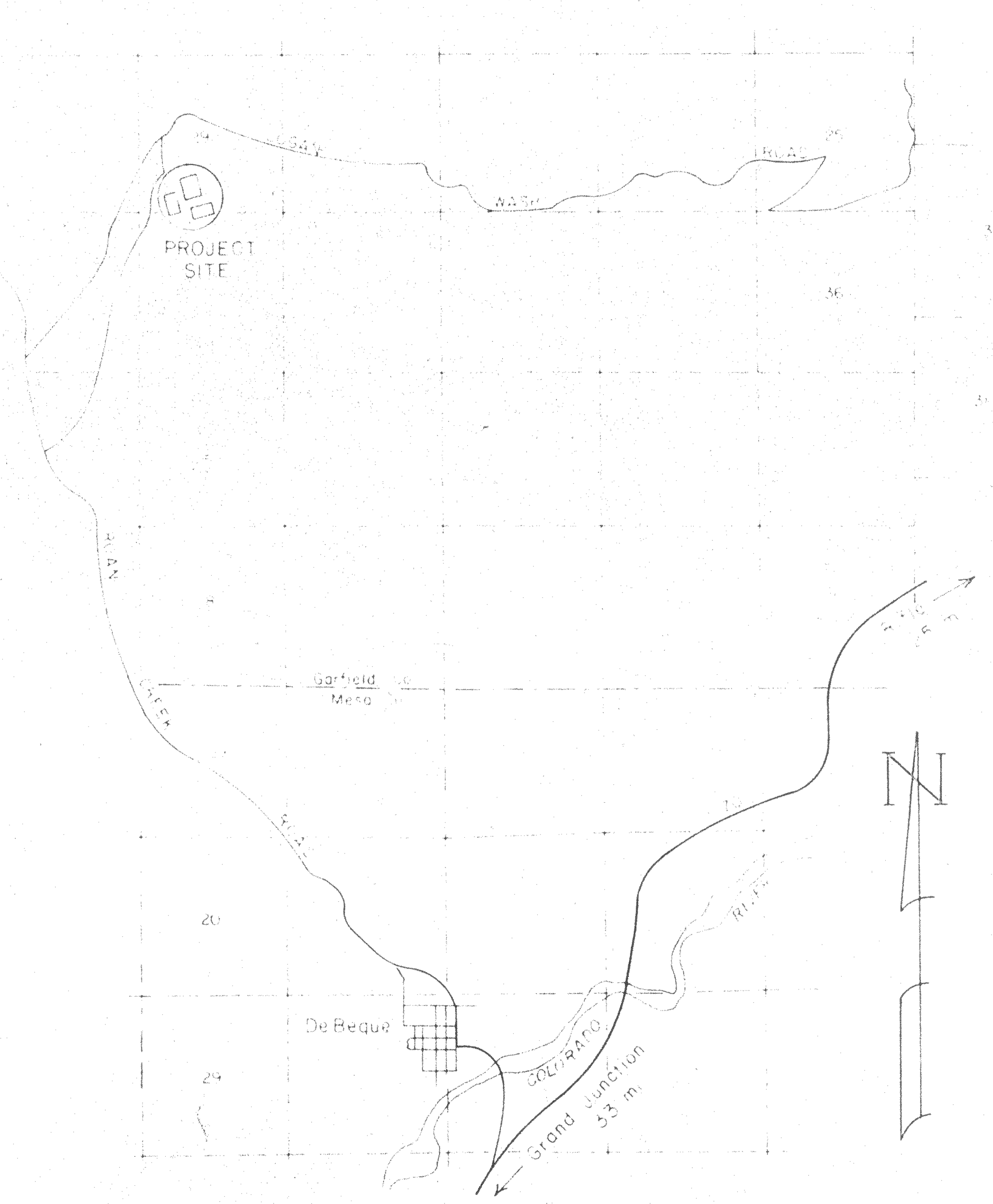
Western Water & Land, Inc.
Applications in Earth Science

ATTACHMENT A

Logan Wash Mine
Original Evaporation Pond Drawings

PROCESS WATER EVAPORATION POND
AND
TRANSMISSION PIPELINE
LOGAN WASH FACILITY

OCCIDENTAL OIL SHALE, INC.



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PREPARED BY
ROLLAND ENGINEERING
844 GRAND AVENUE - SUITE C
GRAND JUNCTION, COLORADO
81501
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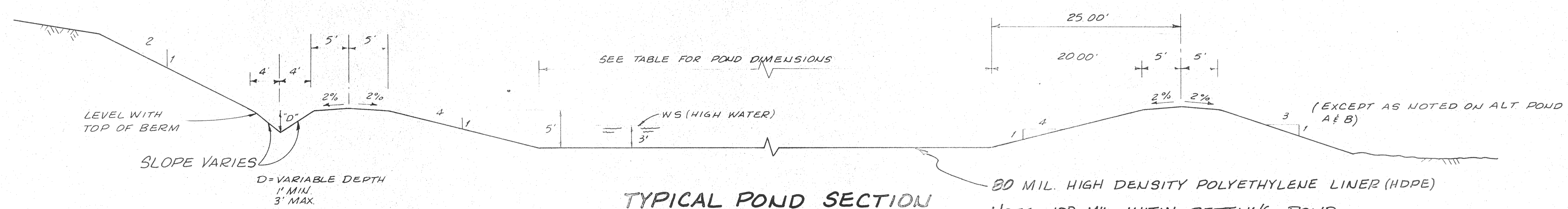


TYPICAL POND SECTION

SCALE 1"=10' HORIZ.
1"=10' VERT.

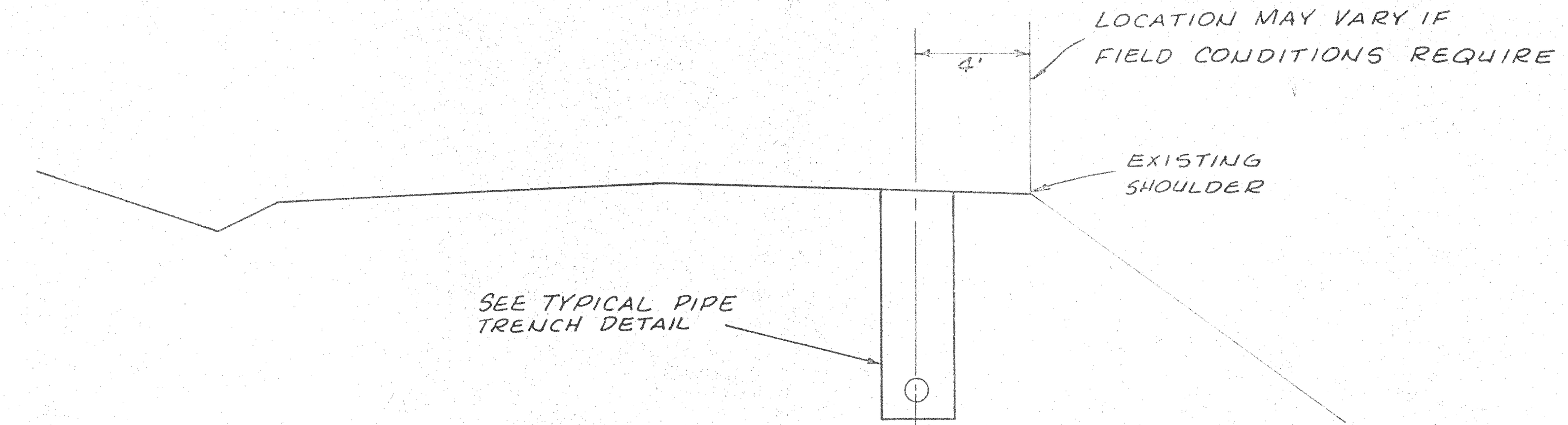
POND DIMENSIONS

POND	BOTTOM DIMENSIONS	BOTT. ELEV.	SURFACE AREA
A	393' x 393'		
B	205' x 405'		
C	210' x 405'		
ALT. A	396' x 396'		
ALT. B	134' x 530'		
ALT. C	210' x 405		
INIT. POND	10' x 80'		

SUMMARY OF QUANTITIES

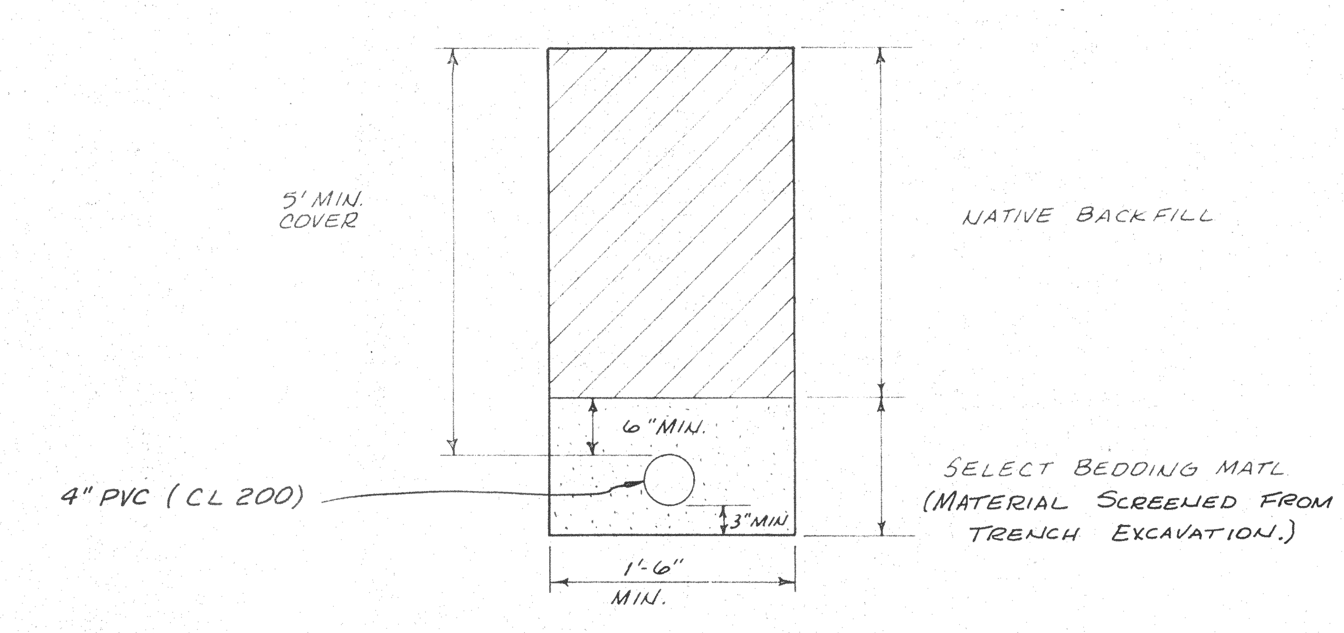
ITEM NO.	DESCRIPTION	UNIT	QUANTITY	AS-BUILT QUANTITY
1.	CLEARING AND GRUBBING	L.S.	1	1
2.	TOPSOIL	C.Y.	5,800	6,460
3.	UNCLASSIFIED EXCAVATION	C.Y.	46,700	46,532
4.	4" P.V.C. PIPE	L.F.	21,000	22,428
5.	6" P.V.C. PIPE	L.F.	2,500	2,220
6.	MANHOLES < 10'	EACH	18	13
6.A	MANHOLES > 10'	EACH	2	3
7.	OUTLET STRUCTURE	EACH	2	2
8.	LEAK DETECTION SYSTEM	L.S.	1	1
9.	8' GAME FENCE	L.F.	2,700	2,563
10.	SEEDING	ACRES	9	9
11.	MOBLIZATION	L.S.	1	1
12.	RIPRAP	CY.	130	28

INFLOW PIPELINE LOCATION

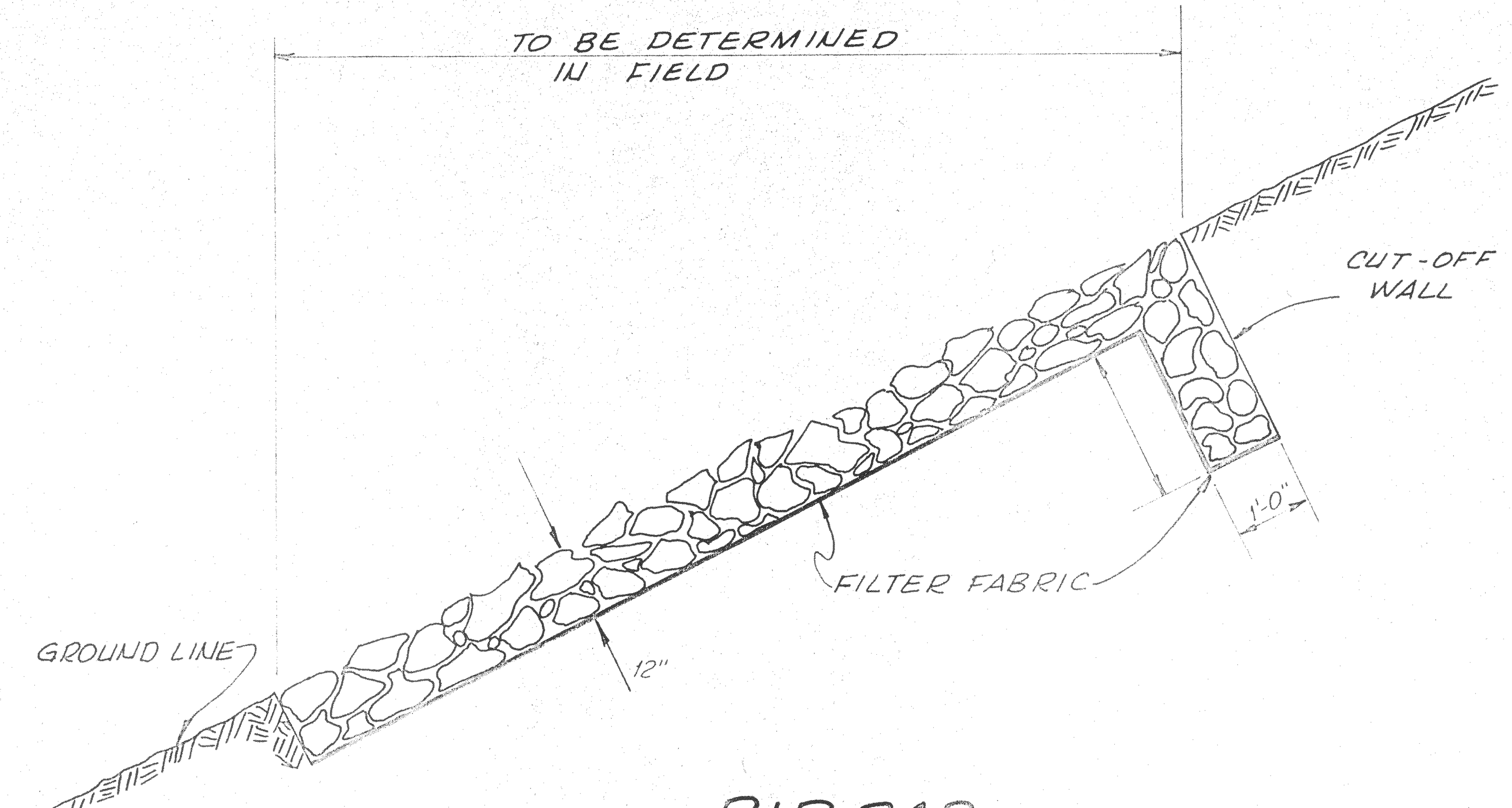


TYPICAL PIPE TRENCH

(NOT TO SCALE)



NOTE:
FOR THAT PORTION OF THE INFLOW PIPELINE THAT RUNS ALONG THE SHOULDER OF THE EXISTING LOGAN WASH ROAD NO GRADE STAKES WILL BE PROVIDED. THE CONTRACTOR WILL BE RESPONSIBLE FOR MAINTAINING A MINIMUM 2% SLOPE ON THE PIPE AND A MINIMUM 5' OF COVER. LINE AND GRADE FOR THAT PORTION OF THE PIPELINE NOT ON THE LOGAN WASH ROAD WILL BE PROVIDED BY THE OWNER.



RIPRAP

AS BUILT DRAWINGS

1	6-7-84	ADDED POLYTHYLENE LINE	TOR

OCCIDENTAL OIL SHALE, INC.
LOGAN WASH FACILITY

PROCESS WATER EVAPORATION PONDS

TYPICAL DETAILS

ROLLAND ENGINEERING GRAND JUNCTION

ROLLAND ENGINEERING
844 Grand Avenue
Suite C
Grand Junction, Colorado 81501
(303) 243-8300

LSS — 4-11-84 — 84-008 — 1 / 8

① EMBANKMENT SLOPES OVER-BUILT WITH EXCESS EXCAVATION.

② EXCESS TOPSOIL LEFT IN STOCKPILES. ALL CUT AND FILL SLOPES ARE COVERED WITH TOPSOIL.

NOTE:
SITE ELEVATION 100 APPROXIMATELY = U.S.G.S. ELEVATION 5470

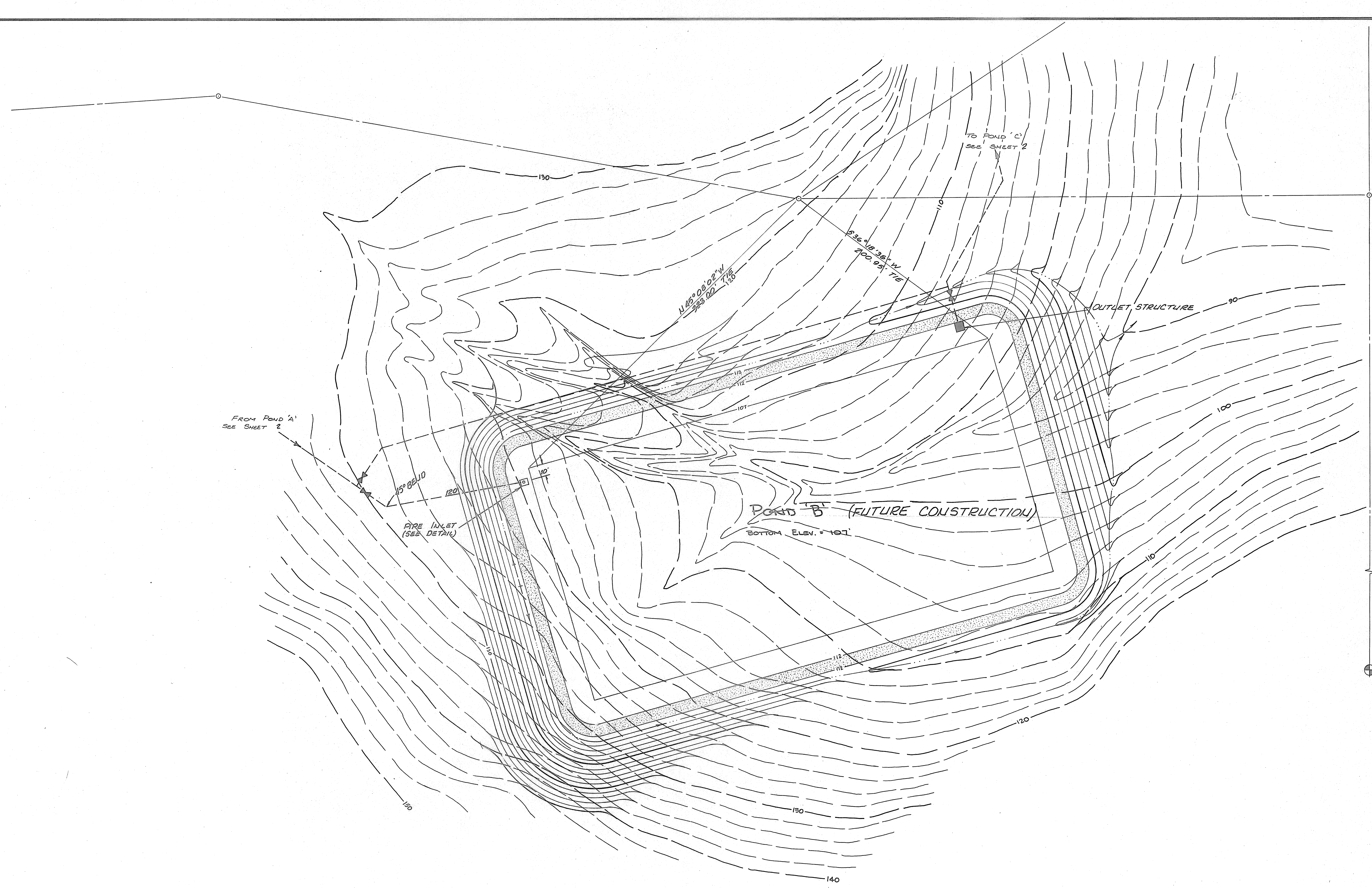
NO.	DATE	REVISION	BY
1	4/30/84	SURVEY CONTROL TIES	J.P.

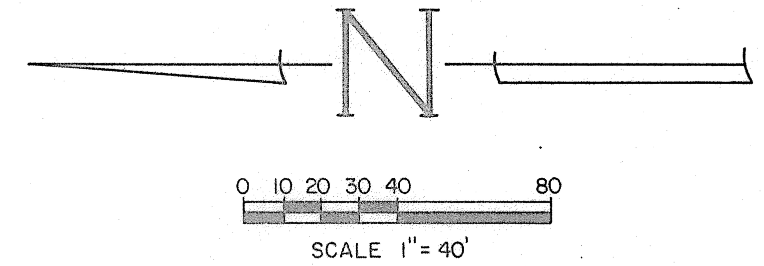
ROLLAND ENGINEERING
844 Grand Avenue
Suite C
Grand Junction, Colorado 81501
(303) 243-8300

OCCIDENTAL OIL SHALE, INC.
LOGAN WASH FACILITY

PROCESS WATER EVAPORATION PONDS

DESIGNED	CHECKED	JOB NO.	SHEET
DRAWN LSS	DATE 3-30-84	84-008	2 OF 8





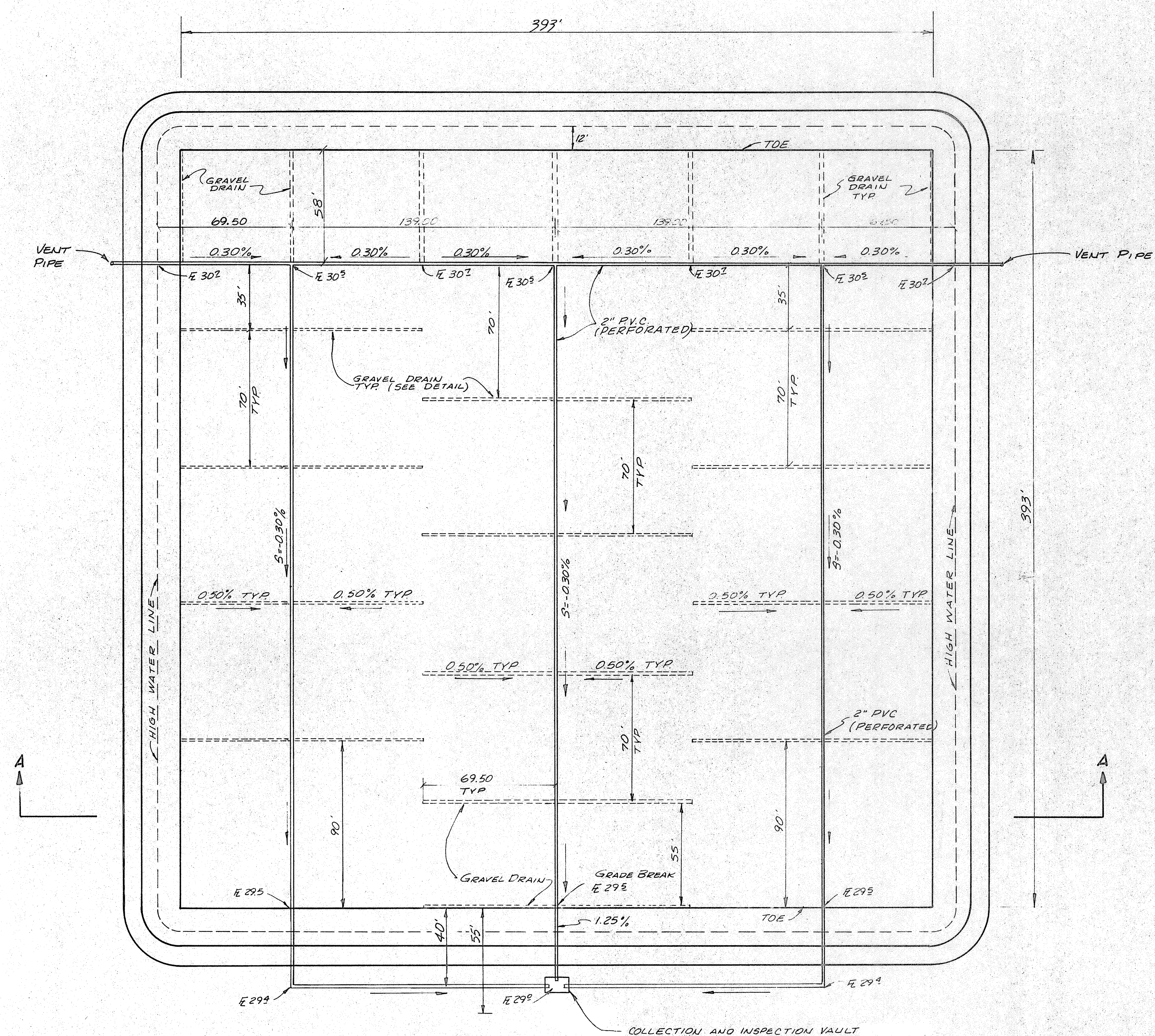
NO.	DATE	REVISION	BY
1	5-17-84	ADD DRAINAGE AROUND TOP OF POND	T.D.R.

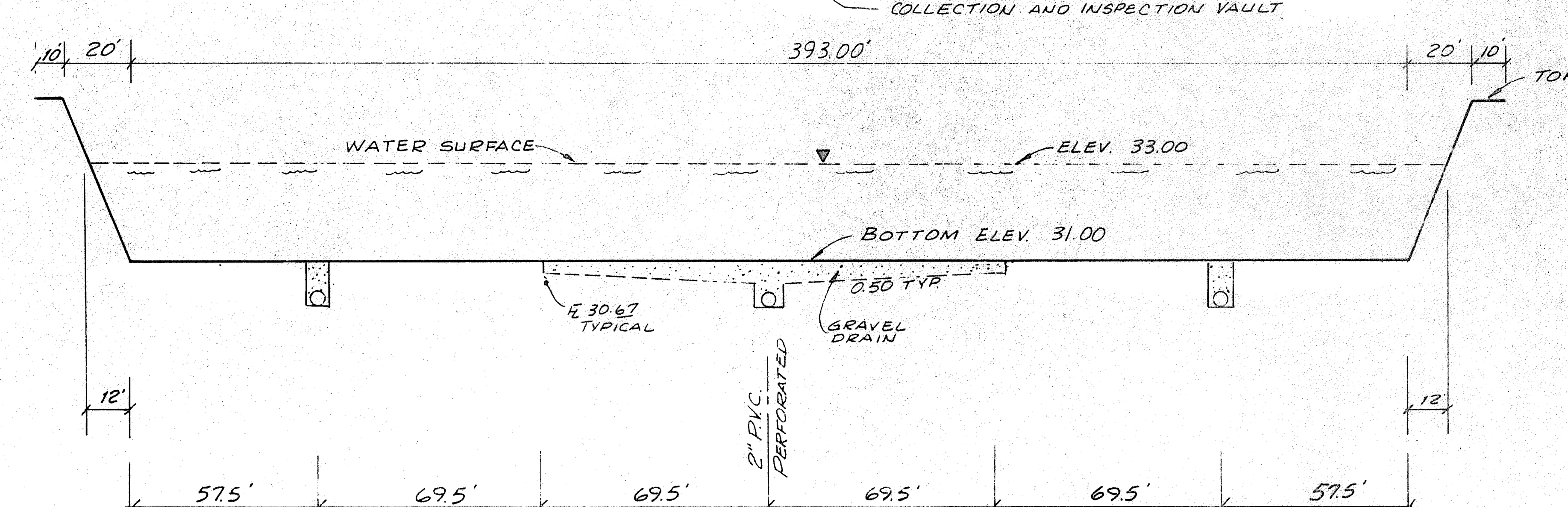
OCCIDENTAL OIL SHALE, INC.
LOGAN WASH FACILITY

PROCESS WATER EVAPORATION POND 'B'

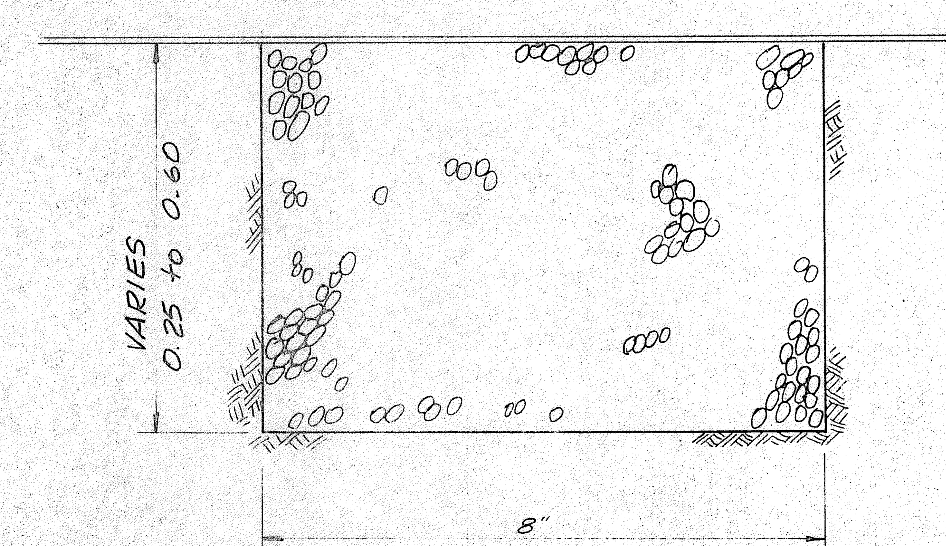
ROLLAND ENGINEERING
844 Grand Avenue
Suite C
Grand Junction, Colorado 81501
(303) 243-8300

DESIGNED	CHECKED	JOB NO.	SHEET 3
DRAWN LSS	DATE 4-7-84	84-008	OF 8

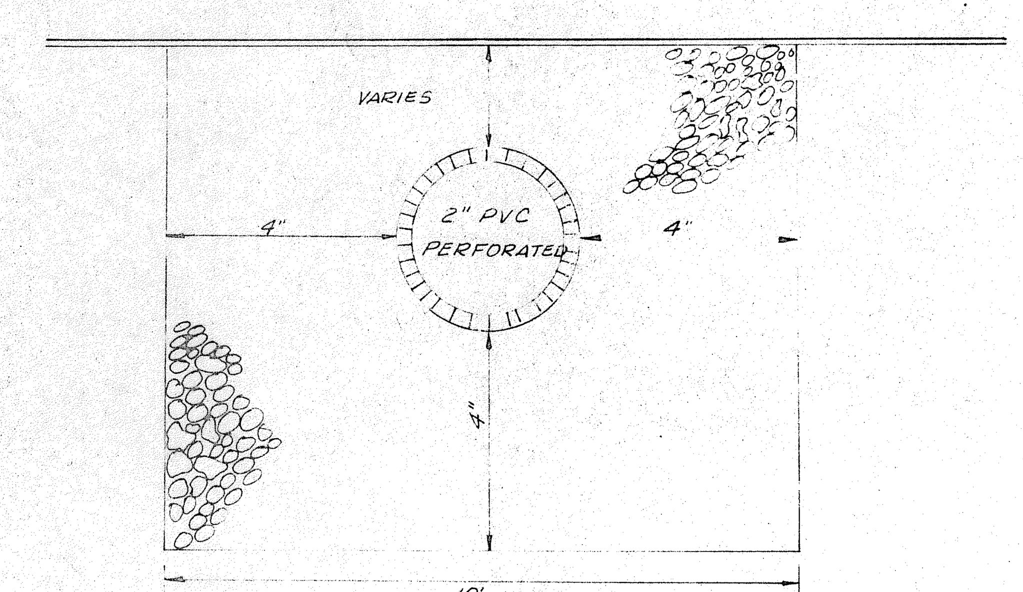




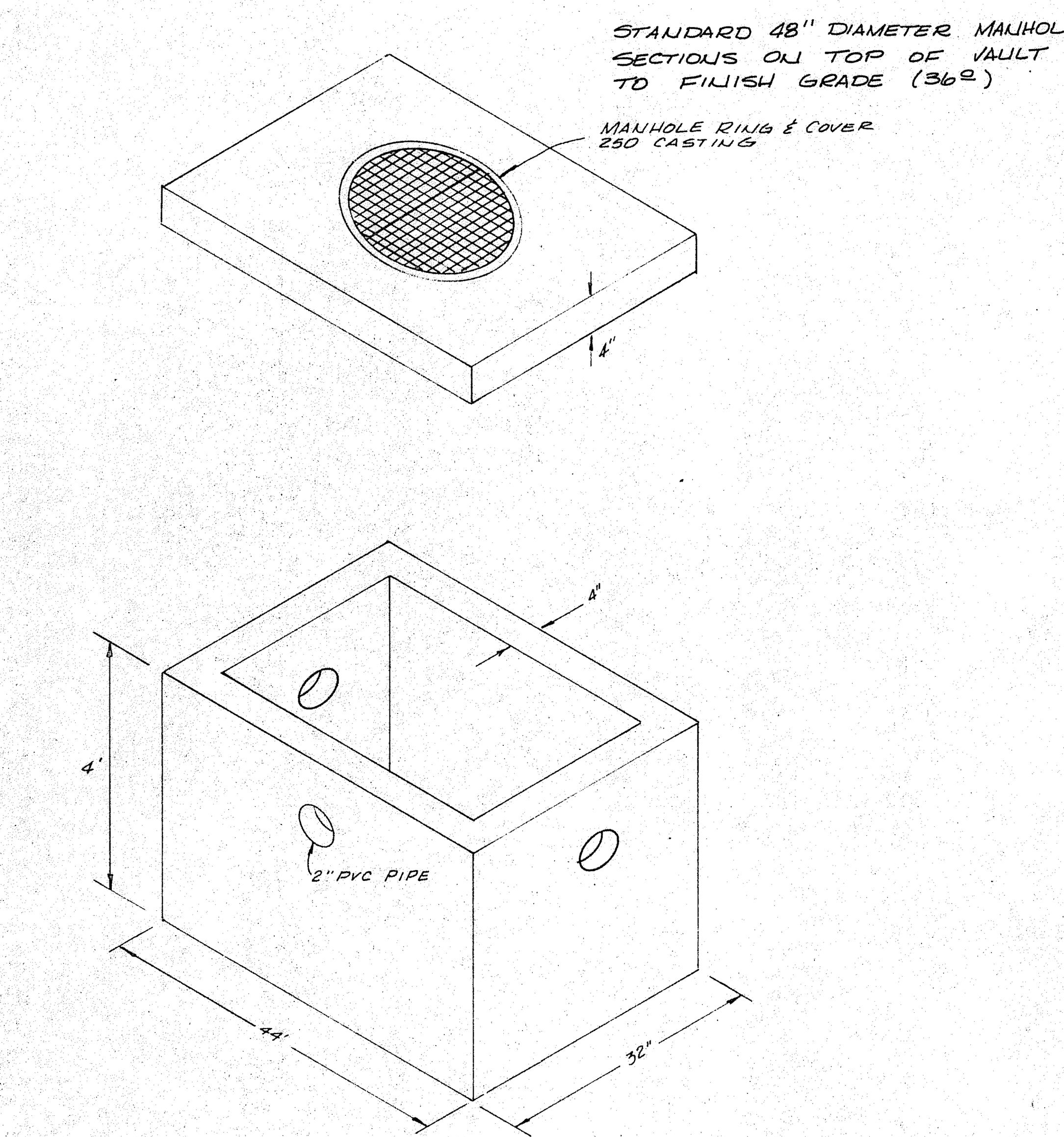
SECTION A-A
1" = 40' HORIZ.
1" = 4' VERT.



GRAVEL DRAIN DETAIL
NO SCALE



PERFORATED PIPE DETAIL
NO SCALE



COLLECTION AND INSPECTION VAULT

REINFORCING NOTES:

1. THE WALL, FLOOR AND TOP SLAB SHALL HAVE #4-BARS AT 12 INCH CENTER IN BOTH DIRECTIONS.
2. THE OPENING IN THE TOP SLAB SHALL BE ADDITIONALLY REINFORCED WITH #5-BARS AROUND THE PERIMETER AT 90° TO EACH OTHER.
3. ALL REBAR TO BE CENTERED IN THE SLAB OR WALK.

AS BUILT DRAWINGS

NO	DATE	REVISION	BY
1	6-7-84	PRELIMINERY	TDR

ROLLAND ENGINEERING GRAND JUNCTION CIVIL STRUCTURAL MANAGEMENT PLANNING DESIGN P E

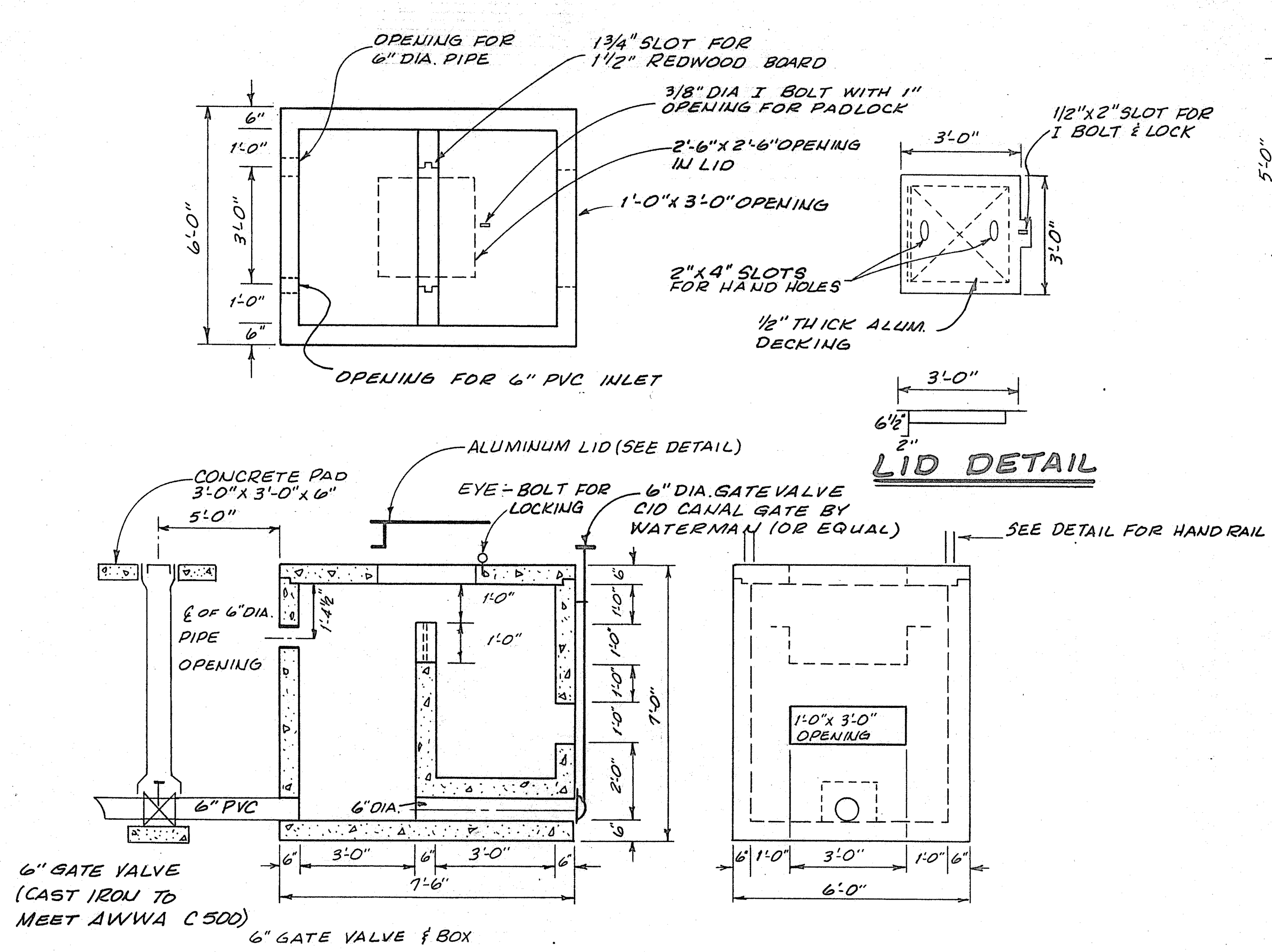
ROLLAND ENGINEERING
844 Grand Avenue
Suite C
Grand Junction, Colorado 81501
(303) 243-8300

OCCIDENTAL OIL SHALE, INC.
LOGAN WASH FACILITY

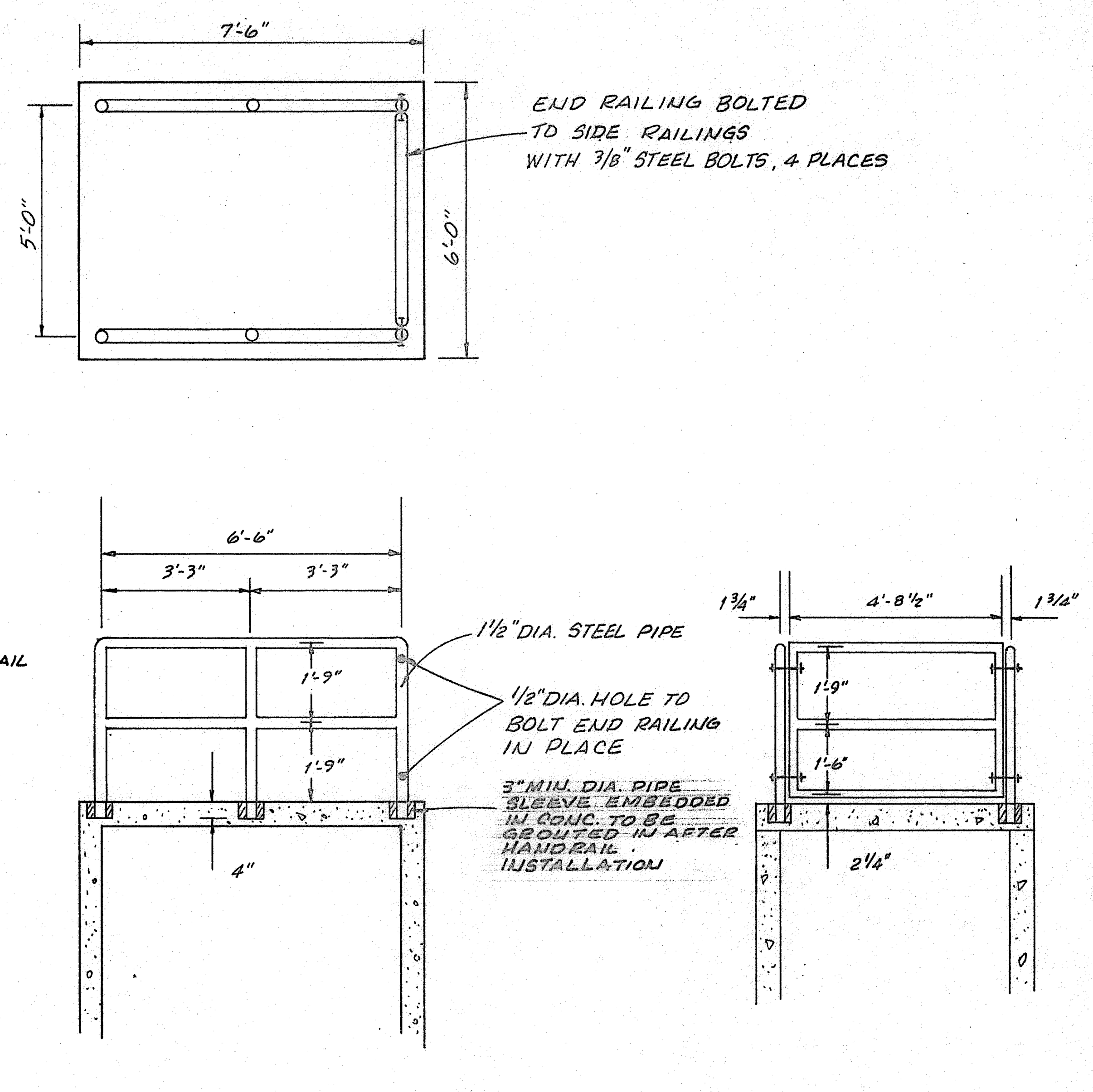
PROCESS WATER EVAPORATION PONDS

LEAK DETECTION SYSTEM DETAILS

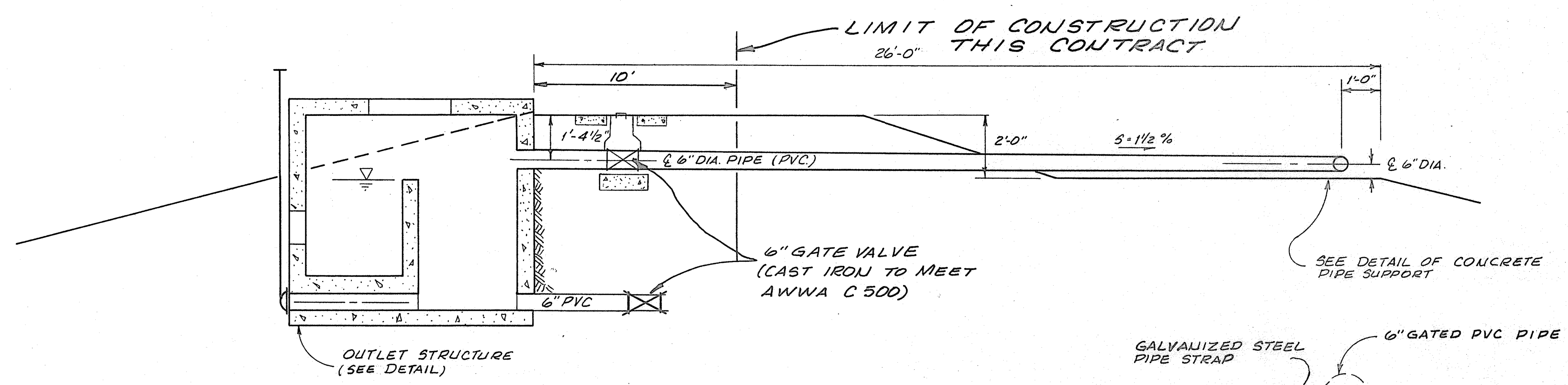
DESIGNED	CHECKED	JOB NO	SHEET
JTP		84-008	4
DRAWN LJS	DATE 6-7-84		OF 8



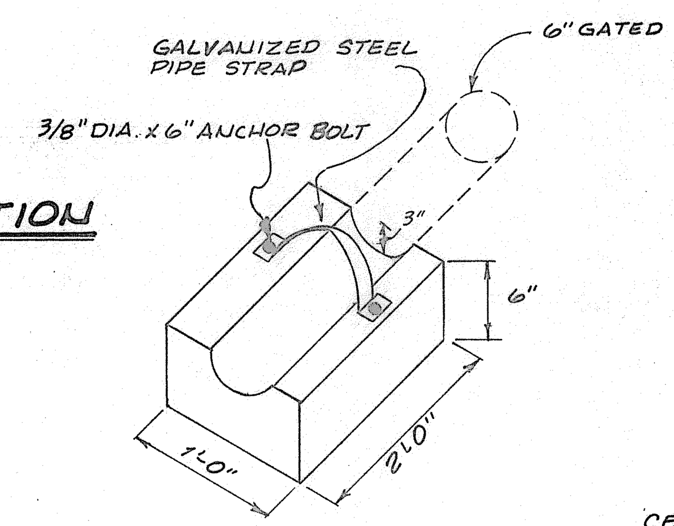
DETAIL OF OUTLET STRUCTURE



DETAIL OF HAND RAILING FOR OUTLET STRUCTURE

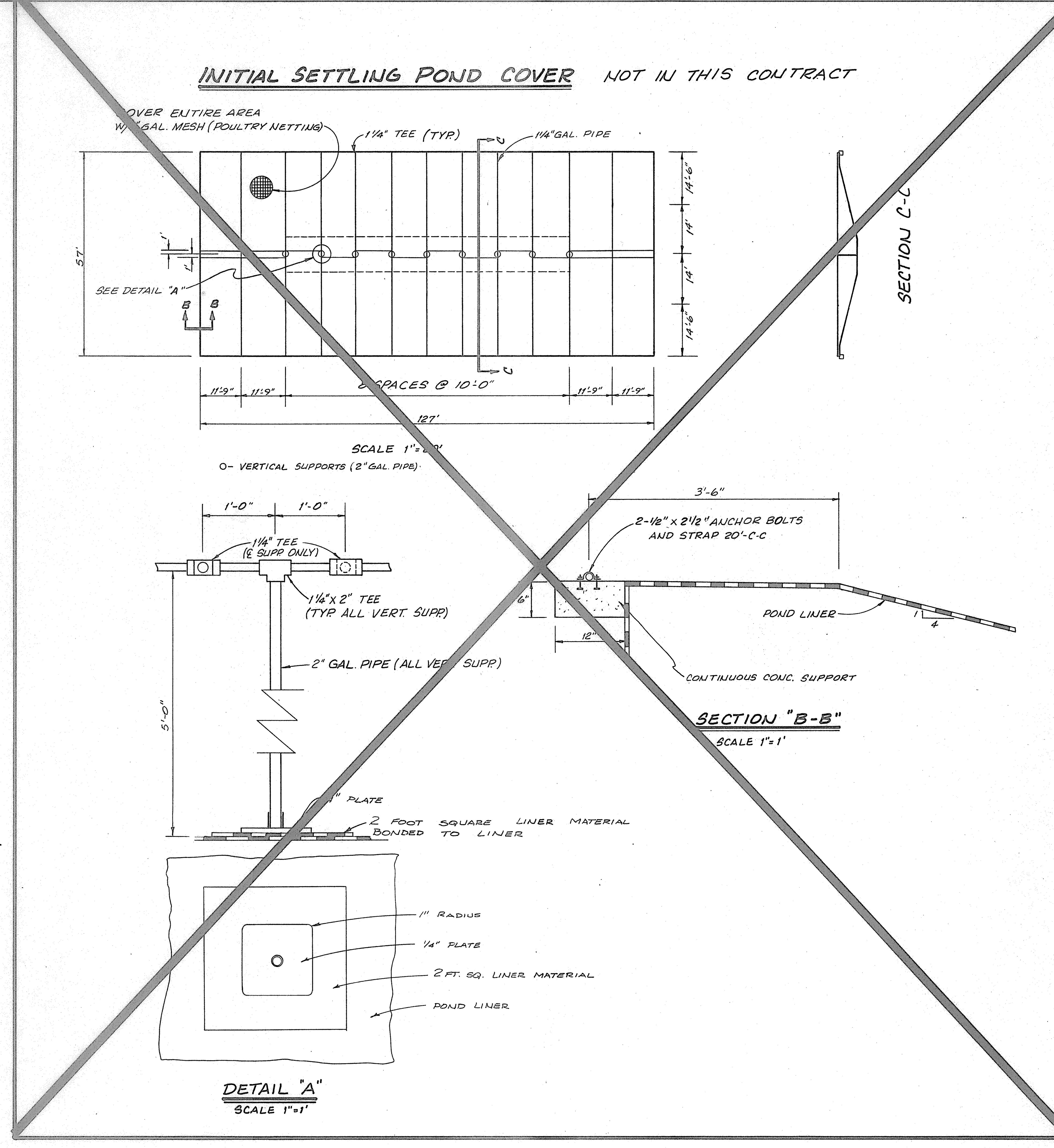


DETAIL OF PIPING FOR EVAPORATION ENHANCER SYSTEM



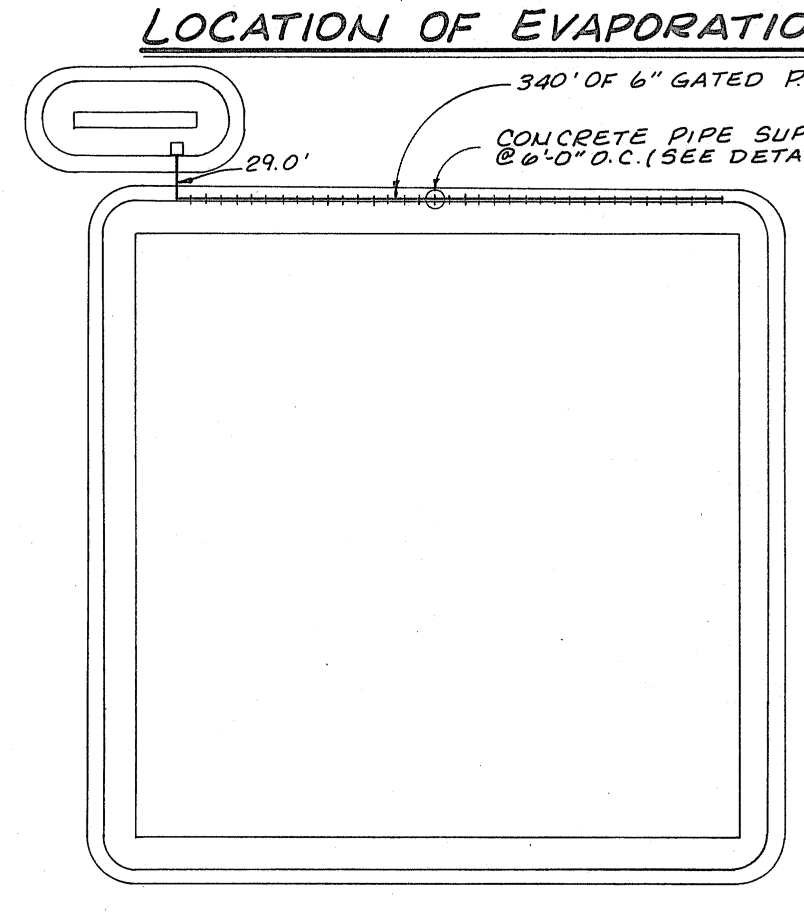
PIPE SUPPORT DETAIL

(NOT IN THIS CONTRACT)



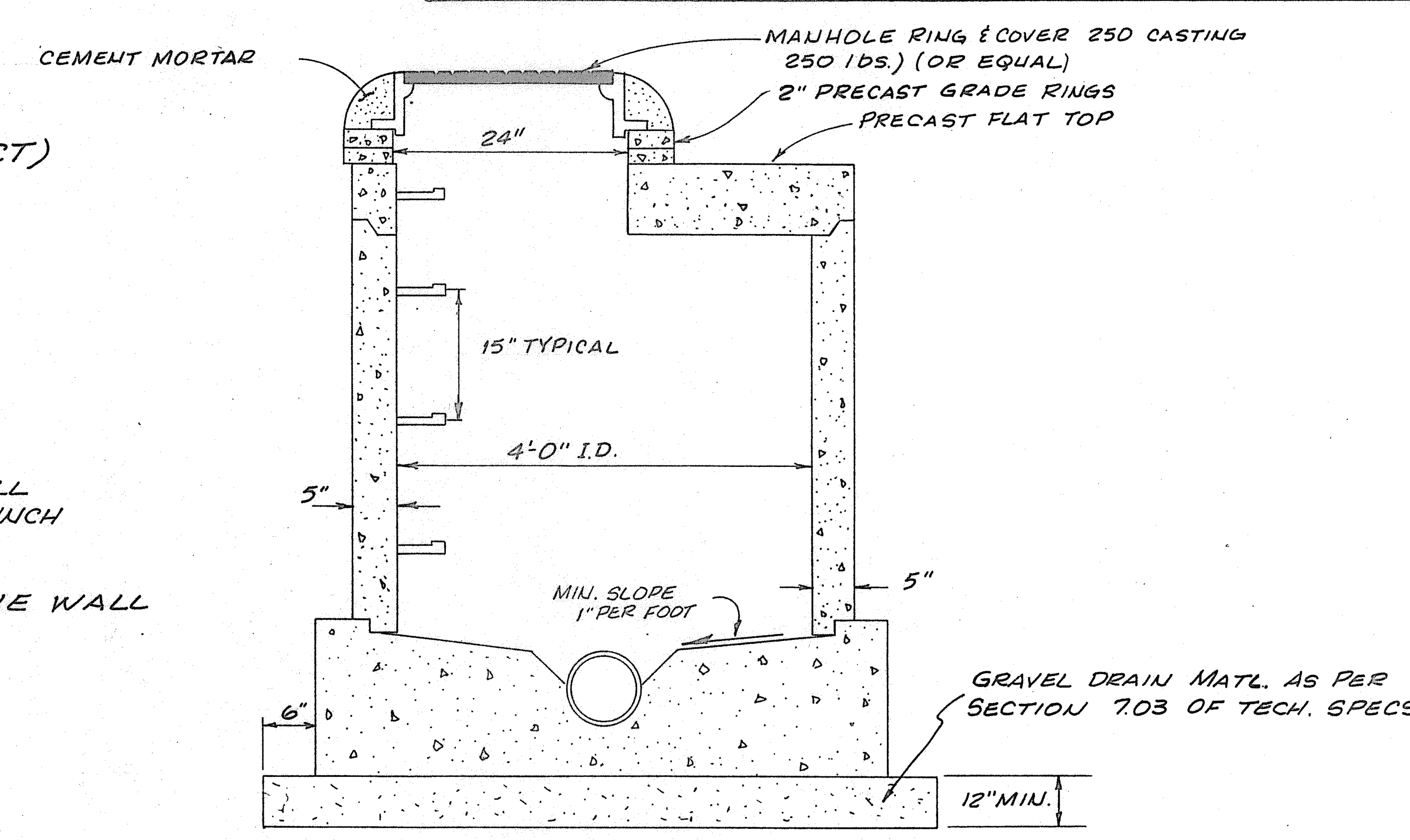
(NOT IN THIS CONTRACT)

LOCATION OF EVAPORATION ENHANCER SYSTEM



OUTLET STRUCTURE REINFORCING

1. THE WALLS, FLOORS AND TOP SLAB SHALL BE REINFORCED WITH NO. 5 BARS ON 12 INCH CENTERS IN BOTH DIRECTIONS.
2. ALL REBAR SHALL BE CENTERD IN THE WALL OR SLAB THICKNESS.



MANHOLE DETAIL

AS BUILT DRAWINGS

NO.	DATE	REVISION	BY
2	6-7-84	PRELIMINARY	TDR
1	5-17-84	CHANGE DETAIL OF SETTLING POND COVER	T.D.R.

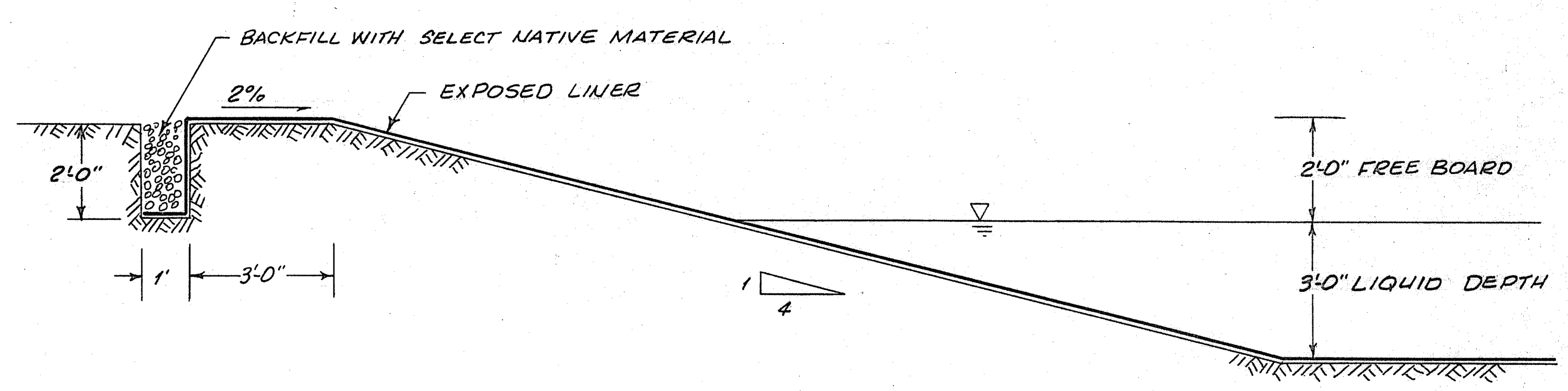
OCCIDENTAL OIL SHALE, INC.
LOGAN WASH FACILITY

PROCESS WATER EVAPORATION PONDS

SPECIAL DETAILS

ROLLAND ENGINEERING
844 Grand Avenue
Suite C
Grand Junction, Colorado 81501
(303) 243-8300

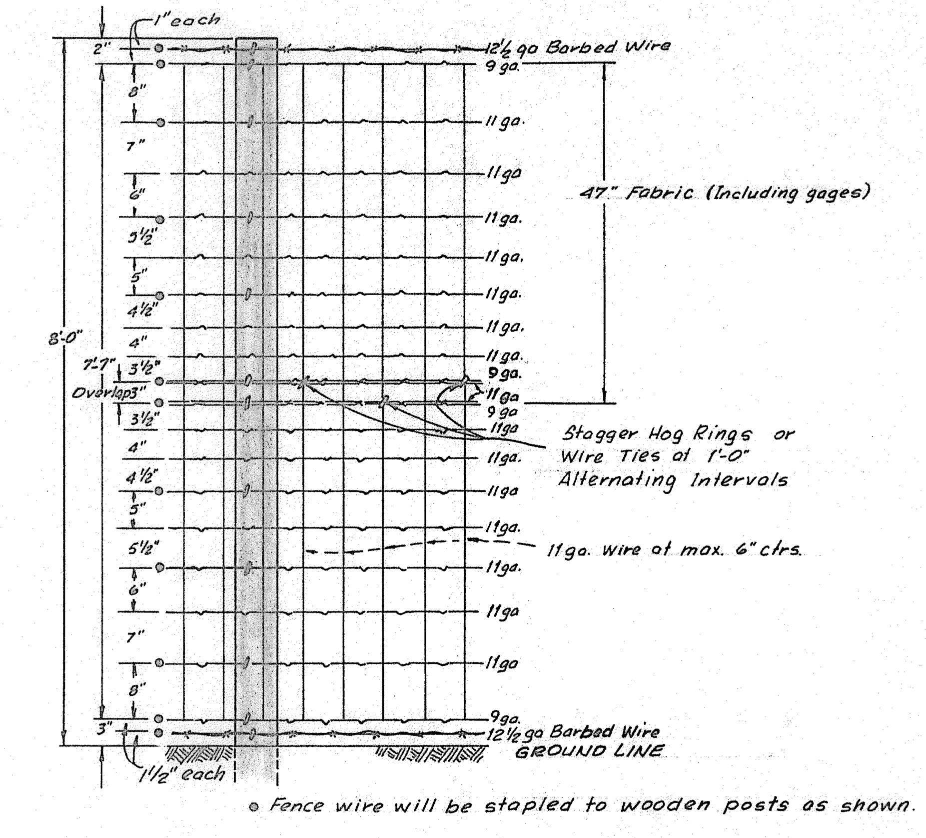
DESIGNED	CHECKED	JOB NO.	SHEET
DRAWN LJS, LSS	DATE 4-12-84	84-008	5 OF 8



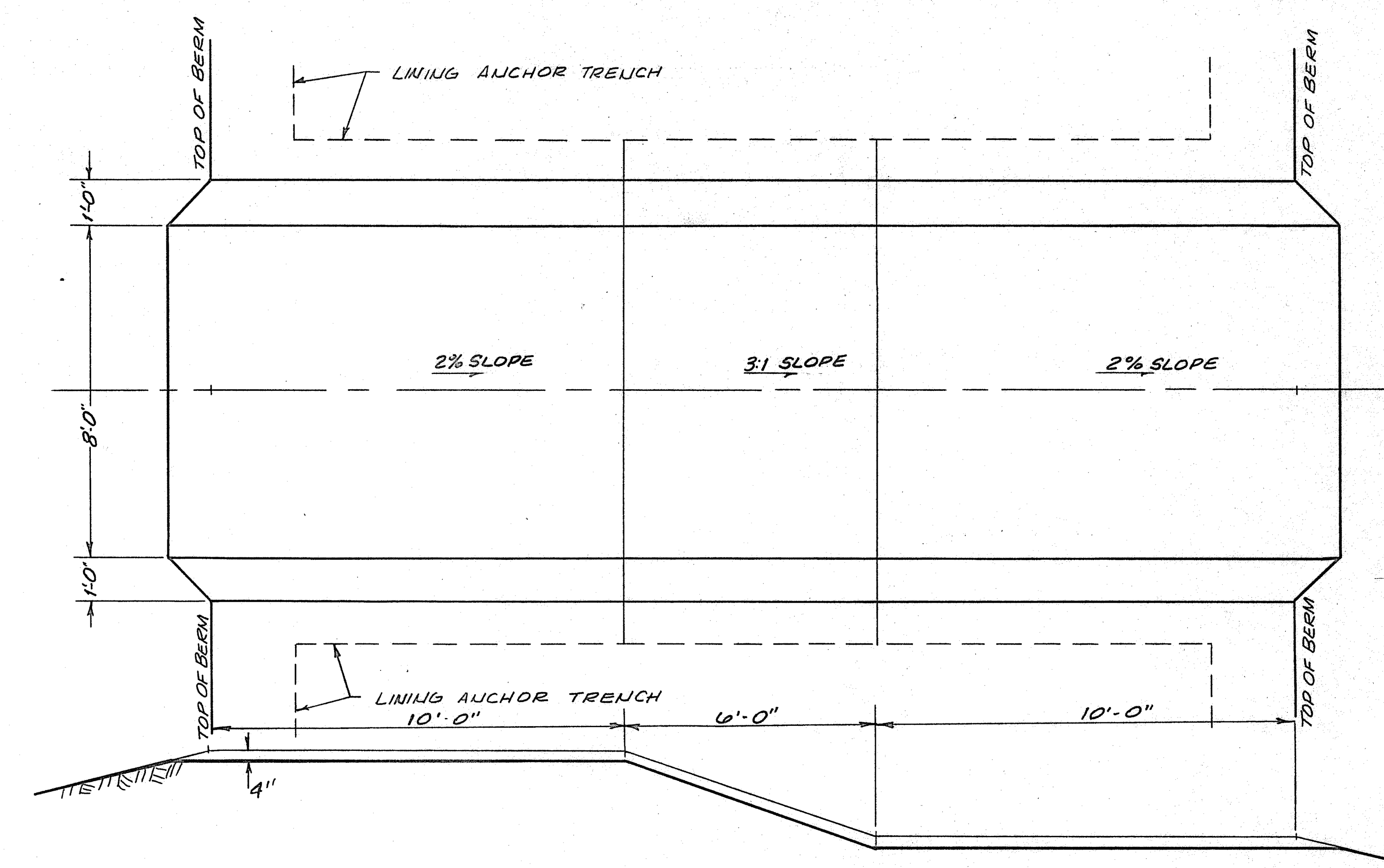
LINING ANCHOR TRENCH DETAIL

GAME FENCE DETAILS

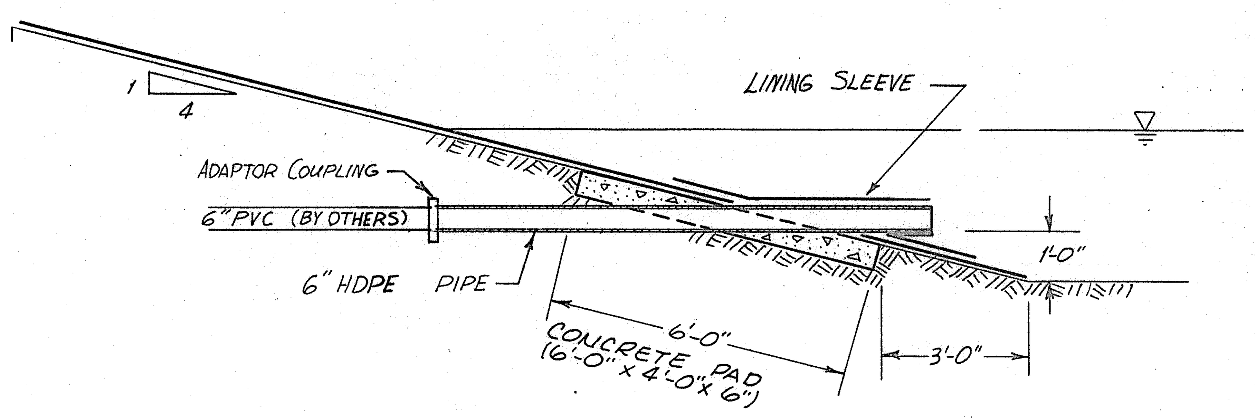
NOT IN THIS CONTRACT



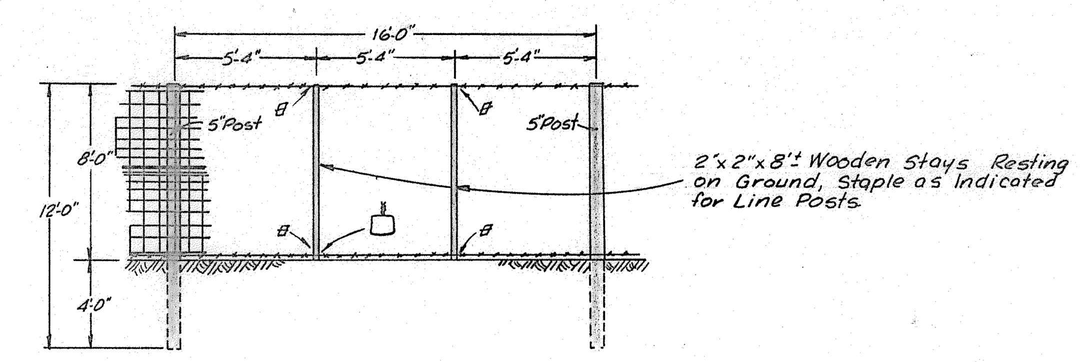
GAME FENCE WIRE FABRIC



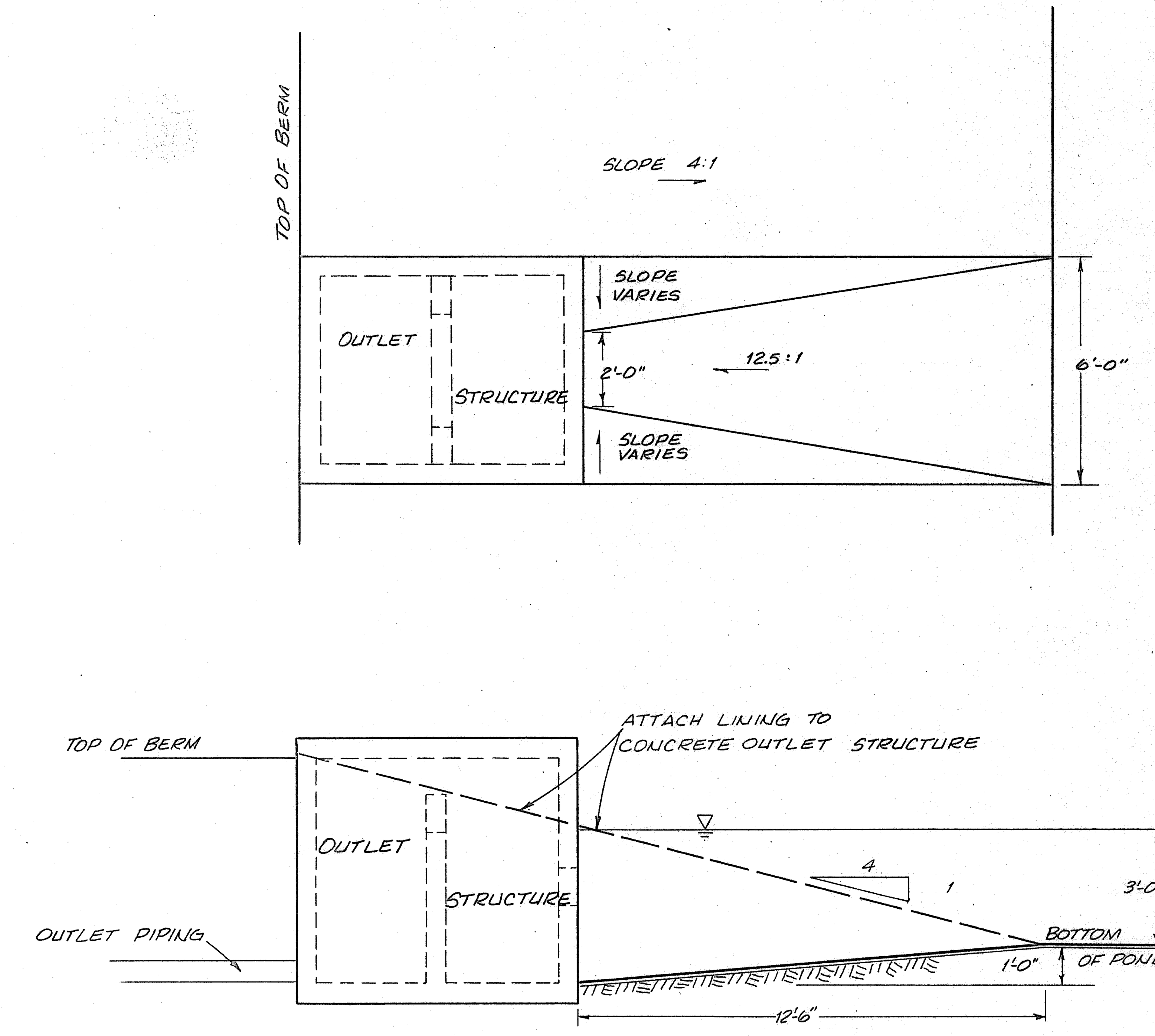
DETAIL OF OVERFLOW SPILLING
(INITIAL SETTLING POND TO POND A)

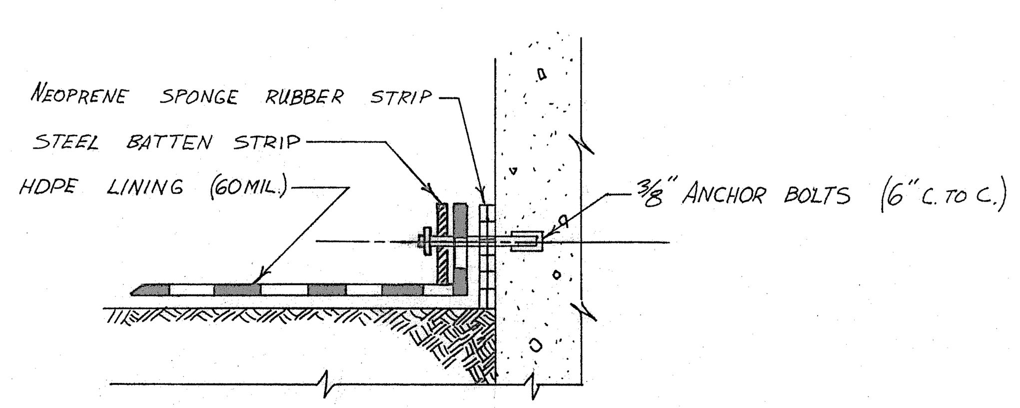


PIPING INLET DETAIL

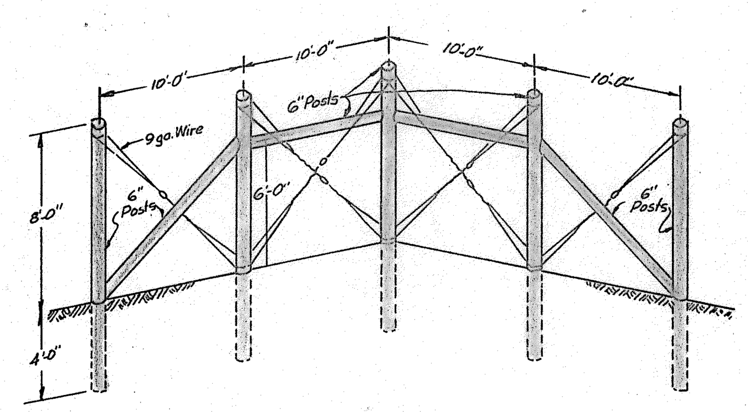


LINE POSTS

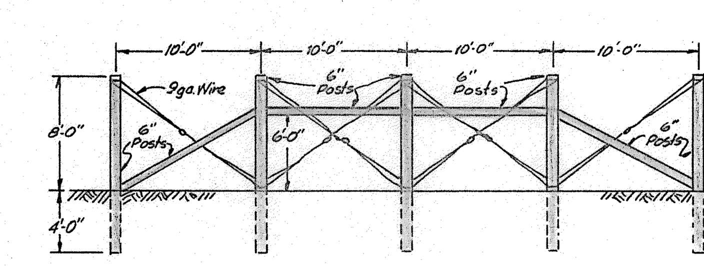




DETAIL OF ATTACHING LINING TO CONCRETE OUTLET STRUCTURE

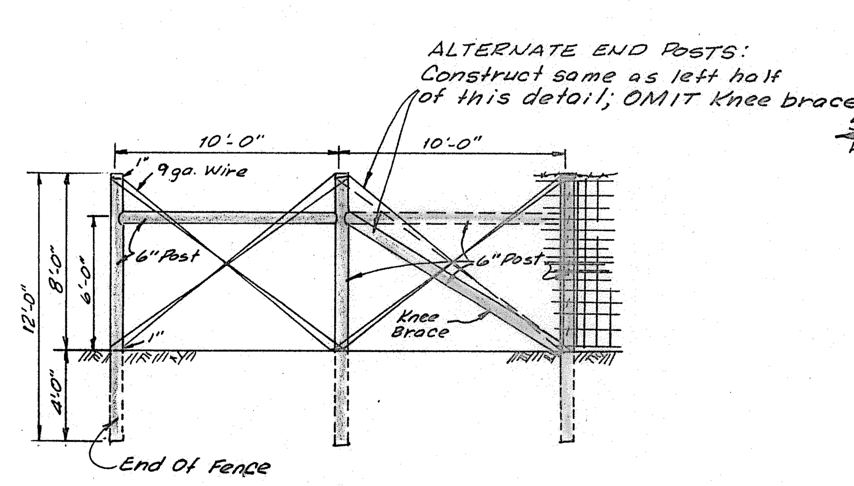


CORNER POSTS

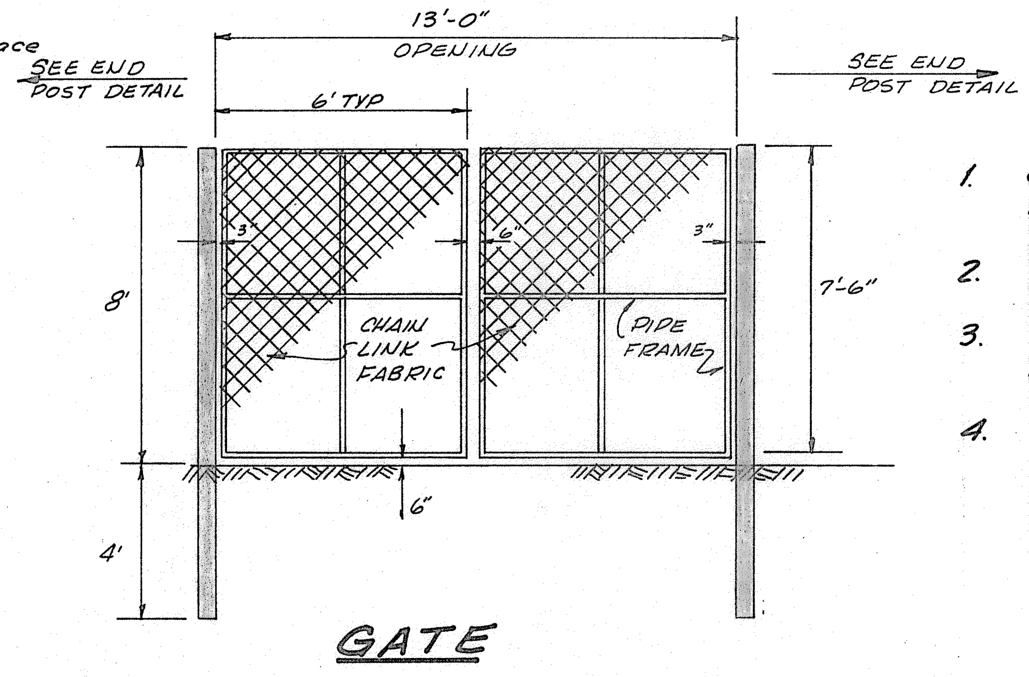


LINE BRACE POSTS

DETAIL OF SLOPING EMBANKMENT AT OUTLET STRUCTURE



END POSTS



GATE

GATE NOTES

1. GATE TO BE A DOUBLE GATE ARRANGEMENT; HINGED AT BOTH SIDES
2. GATE SECTIONS TO BE CHAIN LINK CONSTRUCTION.
3. CHAIN LINK FABRIC TO BE 2" MESH NO. 9 GALVANIZED WIRE.
4. PIPE FRAME TO BE GALVANIZED AND CONFORM TO ASTM A120 SCHEDULE.

AS BUILT DRAWINGS

ROLLAND ENGINEERING GRAND JUNCTION — CIVIL — DESIGN — P.E.

ROLLAND ENGINEERING
844 Grand Avenue
Suite C
Grand Junction, Colorado 81501
(303) 243-8300

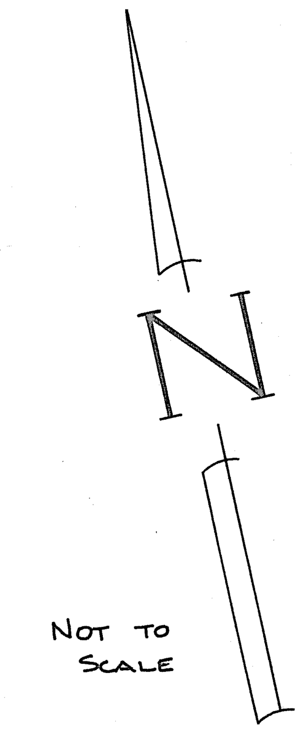
NO	DATE	REVISION	BY
1	6-7-84	ADDED GAME FENCE DETAIL	TOR

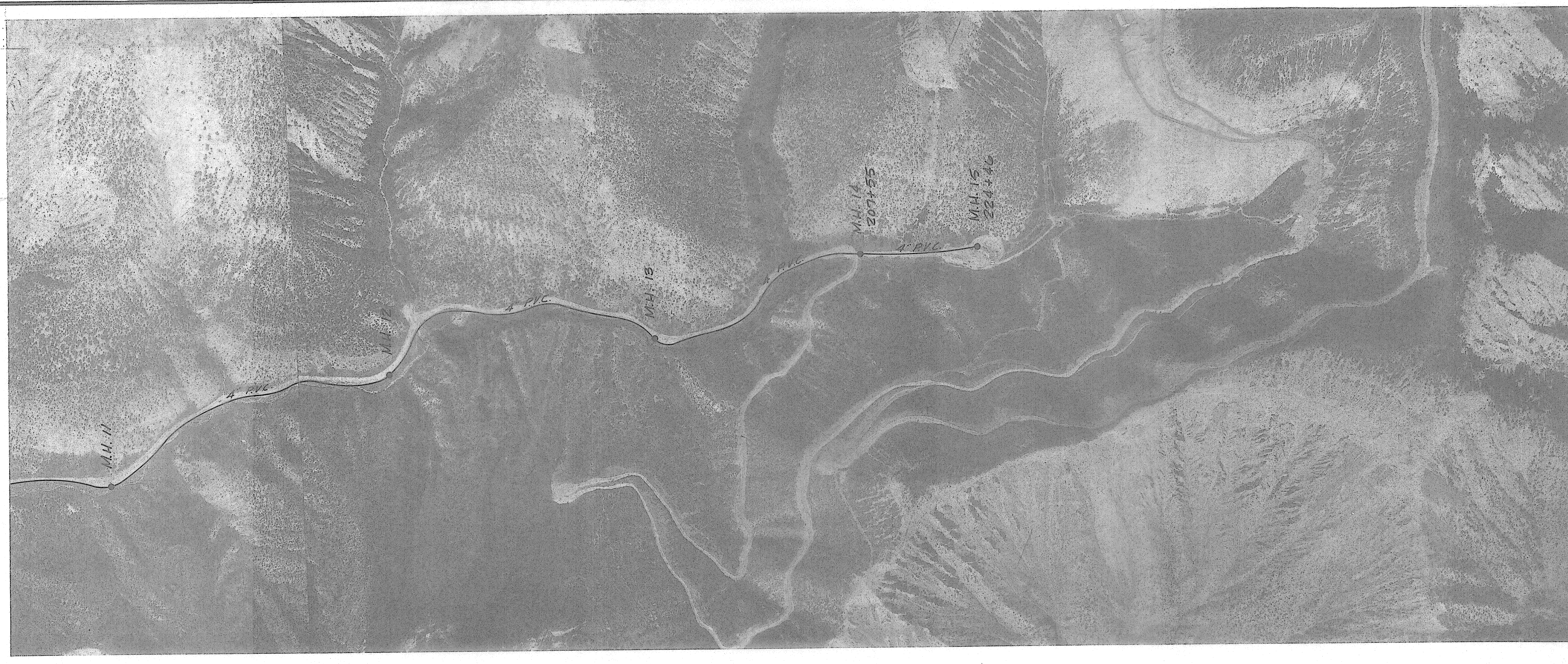
OCCIDENTAL OIL SHALE, INC.
LOGAN WASH FACILITY

PROCESS WATER EVAPORATION PONDS

TYPICAL DETAILS

DESIGNED	CHECKED	JOB NO.	SHEET
DRAWN LJS	DATE 4-12-84	84-008	6 OF 8





AS BUILT DRAWING

NO.	DATE	REVISION	BY
1	6-7-84		TDR

OCCIDENTAL OIL SHALE, INC.
LOGAN WASH FACILITY

PROCESS WATER EVAPORATION PONDS
PLAN VIEW OF PROCESS WATER PIPELINE

ROLLAND ENGINEERING GRAND JUNCTION — CIVIL STRUCTURAL MANAGEMENT PLANNING DESIGN P.E.

ROLLAND ENGINEERING
844 Grand Avenue
Suite C
Grand Junction, Colorado 81501
(303) 243-8300

DESIGNED	CHECKED	JOB NO.	SHEET 7
DRAWN LSS	DATE 4-12-84	84-008	OF 8

KEUFFEL & ESSER A KRATOS Company PLATE 1, PLAN-PROFILE
46 7024 Made in U.S.A.

ATTACHMENT B

Investigative Soil Sampling Results

Western Water & Land, Inc.

April 6, 2018

Mr. Wayne Werkmeister
Field Manager
U.S. BLM Grand Junction Field Office
2815 H Road
Grand Junction, CO 81506

RE: Logan Wash Mine Evaporation Pond – Soil Sampling Results

Dear Mr. Werkmeister:

Western Water & Land, Inc. (WWL) on behalf of Occidental Oil Shale, Inc. (OOSI) and Glenn Springs Holdings, Inc. (GSHI), has completed the soil sampling and analytical evaluation of soils collected from the OOSI Logan Wash Mine Evaporation Pond (Pond). GSHI is planning on installing a new liner on top of the current liner at the Pond. As requested by the BLM, soils under the Pond liner (subliner) were sampled to investigate the potential for soil contamination as a result of any leakage from the existing liner. Specifically, BLM requested that soil samples be collected from beneath the existing Pond liner in low areas of the Pond. Since potential leakage would not be restricted to just low areas of the Pond bottom, WWL also collected soils at distributed sites elsewhere under the Pond liner. Soil samples were also collected around the Pond as background samples. Sediment and precipitated salts within the Pond were collected for Toxicity Characteristic Leaching Procedure (TCLP) analysis.

This letter report describes the methods, analysis, and analytical results of the soil sampling work and concludes with recommendations.

FIELD METHODS

Soil Sampling from Beneath the Pond Liner

Five subliner locations were sampled in dry/high areas of the Pond on November 15-16, 2017 and three locations were sampled in flooded/low areas of the Pond on February 28, 2018. Samples were collected at depth intervals of 0-1 and 3-4 feet, this is approximately equivalent to depths of 5-6 and 8-9 feet below ground surface at the top of the Pond liner slope (the 5-6 foot interval is the first foot below the liner and the 8-9 foot interval begins 3 feet below the liner). Sample locations are shown in Figure 1.

Subliner sampling involved cutting the 60-mil high density polyethylene (HDPE) liner, extracting samples using a manual drive soil sampler and auger, backfilling the sample hole, and repairing the liner. To collect soil samples from beneath the liner in flooded/low areas of the Pond, precipitated minerals and sediments deposited on the liner were removed from the area and concrete rings (2 feet diameter by 1 foot tall) were placed on the liner to isolate the sampling area. Water depth at the time of sampling was approximately 8 inches. A seal was formed at the bottom of the concrete ring with Portland cement mix and powdered bentonite at a rate of 40-80 pounds per ring. The concrete was spread on the outside of the ring and hand packed in place. A marine bilge pump was used to pump the water from within the concrete ring to create a dry space to work. Once the seal around the concrete

743 Horizon Court Suite 330, Grand Junction, CO 81506
Phone: (970) 242-0170 Fax: (970) 242-0270

ring was water-tight, WWL personnel cut through the liner to expose the soil. The holes were typically no bigger than 25 square inches (5x5-inches).

An AMS soil sampler consisting of a 3.25-inch soil auger and a 2.5-inch diameter, 6-inch long soil core sampler was used to collect the subliner samples. The soil core sampler was hammered into the ground surface and samples were collected at intervals of 0-1 feet and 3-4 feet. The auger was used to hand-drill from 1 to 3 feet and the soil was temporarily saved to backfill the holes. Samples were collected in manufacturer supplied plastic sleeves that fit inside of the soil core sampler. After the samples were collected, the holes were backfilled and a subcontractor, H&H Liner®, repaired the holes in the liner.

Two 6-inch long samples were collected at each one-foot interval. Each 6-inch sample was labeled for sample ID, depth, date, and time, and stored for shipment to the analytical laboratory. Subliner samples collected from dry/high areas of the pond were done so using the same methods except isolating and dewatering the areas was not necessary. Sample LW-POND-C1 2.4-2.8 FT was collected from the 2.4-2.8 feet interval because field personnel encountered auger refusal at 2.8 feet.

Each individual 6-inch sleeve was analyzed for soil moisture content by the contracted laboratory (ALS Holland). After the soil moisture content analysis, the two 6-inch samples from each one-foot sampling interval were combined to make one sample for chemical analysis. A summary of samples collected are shown in Table 1.

Background Soil Sampling

Three background soil samples were collected on February 9, 2018 from three different locations along the perimeter of the Pond. The background samples were collected from the east side, northeast corner, and northwest corner of the Pond. These soil samples were considered background soil samples because of their locations being on the perimeter of the Pond, approximately 12 to 15 feet from the anchored liner.

WWL subcontracted HCSI to assist in collecting the background soil samples. HCSI used a CME-55 track drill rig with a hollow-stem auger to drill to the targeted sampling depths. A 4-inch soil core sampler was driven down the hole prior to sample collection to remove any sluffed soil from the hole. A 24-inch long and 1.5-inch diameter split spoon sampler was then driven to collect the samples. Samples were collected at depths of 5-7 and 8-10 feet below the ground surface at the top of the pond liner slope. Standard, industry-accepted sampling protocols were used, including decontamination of split-barrel equipment between sampling runs.

Soil from each two-foot interval was equally distributed in two 8-ounce standard glass jars and the lids taped closed. In this way, each jar represented the respective 2-foot interval sampled. Sample locations are shown in Figure 1.

To reduce loss of moisture during testing, the soil in each 8-ounce jar was analyzed separately for moisture content, and then the soil in both jars was composited for chemical analysis. The average moisture content was used for quantification of constituents. A summary of samples collected are shown in Table 1.

Pond Sediment and Precipitated Salts

Samples of sediments and precipitated salts within the Pond were collected on July 13, 2017 for Toxicity Characteristic Leaching Procedure (TCLP) analysis. Samples were collected as composite samples consisting of multiple grab samples from random locations. A composite salt and a composite sediment sample were collected from both the north half and the south half of the Pond, for a total of four samples. Sample locations are shown in Figure 1. A summary of samples collected are shown in Table 1.

ANALYSIS

The Pond soil samples were analyzed for moisture content, general chemistry, metals, petroleum products, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) as shown in Table 2. The Pond sediment and salt samples were analyzed for general chemistry, TCLP metals, metals, petroleum products, VOCs, and SVOCs as shown in Table 3. The VOC analyses were limited to the more common compounds and the SVOCs were limited to acid compounds (phenols).

ANALYTICAL RESULTS

Laboratory analysis was performed by ECS Lab Sciences in Mt. Juliet, Tennessee for Pond sediment and salt samples collected on July 13, 2017, and by ALS Environmental in Holland, Michigan for the soil samples. WWL conducted a Tier 1 data validation quality control evaluation of the received analytical laboratory data report. The analytical methods used are considered valid and provide quality results. The full laboratory analytical reports are presented in Attachment A. Table 4 shows a summary of the analytical results for soil samples and Table 5 shows a summary of the Pond sediment and salt TCLP results.

Summary statistics (count, minimum, maximum, and average) were calculated for sediment and precipitated salts within the Pond, the background soil samples, and the subliner soil samples (see Table 5 and Table 6). The statistics show a higher average result in the subliner soil samples than the background soil samples for chloride, sodium, nitrate, and SAR; chloride is greater than approximately 5 times, soluble sodium greater than approximately 2 times, nitrate greater than approximately 2-3 times, and SAR greater than approximately 2 times. There was a lower average result in the subliner soil samples than the background soil samples for ammonia, arsenic, and selenium; ammonia was approximately 2 times less than the background average, arsenic was approximately 2-4 times lower, and selenium was approximately 5 times lower.

Table 6 shows a summary statistics for moisture content in all soil groups. The moisture content measurements for the background, dry subliner, and flooded subliner soil samples ranged from 8 to 19%, 9.6 to 21%, and 7.4 to 15%, respectively. The average moisture content for the background, dry subliner, and flooded subliner soils samples was 12.6, 15.6, and 10.5%, respectively. Soil samples collected in the flooded portions of the liner exhibited average moisture content lower than the dry liner sampling locations and the background samples. There was no apparent correlation of moisture content with soil sample location or depth. Field observations indicated soils to be slightly moist to dry in appearance.

Also of interest in Table 6 is soil salinity. Soil salinity concentrations for the background, dry subliner, and flooded subliner soil samples ranged from 3,300 to 9,800 mg/kg, 3,000 to 13,000 mg/kg, and 2,900 to 23,000 mg/kg, respectively. The average salinity concentration for the background, dry subliner, and flooded subliner soils samples was 6,083, 5,580, and 6,983 mg/kg, respectively. Soil samples collected in the flooded portions of the liner exhibited an average salinity concentration slightly higher than the dry liner sampling locations and the background samples. However, the range in salinity between soil sample groups is not considered unusual and there was no apparent correlation of salinity with soil sample location or depth. Field observations indicated the common presence of crystalline selenite ($CaSO_4$) within the soil/weathered rock matrix; no salt mineralization indicative of a liner leak was observed.

The common cation concentrations in the sampled soils reflect ratios commonly observed in natural soils and groundwater. In general, calcium, magnesium, sodium, and potassium are present in descending concentrations as just listed. A similar trend is observed in anion concentrations of sulfate, chloride, nitrate, and fluoride, also in descending concentrations. A comparison of common ion minimum and maximum concentrations in the subliner soils to the Pond salt and sediment samples shows that calcium is 9.5 to 159 times greater; magnesium 3.59 times less to 7.3 times greater, potassium is 37 to 72 times greater, and sodium is 19 to 171 times greater in the salt and sediments.

Toluene was detected in sample LW-NEB1 (background sample) at 46 µg/l at the 5.0 to 7.0 foot depth and J-qualified detected at 33 µg/l at the 8.0 to 10.0 foot depth. M, p-xylene was J-qualified detected at 30 µg/l in sample LW-NW2 8.0-9.0 ft. These detections may be related to sampling or laboratory contamination, and don't exceed the state groundwater protection levels for soil of 50 mg/Kg for toluene and 75 mg/Kg for total xylenes (CDPHE 2011).

The TCLP analysis from the precipitated salt north and south samples collected within the Pond resulted in detectable levels of barium at 0.13 mg/L and 0.189 mg/L, respectively. The TCLP analysis from the sediment north and south samples collected within the Pond resulted in detectable levels of arsenic (0.352 mg/L, 0.504 mg/L, respectively) and barium (0.537 mg/L, 0.499 mg/L, respectively). These analyses were below the regulatory level of maximum concentration of contaminants for toxicity characteristic as outlined by the EPA (40 CFR, Part 268).

There were also detections in the precipitated salt north, and south, and sediment north, and south samples for oil and grease (149 mg/kg, 155 mg/kg, 359 mg/kg, and 505 mg/kg, respectively), TPH – high fraction (1.44 mg/kg, 1.7 mg/kg, 20.3 mg/kg, and 53.9 mg/kg, respectively), and TPH – low fraction (0.050 mg/kg, 0.043 mg/kg, 0.184 mg/kg, and 0.159 mg/kg, respectively). The Colorado Department of Public Health and the Environment (CDPHE) suggests that TPH (GRO plus DRO) in soils should be below the Risk Based Screening Levels (RBSLs) developed by the Division of Oil and Public Safety (OPS) of 500 mg/kg. TPH concentrations did not exceed this standard for the collected samples. There were no other detections from the TCLP analyses of volatiles or semi-volatiles. In addition, based on the ignitability and corrosivity as pH tests, the soils/salts would not be classified as hazardous.

CONCLUSIONS AND RECOMMENDATIONS

The soil samples collected and analyzed at the Logan Wash Mine Evaporation Pond included 6 background samples at 2 depths at 3 locations, and 15 subliner samples at 2 depths at 8 locations. The samples were analyzed for moisture content, general chemistry, metals, petroleum products, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) as shown in Table 2. Two samples of Pond salt precipitate and sediments were also collected and analyzed for general chemistry, TCLP metals, metals, petroleum products, VOCs, and SVOCs as shown in Table 3.

The analytical results for the subliner soil samples do not indicate an increase in moisture content compared to background samples, nor do the results demonstrate evidence of soil contamination from Pond fluids. It is recommended that OOSI proceed with the inspection and remediation of the north and south leak detection pipes beneath the Pond as requested by the BLM, and also proceed with plans to reline the Pond in 2018.

If you have any questions or concerns, please contact me at (970) 242-0170.

Sincerely,

Bruce D. Smith
Principal Hydrogeologist
WESTERN WATER & LAND, INC.

Figure 1 – Sampling Locations Map
Tables
Attachment A – Laboratory Reports

References

CDPHE. 2011. Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division. Table 1. Colorado Soil Evaluation Values (CSEV Table) – July 2011. <http://www.s2scientific.com/images/CDPHE%20Soil%20Evaluation%20Values%202011.pdf>