

 **FREEPORT-McMoRAN**  
Freeport-McMoRan Chino Mines Company  
P.O. Box 10  
Bayard, NM 88023

March 20, 2025

**Certified Mail # 70190140000026681294**

Mr. Kevin Barnes  
Energy, Minerals and Natural Resources Department (EMNRD)  
Mining and Minerals Division (MMD)  
1220 South St. Francis Drive  
Santa Fe, New Mexico 87505

Dear Mr. Barnes:

**Re: Freeport-McMoRan Chino Mines Company, Lampbright Far East Sump  
Upgrade Project, Mining Act Permit GR009RE**

Freeport-McMoRan Chino Mines Company (Chino) submits the plan for the upgrades to the Lampbright Far East Sump (LFES). This upgrade was included in the 2024 Closure Closeout Plan. However, the detailed plan and comprehensive description of the project is attached for your review.

The attached documentation includes the following:

- Professional Engineered Construction plans
- Construction Specifications
- Description of the Project
- Estimated Timeline of Construction

Chino formally requests an amendment to the Closure Closeout Plan (CCP) to incorporate the detailed plans and specifications of the Lampbright Far East Sump Project, as referenced in section 9.2.3 of the CCP.

Given the time-sensitive nature of this project, we are requesting conditional approval to commence construction. Due to its historical significance, age, and current operational importance as a PLS and stormwater management collection system, the enclosed design outlines plans for the modification and upgrade of the current system of the (LFES) that will ensure optimal functionality and containment in the future.

The anticipated start date for the project is April 28, 2025. Attached to this letter is a sample timeline for the construction phase. Chino estimates that the construction will require one year to complete. The estimated new disturbance will not exceed 25 acres. The reclamation costs for this disturbance are included in the Chino CCP under the miscellaneous area and the financial assurance for the North Mine Area. We remain within the 72-acre disturbance threshold. We appreciate your attention to this matter. If you have any questions or concerns related to this project, please contact me at 575-694-0013 or Mariana Lafon at (575) 912-5234.

Sincerely,

  
Tyler R. Johnson, Chief Engineer  
Environmental Services

TRJ:ml  
Enclosures  
20250318-002

# Professional Engineered Construction Plans

# LAMPBRIGHT FAR EAST SUMP (LFES)

## PLS COLLECTION SYSTEM, STORMWATER POND AND MSE WALLS

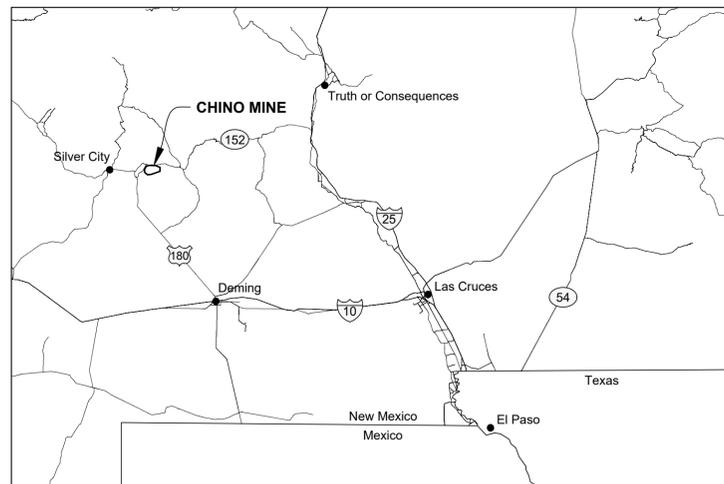
TOWNSHIP 17 SOUTH, RANGE 11 & 12 WEST, 6TH P.M.  
 TOWNSHIP 18 SOUTH, RANGE 11 WEST, 6TH P.M.  
 CHINO MINE, NEW MEXICO

**PHASING PLAN**

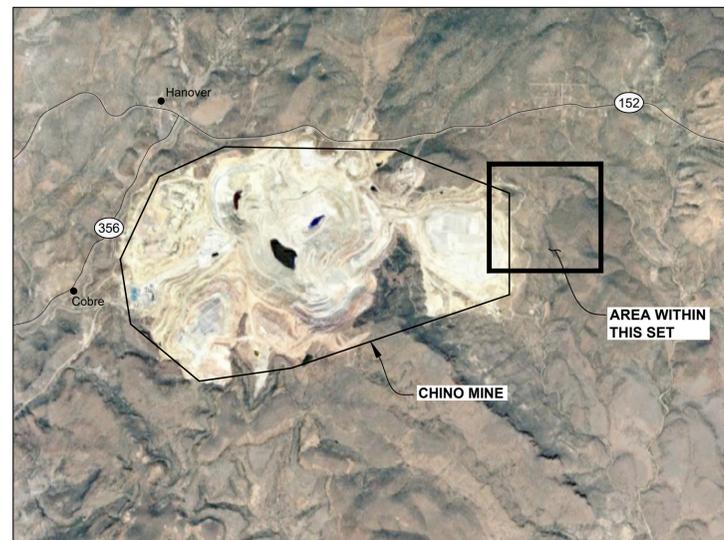
- Phase 1: - For Collection of proposed 10,000 gpm PLS flow from LFES and Stormwater Capture
- MSE Wall
  - PLS Toe Drain To The LFES PLS Collection Tank
  - LFES PLS Tank
  - One PLS Gravity Line from the LFES PLS Tank to Stainless Steel Tank at Res. 8
  - Infiltration Pond
  - Pipeline from Infiltration Pond to LFES Stormwater Pond
  - LFES Stormwater Pond
  - Gravity Pipeline from LFES Stormwater Pond to Res. 8

- Phase 2: - For Collection of proposed 10,000 gpm PLS flow from proposed North Lampbright Expansion and pumping of:
- PLS Pumps from New LFES PLS Tank to Flemming Pond 2
  - Pump line from LFES PLS Tank to Flemming Pond 2
  - Second PLS gravity pipeline from the LFES PLS Tank to Stainless Steel Tank at Res. 8
  - Pump line from Stormwater Vault to Stormwater Tank above LFES area
  - Sediment removal system

VICINTY MAP



LOCATION MAP



**SHEET INDEX**

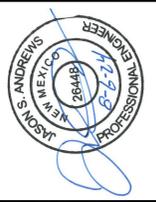
- G-1 COVER
- C-1 SITE PLAN
- C-2 TEST PIT LOCATIONS AND GROUNDWATER SURFACE CONTOURS
- C-3 PROPOSED SITE PLAN
- C-4 MAIN LAMPBRIGHT LEACH STOCKPILE TOE DRAIN PLAN AND PROFILE
- C-5 INFILTRATION POND TO LFES STORMWATER POND PIPE PLAN AND PROFILE
- C-6a LFES PLS LINE TO RESERVOIR 8 TANK PLAN
- C-6b LFES PLS LINE TO RESERVOIR 8 TANK PROFILE
- C-7a LFES STORMWATER POND GRAVITY PIPE TO RESERVOIR 8 PLAN
- C-7b LFES STORMWATER POND GRAVITY PIPE TO RESERVOIR 8 PROFILE
- C-8a NON-CONTACT DIVERSION CHANNEL #1 PLAN AND PROFILE
- C-8b NON-CONTACT DIVERSION CHANNEL #2 AND EMERGENCY SPILLWAY PLAN AND PROFILE
- C-9 LFES STORMWATER POND PLAN AND SECTIONS
- C-10 LFES PLS TANK GRADING PLAN AND SECTIONS
- C-11 RETAINING WALL AND CHANNEL PLAN AND PROFILE
- C-12 RETAINING WALL AND CHANNEL CROSS SECTIONS
- C-13 VAULT TO EXISTING LAMPBRIGHT STORMWATER BOOSTER TANK PLAN AND PROFILE
- C-14a PIPE TO PUMP LFES PLS DISCHARGE TO FLEMMING POND 2 PLAN
- C-14b PIPE TO PUMP LFES PLS DISCHARGE TO FLEMMING POND 2 PROFILE
- D-1 VAULT DETAILS
- D-2 LINER DETAILS
- D-3 DETAILS
- S-1 HILFIKER WALL DETAILS
- S-2 HILFIKER WALL CONSTRUCTION SEQUENCE
- M-1 P & ID
- M-2 TANK PIPING DETAILS
- M-3 TANK PIPING DETAILS
- M-4 TANK PUMP PAD
- M-5 PIPING DETAILS

**REVISIONS**

Revision	Date	Description
0	7/15/2024	FOR CLIENT REVIEW
1	7/30/2024	FOR AGENCY APPROVAL

Designed by: **EA** Engineering Analytics, Inc.  
 1500 Sycamore Point Road, Suite 209  
 El Paso, TX 79905  
 (970) 485-1111

Designed by: DBS  
 Approved by: JSA



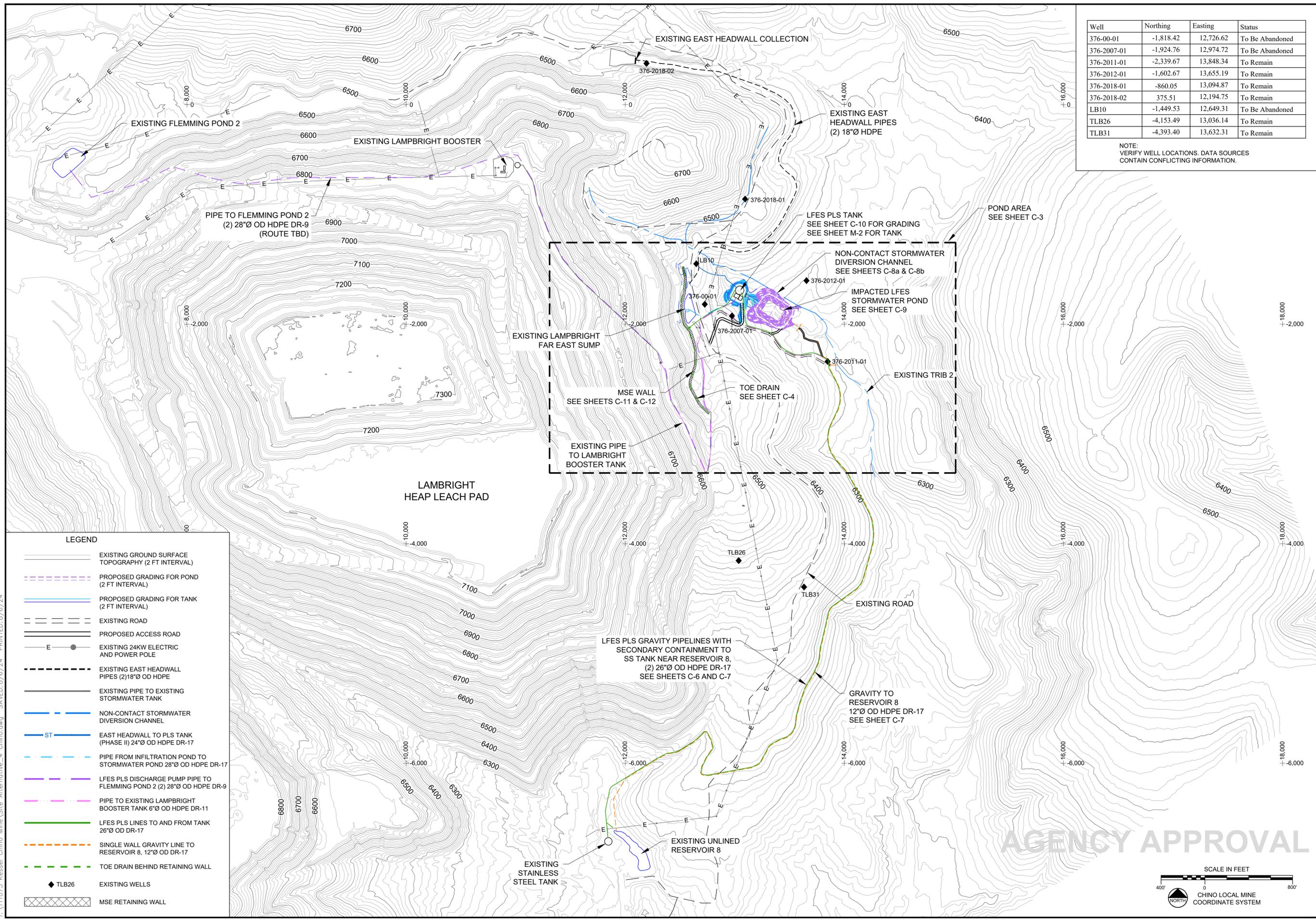
**LAMPBRIGHT  
 FAR EAST SUMP (LFES)  
 PLS COLLECTION SYSTEM,  
 STORMWATER POND  
 AND MSE WALLS**

**COVER**

Project Number: 111073  
 Date: July 30, 2024  
 Sheet: **G-1**

AGENCY APPROVAL

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Well	Northing	Easting	Status
376-00-01	-1,818.42	12,726.62	To Be Abandoned
376-2007-01	-1,924.76	12,974.72	To Be Abandoned
376-2011-01	-2,339.67	13,848.34	To Remain
376-2012-01	-1,602.67	13,655.19	To Remain
376-2018-01	-860.05	13,094.87	To Remain
376-2018-02	375.51	12,194.75	To Remain
LB10	-1,449.53	12,649.31	To Be Abandoned
TLB26	-4,153.49	13,036.14	To Remain
TLB31	-4,393.40	13,632.31	To Remain

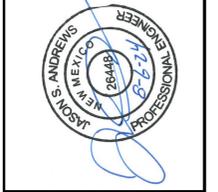
NOTE:  
VERIFY WELL LOCATIONS, DATA SOURCES  
CONTAIN CONFLICTING INFORMATION.

LEGEND	
	EXISTING GROUND SURFACE TOPOGRAPHY (2 FT INTERVAL)
	PROPOSED GRADING FOR POND (2 FT INTERVAL)
	PROPOSED GRADING FOR TANK (2 FT INTERVAL)
	EXISTING ROAD
	PROPOSED ACCESS ROAD
	EXISTING 24KW ELECTRIC AND POWER POLE
	EXISTING EAST HEADWALL PIPES (2) 18" OD HDPE
	EXISTING PIPE TO EXISTING STORMWATER TANK
	NON-CONTACT STORMWATER DIVERSION CHANNEL
	EAST HEADWALL TO PLS TANK (PHASE II) 24" OD HDPE DR-17
	PIPE FROM INFILTRATION POND TO STORMWATER POND 28" OD HDPE DR-17
	LFES PLS DISCHARGE PUMP PIPE TO FLEMING POND 2 (2) 28" OD HDPE DR-9
	PIPE TO EXISTING LAMPBRIGHT BOOSTER TANK 6" OD HDPE DR-11
	LFES PLS LINES TO AND FROM TANK 26" OD DR-17
	SINGLE WALL GRAVITY LINE TO RESERVOIR 8, 12" OD DR-17
	TOE DRAIN BEHIND RETAINING WALL
	EXISTING WELLS
	MSE RETAINING WALL

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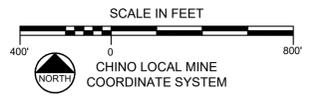
Designed by:  
Engineering Analytics, Inc.  
1600 Specter Point Road, Suite 209  
97104-8831-111



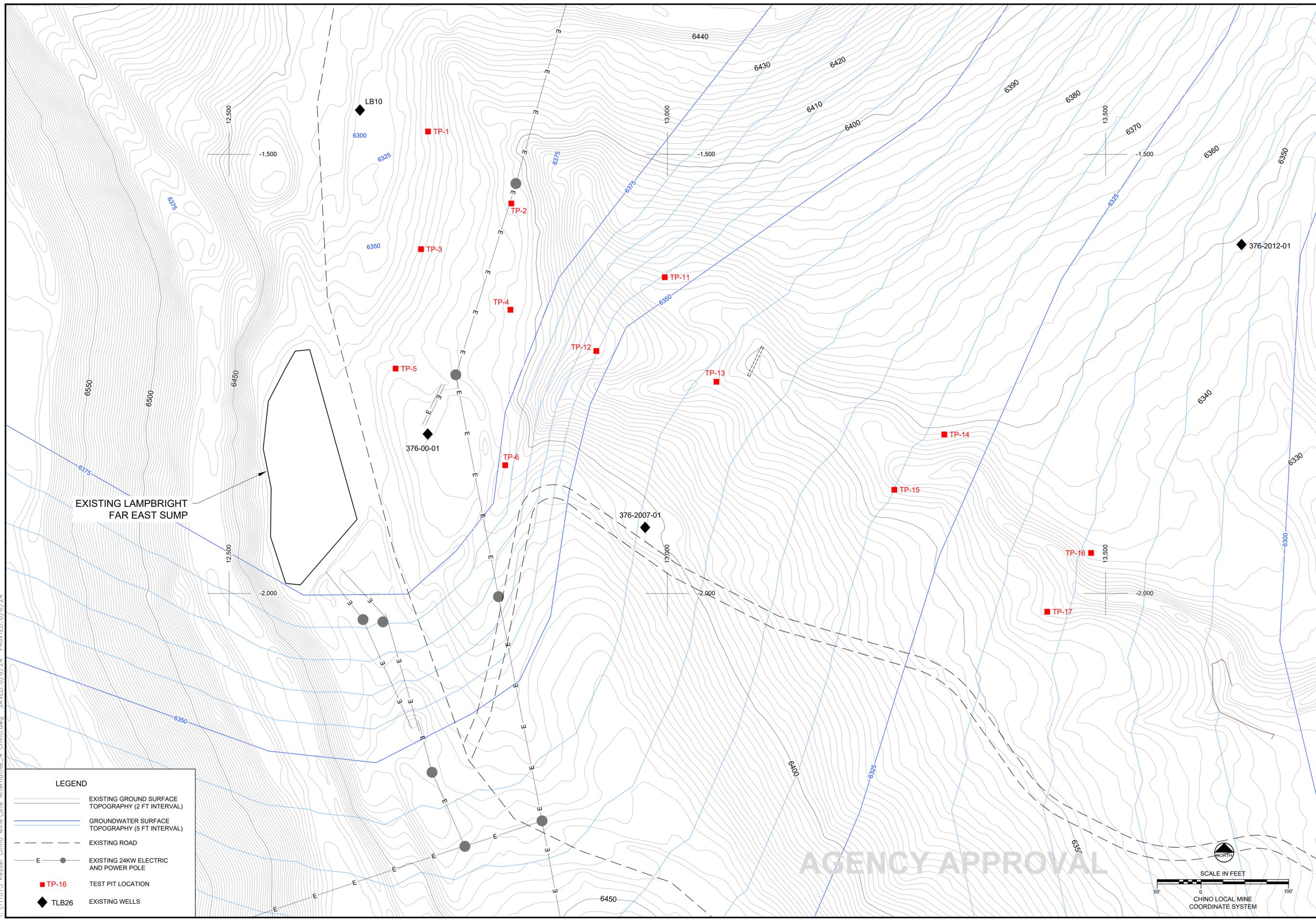
**LAMPBRIGHT FAR EAST SUMP (LFES) PLS COLLECTION SYSTEM, STORMWATER POND AND MSE WALLS**

<b>SITE PLAN</b>	
Project Number:	111073
Date:	July 30, 2024
Sheet:	C-1

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LEGEND	
	EXISTING GROUND SURFACE TOPOGRAPHY (2 FT INTERVAL)
	GROUNDWATER SURFACE TOPOGRAPHY (5 FT INTERVAL)
	EXISTING ROAD
	EXISTING 24KW ELECTRIC AND POWER POLE
	TEST PIT LOCATION
	EXISTING WELLS

**TEST PIT LOCATIONS AND GROUNDWATER SURFACE CONTOURS**

**LAMPBRIGHT FAR EAST SUMP (LFES) PLS COLLECTION SYSTEM, STORMWATER POND AND MSE WALLS**

**AGENCY APPROVAL**

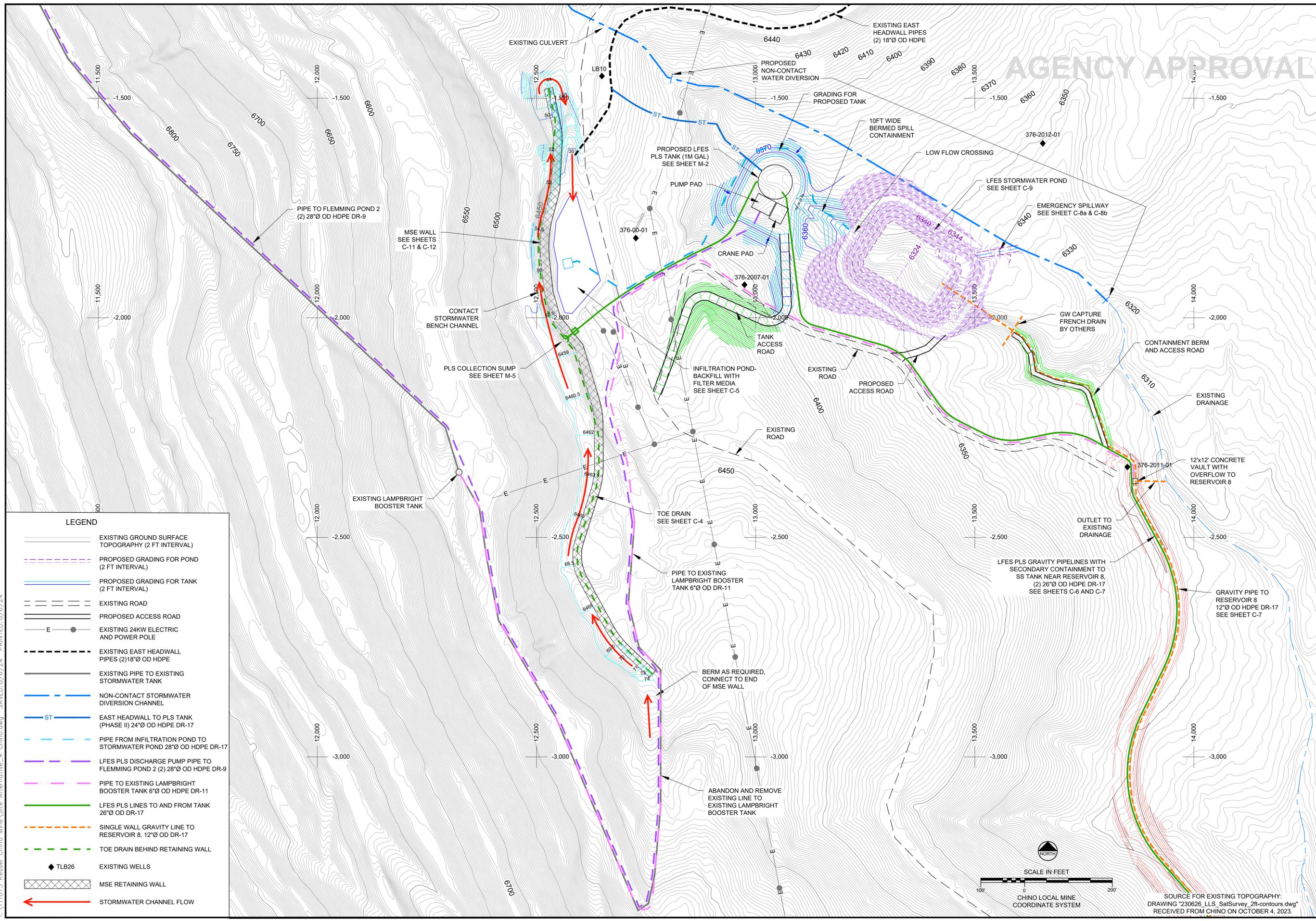
Project Number: 111073  
 Date: July 30, 2024  
 Sheet: C-2

REVISIONS	
Revision	Description
0	FOR CLIENT REVIEW
1	FOR AGENCY APPROVAL

Designed by: Engineering Analytics, Inc.  
 1500 Sycamore Point Road, Suite 209  
 Irvine, CA 92614  
 (949) 453-1111

Designed by: DBS  
 Approved by: JSA

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**LEGEND**

- EXISTING GROUND SURFACE TOPOGRAPHY (2 FT INTERVAL)
- PROPOSED GRADING FOR POND (2 FT INTERVAL)
- PROPOSED GRADING FOR TANK (2 FT INTERVAL)
- EXISTING ROAD
- PROPOSED ACCESS ROAD
- EXISTING 24KW ELECTRIC AND POWER POLE
- EXISTING EAST HEADWALL PIPES (2) 18" Ø OD HDPE
- EXISTING PIPE TO EXISTING STORMWATER TANK
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- EAST HEADWALL TO PLS TANK (PHASE II) 24" Ø OD HDPE DR-17
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- LFES PLS DISCHARGE PUMP PIPE TO FLEMMING POND 2 (2) 28" Ø OD HDPE DR-9
- PIPE TO EXISTING LAMPBRIGHT BOOSTER TANK 6" Ø OD HDPE DR-11
- LFES PLS LINES TO AND FROM TANK 26" Ø OD DR-17
- SINGLE WALL GRAVITY LINE TO RESERVOIR 8, 12" Ø OD DR-17
- TOE DRAIN BEHIND RETAINING WALL
- EXISTING WELLS
- MSE RETAINING WALL
- STORMWATER CHANNEL FLOW

REVISIONS	
Revision	Description
0	FOR CLIENT REVIEW
1	FOR AGENCY APPROVAL

Designed by:  1500 Specter Point Road, Suite 209 970 488-5111	Designed by: DBS Approved by: JSA
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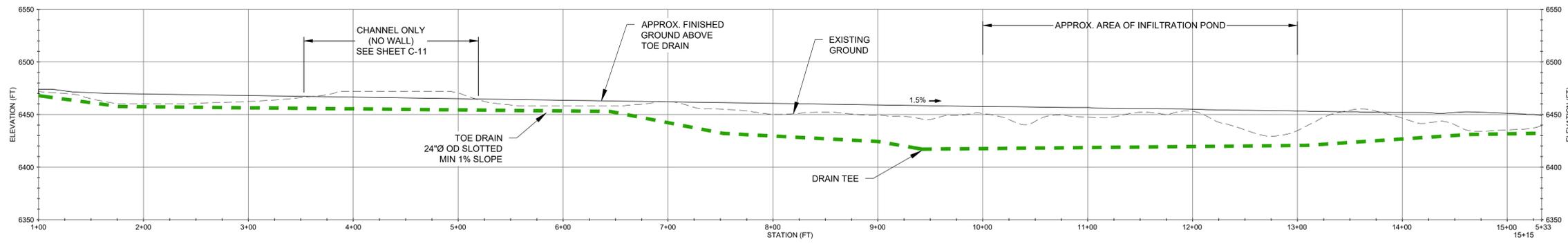
  

**LAMPBRIGHT FAR EAST SUMP (LFES) PLS COLLECTION SYSTEM, STORMWATER POND AND MSE WALLS**

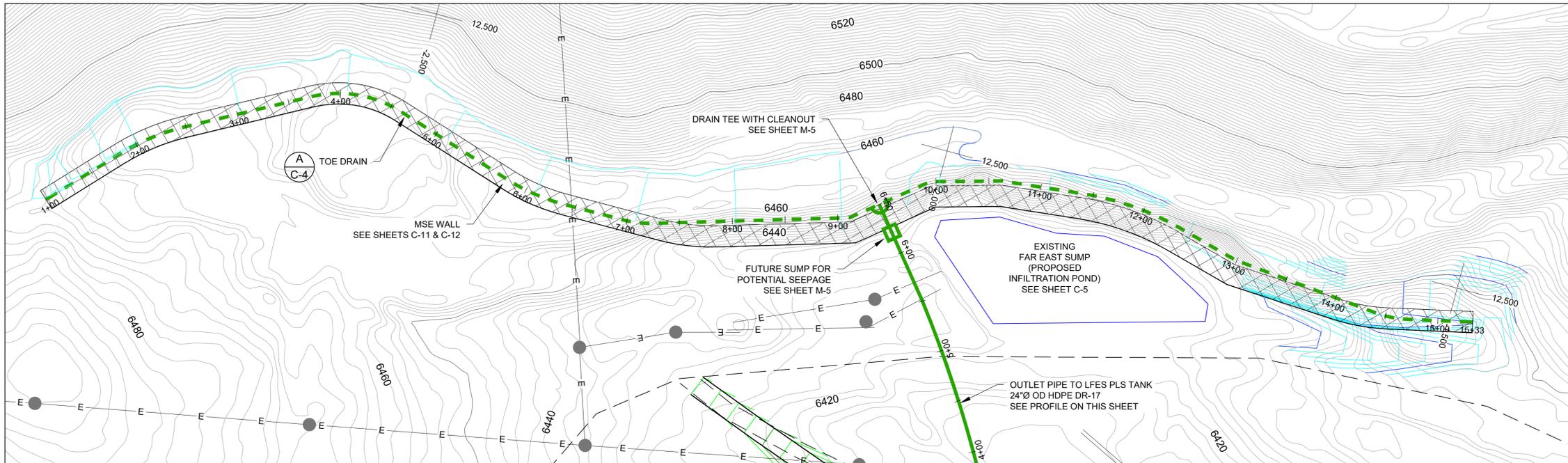
**PROPOSED SITE PLAN**

Project Number:	111073
Date:	July 30, 2024
Sheet:	<b>C-3</b>

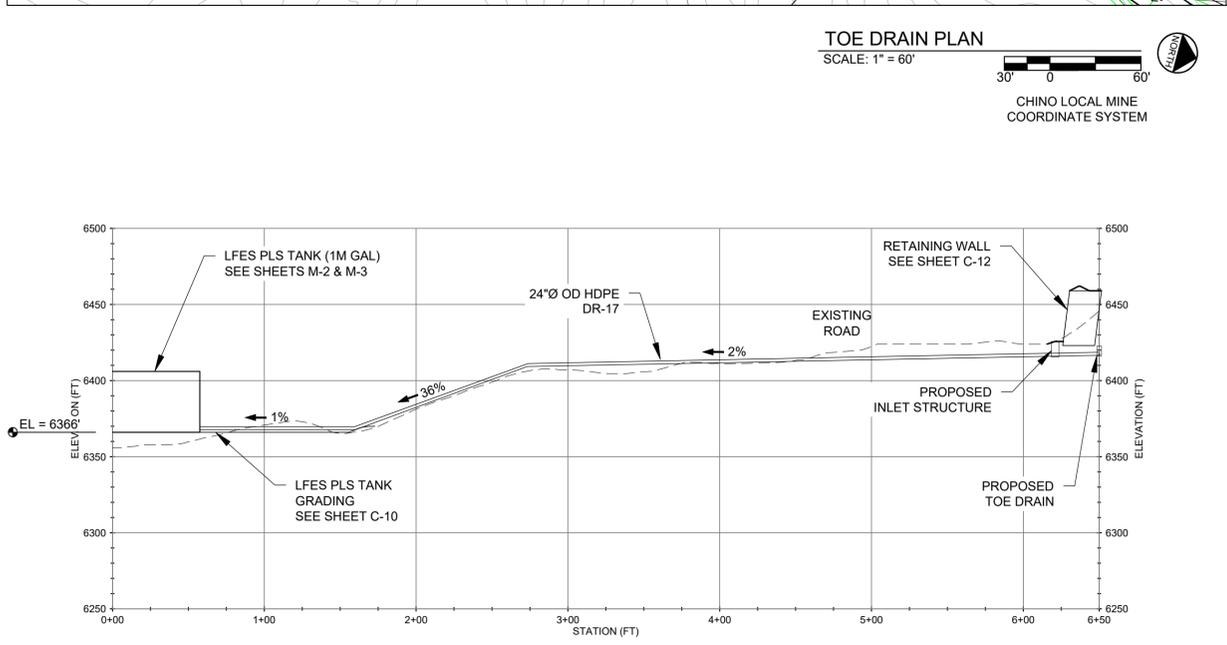
SCALE IN FEET  
 CHINO LOCAL MINE COORDINATE SYSTEM  
 SOURCE FOR EXISTING TOPOGRAPHY: DRAWING "230626\_LLS\_SatSurvey\_2ft-contours.dwg" RECEIVED FROM CHINO ON OCTOBER 4, 2023.



**TOE DRAIN PROFILE**  
SCALE: 1" = 60'

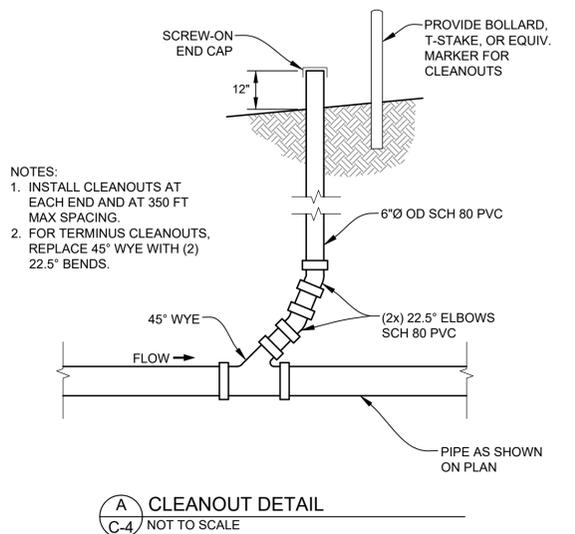


**TOE DRAIN PLAN**  
SCALE: 1" = 60'



**LFES PLS TANK TO TOE DRAIN PROFILE**  
SCALE: 1" = 60'

REQUIRED GRADATION FOR #9 ASTM C33 GRAVEL			
SIZE	(mm)	PERCENT PASSING	+/- (%)
3/8-INCH	9.53	100.00	-
NO. 4	4.75	87.50	2.5
NO. 8	2.36	37.50	2.5
NO. 16	1.18	7.50	2.5
NO. 50	0.3	2.50	2.5
NO. 100	0.15	0.00	2.5
NO. 200	0.075	0.00	2.5

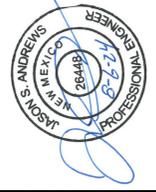


- NOTES:
- INSTALL CLEANOUTS AT EACH END AND AT 350 FT MAX SPACING.
  - FOR TERMINUS CLEANOUTS, REPLACE 45° WYE WITH (2) 22.5° BENDS.

REVISIONS		
Revision	Date	Description
0	7/15/2024	FOR CLIENT REVIEW
1	7/30/2024	FOR AGENCY APPROVAL

Designed by: **Engineering Analytics, Inc.**  
1500 Special Point Road, Suite 209  
9700 688-3111

Designed by: **DBS**  
Approved by: **JSA**

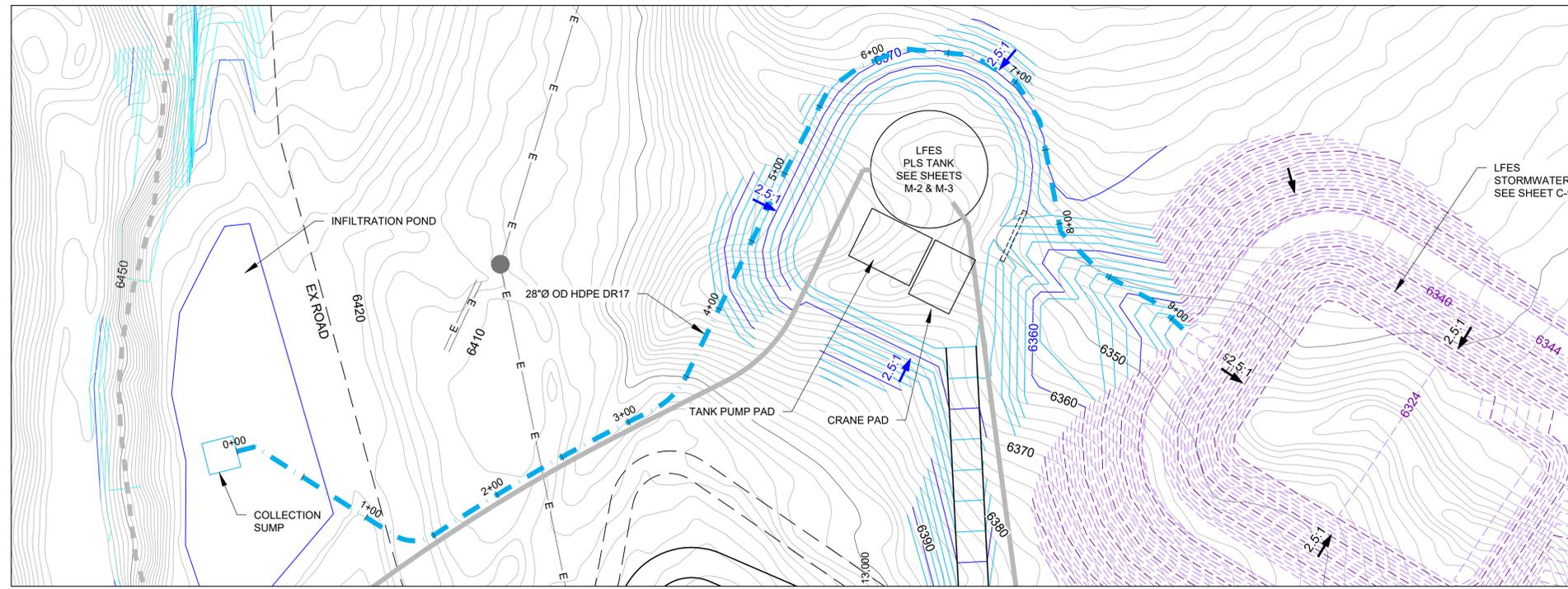


**LAMPBRIGHT  
FAR EAST SUMP (LFES)  
PLS COLLECTION SYSTEM,  
STORMWATER POND  
AND MSE WALLS**

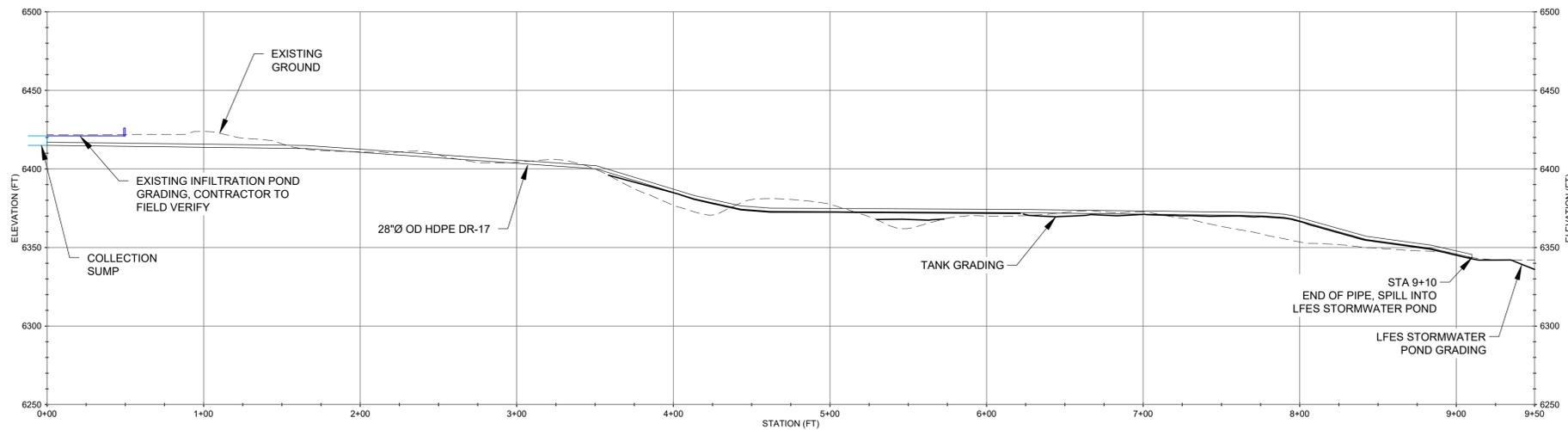
**MAIN LAMPBRIGHT  
LEACH STOCKPILE  
TOE DRAIN  
PLAN AND PROFILE**

Project Number: 111073  
Date: July 30, 2024  
Sheet: **C-4**

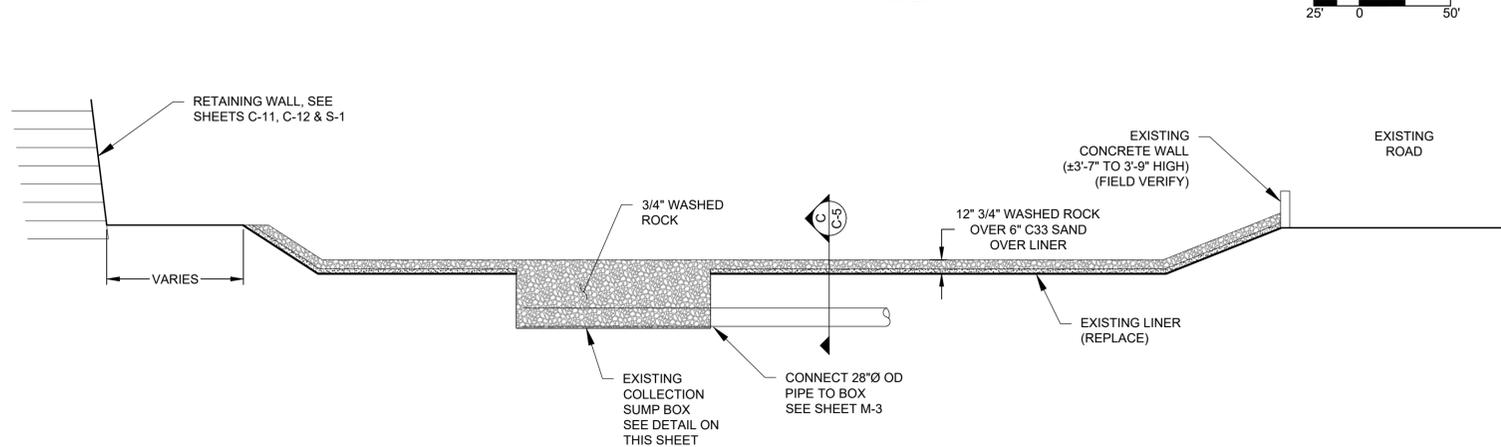
**AGENCY APPROVAL**



**INFILTRATION POND TO LFES STORMWATER POND PLAN**  
 SCALE: 1" = 50'

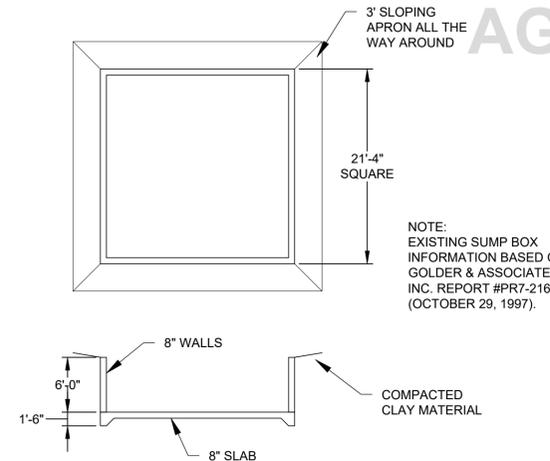


**INFILTRATION POND TO LFES STORMWATER POND PROFILE**  
 SCALE: 1" = 50'

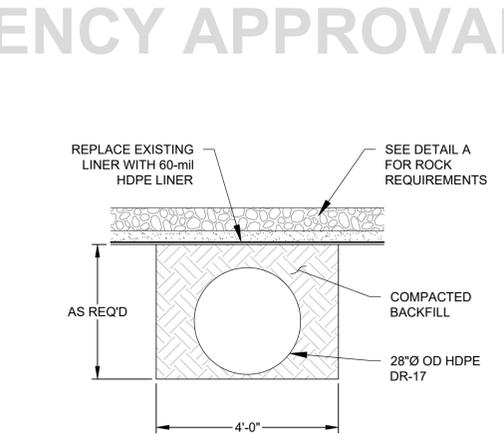


**(A) TYPICAL INFILTRATION POND SECTION**  
 SCALE: 1" = 10'

NOTES:  
 1. EXISTING CONFIGURATION IS BASED ON HISTORICAL PHOTOGRAPHS. CONTRACTOR TO FIELD VERIFY.  
 2. REPLACE ENTIRE LINER.



**(B) EXISTING SUMP BOX**  
 SCALE: 1" = 10'



**(C) PIPE TRENCH DETAIL**  
 SCALE: 1/2" = 1'-0"

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 970 488-5111

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 Approved by: JSA



**LAMPBRIGHT  
 FAR EAST SUMP (LFES)  
 PLS COLLECTION SYSTEM,  
 STORMWATER POND  
 AND MSE WALLS**

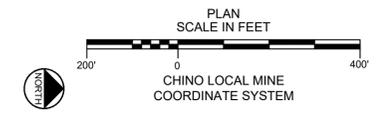
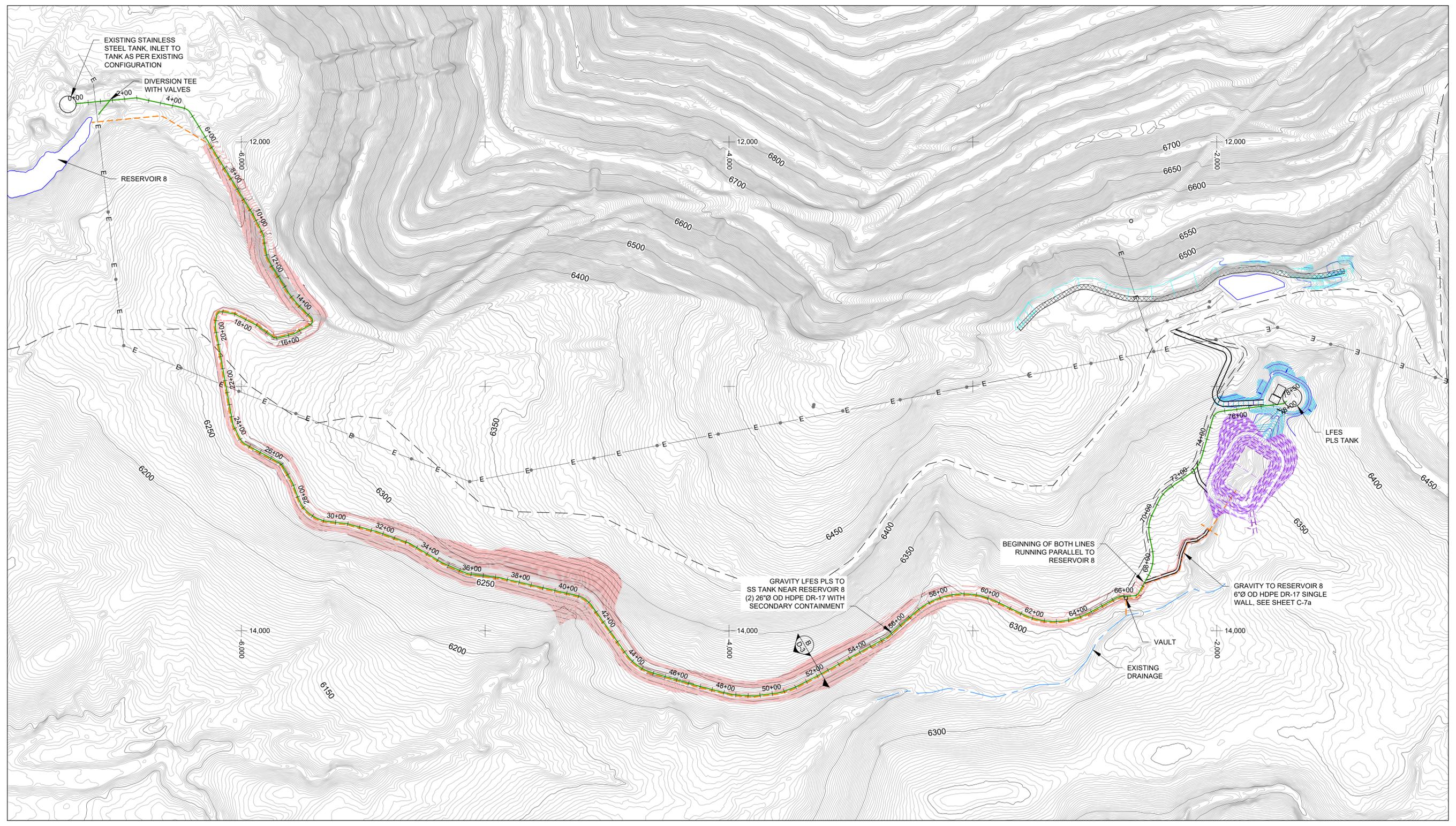
**INFILTRATION  
 POND TO LFES  
 STORMWATER POND  
 PIPE PLAN  
 AND PROFILE**

Project Number: 111073  
 Date: July 30, 2024  
 Sheet: C-5

AGENCY APPROVAL

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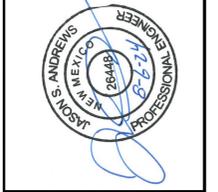
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**Engineering Analytics, Inc.**  
 1500 Sycamore Point Road, Suite 209  
 970 988-5111

Designed by: DBS  
 Approved by: JSA



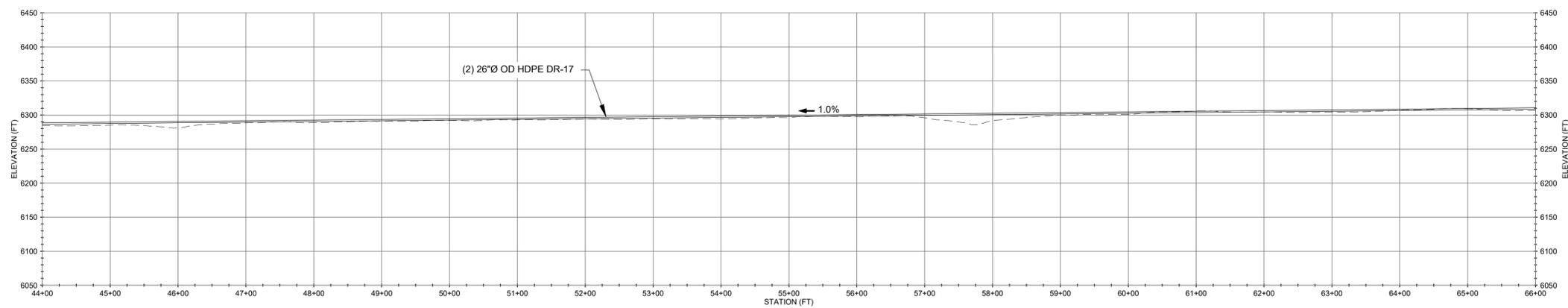
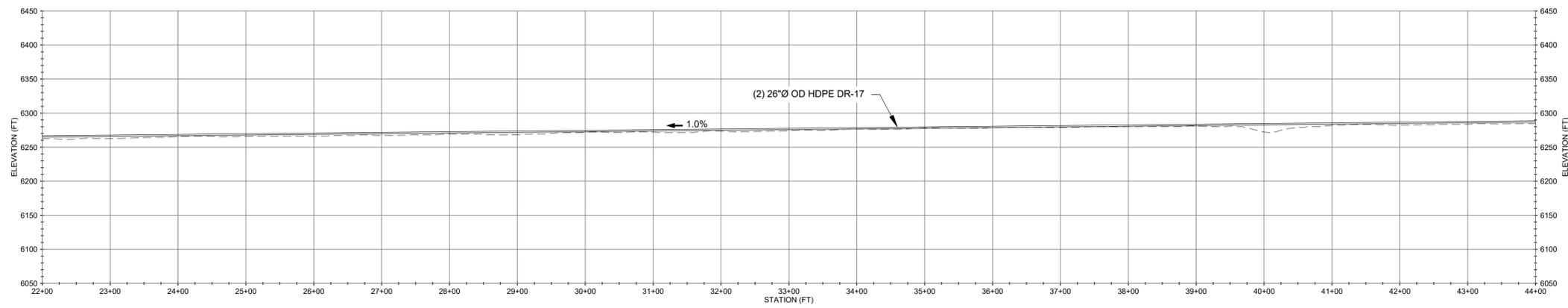
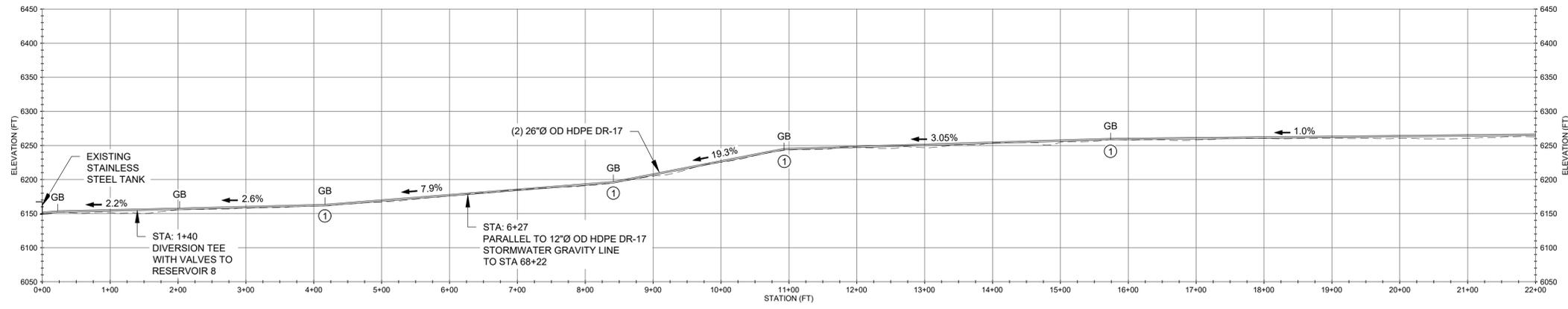
**LAMPBRIGHT  
 FAR EAST SUMP (LFES)  
 PLS COLLECTION SYSTEM,  
 STORMWATER POND  
 AND MSE WALLS**

**LFES PLS LINE TO  
 RESERVOIR 8 TANK  
 PLAN**

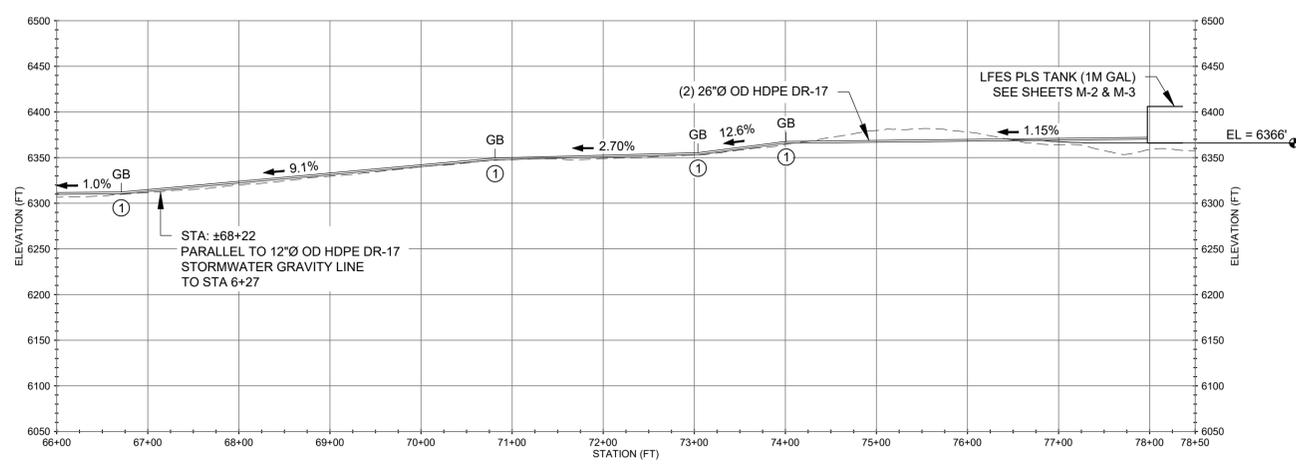
Project Number: 111073  
 Date: July 30, 2024  
 Sheet: C-6a

**AGENCY APPROVAL**

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NOTE:  
① INSTALL AIR-VAC VALVE PER DETAIL XX.XX



RESERVOIR 8 TANK TO LFES PLS TANK PROFILE



**REVISIONS**

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Engineering Analytics, Inc.  
1500 Spectrum Point Road, Suite 209  
Fremont, CA 94531  
(970) 485-3111

Designed by: DBS  
Approved by: JSA



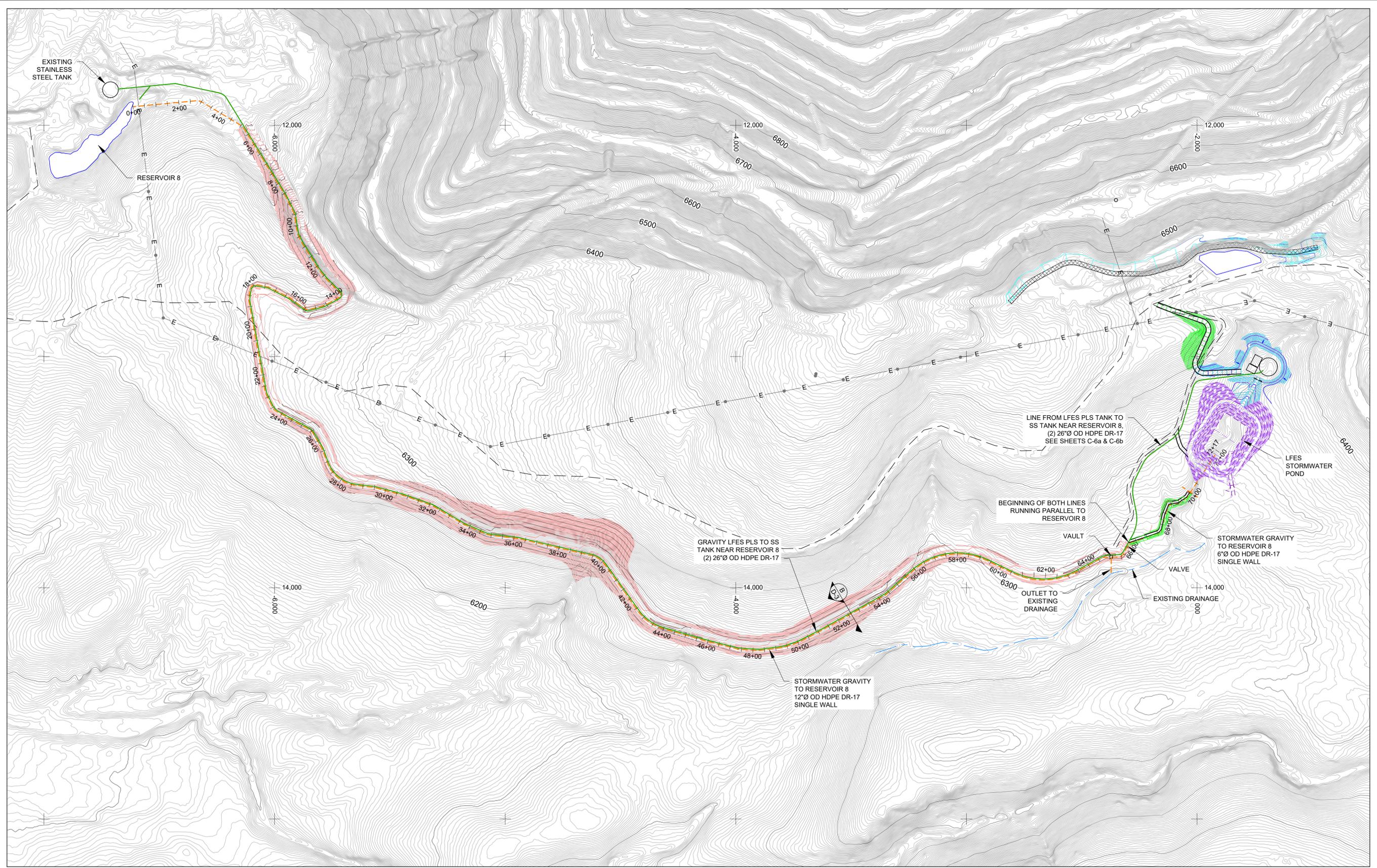
**LAMPBRIGHT  
FAR EAST SUMP (LFES)  
PLS COLLECTION SYSTEM,  
STORMWATER POND  
AND MSE WALLS**

**LFES PLS LINE TO  
RESERVOIR 8 TANK  
PROFILE**

Project Number: 111073  
Date: July 30, 2024  
Sheet: C-6b

AGENCY APPROVAL

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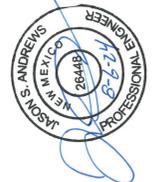
NOTE:  
SEE SHEET C-7b FOR PROFILE.

AGENCY APPROVAL

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Engineering Analytics, Inc.  
1500 Sycamore Point Road, Suite 209  
P.O. Box 1111  
97070-1111

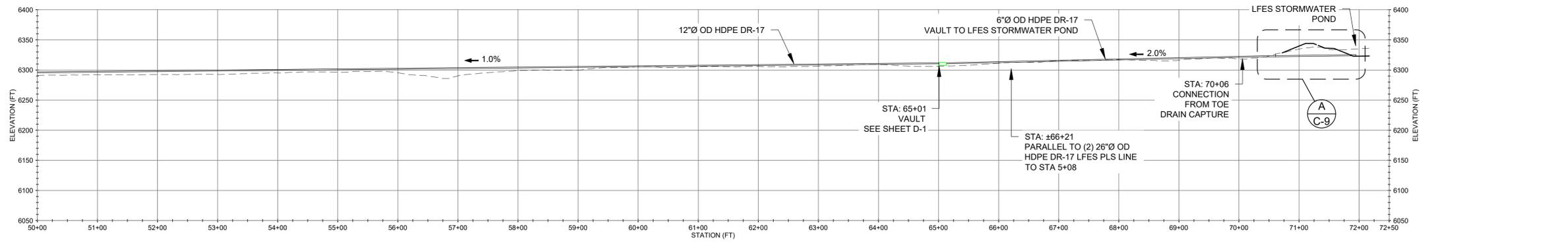
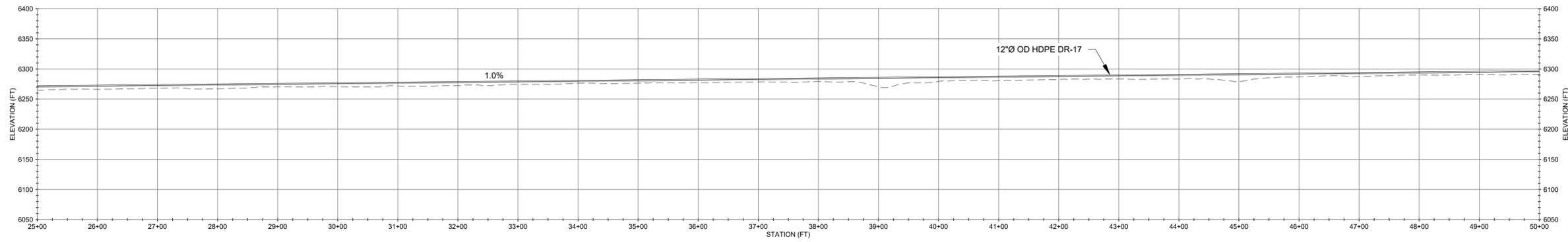
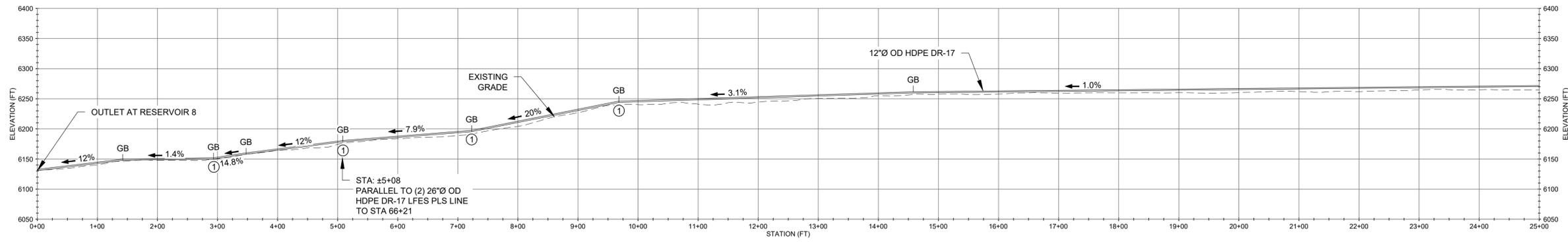
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**LAMPBRIGHT  
FAR EAST SUMP (LFES)  
PLS COLLECTION SYSTEM,  
STORMWATER POND  
AND MSE WALLS**

**LFES STORMWATER  
POND GRAVITY PIPE  
TO RESERVOIR 8  
PLAN**

Project Number: 111073  
Date: July 30, 2024  
Sheet: C-7a



RESERVOIR 8 TO LFES STORMWATER POND PROFILE



NOTE:  
 ① INSTALL AIR-VAC VALVE PER DETAIL XX.XX

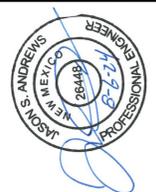
NOTE:  
 SEE SHEET C-7a FOR PLAN.

REVISIONS

Revision	Date	Description
0	7/15/2024	FOR CLIENT REVIEW
1	7/30/2024	FOR AGENCY APPROVAL

Designed by:  
 Engineering Analytics, Inc.  
 1500 Sycamore Point Road, Suite 209  
 970 688-5111

Designed by: DBS  
 Approved by: JSA

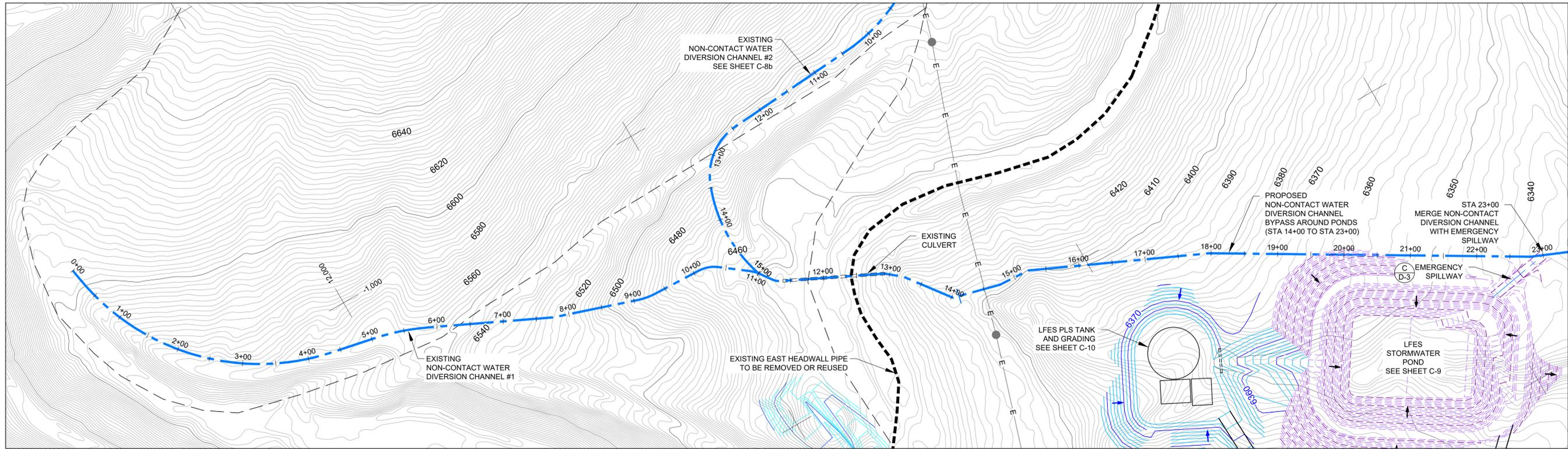


LAMPBRIGHT  
 FAR EAST SUMP (LFES)  
 PLS COLLECTION SYSTEM,  
 STORMWATER POND  
 AND MSE WALLS

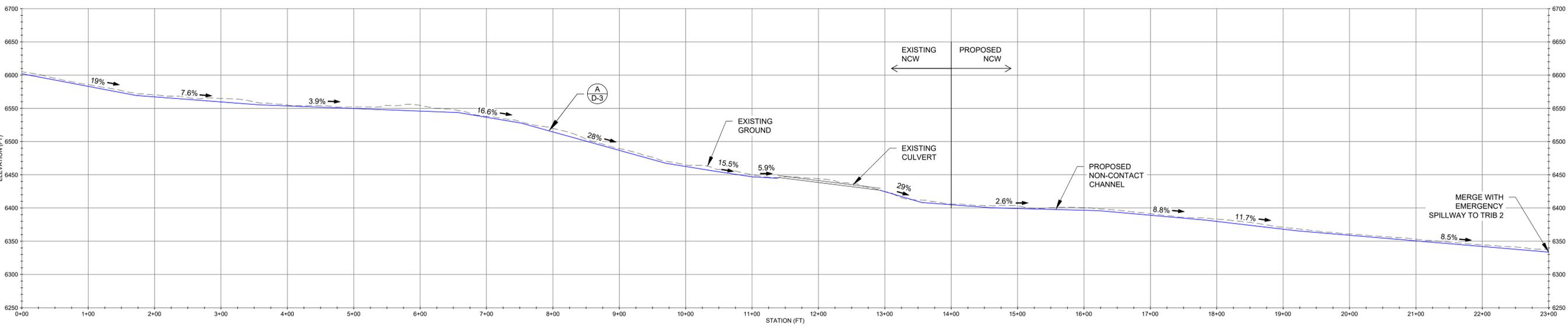
LFES STORMWATER  
 POND GRAVITY PIPE  
 TO RESERVOIR 8  
 PROFILE

Project Number: 111073  
 Date: July 30, 2024  
 Sheet: C-7b

AGENCY APPROVAL



**NON-CONTACT DIVERSION CHANNEL #1 PLAN**  
 SCALE: 1" = 80'  
 CHINO LOCAL MINE COORDINATE SYSTEM



**NON-CONTACT DIVERSION CHANNEL #1 PROFILE**  
 SCALE: 1" = 80'

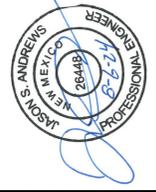
NOTE:  
 SEE SHEET D-3 FOR  
 CHANNEL DETAILS  
 AND SPECS.

**REVISIONS**

Revision	Date	Description
0	7/15/2024	FOR CLIENT REVIEW
1	7/30/2024	FOR AGENCY APPROVAL

Designed by: Engineering Analytics, Inc.  
 1500 Sycamore Point Road, Suite 209  
 9770 688-5111

Designed by: DBS  
 Approved by: JSA



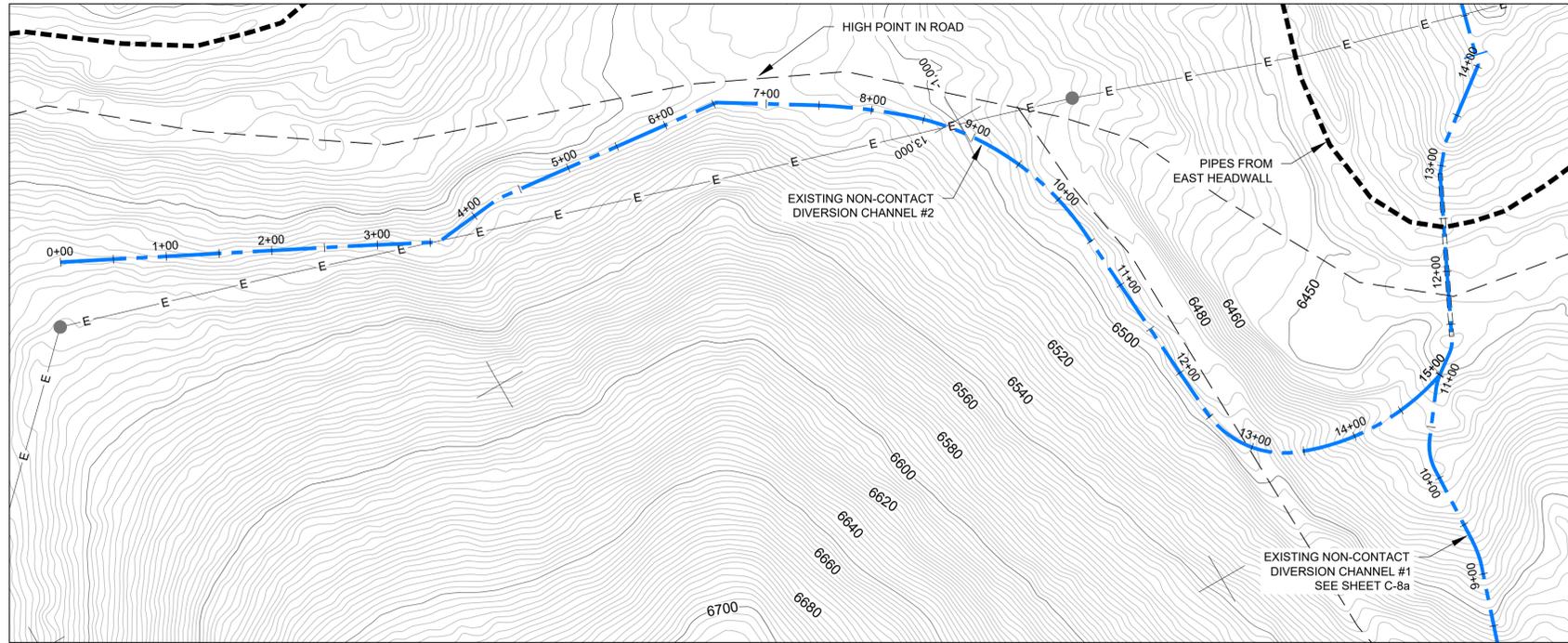
**LAMPBRIGHT  
 FAR EAST SUMP (LFES)  
 PLS COLLECTION SYSTEM,  
 STORMWATER POND  
 AND MSE WALLS**

**NON-CONTACT  
 DIVERSION CHANNEL #1  
 PLAN AND PROFILE**

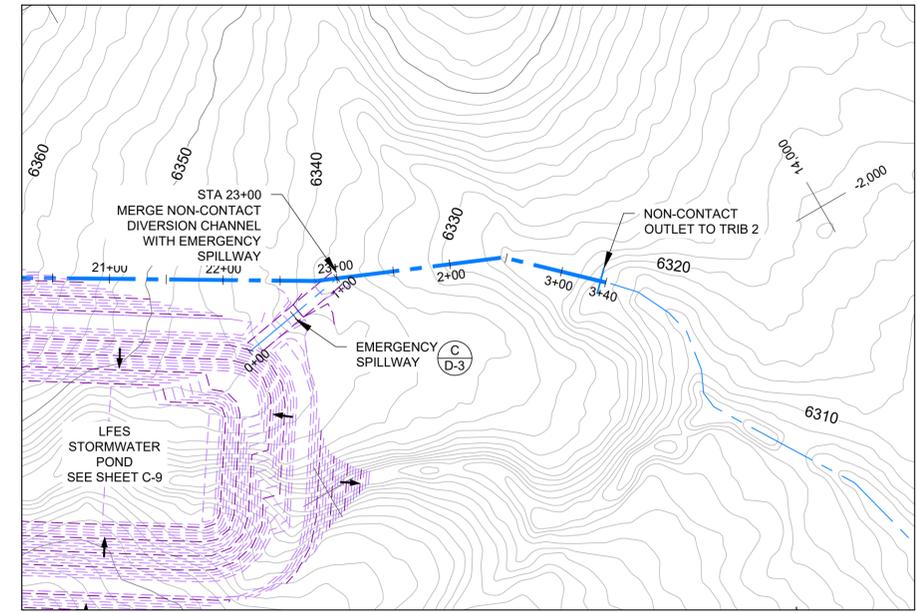
Project Number: 111073  
 Date: July 30, 2024  
 Sheet: C-8a

AGENCY APPROVAL

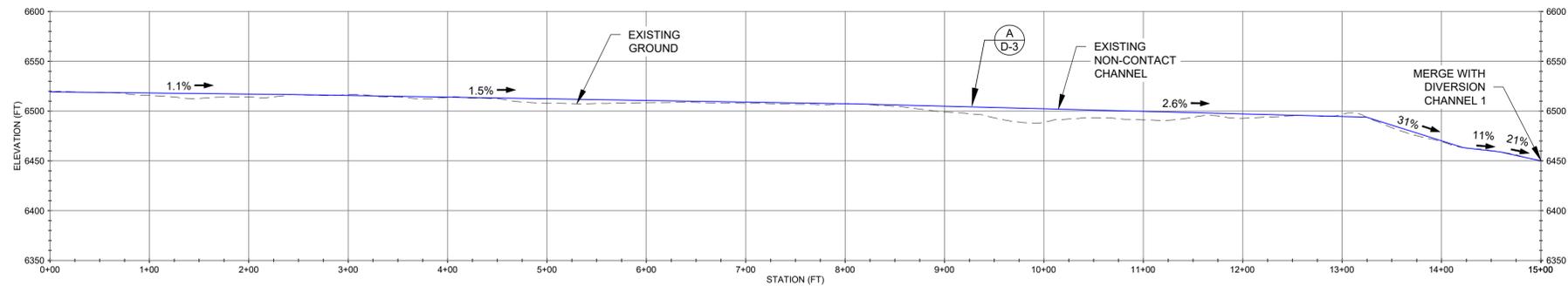
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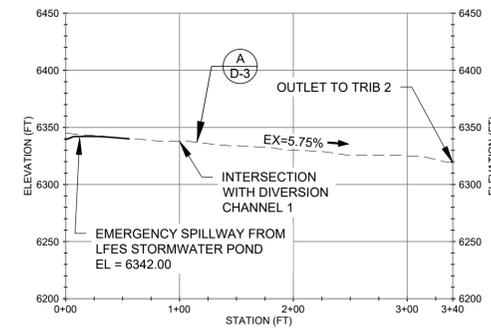
**NON-CONTACT DIVERSION CHANNEL #2 PLAN**  
 SCALE: 1" = 80'  
 CHINO LOCAL MINE COORDINATE SYSTEM



**EMERGENCY SPILLWAY PLAN**  
 SCALE: 1" = 80'



**A NON-CONTACT DIVERSION CHANNEL #2 PROFILE**  
 SCALE: 1" = 80'



**B EMERGENCY SPILLWAY PROFILE**  
 SCALE: 1" = 80'

NOTE:  
 SEE SHEET D-3 FOR  
 CHANNEL DETAILS  
 AND SPECS.

**REVISIONS**

Revision	Date	Description
0	7/15/2024	FOR CLIENT REVIEW
1	7/30/2024	FOR AGENCY APPROVAL

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 1500 Sycamore Point Road, Suite 209  
 97704-8853  
 (503) 688-5111

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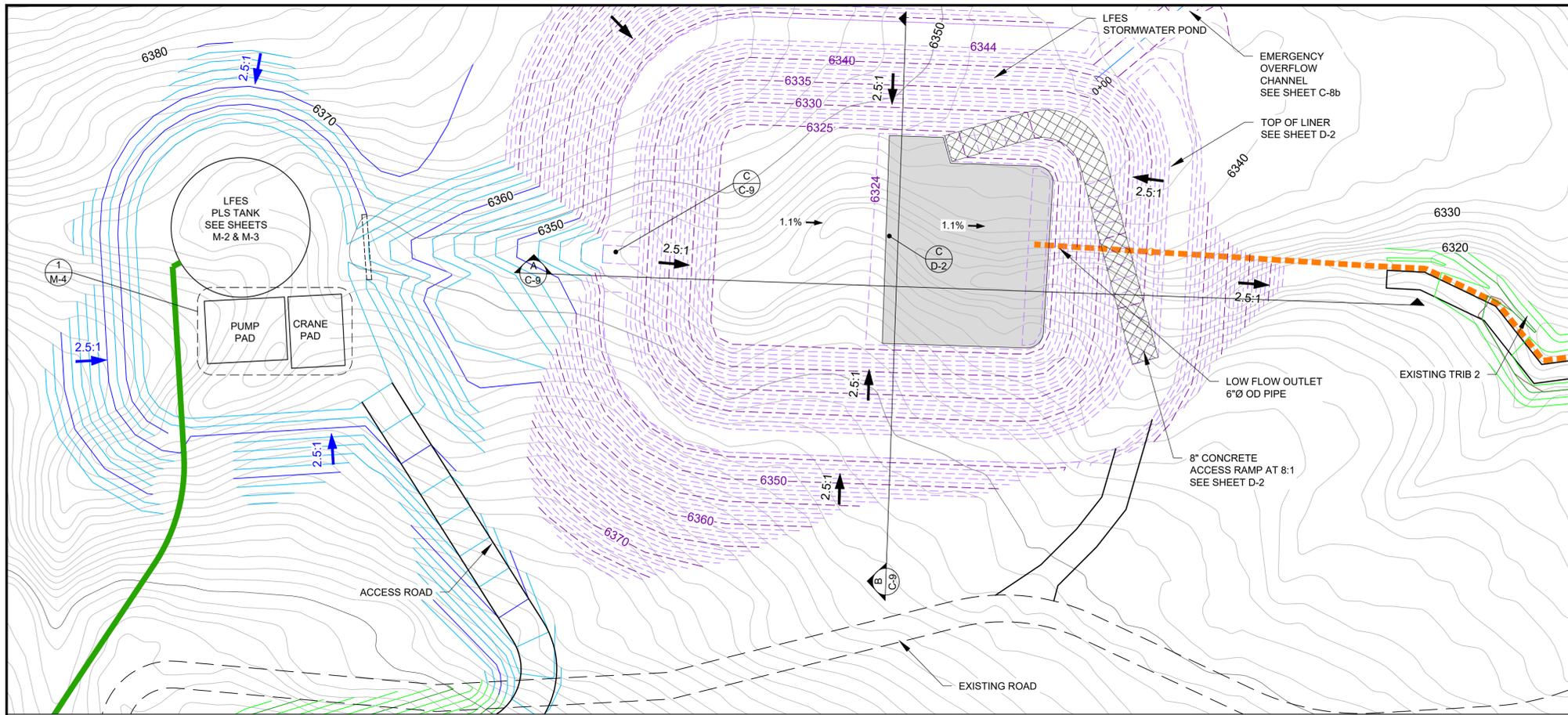


**LAMPBRIGHT  
 FAR EAST SUMP (LFES)  
 PLS COLLECTION SYSTEM,  
 STORMWATER POND  
 AND MSE WALLS**

**NON-CONTACT  
 DIVERSION CHANNEL #2  
 AND EMERGENCY  
 SPILLWAY  
 PLAN AND PROFILE**

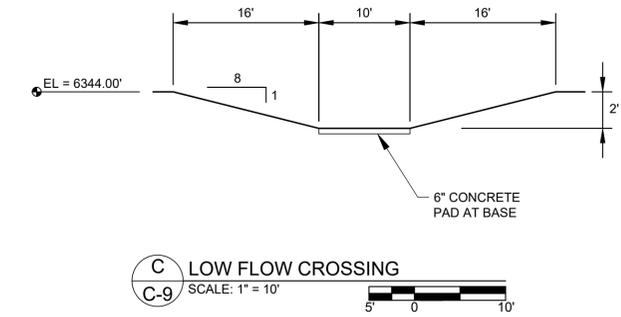
Project Number: 111073  
 Date: July 30, 2024  
 Sheet: C-8b

**AGENCY APPROVAL**



**LFES STORMWATER POND PLAN**  
SCALE: 1" = 40'

CHINO LOCAL MINE  
COORDINATE SYSTEM



**C LOW FLOW CROSSING**  
SCALE: 1" = 10'

**STAGE STORAGE TABLE**

ELEV	AREA (sq. ft.)	DEPTH (ft)	AVG END INCR. VOL. (cu. ft.)	AVG END TOTAL VOL. (cu. ft.)	AVG END TOTAL VOL. (ac. ft.)
6323	953.33	N/A	N/A	N/A	0.00
6324	10910.68	1	5,932.0	5,932.0	0.14
6325	22,460.98	1	16,685.8	22,617.8	0.52
6326	24,066.97	1	23,264.0	45,881.8	1.05
6328	27,380.60	2	51,447.6	97,329.4	2.23
6330	30,829.77	2	58,210.4	155,539.8	3.57
6332	35,409.49	2	66,239.3	221,779.0	5.09
6334	39,340.04	2	74,749.5	296,528.5	6.81
6336	43,413.14	2	82,753.2	379,281.7	8.71
6338	47,629.89	2	91,043.0	470,324.7	10.80
6340	51,946.27	2	99,576.2	569,900.9	13.08
6342	56,488.20	2	108,434.5	678,335.4	15.57
6344	61,235.93	2	117,724.1	796,059.5	18.28

VOLUMES:  
OPERATIONAL STORAGE VOLUME:  
25,124 CU YD = 15.57 AC-FT  
CUT/FILL BALANCE

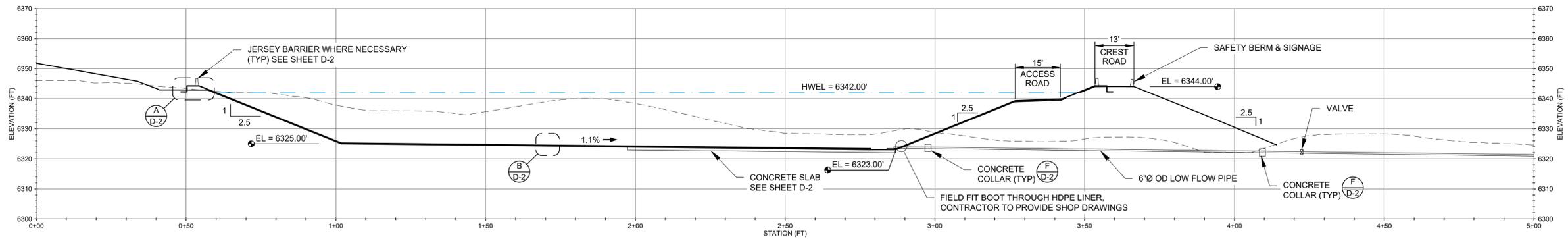
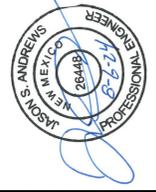
	CUT (CY)	FILL (CY)	NET (CY)
LFES STORMWATER POND	38,810	3,170	35,640 (C)
LFES PLS TANK GRADING	2,000	8,600	6,600 (F)

**REVISIONS**

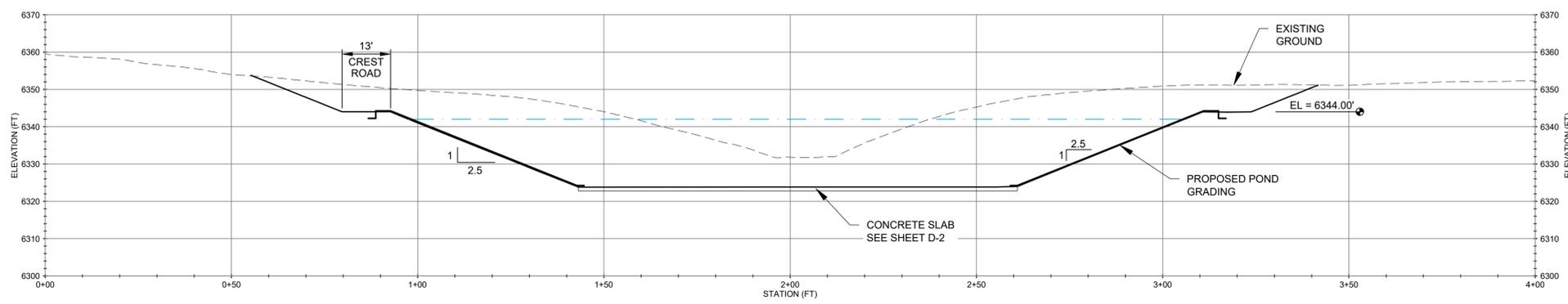
Revision	Date	Description
0	7/15/2024	FOR CLIENT REVIEW
1	7/30/2024	FOR AGENCY APPROVAL

Designed by: **Engineering Analytics, Inc.**  
1500 Sycamore Point Road, Suite 209  
Petaluma, CA 94952  
(707) 468-5111

Designed by: **DBS**  
Approved by: **JSA**



**A CROSS SECTION**  
SCALE: 1" = 20'



**B CROSS SECTION**  
SCALE: 1" = 20'

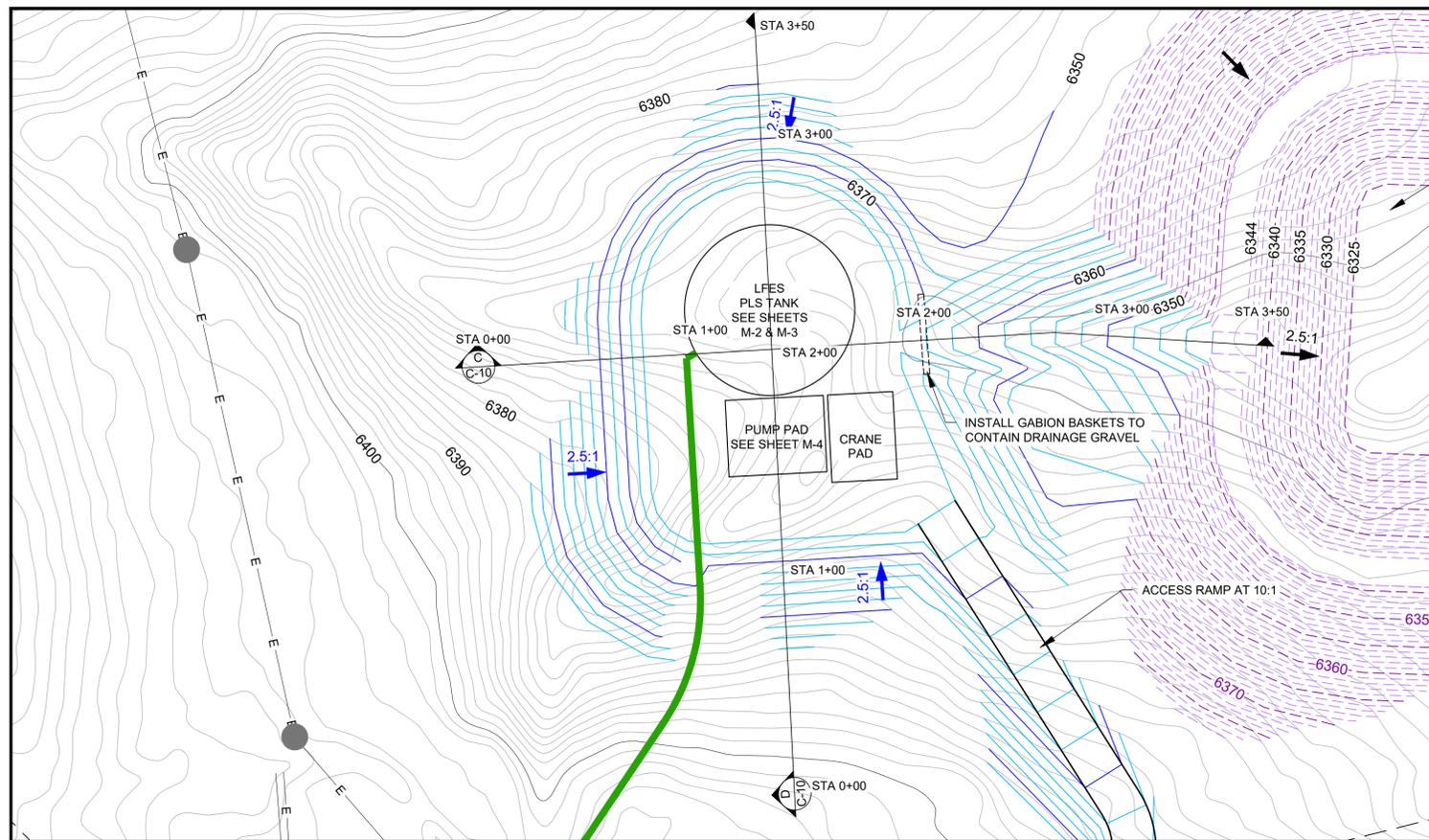
NOTE:  
1. GROUND WATER DEPTH BELOW EXISTING GROUND SURFACE PER TELESTO 2024. THUS NO UNDERDRAIN IS REQUIRED.

**AGENCY APPROVAL**

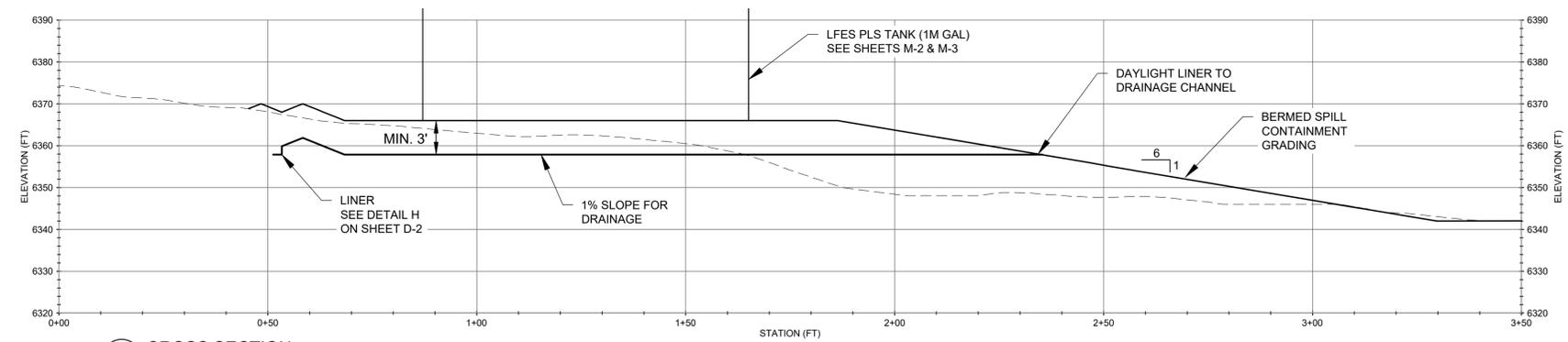
**LAMPBRIGHT  
FAR EAST SUMP (LFES)  
PLS COLLECTION SYSTEM,  
STORMWATER POND  
AND MSE WALLS**

**LFES STORMWATER  
POND PLAN AND  
SECTIONS**

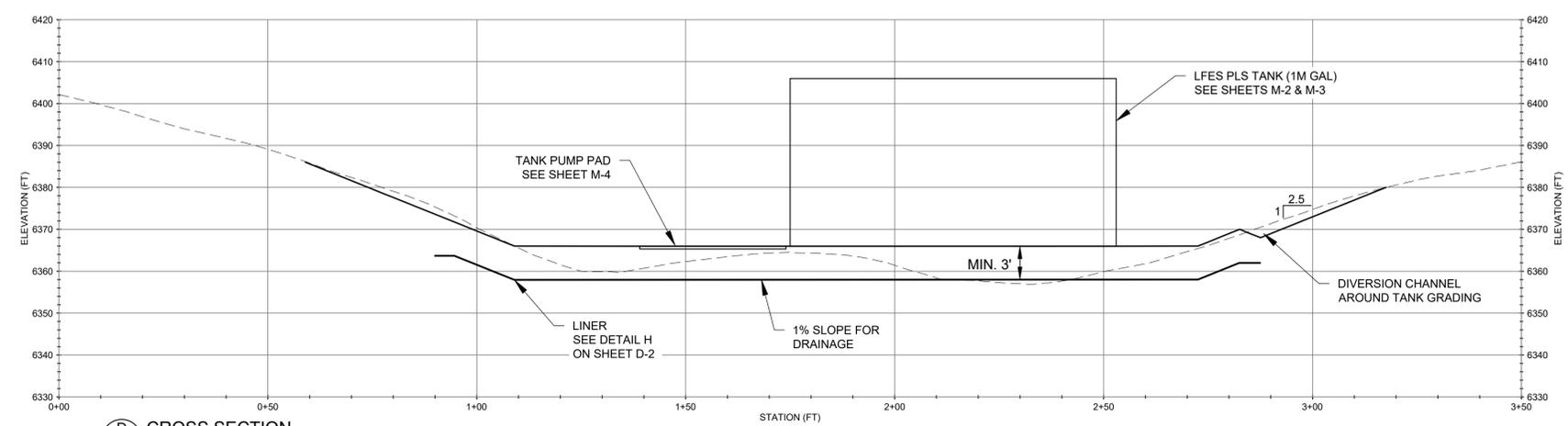
Project Number: 111073  
Date: July 30, 2024  
Sheet: C-9



**LFES TANK GRADING PLAN**  
 SCALE: 1" = 40'  
 CHINO LOCAL MINE COORDINATE SYSTEM



**C CROSS SECTION**  
 C-10 SCALE: 1" = 20'



**D CROSS SECTION**  
 C-10 SCALE: 1" = 20'

**REVISIONS**

Revision	Date	Description
0	7/15/2024	FOR CLIENT REVIEW
1	7/30/2024	FOR AGENCY APPROVAL

Designed by:  
 Engineering Analytics, Inc.  
 1500 Spectra Point Road, Suite 209  
 Irvine, CA 92614  
 (949) 488-5111

Designed by: DBS  
 Approved by: JSA

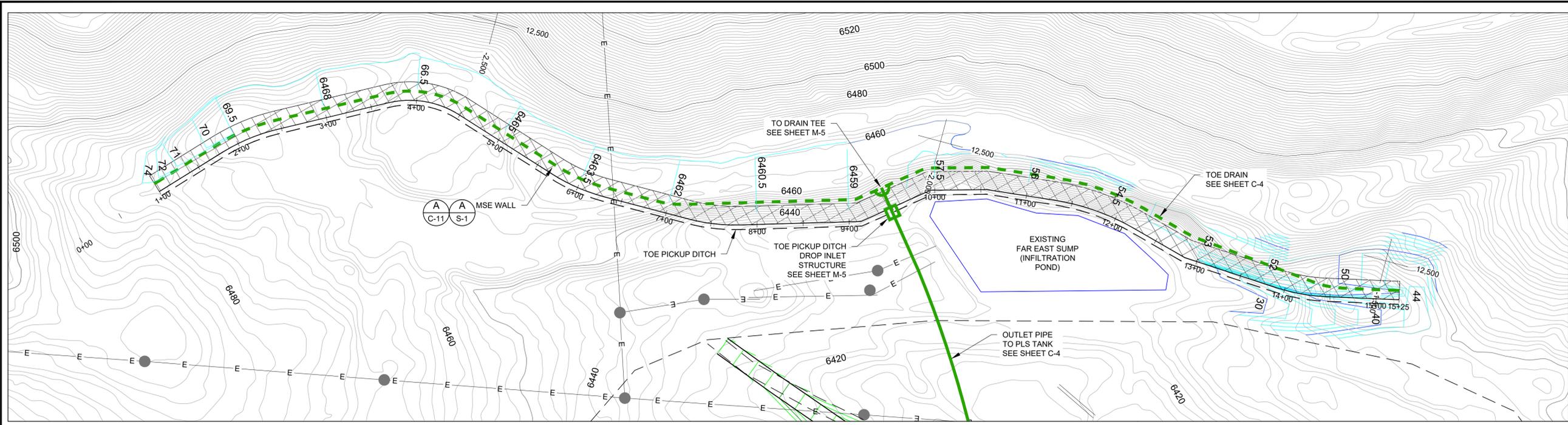


**LAMPBRIGHT  
 FAR EAST SUMP (LFES)  
 PLS COLLECTION SYSTEM,  
 STORMWATER POND  
 AND MSE WALLS**

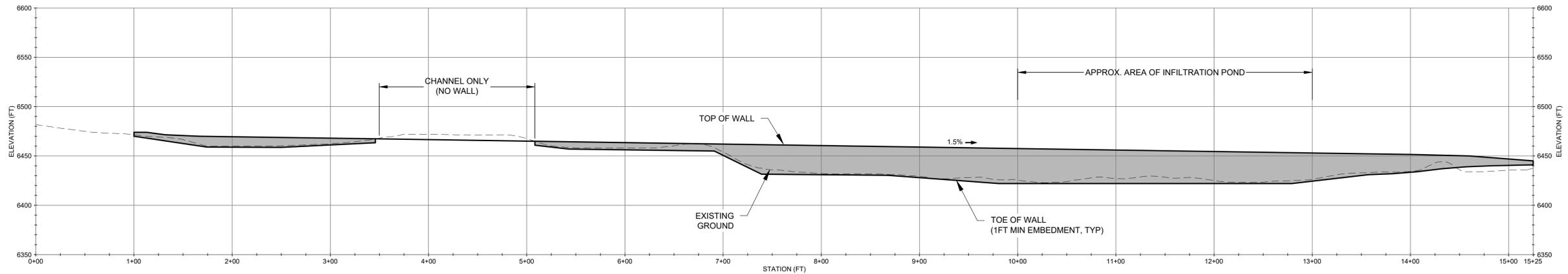
**LFES PLS TANK  
 GRADING PLAN AND  
 SECTIONS**

Project Number: 111073  
 Date: July 30, 2024  
 Sheet: C-10

**AGENCY APPROVAL**



**RETAINING WALL PLAN**  
SCALE: 1" = 60'



**A WALL FACE PROFILE**  
C-11 SCALE: 1" = 60'

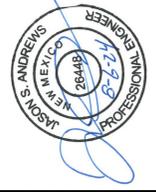
NOTE:  
DEPTH OF BEDROCK TO BE  
FIELD VERIFIED PRIOR TO  
INSTALLATION OF THE WALL.

**REVISIONS**

Revision	Date	Description
0	7/15/2024	FOR CLIENT REVIEW
1	7/30/2024	FOR AGENCY APPROVAL

Designed by:  
Engineering Analytics, Inc.  
1600 Special Point Road, Suite 209  
Plymouth, MN 55441  
(763) 488-3111

Designed by: DBS  
Approved by: JSA



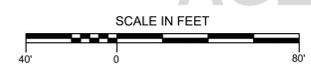
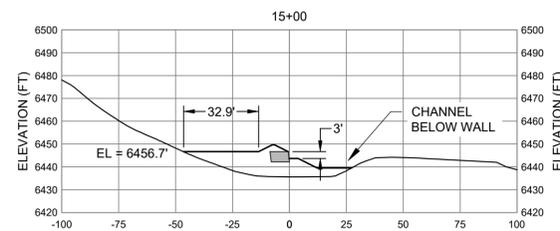
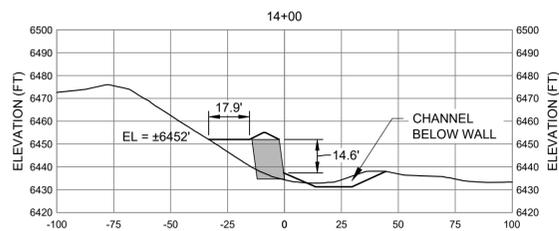
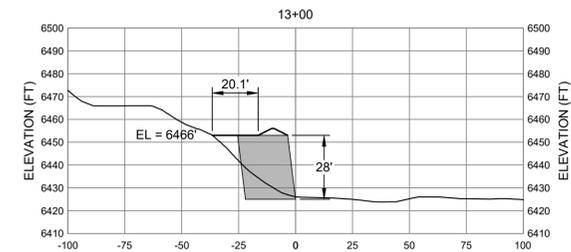
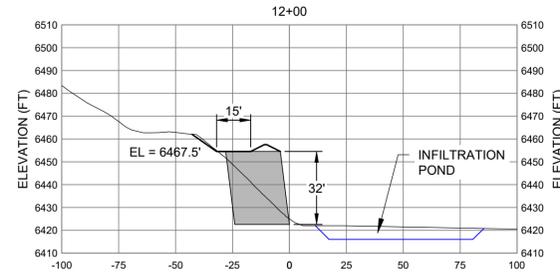
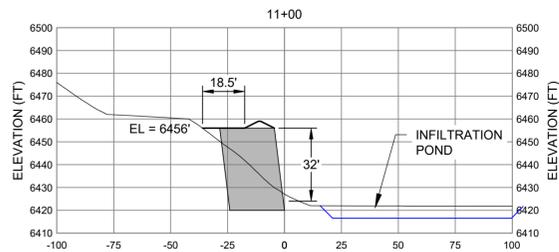
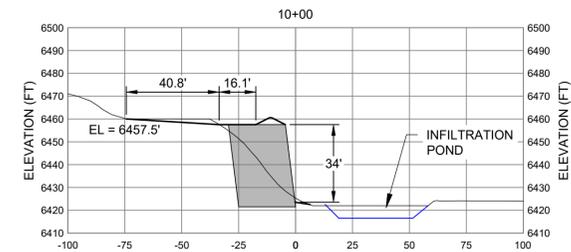
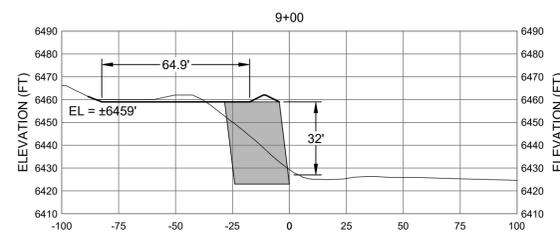
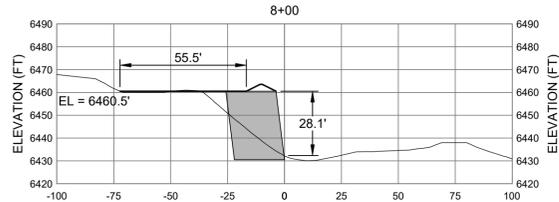
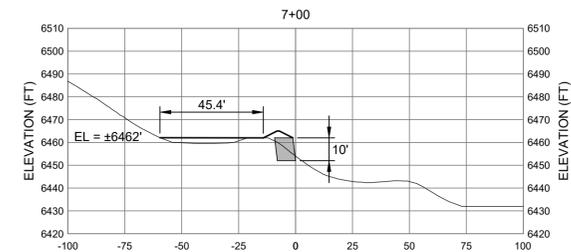
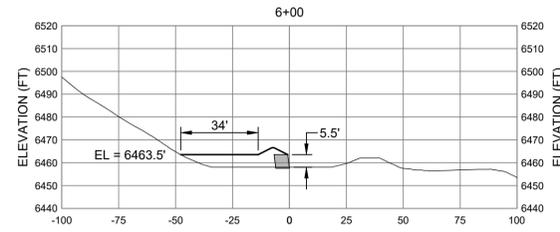
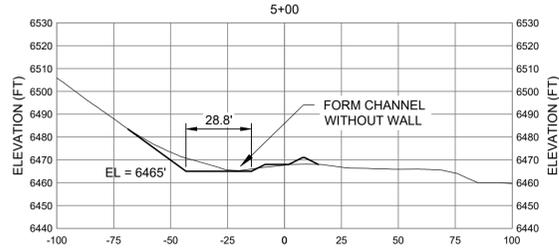
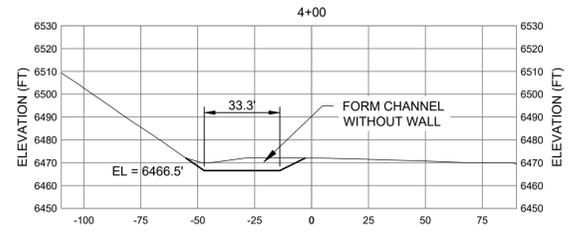
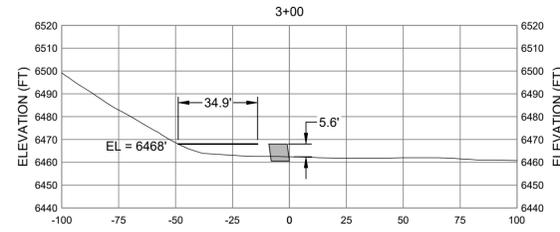
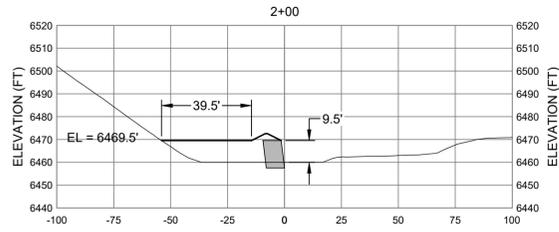
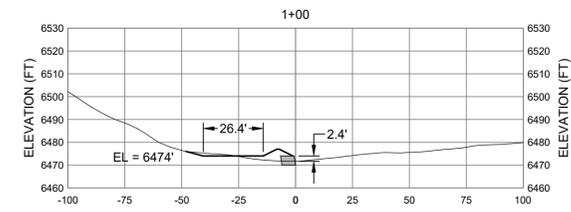
**LAMPBRIGHT  
FAR EAST SUMP (LFES)  
PLS COLLECTION SYSTEM,  
STORMWATER POND  
AND MSE WALLS**

**RETAINING WALL  
AND CHANNEL  
PLAN AND PROFILE**

**AGENCY APPROVAL**

Project Number:	111073
Date:	July 30, 2024
Sheet:	C-11

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**REVISIONS**

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0	7/15/2024	FOR CLIENT REVIEW
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**EA** Engineering Analytics, Inc.  
 1600 Specter Point Road, Suite 209  
 Irvine, CA 92614  
 (949) 453-3111

Designed by: DBS  
 Approved by: JSA



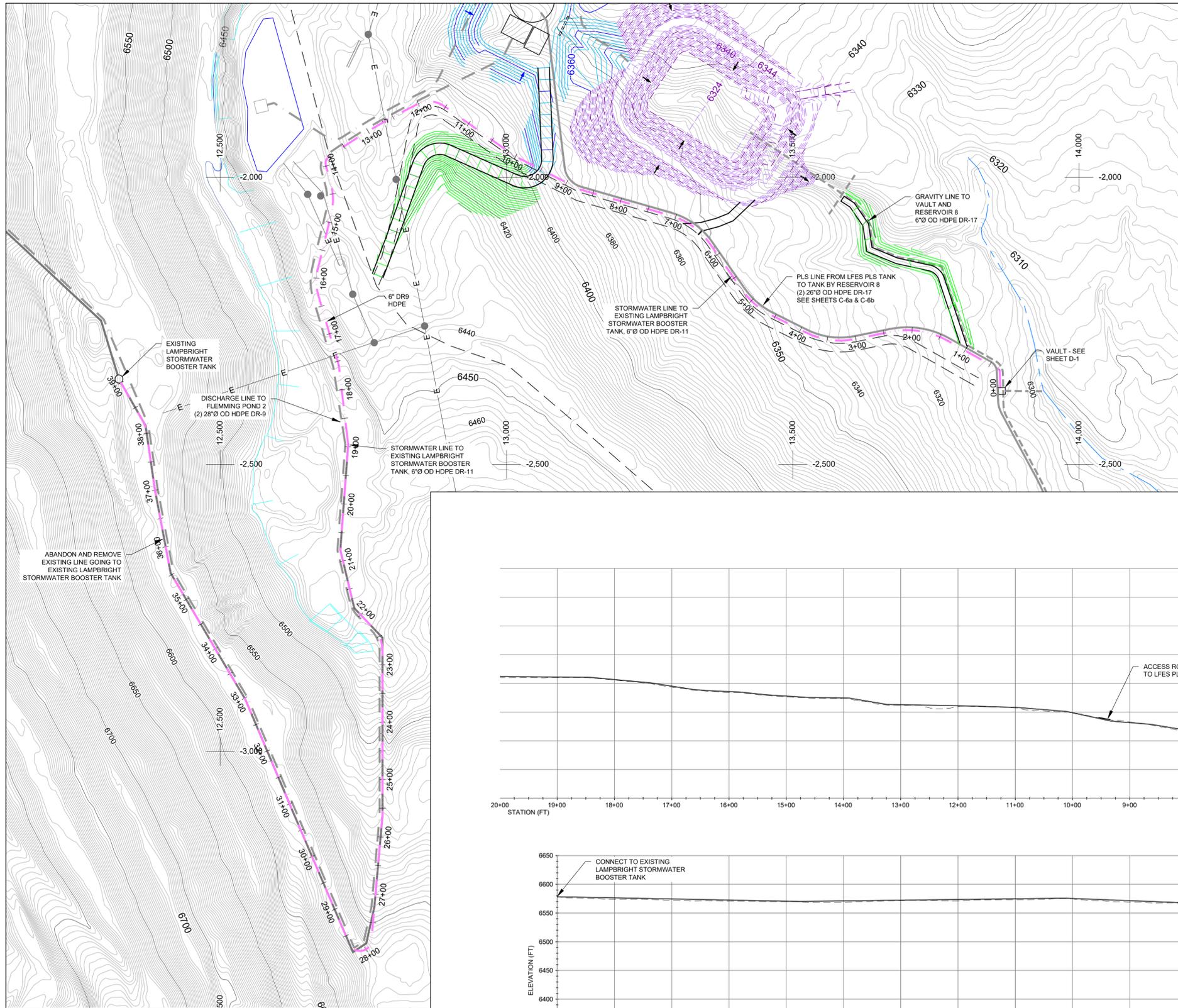
**LAMPBRIGHT  
 FAR EAST SUMP (LFES)  
 PLS COLLECTION SYSTEM,  
 STORMWATER POND  
 AND MSE WALLS**

**RETAINING WALL  
 AND CHANNEL  
 CROSS SECTIONS**

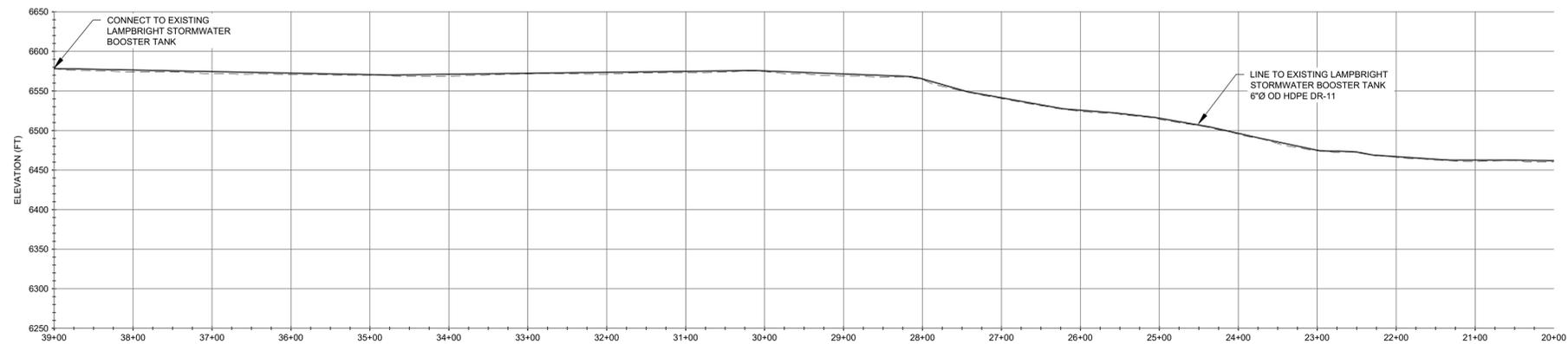
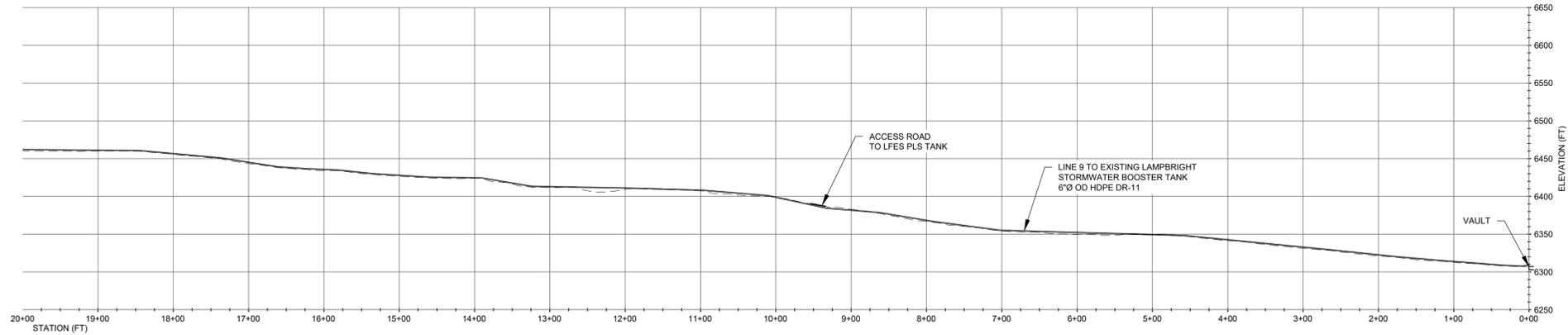
AGENCY APPROVAL

Project Number:	111073
Date:	July 30, 2024
Sheet:	C-12

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LFES PLAN VIEW  
SCALE: 1" = 100'



CROSS SECTION

SCALE: 1" = 100'



REVISIONS

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0	7/15/2024	FOR CLIENT REVIEW
1	7/30/2024	FOR AGENCY APPROVAL

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Brea, CA 92625  
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LAMPBRIGHT  
FAR EAST SUMP (LFES)  
PLS COLLECTION SYSTEM,  
STORMWATER POND  
AND MSE WALLS

VAULT TO EXISTING  
LAMPBRIGHT  
STORMWATER  
BOOSTER TANK  
PLAN AND PROFILE

Project Number: 111073

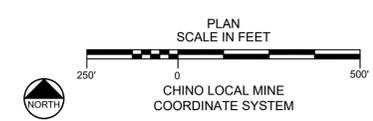
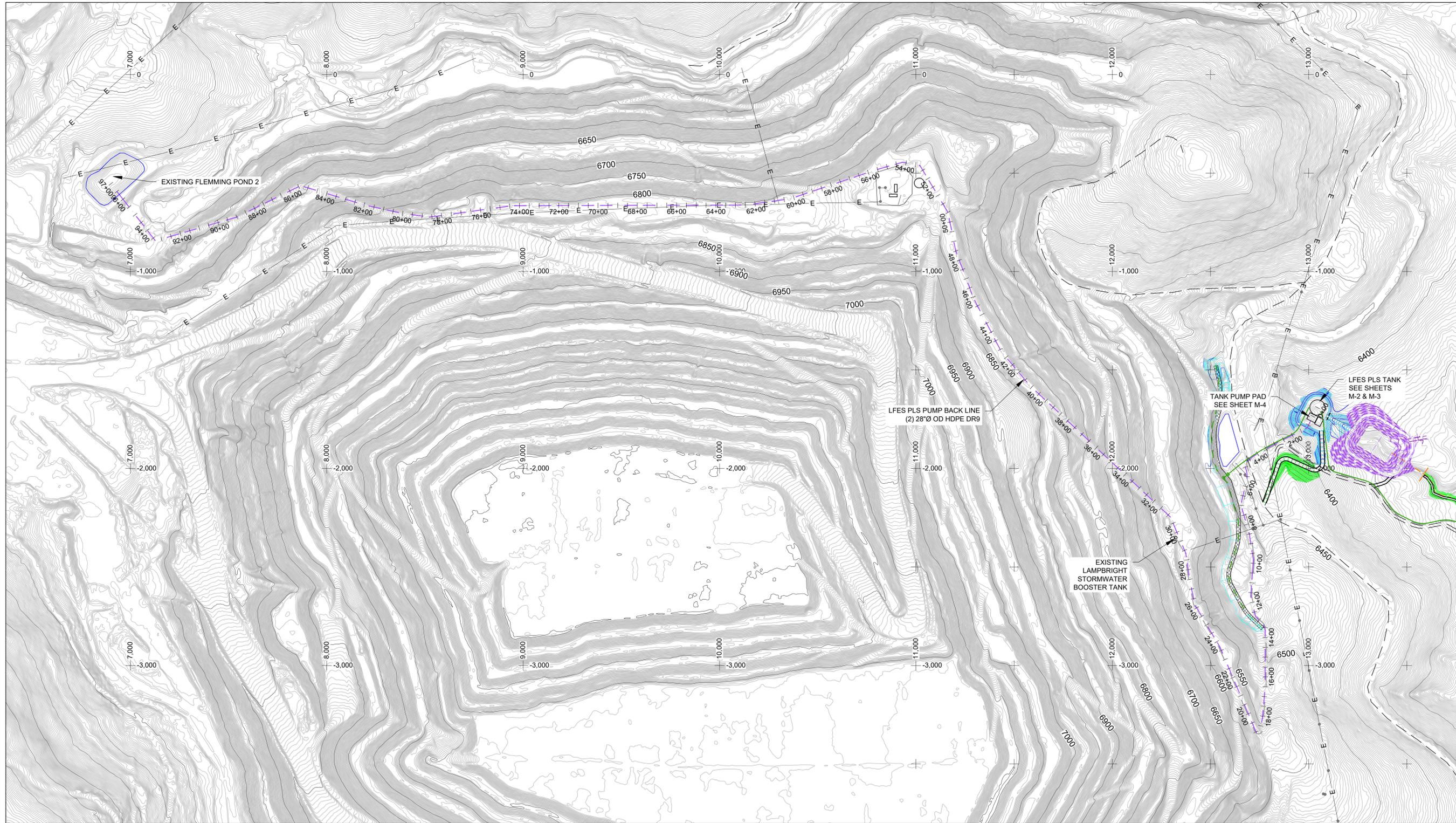
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Sheet: C-13

AGENCY APPROVAL

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Approved by: JSA

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 1500 Sycamore Point Road, Suite 209  
 97704-8853-111

Designed by: DBS

Approved by: JSA



**LAMPBRIGHT FAR EAST SUMP (LFES) PLS COLLECTION SYSTEM, STORMWATER POND AND MSE WALLS**

**PIPE TO PUMP LFES PLS DISCHARGE TO FLEMING POND 2 PLAN**

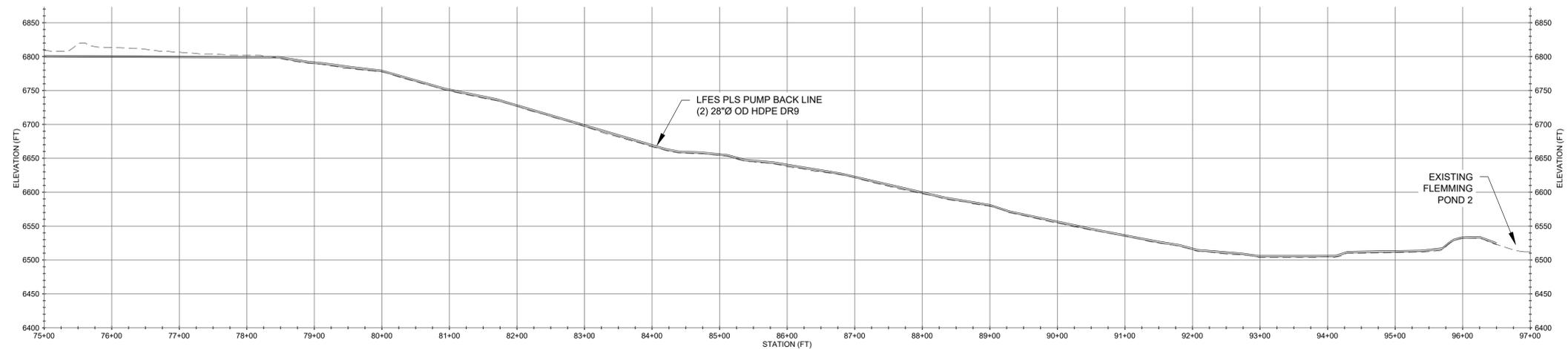
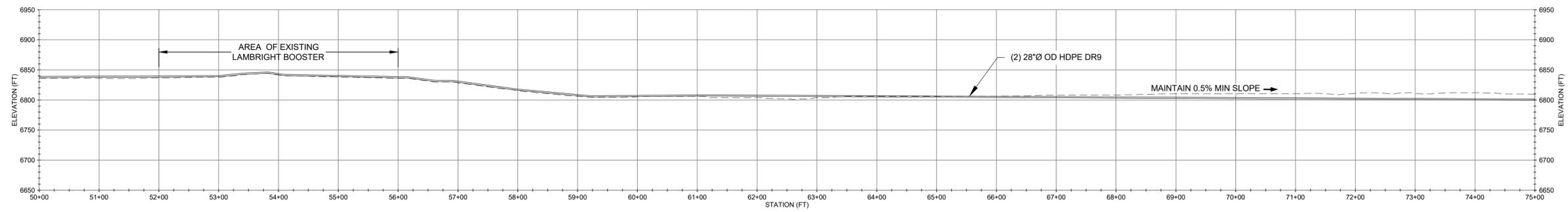
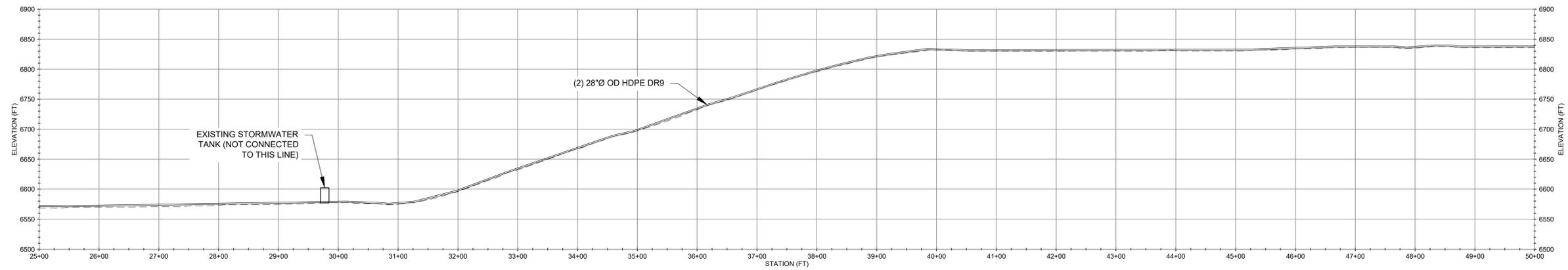
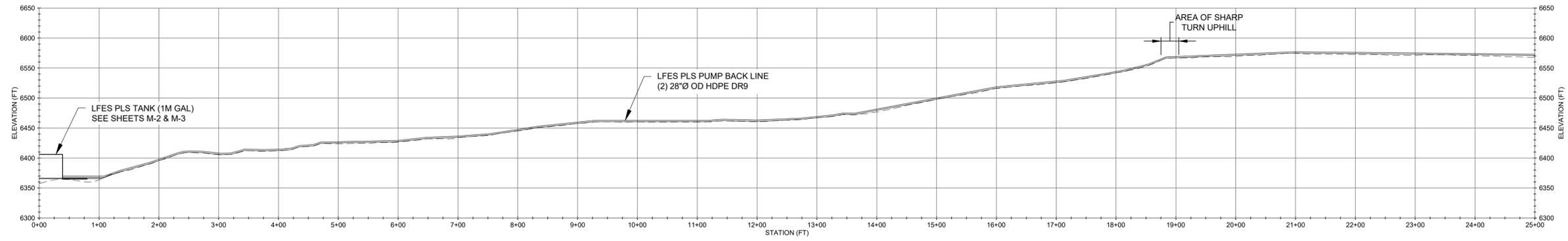
Project Number: 111073

Date: July 30, 2024

Sheet: C-14a

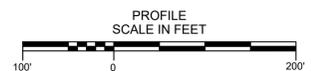
**AGENCY APPROVAL**

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PROFILES

AGENCY APPROVAL



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1500 Specter Point Road, Suite 209  
Chino, CA 91710  
(970) 685-3111



Designed by: DBS  
Approved by: JSA

LAMBRIGHT  
FAR EAST SUMP (LFES)  
PLS COLLECTION SYSTEM,  
STORMWATER POND  
AND MSE WALLS

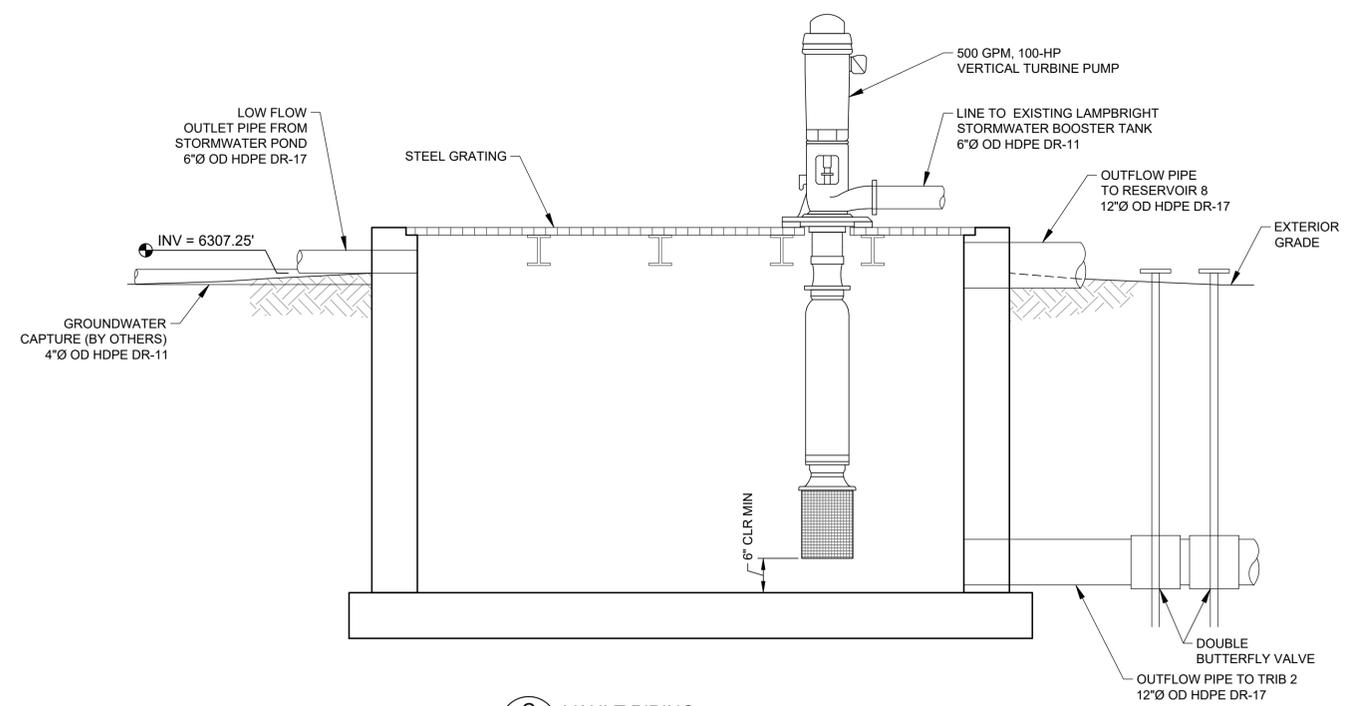
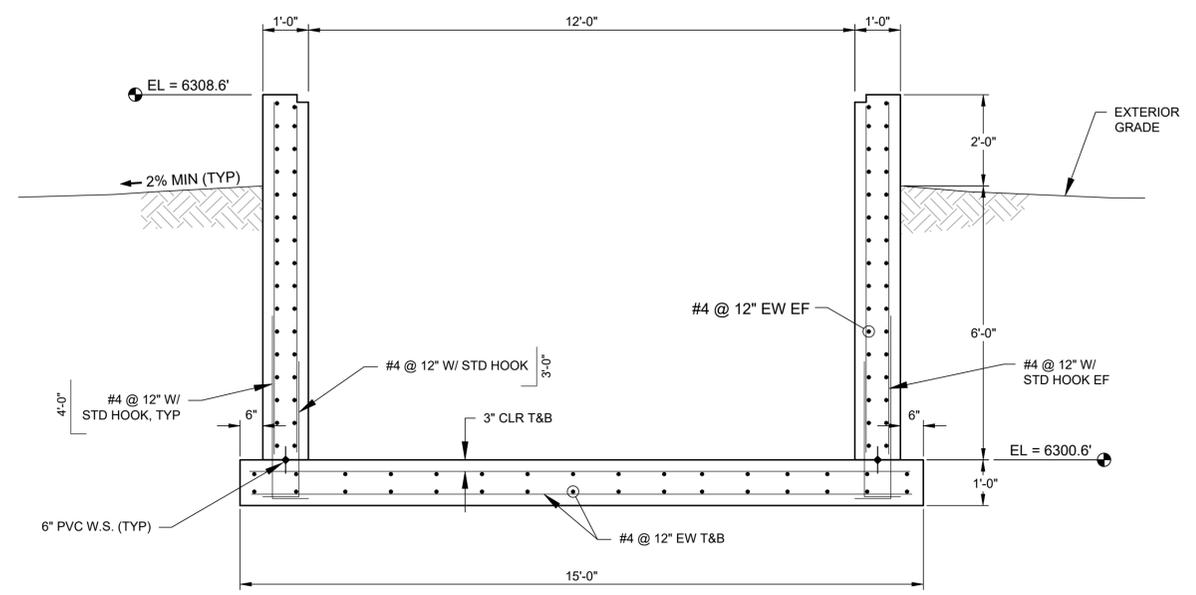
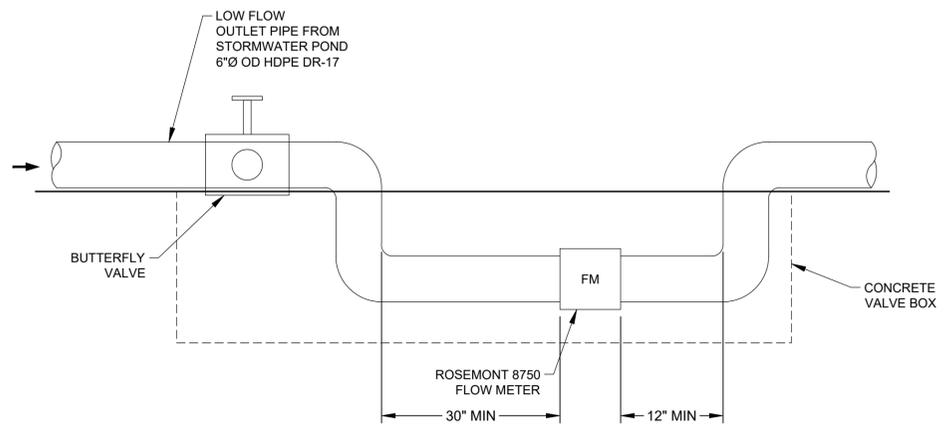
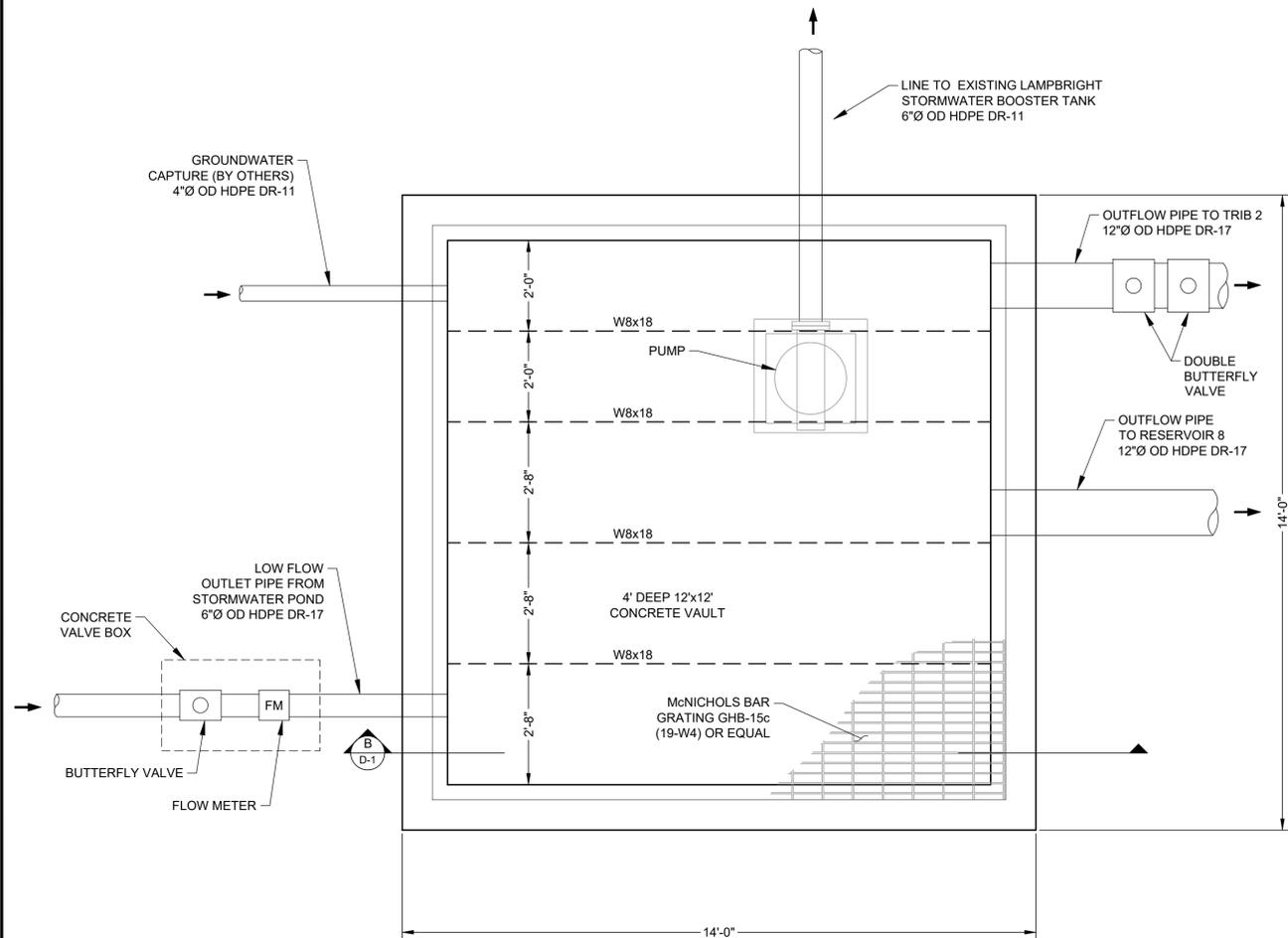
PIPE TO PUMP LFES  
PLS DISCHARGE TO  
FLEMING POND 2  
PROFILE

Project Number: 111073

Date: July 30, 2024

Sheet: C-14b

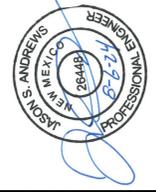
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REVISIONS		
Revision	Date	Description
0	7/15/2024	FOR CLIENT REVIEW
1	7/30/2024	FOR AGENCY APPROVAL

Designed by: **Engineering Analytics, Inc.**  
1500 Sycamore Point Road, Suite 209  
Plymouth, MN 55441  
(970) 488-5111

Designed by: **DBS**  
Approved by: **JSA**

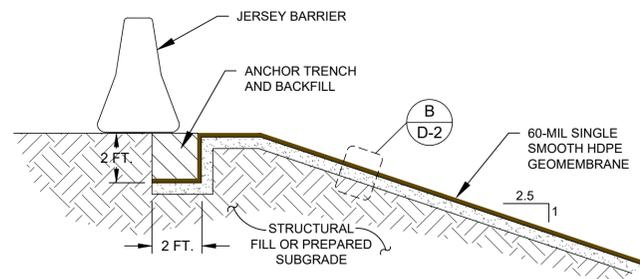


**LAMPBRIGHT FAR EAST SUMP (LFES) PLS COLLECTION SYSTEM, STORMWATER POND AND MSE WALLS**

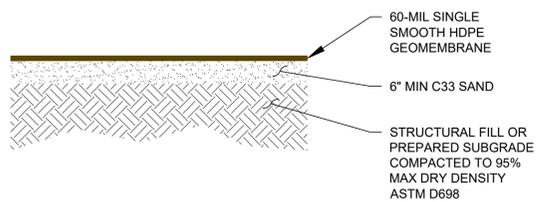
**VAULT DETAILS**

Project Number: 111073  
Date: July 30, 2024  
Sheet: D-1

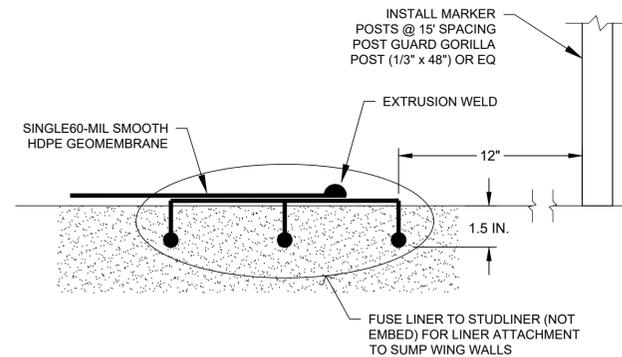
**AGENCY APPROVAL**



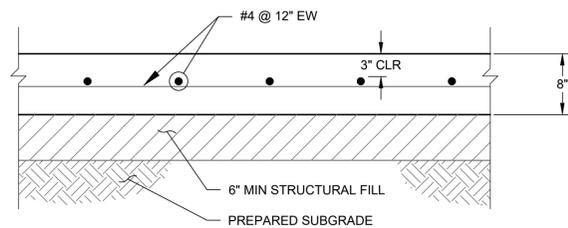
**A** TYPICAL HDPE LINER ANCHOR TRENCH SECTION  
D-2 NOT TO SCALE



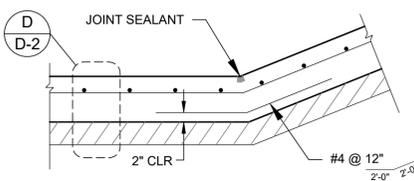
**B** TYPICAL LINER SYSTEM  
D-2 NOT TO SCALE



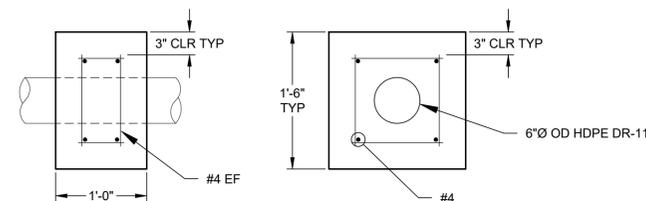
**C** TYPICAL HDPE LINER EMBED DETAIL  
D-2 NOT TO SCALE



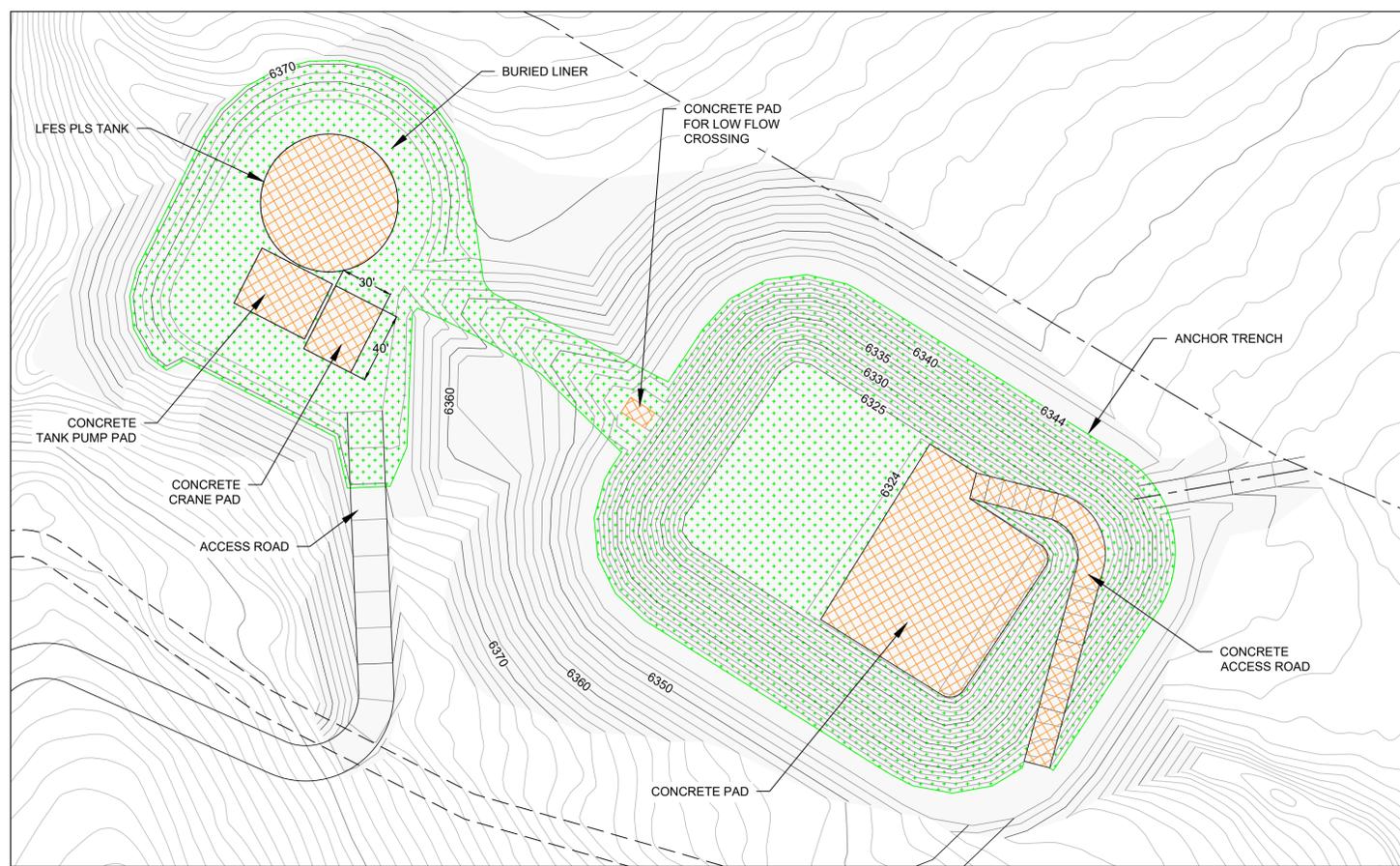
**D** TYPICAL CONCRETE PAD DETAIL  
D-2 SCALE: 1" = 1'-0"



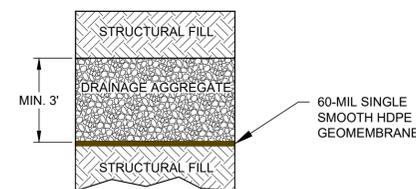
**E** CONSTRUCTION JOINT AT TRANSITION  
D-2 SCALE: 1/2" = 1'-0"



**F** TYPICAL CONCRETE COLLAR  
D-2 SCALE: 1" = 1'-0"



**G** LFES LINER PLAN  
D-2 SCALE: 1" = 50'

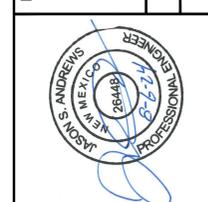


**H** LINER SYSTEM DETAIL  
D-2 NOT TO SCALE

REVISIONS	
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0	FOR CLIENT REVIEW
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Designed by: DBS  
Approved by: JSA

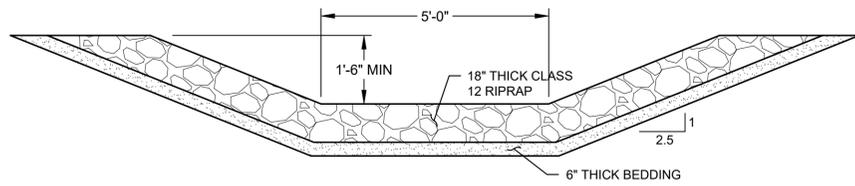


**LAMPBRIGHT  
FAR EAST SUMP (LFES)  
PLS COLLECTION SYSTEM,  
STORMWATER POND  
AND MSE WALLS**

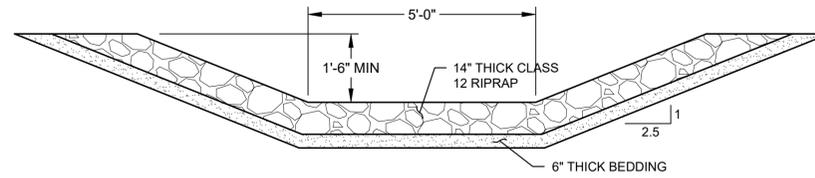
**LINER DETAILS**

Project Number: 111073  
Date: July 30, 2024  
Sheet: D-2

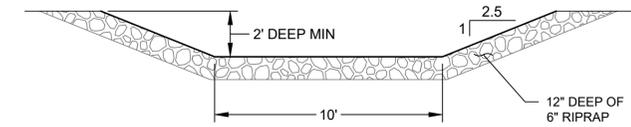
AGENCY APPROVAL



**A** HEAP STORMWATER CHANNEL  
**D-3** SCALE: 1/2" = 1'-0"



**B** NON-CONTACT STORMWATER CHANNEL  
**D-3** SCALE: 1/2" = 1'-0"



**C** EMERGENCY SPILLWAY SECTION  
**D-3** SCALE: 1/4" = 1'-0"

**DISCHARGE CHANNEL RIPRAP GRADATION REQUIREMENTS**

CLASS AND NOMINAL THICKNESS	STONE SIZE	PERCENT OF TOTAL WEIGHT SMALLER THAN THE GIVEN SIZE
CLASS 12 d <sub>50</sub> = 12"	24"	100
	21"	70-100
	18"	50-70
	12"	35-50
	4"	2-10

**DISCHARGE CHANNEL BEDDING REQUIREMENTS**

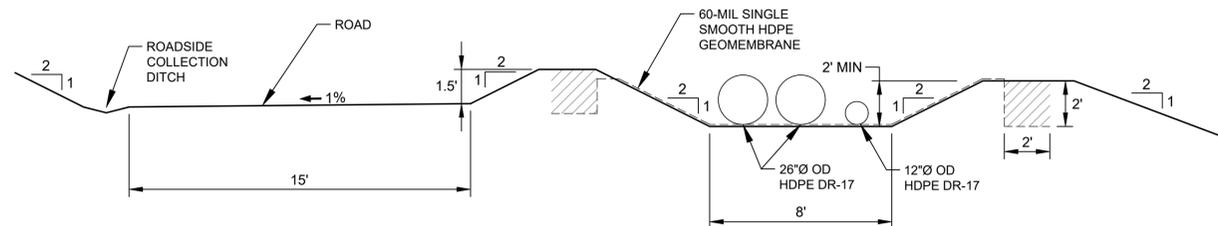
U.S. STANDARD SIEVE SIZE	PERCENT PASSING BY WEIGHT
4 inch	100
3 inch	90 - 100
1-1/2 inch	40 - 80
3/4 inch	20 - 50
3/8 inch	15 - 40
No. 4	5 - 25
No. 8	< 15

**STORMWATER CHANNEL RIPRAP GRADATION REQUIREMENTS**

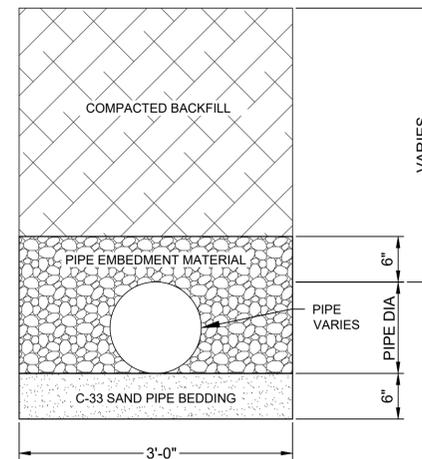
CLASS AND NOMINAL THICKNESS	STONE SIZE	PERCENT OF TOTAL WEIGHT SMALLER THAN THE GIVEN SIZE
CLASS 9 d <sub>50</sub> = 9"	18"	100
	15"	70-100
	12"	50-70
	9"	35-50
	3"	2-10

**STORMWATER CHANNEL BEDDING REQUIREMENTS**

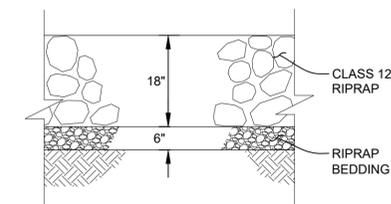
U.S. STANDARD SIEVE SIZE	PERCENT PASSING BY WEIGHT
4 inch	100
3 inch	90 - 100
1-1/2 inch	40 - 80
3/4 inch	20 - 50
3/8 inch	15 - 40
No. 4	5 - 25
No. 8	< 15



**D** TYPICAL PIPE CORRIDOR  
**D-3** SCALE: 1/4" = 1'-0"



**E** TYPICAL TRENCH DETAIL - SINGLE PIPE  
**D-3** SCALE: 1" = 1'-0"



**F** CLASS 12 RIPRAP TYPICAL DETAIL  
**D-3** SCALE: 1/2" = 1'-0"

**REVISIONS**

Revision	Date	Description
0	7/15/2024	FOR CLIENT REVIEW
1	7/30/2024	FOR AGENCY APPROVAL

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**EA** Engineering Analytics, Inc.  
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 (970) 485-3111



Designed by: DBS  
 Approved by: JSA

**LAMPBRIGHT  
 FAR EAST SUMP (LFES)  
 PLS COLLECTION SYSTEM,  
 STORMWATER POND  
 AND MSE WALLS**

**DETAILS**

Project Number: 111073  
 Date: July 30, 2024  
 Sheet: D-3

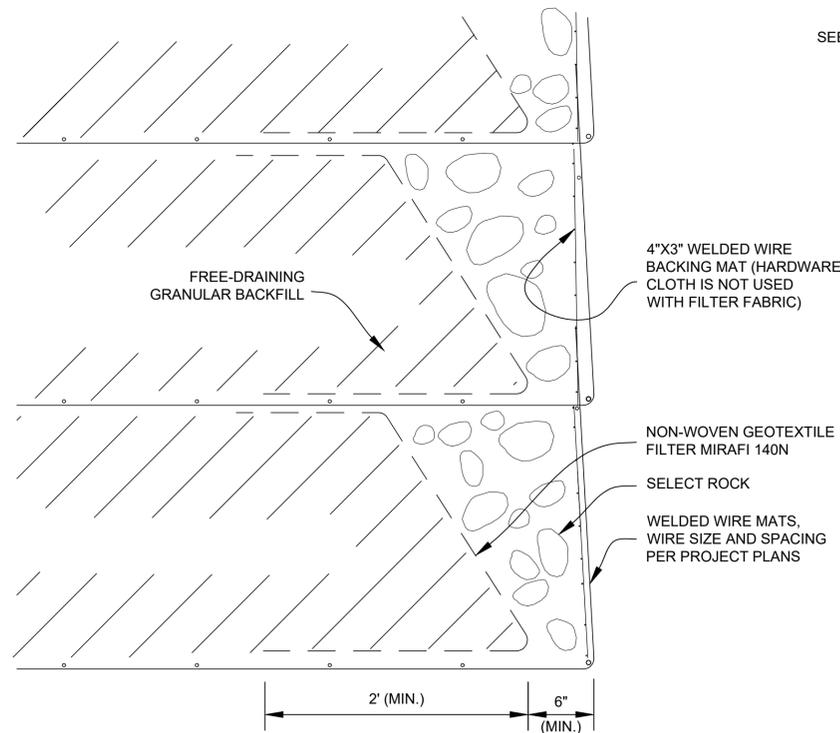
**AGENCY APPROVAL**

NOTES:

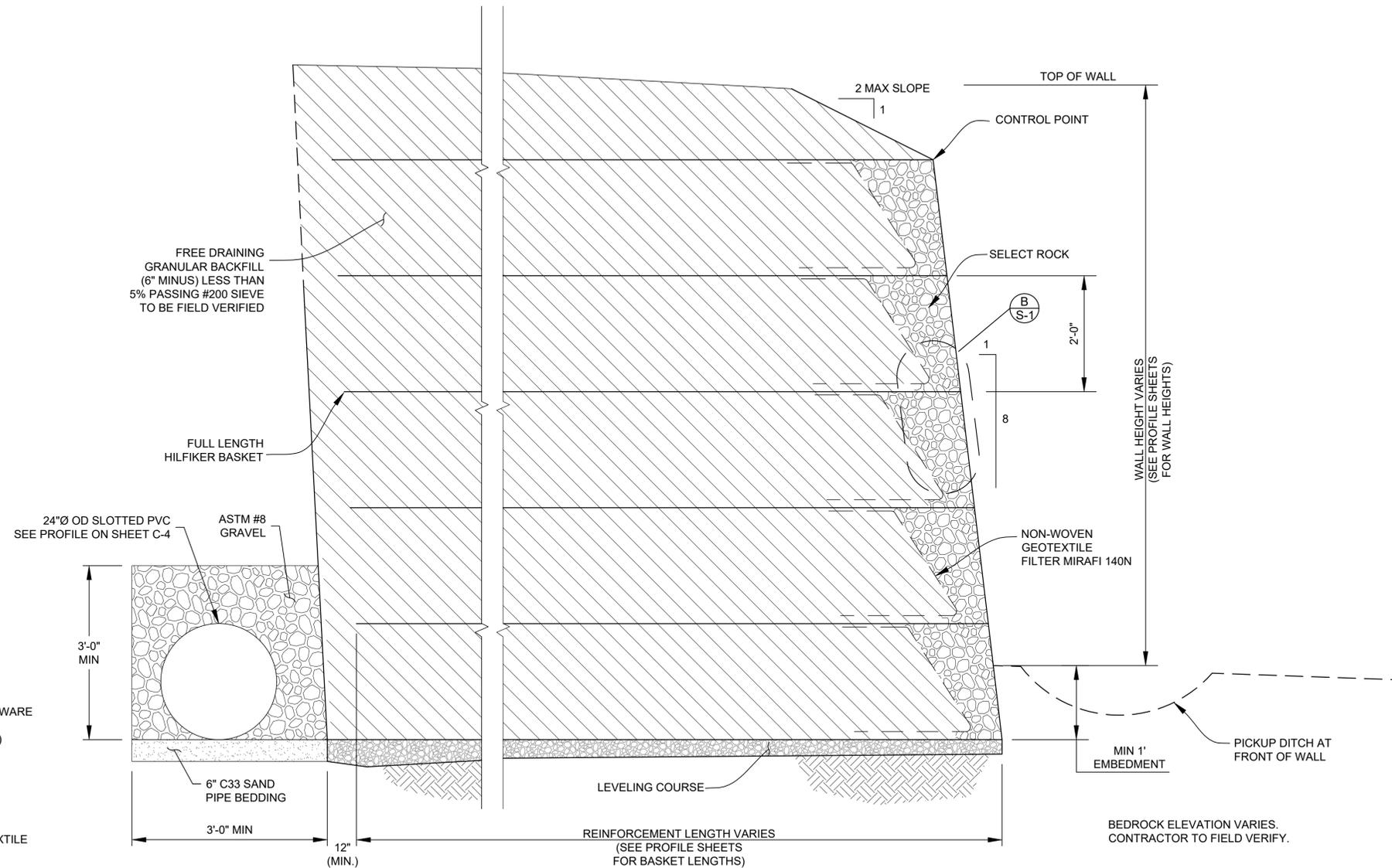
- ① WELDED WIRE REINFORCEMENT SYSTEMS REQUIRE A TOP REINFORCEMENT MAT.
- ② TERMINATE WIRE-FACE WALL AT THE BEGINNING AND END OF EACH LIFT WITH A RETURN OF THE WALL FACING MATERIAL A MINIMUM OF 4' INTO THE BACKFILL.
- ③ USE 316 L WIRE BASKETS PER TABLE:

Wall Height (ft)	Reinforcement Length (ft)	Depth of Reinforcement (ft)	Wire Type
≤4	5	0 to 4	W4.5
>4 to ≤7.5	6.5	0 to 7.5	W4.5
>7.5 to ≤13.5	11	0 to 13.5	W4.5
>13.5 to ≤21.5	18	0 to 21.5	W4.5
>21.5 to ≤29.5	24	0 to 29.5	W4.5
>29.5 to ≤31.5	26	18 to 31.5 0 to 16	W4.5 W7.0
>31.5 to ≤35.5	29	14 to 35.5 0 to 12	W4.5 W7.0

- ④ CONTRACTOR TO PROVIDE SHOP DRAWINGS AND DETAILS FOR HILFIKER BASKETS.



**B**  
S-1  
REINFORCED HILFIKER WALL DETAIL  
NOT TO SCALE



**A**  
S-1  
TYPICAL HILFIKER SECTION  
NOT TO SCALE

REVISIONS

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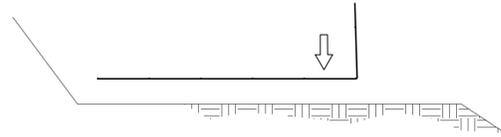
LAMPBRIGHT  
FAR EAST SUMP (LFES)  
PLS COLLECTION SYSTEM,  
STORMWATER POND  
AND MSE WALLS

HILFIKER WALL  
DETAILS

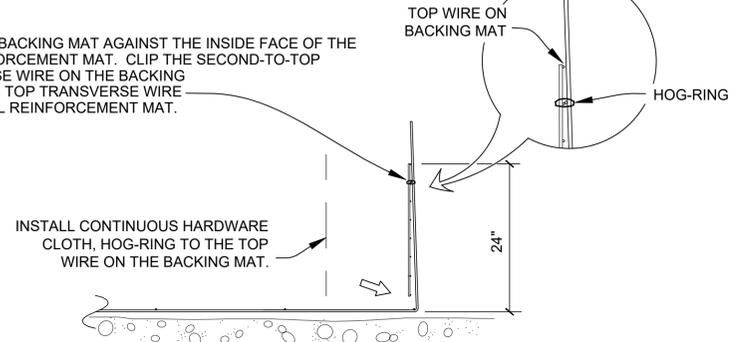
AGENCY APPROVAL

Project Number: 111073  
Date: July 30, 2024  
Sheet: S-1

**STEP 1**  
PLACE THE FIRST COURSE OF SOIL REINFORCEMENT MATS ON PREPARED FOUNDATION

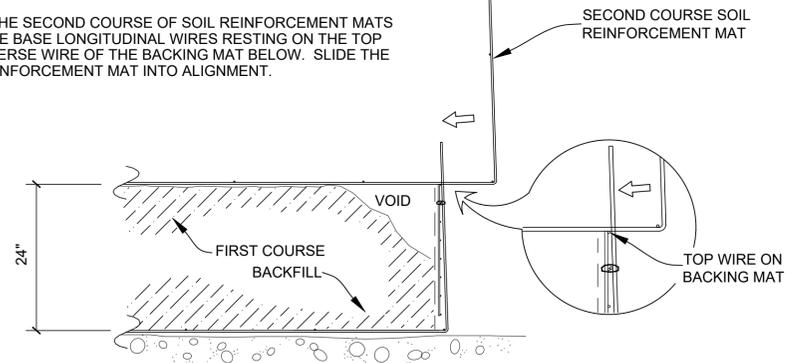


**STEP 2**  
PLACE THE BACKING MAT AGAINST THE INSIDE FACE OF THE SOIL REINFORCEMENT MAT. CLIP THE SECOND-TO-TOP TRANSVERSE WIRE ON THE BACKING MAT TO THE TOP TRANSVERSE WIRE ON THE SOIL REINFORCEMENT MAT.

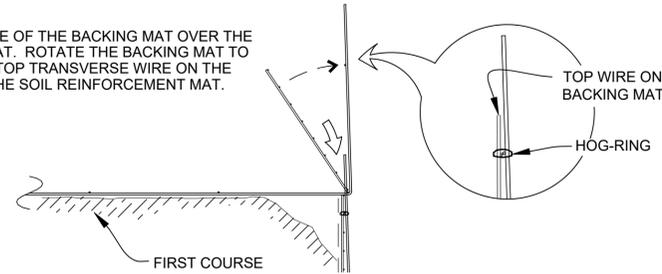


**STEP 3**  
PLACE AND COMPACT THE BACKFILL IN LAYERS AND DENSITIES AS SPECIFIED IN THE PROJECT PLANS. LEAVE A VOID AT THE FACE AS SHOWN.

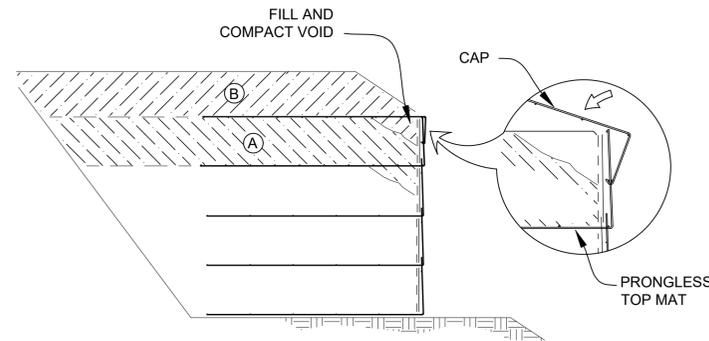
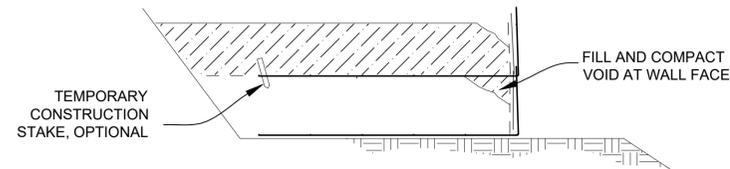
PLACE THE SECOND COURSE OF SOIL REINFORCEMENT MATS WITH THE BASE LONGITUDINAL WIRES RESTING ON THE TOP TRANSVERSE WIRE OF THE BACKING MAT BELOW. SLIDE THE SOIL REINFORCEMENT MAT INTO ALIGNMENT.



**STEP 4**  
HOOK THE BOTTOM TRANSVERSE WIRE OF THE BACKING MAT OVER THE VERTICAL PRONGS ON THE LOWER MAT. ROTATE THE BACKING MAT TO VERTICAL AND CLIP THE SECOND-TO-TOP TRANSVERSE WIRE ON THE BACKING MAT TO THE TOP WIRE ON THE SOIL REINFORCEMENT MAT.



**STEP 5**  
INSTALL THE CONTINUOUS HARDWARE CLOTH. PLACE AND COMPACT THE BACKFILL TO THE BASE ELEVATION OF THE NEXT MAT. REPEAT STEPS 3 THROUGH 5 TO THE TOP LIFT.



**STEP 6: TOP LIFT**  
PLACE THE TOP LIFT PRONGLESS MAT, BACKING MAT AND CONTINUOUS HARDWARE CLOTH. PLACE AND COMPACT BACKFILL IN AREA "A". HOOK THE CAP OVER THE MIDDLE TRANSVERSE WIRE ON THE PRONGLESS MAT, AND ROTATE INTO PLACE. BACKFILL "B" TO 1'-6" MIN. COVER OVER THE CAP.

**CONSTRUCTION SEQUENCE**  
NOT TO SCALE

**REVISIONS**

Revision	Date	Description
0	7/15/2024	FOR CLIENT REVIEW
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Approved by: JSA



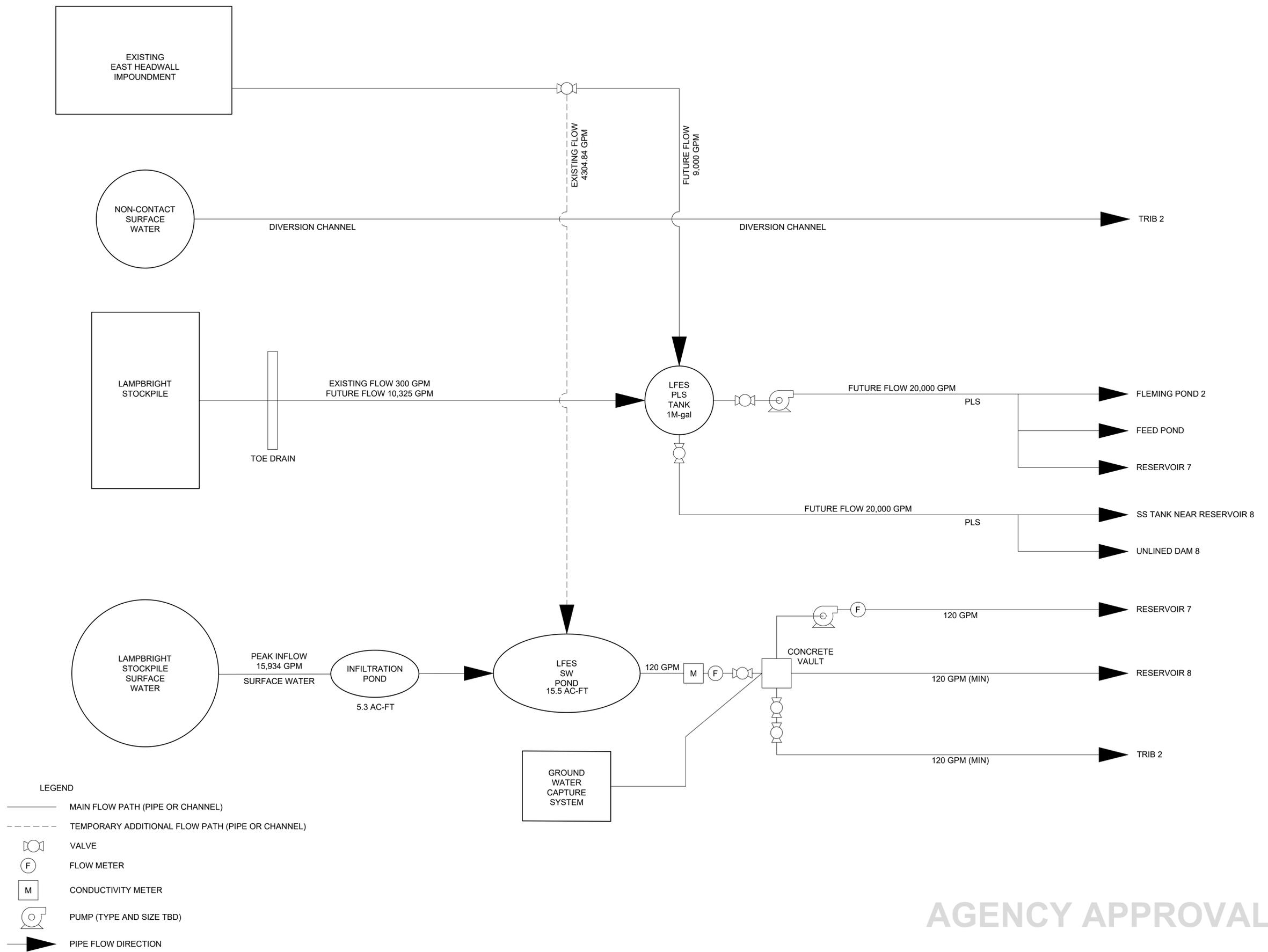
**LAMPBRIGHT  
FAR EAST SUMP (LFES)  
PLS COLLECTION SYSTEM,  
STORMWATER POND  
AND MSE WALLS**

**HILFIKER WALL  
CONSTRUCTION  
SEQUENCE**

**AGENCY APPROVAL**

Project Number:	111073
Date:	July 30, 2024
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- LEGEND**
- MAIN FLOW PATH (PIPE OR CHANNEL)
  - - - TEMPORARY ADDITIONAL FLOW PATH (PIPE OR CHANNEL)
  - ⊗ VALVE
  - (F) FLOW METER
  - (M) CONDUCTIVITY METER
  - ⊕ PUMP (TYPE AND SIZE TBD)
  - ▶ PIPE FLOW DIRECTION

**AGENCY APPROVAL**

REVISIONS	
Revision	Description
0	FOR CLIENT REVIEW
1	FOR AGENCY APPROVAL

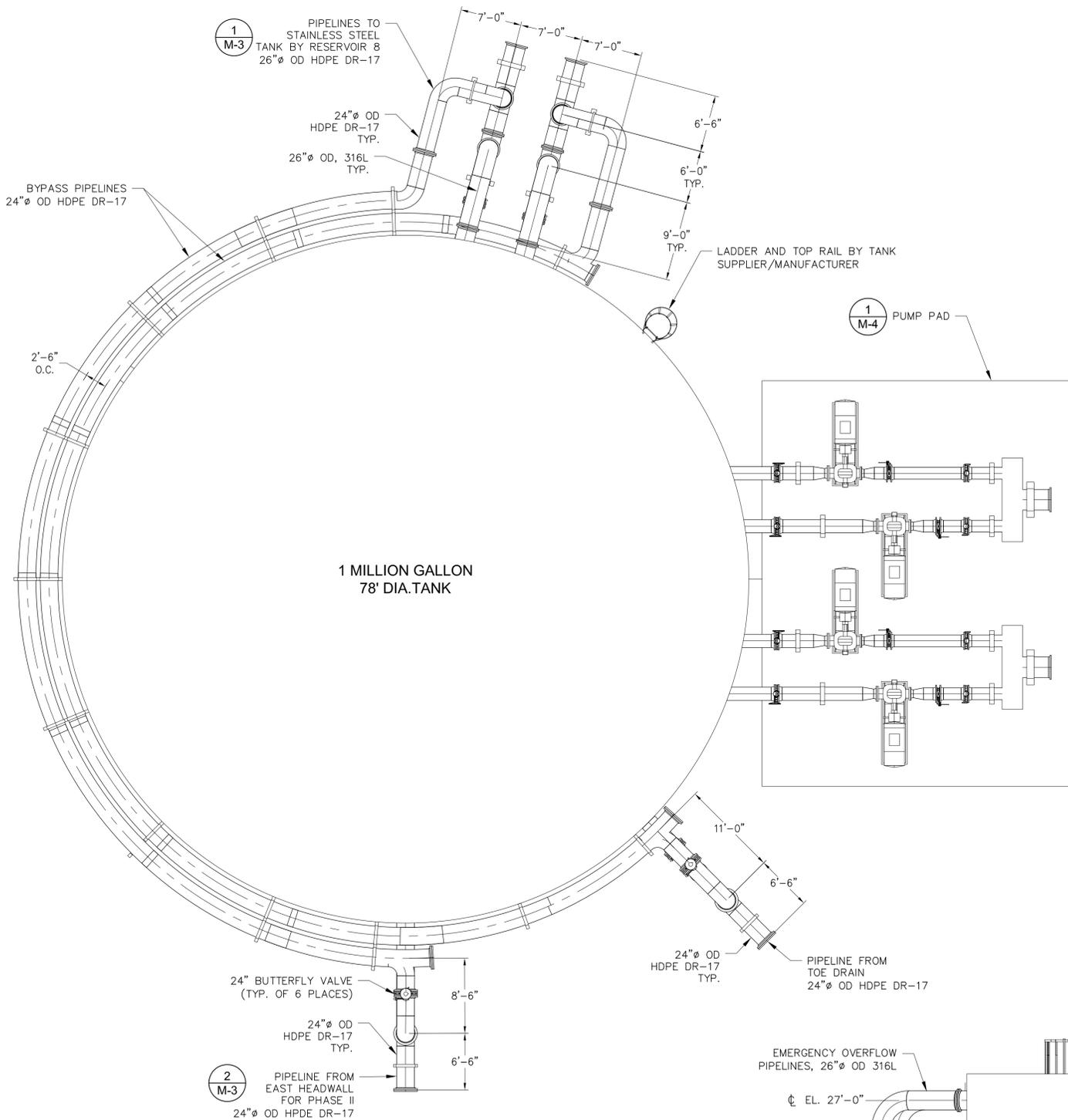
Designed by:	Engineering Analytics, Inc. 1600 Spectra Point Road, Suite 209 Chino, CA 91710 (970) 488-3111
Designed by:	DBS
Approved by:	JSA

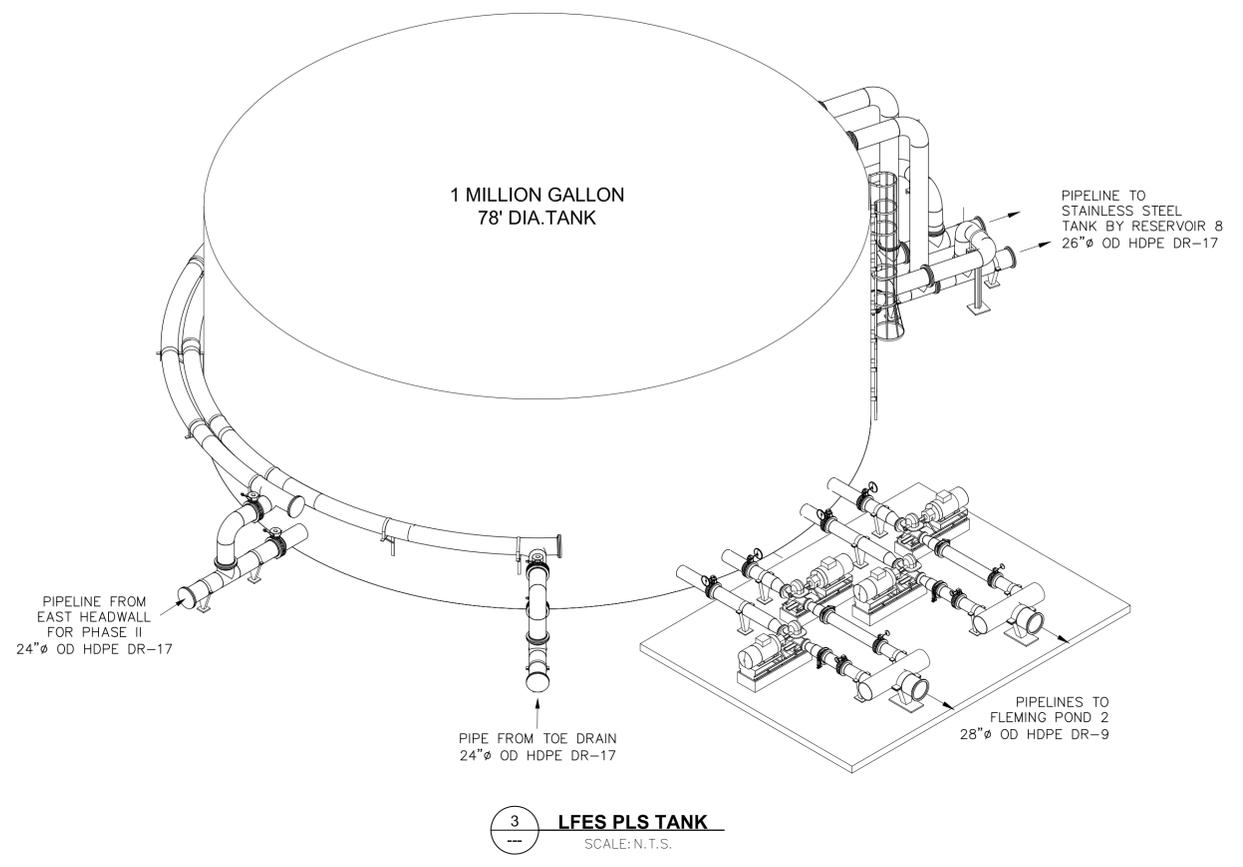
**LAMPBRIGHT FAR EAST SUMP (LFES) PLS COLLECTION SYSTEM, STORMWATER POND AND MSE WALLS**

**P & ID**

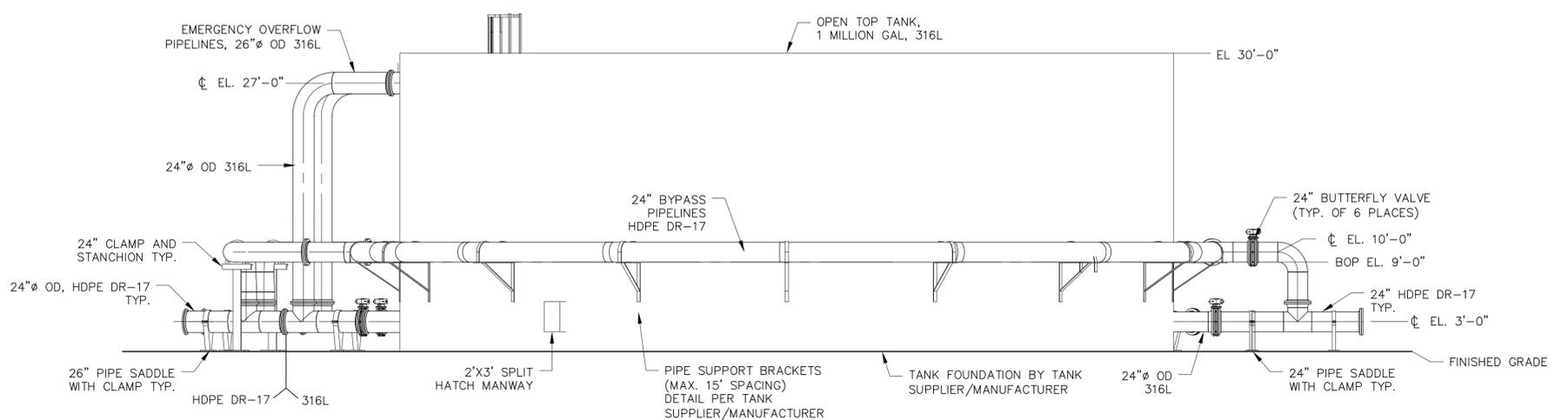
Project Number:	111073
Date:	July 30, 2024
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1 M-2 LFES PLAN VIEW  
SCALE: 1/8" = 1'-0"



2 LFES LEFT SIDE ELEVATION VIEW  
SCALE: 1/8" = 1'-0"



REVISIONS		
Description	Date	Revision
FOR CLIENT REVIEW	7/15/2024	0
FOR AGENCY APPROVAL	7/30/2024	1

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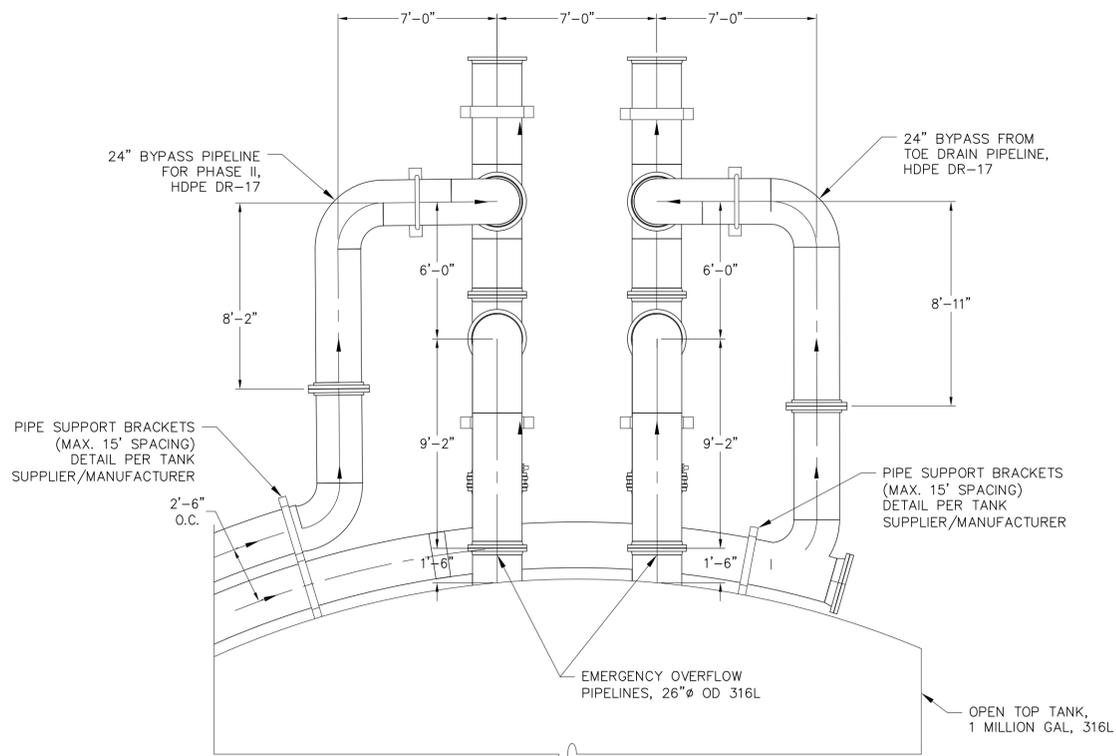


LAMPBRIGHT  
FAR EAST SUMP (LFES)  
PLS COLLECTION SYSTEM,  
STORMWATER POND  
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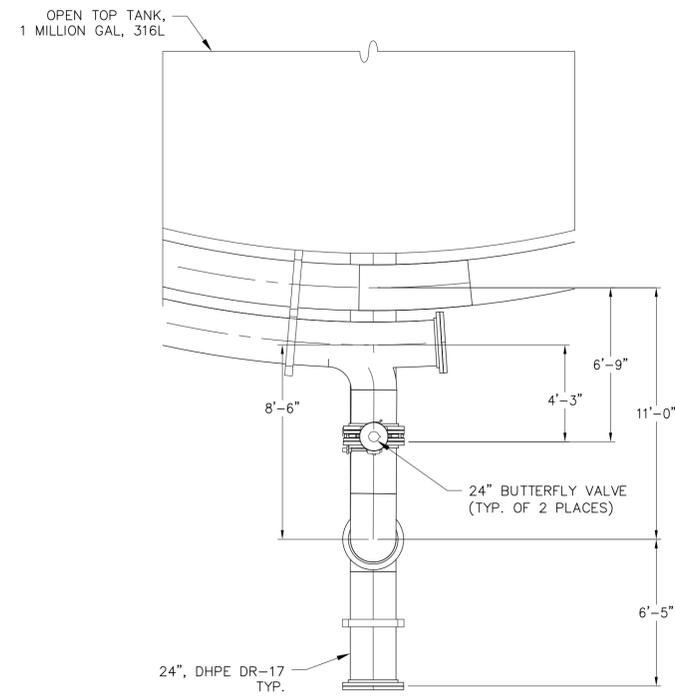
TANK PIPING  
DETAILS

Project Number: 111073  
Date: July 30, 2024  
Sheet: M-2

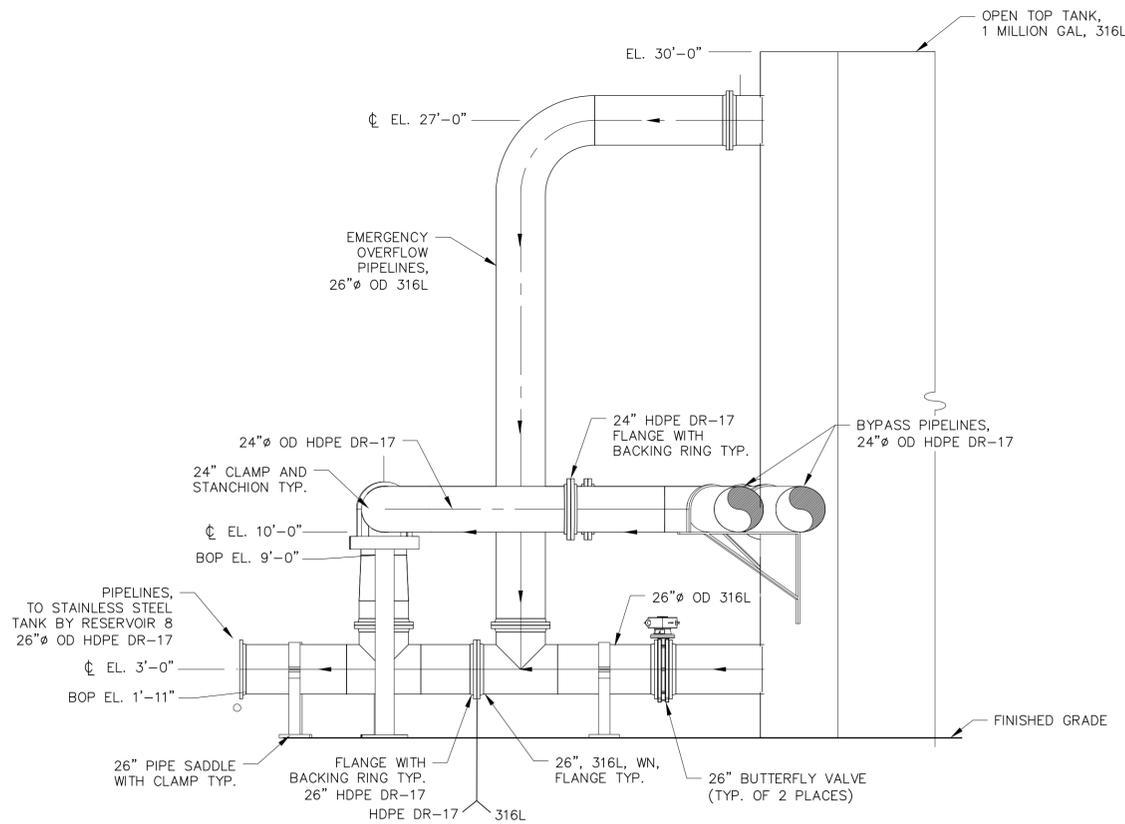
AGENCY APPROVAL



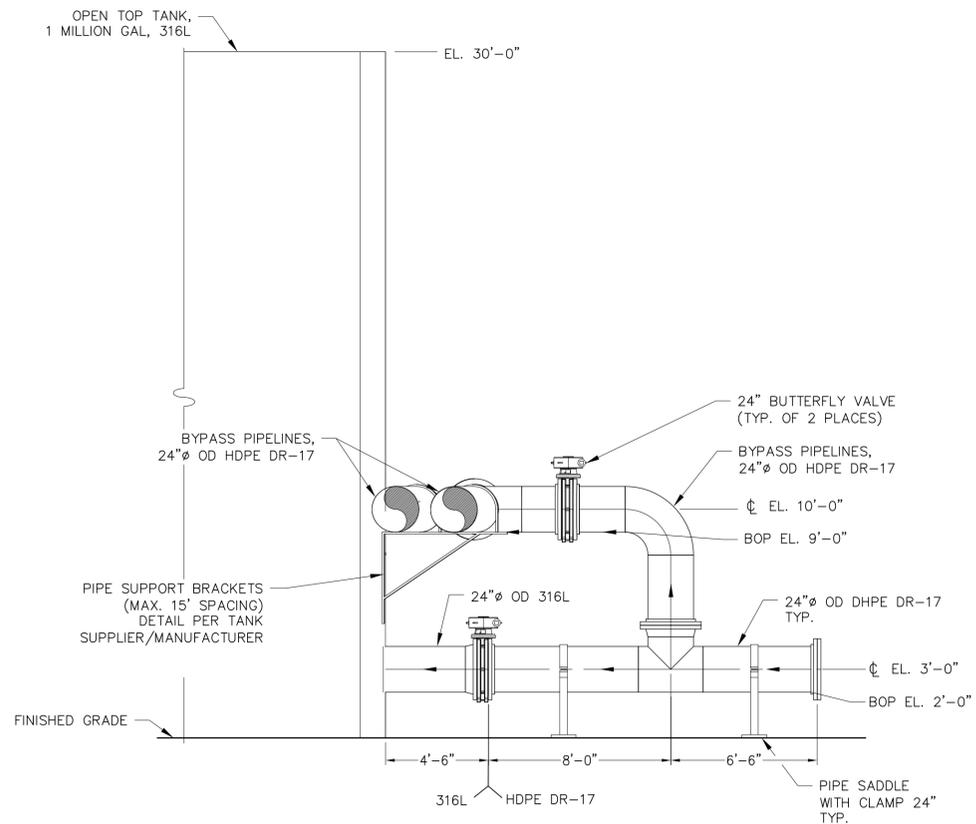
1 PLAN VIEW  
M-2 SCALE: 1/4"=1'-0"



PLAN VIEW  
SCALE: 1/4"=1'-0"



4 PIPELINES TO TANK BY RESERVOIR - DETAIL  
SCALE: 1/4"=1'-0"



5 BYPASS PIPELINE - TYPICAL DETAIL  
SCALE: 1/4"=1'-0"

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Engineering Analytics, Inc.  
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Approved by: JSA



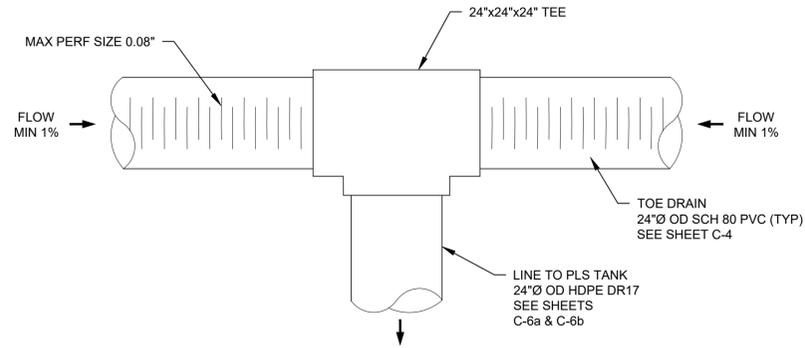
LAMPBRIGHT  
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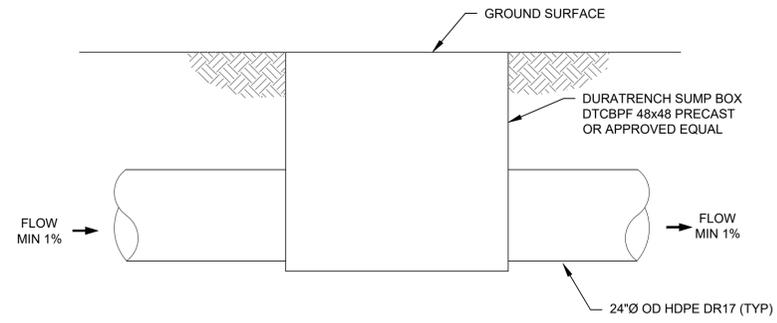
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Date:	July 30, 2024
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AGENCY APPROVAL

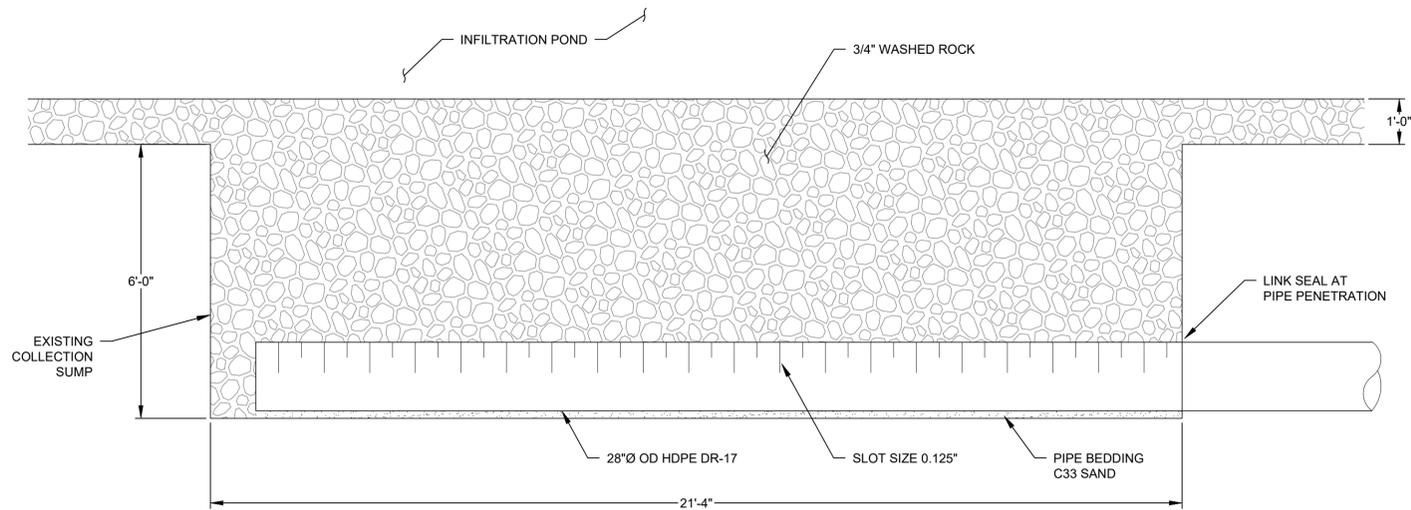




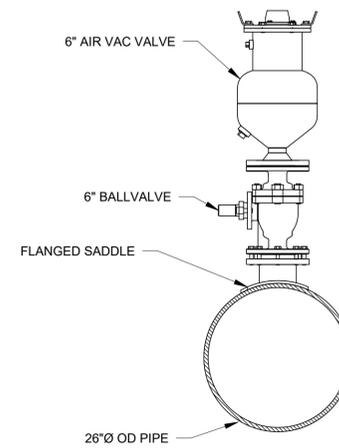
1 TOE DRAIN TEE  
C-4 SCALE: 1/2" = 1'-0"



2 DROP INLET AT TOE OF WALL  
C-4 SCALE: 1/2" = 1'-0"



3 SETTling POND DRAIN DETAIL  
C-4 SCALE: 1/2" = 1'-0"



4 AIR VAC DETAIL  
NOT TO SCALE

REVISIONS

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1	7/30/2024	FOR AGENCY APPROVAL

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Engineering Analytics, Inc.  
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LAMPBRIGHT  
FAR EAST SUMP (LFES)  
PLS COLLECTION SYSTEM,  
STORMWATER POND  
AND MSE WALLS

PIPING DETAILS

Project Number:	111073
Date:	July 30, 2024
Sheet:	M-5

AGENCY APPROVAL

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# Construction Specifications

**PROJECT SPECIFICATIONS  
FOR AGENCY REVIEW**

**LAMPBRIGHT FAR EAST SUMP**

**August 7, 2024**

PREPARED FOR  
**Freeport-McMoRan**  
Chino Mine  
Silver City, NM

PREPARED BY  
**Engineering Analytics, Inc.**  
1600 Specht Point Road  
Fort Collins, CO. 80525

# LAMPBRIGHT FAR EAST SUMP PROJECT

## CONSTRUCTION SPECIFICATIONS

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# **DIV 1 – GENERAL REQUIREMENTS**

## SECTION 01010

### SUMMARY OF WORK

#### 1.1 DOCUMENTS

A. Drawings: Lampbright Far East Sump Design Set.

1. Do not scale drawings
2. Take all dimensions and measurements from actual equipment to be furnished. All dimensions and measurements must be verified in the field. Locations, distances, and elevations will be governed by actual field conditions.
3. Owner will provide surveying of the alignment prior to construction. Contractor shall be responsible for all surveying and measurements taken in the field for final (as-built) documentation.

#### 1.3 WORK SEQUENCE

- A. Contractor shall determine the sequence of activities consistent with the requirements of the Contract Documents.

#### 1.4 DELIVERY & RECEIPT OF EQUIPMENT AND MATERIALS

- A. Contractor is responsible for the delivery, receipt, storage, protection and use of equipment and materials in conjunction with this Work. Owner will not receive or take any responsibility for other equipment and materials delivered to the site. Contractor will assume responsibility for loading, unloading, storage, and protection of equipment and materials.

#### 1.5 NOTICE TO OWNERS AND AGENCIES

- A. Give notification sufficiently in advance to enable affected persons to provide for their needs when necessary.

#### 1.6 PHOTO DOCUMENTATION

- A. The Owner or Owner's representative shall photo-document the entire project prior to start of construction for documentation of existing conditions.
- B. Contractor shall photo-document detailed elements of work as it is performed and submit photos to Owner's representative weekly, at a minimum.

#### 1.7 SITE REQUIREMENTS

- A. Contractor will comply with applicable Mine Safety and Health Administration (MSHA) requirements.

- B. Contractor shall develop its own project-specific Health and Safety Plan, and shall also abide by Owner's Health and Safety requirements.

END OF SECTION

## SECTION 01040

### COORDINATION

#### 1.1 GENERAL

- A. Contractor is responsible for the coordination of operations under the Contract in a manner which will facilitate progress of the Work.
- B. Conform to the requirements of concerned public agencies in respect to the timing and manner of performance of operations which affect the requirements or service of utilities, agencies, or public safety.
- C. If difficult conditions develop or are encountered, or if conditions differ materially from those shown on the drawings, Contractor shall prepare, at Engineer's request, large-scale drawings showing proposed solutions for Engineer's acceptance.
- D. Coordinate activities with Owner.

#### 1.2 CONFERENCES

- A. Contractor shall hold conferences for coordination of the Work when necessary.
- B. Owner may hold coordination conferences to be attended by all involved when Contractor's operations affects, or is affected by, the work of others.
  - 1. Contractor shall participate in such conferences accompanied by Subcontractors as required by Owner.

#### 1.3 PROGRESS MEETINGS

- A. Contractor shall schedule and hold regular progress meetings at the Freeport-McMoRan Chino Mine at least weekly, and at other times as requested by the Owner's Representative or Owner or as required by the progress of the work.
- B. Attendance shall include:
  - 1. Contractor and Superintendent.
  - 2. Owner's Representative(s).
  - 3. Others as may be requested by Contractor or Owner.
- C. Minimum agenda shall include:
  - 1. Review of work progress since last meeting.
  - 2. Identification and discussion of items which may affect work.
  - 3. Review of any pending change orders.
  - 4. Revision of Construction Schedule as appropriate.
- D. Owner, or Owner's designated representative, shall preside at meetings and record and distribute minutes to the participants.

END OF SECTION

## SECTION 01310

### CONSTRUCTION SCHEDULES

#### 1.1 GENERAL

- A. This section covers the planning, scheduling and reporting of all activities required to complete the Work. The construction schedules shall include an arrow diagram, tabulated schedules, and a Shop Drawing schedule.
- B. For special restrictions on float and time extensions reference is made to the Agreement.
- C. Special attention is directed to the requirements of the following:
  - 1. Section 01016, Maintenance of Operations.
  - 2. Section 01010, Summary of Work.

#### 1.2 SUBMITTAL

- A. Submit three copies of the arrow diagram, tabulated schedule and Shop Drawings schedule within fourteen (14) days of the Notice of Award.
- B. Review the arrow diagram and schedules with Owner, Contractor, Engineer, Resident Project Representative, and Contractor's Representative who prepared the schedule within 5 days of submittal.
- C. Revise and resubmit the arrow diagram and schedules at least 10 days prior to submitting the first Application for progress payment.
- D. Failure to submit an approved arrow diagram and schedule will be considered cause for withholding progress payments.

## 1.3 CONTENT

### A. Arrow Diagram.

1. Activity-on-arrow type in sufficient detail to indicate:
  - a. Shop Drawing receipt from manufacturer, submittal to Engineer, review and return to Contractor.
  - b. Equipment order, manufacturer, delivery, installation, start-up and testing.
  - c. Concrete pours.
  - d. Subcontractor items of work: include a code to identify subcontractor responsibility for each activity.
2. Activity breakdown.
  - a. Coordinate the activity breakdown with the schedule of values or bid item list.
  - b. Do not show activities of less than one day duration.
3. Label each activity to show:
  - a. Brief description of activity.
  - b. Total float.
  - c. Contractor or Subcontractor responsibility.
  - d. Estimated duration of the activity in working days.
4. Indicate the critical path of activities with a heavy line.
5. The arrow diagram may be divided into a number of separate sheets with suitable notations relating the interface between sheets.
  - a. Maximum sheet size: 22" by 34".

### B. Tabulated schedules.

1. Prepare three computer chronological schedules showing for each activity:
  - a. Early starting date.
  - b. Degree of criticalness (float).
  - c. Estimated duration.
  - d. Activity description.
  - e. Responsibility.
2. Preface each tabulation with:
  - a. Project name.
  - b. Contractor.
  - c. Type of tabulation (Initial or updated).
  - d. Project duration.
  - e. Project scheduled completion date.
  - f. The effective or starting date of the schedule.
  - g. If an updated schedule, the new project completion date and project status.

### C. Shop Drawing schedule.

1. Prepare a schedule of the items of materials and equipment for which Shop Drawings are required.
2. For each Shop Drawing indicate:
  - a. Date of submittal to Engineer.
  - b. Required date of return to Contractor.
3. For minimum time of review reference Section 01340.

## 1.4 REPORTING

- A. Submit updated schedules as specified in 1.3.B. and 1.3.C. above with each application for progress payment.
  - 1. Identify:
    - a. Activities that have been completed with actual start and completion dates.
    - b. Percent complete and remaining duration of each activity on which work is currently in progress.
- B. Submit a revised arrow diagram at least every 14 days to reflect changes in the progress of the Work.
- C. Submit with each application for progress payment a statement detailing corrective actions that will be taken for activities which are not expected to be completed within the time available (including any float time).
- D. Failure to submit updated schedules, revised arrow diagrams, or corrective action statements as specified in paragraphs 1.5.A., B. and C. above will be considered cause for withholding of progress payments.

## 1.5 DISTRIBUTION

- A. Distribute copies of the most current arrow diagram and schedules as follows:
  - 1. Three copies and one reproducible copy to Engineer for transmittal to Owner, Resident Project Representative and Professional Associates when appropriate.
  - 2. Job site file.
  - 3. Project record documents.
  - 4. Subcontractors when appropriate.
- B. Instruct recipients to promptly report to Contractor, in writing, problems anticipated with the projections shown in the schedules.

## 1.6 ENGINEER'S RESPONSIBILITY

- A. Engineer's review of the schedules is only for the purpose of checking conformity with the Contract Documents and assisting Contractor in coordinating the Work with the needs of the Project. It is not to be construed as relieving Contractor from any responsibility to determine the means, methods, techniques, sequences and procedures of construction.

END OF SECTION

## SECTION 01340

### SHOP DRAWINGS

#### 1.1 GENERAL

- A. Submit Shop Drawings, and other submittals as required by individual specification sections.
  - 1. Engineer will not accept Shop Drawings or other submittals from anyone but Contractor.
  - 2. In relation to the requirements of the General Conditions on the Contractor's review, the Contractor assumes full responsibility and risk for misfits due to errors in Contractor's submittals. Contractor is responsible for the dimensions and the design of adequate connections and details.
- B. Schedule: Reference Section 01310, Construction Schedules. Submittals received by Engineer prior to the time set forth in the approved schedule will be reviewed at any time convenient to Engineer before the time required by the schedule. The Engineer will have a minimum of 7 days for review of submittals.
- C. Any need for more than one resubmission, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Time unless delay of the Work is directly caused by failure of Engineer to return any scheduled submittal within 15 days after receipt in his office of all information required for review of the submittals or for any other reason which prevents Engineer's timely review. Failure of Contractor to coordinate submittals that must be reviewed together will not entitle Contractor to an extension of Contract Time or an increase in Contract Price.
- D. Resubmit for review a correct submittal if errors are discovered during manufacture or fabrication.
- E. Do not use materials or equipment for which Shop Drawings or samples are required until such submittals, stamped by Contractor and properly marked by Engineer, are at the site and available to workmen.
- F. Do not use Shop Drawings which do not bear Engineer's mark "NO EXCEPTION TAKEN" in the performance of the Work. Review status designations listed on Engineer's submittal review stamp are defined as follows:
  - 1. NO EXCEPTION TAKEN  
Signifies material or equipment represented by the submittal conforms with the design concept, complies with the information given in the Contract Documents and is acceptable for incorporation in the Work. Contractor is to proceed with fabrication or procurement of the items and with related work. Copies of the submittal are to be transmitted for final distribution.
  - 2. REVISE AS NOTED  
Signifies material or equipment represented by the submittal conforms with the design concept, complies with the information given in the Contract Documents and is acceptable for incorporation in the Work in accordance with Engineer's notations. Contractor is to proceed with the Work in accordance with Engineer's notations and

is to submit a revised submittal responsive to notations marked on the returned submittal or written in the letter of transmittal.

3. REJECTED

Signifies material or equipment represented by the submittal does not conform with the design concept or comply with the information given in the Contract Documents and is not acceptable for use in the Work. Contractor is to submit submittals responsive to the Contract Documents.

4. FOR REFERENCE ONLY

Signifies submittals which are for supplementary information only; pamphlets, general information sheets; catalog cuts, standard sheets, bulletins and similar data, all of which are useful to Engineer or Owner in design, operation, or maintenance, but which by their nature do not constitute a basis for determining that items represented thereby conform with the design concept or comply with the information given in the Contract Documents. Engineer reviews such submittals for general information but not for substance.

## 1.2 SUBMITTAL REGISTER

A. The Contractor shall complete the Submittal Register and submit with the Final Construction Schedule submittal. Resubmit an updated Submittal Register with each application for progress payment until all submittals are accepted by the Engineer. A copy of the format of the Submittal Register is provided at the back of this section, Contractor may reproduce the form for their use.

B. Instructions for Completing the Submittal Register:

Column 1: References, specification section, and paragraph in which submittal is requested for each item of equipment or material.

Column 2: Describes types of submittal required, i.e., shop drawing, certificate, etc.

Column 3: Material or item for which submittal is required.

Column 4: Contractor shall provide the date that he intends to make each submittal.

Column 5: Contractor shall provide that date by which each submittal must be approved to accomplish timely incorporation into the project.

Column 6: Contractor shall provide the mailing date of the initial submittal is made to the Engineer.

Column 7: Contractor shall record the review action of the Engineer to the last submit for the item, equipment, or material.

Column 8: Contractor shall record the mailing date of subsequent submittal for each item, equipment, and material until submittal is accepted by Engineer.

Column 9: Contractor may record remarks as necessary to coordinate with other submittals or provide necessary information.

## 1.3 SHOP DRAWINGS

- A. Include the following information as required to define each item proposed to be furnished.
1. Fabrication drawings.
  2. General outline drawings of items showing overall dimensions, location of major components, and weights.
  3. Relation to adjacent or critical features of the Work or materials.
  4. Field dimensions, clearly identified as such.
  5. Applicable standards, such as ASTM or Federal Specification numbers.
  6. Type and model number of materials/equipment.
  7. Drawings, catalogs or parts thereof, manufacturer's specifications and data, instructions, performance characteristics and capacities, and other information specified or necessary:
    - a. For Engineer to determine that the materials and equipment conform with the design concept and comply with the intent of the Contract Documents.
    - b. For the proper installation, and maintenance of the materials and equipment which Engineer will review for general information but not for substance.
    - c. For Engineer to determine what supports, anchorages, structural details, connections and services are required for materials and equipment, and the effect on contiguous or related structures, materials and equipment.
  8. Parts, devices, controls and accessories forming a part of equipment.
  9. Complete dimensions, clearances required, design criteria, materials of construction and the like to enable Engineer to review the information effectively.
  10. Bills of materials and lists of spare parts being provided.
  11. Color cards and similar items.
  12. Net weight of completed equipment assemblies.
  13. Manufacturer's name, model number, and descriptive literature for all component parts described by a Specification Section.
- B. Manufacturer's standard drawings, schematics and diagrams:
1. Delete information not applicable to the Work.
  2. Supplement standard information to provide information specifically applicable to the Work.
- C. Manufacturer's warranties: reference Section 01740.
- D. Format.
1. Present in a clear and thorough manner.
  2. Minimum sheet size: 8½" x 11".
  3. Clearly mark each copy to identify pertinent products and models.
  4. Individually annotate standard drawings which are furnished, cross out items that do not apply, describe exactly which parts of the drawing apply to the equipment being furnished.
  5. Individually annotate catalog sheets to identify applicable items.
  6. Provide a separate transmittal form for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken

together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole.

7. Reproduction or copies of portions of Contract Documents:
  - a. Not acceptable as complete fabrication drawings.
  - b. Acceptable when used as a drawing upon which to indicate information on erection or to identify detail drawings.
8. Clearly identify the following:
  - a. Date of submission.
  - b. Project title and number.
  - c. Names of Contractor, Supplier and Manufacturer.
  - d. Specification section number, specification article number for which items apply, intended use of item in the work, and equipment designation.
  - e. Identify details by reference to sheet, detail, schedule or room numbers shown in the Contract Documents.
  - f. Deviations from Contract Documents. Revisions on resubmittals.
  - g. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and the Contract Documents.

#### 1.4 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other contractor.
- B. Each submittal shall have the Shop Drawing Submittal Record attached and filled out properly by Contractor.
- C. Do not submit operation and maintenance data with Shop Drawings unless so specified or required by Engineer to determine if equipment will comply with the Contract Documents.
- D. Minimum number required
  1. Shop Drawings.
    - a. If by Hardcopy, the number Contractor requires (a maximum of six), plus three (3) copies which will be retained by Engineer. If Electronic Copy, one copy to Engineer.
    - b. Submit four (4) additional copies (no exception taken) for inclusion in Operation and Maintenance manuals where Operation and Maintenance manuals are called for. Where field modifications are made after acceptance, indicate "as constructed" conditions, mark copies "AS CONSTRUCTED", and submit prior to Substantial Completion.

#### 1.5 RESUBMISSION REQUIREMENTS

- A. Each resubmittal shall have the Shop Drawing Submittal Record attached and filled out properly by Contractor.
- B. Make corrections or changes required by Engineer and resubmit until accepted.

- C. In writing call Engineer's attention to deviations that the submittal may have from the Contract Documents.
- D. In writing call specific attention to revisions other than those called for by Engineer on previous submissions.
- E. Shop Drawings.
  - 1. Include additional drawings that may be required to show essential details of any changes proposed by Contractor along with required piping layouts.

# SHOP DRAWING SUBMITTAL RECORD

(To accompany each and every submittal)

Contractor: \_\_\_\_\_

Date of Submittal: \_\_\_\_\_

Name of Supplier: \_\_\_\_\_

Name of Manufacturer: \_\_\_\_\_

Specification Section Number: \_\_\_\_\_

Specification Article Number: \_\_\_\_\_

Is this 1st, 2nd, 3rd, 4th, etc. submittal of this section?

(Circle one) 1 2 3 4 or \_\_\_\_\_

Is this the 1st, 2nd, 3rd, 4th, etc. submittal of this submittal?

(Circle one) A B C D or \_\_\_\_\_

Intended use of item in work: \_\_\_\_\_

Equipment designation: \_\_\_\_\_

Drawing sheet number where item is found: \_\_\_\_\_

Detail or Section Number where item is found: \_\_\_\_\_

All deviations from the Contract Documents are hereby noted:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Check if additional items are noted on sheets attached to this form and list number of attached sheets: items \_\_\_\_\_; sheets \_\_\_\_\_

We hereby certify that we have reviewed the referred submittal and find it to be in compliance with the requirements of the Work and Contract Documents; with the exception of the deviations noted above. It is understood that if in the opinion of the Engineer this submittal has not been adequately reviewed, the submittal will be returned prior to any review by the Engineer. It is further understood that the time required to return the inadequately reviewed submittal and resubmit it, will not entitle Contractor to extension of the Contract Time or Contract Price, even if the item(s) are on the critical path.

Date: \_\_\_\_\_

Signature: \_\_\_\_\_  
(Contractor)



## SECTION 01410

### TESTING

#### 1.1 GENERAL

- A. Provide such equipment and facilities as the Engineer may require for conducting field tests and for collecting and forwarding samples.
  - 1. Do not use any materials or equipment represented by samples until tests, if required, have been made and the materials or equipment are found to be acceptable.
  - 2. Any product which becomes unfit for use after approval, hereof, shall not be incorporated into the work.
- B. Materials or equipment proposed to be used may be tested at any time during their preparation or use. Furnish the required samples without charge and give sufficient notice of the placing of orders to permit the testing. Products may be sampled either prior to shipment or after being received at the site of the work.
- C. Tests shall be made by an accredited testing laboratory selected by the Owner. Except as otherwise provided, sampling and testing of all materials and the laboratory methods and testing equipment shall be in accordance with the latest standards and tentative methods of the American Society for Testing Materials (ASTM).
- D. Where additional or specified information concerning testing methods, sample sizes, etc., is required, such information is included under the applicable sections of the Specifications. Any modification of, or elaboration on, these test procedures which may be included for specific materials under their respective sections in the Specifications shall take precedence over the procedures referenced in C. above.
- E. Reports of tests made by testing laboratory shall be distributed as follows:
  - 1. Contractor - one copy
  - 2. Owner - one copy
  - 3. Engineer - two copies

#### 1.2 OWNER'S RESPONSIBILITIES

- A. Owner shall be responsible for and shall pay all costs in connection with testing for the following:
  - 1. Tests not called for by the Specifications for materials delivered to the site, but deemed necessary by Engineer.

#### 1.3 CONTRACTOR'S RESPONSIBILITIES

- A. In addition to those inspections and tests called for in the Contract, Contractor shall also be responsible for and shall pay all costs in connection with testing required for the following:
  - 1. Performance and field testing specifically called for by the specifications.
  - 2. Retesting for Work or materials found defective or unsatisfactory, including tests covered under 1.2 above.
    - a. Quantity and nature of tests: Determined by Owner.

- b. Tests: taken in presence of Engineer.
  - c. Proof of noncompliance: Contractor liable for correction action which Owner feels is required including complete removal and replacement of defective material or equipment.
3. Testing of pressure piping systems, including connections to water system, if required, along with appurtenances.
  4. Testing of gravity piping systems.
  5. Testing required under Specifications for acceptance of materials, including those listed under 1.2 above.
  6. Tests of material or equipment offered as substitute for specified item on which tests may be required in order to prove its compliance with specifications.

#### 1.4 CONTRACTOR'S QUALITY CONTROL SYSTEM

- A. General: The Contractor shall establish a quality control system to perform sufficient inspection and tests of all items of work, including that of his subcontractors, to ensure conformance to the functional performance of this project. This control shall be established for all construction except where the Contract Documents provide for specific compliance tests by testing laboratories employed by the Owner. Contractor's control system shall specifically include all testing required by the various sections of the Specifications.
- B. Contractor's quality control system is the means by which he assures himself that his construction complies with the requirements of the Contract Documents. Controls shall be adequate to cover all construction operations and should be keyed to the proposed construction schedule.
- C. Records: Maintain correct records on an appropriate form for all inspections and tests performed, instructions received from the Engineer or Owner and actions taken as a result of those instructions. These records shall include evidence that the required inspections or tests have been performed (including type and number of inspections or test, nature of defects, causes for rejection, etc.) proposed or directed remedial action, and corrective action taken. Document inspections and tests as required by each section of the Specifications. Provide copies to Engineer weekly.

END OF SECTION

## SECTION 01531

### ENVIRONMENTAL SAFETY AND WORKER PROTECTION

#### PART 1 GENERAL

##### 1.1 DESCRIPTION

A. Environmental safety and worker protection, including monitoring and exposure to workers and providing an appropriate response. In addition to the requirements under the Contractor Health & Policy Safety Program (attached to the Agreement), the following requirements will apply. In the case of conflict between this section and the Agreement the more worker-protective portion will apply.

##### 1.2 TRAINING

A. Mine Safety and Health Administration  
1. Comply with all requirements under the Law.

##### 1.3 CONTRACTOR HEALTH AND SAFETY PLAN

A. Contractor shall prepare and provide Owner a written, *site-specific* Health and Safety Plan (HASP) for Contractor's employees, Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work, no later than 3 days prior to beginning Work.

1. The HASP shall address the procedures and methods that will be implemented to ensure the safety of workers, the Owner, Owner's representatives, other site personnel associated with the project, and the general public during the period of construction.
2. The HASP shall ensure compliance with all local, state, and federal health and safety regulations regarding occupational health and safety applicable for the planned construction activities.
3. The HASP shall include Activity Hazard Analyses (AHAs) for each planned work activity, and the requirement for documented daily tailgate safety meetings.

##### 1.4 OWNER HEALTH AND SAFETY PLAN

A. In addition to the Contractor-supplied HASP, Contractor agrees to abide by the Owner's HASP, attachments to the HASP, and applicable Standard Operating Procedures.

END OF SECTION

## SECTION 01545

### PROTECTION OF PROPERTY

#### 1.1 GENERAL

- A. This section covers protection of property and its appurtenances, both private and public.
- B. Contractor shall be responsible for initiating, maintaining and supervising all the necessary protection to prevent damage, injury or loss to:
  - 1. The Work and materials and equipment to be incorporated in the project, whether in storage on or off the site: and
  - 2. Property at the site or adjacent thereto, including trees, vegetations, shrubs, lawns, walks, pavements, roadways, structures, equipment, utilities and Underground Facilities not designated for removal, relocation or replacement in the course of construction.
- C. Confine operations to within the smallest footprint possible.

#### 1.2 UNDERGROUND OBSTRUCTIONS

- A. Notify each utility owner and request utilities be field located by surface reference at least 48 working hours prior to trenching or excavation.
- B. Underground obstructions known to Engineer are shown on Drawings. However, locations shown may provide inaccurate and other obstructions not known to Engineer may be encountered.
- C. Sufficiently in advance of construction, expose and verify size, location and elevation of underground utilities and other obstructions where conflicts might exist to permit changes in alignment or grade in the event of conflict.
  - 1. Notify Engineer in case of conflict.
  - 2. In case of conflict the alignment or grade of the proposed Work may be changed by Engineer.
- D. Maintain, protect and support existing utilities and appurtenances by shoring, bracing or other means.
- E. Take such protective measures as the utility may direct where alternations or moving of utilities is required.

#### 1.3 ABOVE GROUND APPURTENANCES

- A. Maintain, protect, and support existing utilities and other appurtenances against damage by shoring, bracing, or other means. Contractor shall minimize disturbance of any existing steel pipe or other pipeline-related objects.
- B. Do not stockpile excavated material against existing appurtenances.

END OF SECTION

## SECTION 01560

### TEMPORARY CONTROLS

#### 1.1 NOISE CONTROL

- A. Take reasonable measures to avoid unnecessary noise when construction activities are being performed in populated areas.
- B. Construction machinery and vehicles shall be equipped with practical sound muffling devices, and operated in a manner to cause the least noise consistent with efficient performance of the Work.

#### 1.2 DUST CONTROL

- A. Dusty materials in piles or in transit shall be covered to prevent blowing.
- B. Earth surfaces subject to dust generation shall be kept moist with water or by application of a chemical dust suppressant.
  - 1. Chemical dust suppressant shall not be injurious to existing or future vegetation and shall be approved prior to use by regulatory agencies having jurisdiction.

#### 1.3 POLLUTION CONTROL

- A. Prevent the pollution of drains and water courses by sanitary wastes, concrete, sediment, debris and other substances resulting from construction activities.
  - 1. Retain spent oils, hydraulic fluids and other petroleum fluids in containers and dispose off the site.
  - 2. Prevent sediment, debris or other substances from entering sanitary sewers, storm drains, drainages, streams, diversion channels, and culverts.

#### 1.4 EROSION CONTROL

- A. Take such measures as are necessary to prevent erosion of soil that might result from construction activities.
  - 1. Measures in general will include:
    - a. Control of runoff.
    - b. Trapping of sediment.
    - c. Minimizing area and duration of soil exposure.
    - d. Best Management Practices shall be followed including temporary materials such as hay bales, sand bags, plastic sheets, riprap or culverts to prevent the erosion of banks and beds of watercourses or drainage swales where runoff will be increased due to construction activities.
- B. Preserve natural vegetation to greatest extent possible.
- C. Locate temporary storage and route construction traffic to agency-approved roadways so as to preserve vegetation and minimize erosion.

END OF SECTION

## SECTION 01590

### FIELD OFFICES AND SHEDS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Contractors shall furnish, install and maintain temporary field office.
- B. Furnish, install and maintain storage and work sheds needed for construction.

##### 1.2 LOCATION

- A. Field office and storage facilities will be determined by Contractor subject to Owner's and Engineer's acceptance.

##### 1.3 CONSTRUCTION

- A. Structurally sound, weathertight, with floors raised above ground.
- B. Temperature transmission resistance: Compatible with occupancy and storage requirements.
- C. At Contractor's option, portable or mobile buildings or trailers may be used if tied down adequately.
  - 1. Mobile homes or trailers, when used for offices, shall be modified for office use.
  - 2. Trailers may be used for storage sheds.
  - 3. Do not use as living quarters.

##### 1.4 STORAGE SHEDS

- A. Meet requirements of the various trades.
- B. Dimensions: Adequate for storage and handling of products.
- C. Ventilation and heating: Comply with requirements for the products stored.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. May be new or used, but must be serviceable, adequate for the required purpose, and must not violate applicable codes or regulations.

## PART 3 - EXECUTION

### 3.1 REMOVAL

- A. Remove temporary field offices and storage sheds, contents and services at a time they are no longer needed.
- B. Removal and cleanup is required for Final Acceptance.

END OF SECTION

## SECTION 01600

### MATERIALS AND EQUIPMENT

#### 1.1 PRODUCTS

- A. Products include material, equipment and systems.
  - 1. Comply with Specifications and referenced standards as minimum requirements.
  - 2. Components supplied in quantity within a Specification Section: Same and interchangeable.
  - 3. Do not use materials and equipment removed from existing premises or structures, except as specifically required, or permitted, by the Contract Documents.
- B. Products mean new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.

#### 1.2 COORDINATION

- A. Provide for space requirements, configuration, performance, changes in electrical and mechanical work, changes in bases, supports, structural work and other alterations in Work as required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Drawings or Specifications.
- B. Where Contract Documents permit selection from several options, or where substitutions are authorized, coordinate clearance and other requirements with other Work so that selected or substituted item operates properly and properly fits in the available space.
- C. Integrate and coordinate work so that the required performance of each item and system is achieved.
- D. Conduct work in a manner to avoid injury or damage to previously placed or existing work.

#### 1.3 TRANSPORTATION AND HANDLING

- A. Transport and handle products in accordance with product supplier's and/or manufacturer's instructions.
- B. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
  - 1. Reject damaged and defective items.

- D. Hoisting and stockpiling of materials and equipment on site.
  - 1. Palletized or packaged in appropriate containers in appropriate locations.

#### 1.4 STORAGE AND PROTECTION

- A. Store products in accordance with supplier's and/or manufacturer's recommendations.
  - 1. Keep seals and labels intact and legible.
  - 2. Store sensitive products in weather-tight, climate controlled enclosures maintained within temperature and humidity ranges recommended by manufacturer.
  - 3. Store loose granular materials on solid surfaces in well drained area; prevent mixing foreign matter.
- B. Exterior Storage Protection:
  - 1. Fabricated Products: Place on sloped supports above ground.
  - 2. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
- C. On-Site Storage:
  - 1. Contractor may store materials and equipment near the construction area. The Contractor assumes liability for use of this area in relation to the storage of materials and equipment at this site. It is the responsibility of the Contractor to obtain additional storage areas if needed. The Contractor may have to share this site for storage with other contractors with which the Owner may have contracts. Contractor's stored equipment and materials will not infringe or impede access to the water treatment plant or access around the water treatment plant. Contractor is responsible for the security and protection of stored materials and equipment.
- E. Inspection: Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under recommended conditions.
- F. Protection of Work: equipment left unconnected shall be capped, plugged or otherwise properly protected to prevent damage or the intrusion of foreign matter while in storage at the project site or during installation.

#### 1.5 INSTALLATION AND GENERAL CONSTRUCTION REQUIREMENTS

- A. Hold pre-installation meeting at site before installation of each major component of work which requires coordination with other units of work. Installer and manufacturer's representatives of particular work and affected work shall attend.
  - 1. Notify Engineer of meeting time.
  - 2. Discuss coordination of work with other work including Shop Drawings, Product Data, possible conflicts, compatibility concerns, acceptability of substrates, protection, etc.
  - 3. Record significant discussions at each meeting, agreements, disagreements and final plan of action. Distribute record to those in attendance and to Engineer.
  - 4. Do not proceed with unit of work until pre-installation meeting is successfully concluded with agreed upon place of action.
  - 5. Engineer may waive this requirement if he feels adequately informed at weekly

meetings.

- B. Inspection of Substrates: Require installer of each major unit of work to inspect substrate to receive work and conditions under which work is to be performed.
  - 1. Report unsatisfactory conditions to Contractor in writing with copy to Engineer.
  - 2. Do not proceed with work until unsatisfactory conditions have been corrected.
- C. Where installations include manufactured products, comply with manufacturer's applicable drawings, instructions, and recommendations for installation.
  - 1. Notify Engineer of conflicts between manufacturer's instructions or recommendation and requirements specified or indicated.
  - 2. Maintain copy of manufacturer's applicable drawings and printed instructions on-site.
- D. Provide attachment and correction devices and methods for securing work.
  - 1. Secure work true to line and level, and within specified tolerances, or if not specified, industry recognized tolerances.
  - 2. Allow for ample and normal expansion and contraction for building components and piping systems that are subject to such.
  - 3. Exposed Joints:
    - a. Provide uniform joint width.
    - b. Arrange joints to obtain best visual effect.
    - c. Refer questionable visual-effect choices to Engineer for final decision.
  - 4. Erect, install, and secure components in a structurally sound and appropriate manner.
- E. Provide dielectric unions or proper dielectric insulation where required for separation of dissimilar metals and protection from galvanic corrosion.
- F. Measurements and Dimensions: Recheck as integral step of starting each installation.
- G. Climatic Conditions and Product Status: Install each unit of work under conditions to ensure best possible results in coordination with entire project.
  - 1. Isolate each unit of work from incompatible work as necessary to prevent deterioration.
  - 2. Coordinate enclosure of work with required inspections and tests to minimize necessity of uncovering work for those purposes.
  - 3. Handle materials in a manner to prevent scratching, abrading, distortion, chipping, breaking, or other disfigurement.
- H. Furnish workmen and attendants on a continuous basis as required to complete activities that must be performed without interruption for proper results.
- I. Temporary Bracing, Shoring, or Other Support.
  - 1. Provide where necessary.
  - 2. Keep in place until final connections are installed.
  - 3. Leave in place as long as practical for safety and to maintain proper alignment.

- J. Leave finished surfaces smooth and flat, free from wrinkles, warps, scratches, dents, and other imperfections.
- K. Furnish materials in longest practical lengths and largest practical sizes to avoid unnecessary jointing.

#### 1.6 SPARE PARTS

- A. Turn spare parts over to Owner at Substantial Completion.
  - 1. Provide Owner with written list of spare parts being provided.

#### 1.7 PRODUCTS OPTIONS

- A. Reference Agreement and Contract Documents concerning product options, limitations on substitutions, "or equal", Contractor representation, and submittal procedures requirements.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

1.1 SUBSTANTIAL COMPLETION

- A. Substantial Completion is defined as having been achieved when Phase 3 (Section 01016 Maintenance of Operation, Article 1.3.D) is complete.
- B. All Work must be complete for Final Acceptance.

1.2 FINAL INSPECTION AND ACCEPTANCE

- A. Reference the conditions of the Contract.

END OF SECTION

## SECTION 01711

### SITE CLEANUP

#### 1.1 GENERAL

- A. Execute cleanup, during progress of the Work, and at completion of the Work.
- B. Adequate cleanup will be a condition for recommendation of progress payments.

#### 1.2 DESCRIPTION

- A. During the progress of the Work, Contractor shall keep the site and other areas free from accumulations of waste materials, rubbish, and other debris.
- B. Prior to Substantial Completion of the Work Contractor shall clean the site and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- C. Store volatile wastes in covered containers and dispose offsite.
- D. Provide on-site covered containers for the collection of waste materials, debris and rubbish.
- E. Neatly store construction materials, such as concrete forms, when not in use.
- F. Broom clean exterior paved surfaces and rake other exterior surfaces.

#### 1.3 DISPOSAL

- A. Debris, rubbish, and loose wastes shall not be buried or burned on the site or disposed of into storm drains, sanitary sewers, streams or waterways. Wastes shall be disposed as directed by Engineer or Owner and shall conform to applicable Laws and Regulations.
- B. Dispose of sanitary facility waste off-site in accordance with applicable Law and Regulations.

END OF SECTION

## SECTION 01720

### PROJECT RECORD DOCUMENTS

#### 1.1 GENERAL

- A. Maintain at the site one record copy of:
  - 1. Contract Documents
  - 2. Documents and samples called for in the Contract Documents
  - 3. Field Test Records

#### 1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. File documents and samples in accordance with the specification's section numbers.
- B. Maintain documents and samples in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

#### 1.3 RECORDING

- A. Label each document "PROJECT RECORD" in neat large printed letters.
- B. Record information concurrently with construction progress.
  - 1. Do not cover Work until required information is recorded.
- C. Marking of Project Records.
  - 1. Legible and with a dark pen or pencil.
  - 2. Ink shall not be water-based or subject to easy smearing.
- D. Mark Drawings to record actual construction.
  - 1. Field dimensions, elevations, and details.
  - 2. Changes made by a Modification.
  - 3. Details not on original Drawings.
  - 4. Horizontal and vertical locations of underground utilities and appurtenances, referenced to a minimum of two permanent surface improvements.
  - 5. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.

#### 1.4 SUBMISSION

- A. Provide one complete set of Record Documents to Owner as part of final completion. Accompany submittal with transmittal letter in duplicate containing:
  - 1. Date.
  - 2. Project title and number.
  - 3. Contractor's name, address, and telephone number.
  - 4. Index containing title and number of each Record Document.
  - 5. Signature of Contractor or his authorized representative.

END OF SECTION

## SECTION 01740

### WARRANTIES

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section describes the disposition of warranties submitted on the project.
- B. Requirements under the Agreement will take precedence if in conflict with this Section.
- C. It is explicitly understood that nothing in any warrantee shall relieve the Contractor from rights and privileges of the Owner as set forth in these Contract documents in relation to products and services as intended or described in these Contract documents.
- D. It is explicitly understood that manufacturer's warranties are an attempt to limit their liability under law. As a condition of warranties submitted by manufacturers or others on this project, it is understood that the requirements of this section supersede warranties submitted. Engineer will not review warranties as to substance of manufacturers trying to limit their liability. Such attempts to limit liability that is in violation of these Contract documents is void and without legal effect.
- E. The submittal of warranties on this project shall not in any way relieve Contractor of their responsibilities for Contractor's General Warranty and Guarantee and Correction Period as defined in the Agreement and related requirements contained in these Contract documents.

##### 1.2 SUBMITTAL OF WARRANTIES NOT CALLED FOR IN THE CONTRACT DOCUMENTS.

- A. If the time period of the Warranty falls within the correction period specified for the project the Warranty shall be without effect on the project. Contractor may use said Warranty for their own use if Contractor elects. The Engineer will not review said Warranties, if submitted.
- B. If Contractor submits Warranties and the time period of the Warranty exceeds the correction period specified for the project, these Warranties shall be accepted under the following conditions.
  - 1. Engineer shall not review the Warranty for substance.
  - 2. During the Correction Period of the project the Warranty shall be for the use of the Contractor as it relates to Contractor's responsibilities under the correction period.
  - 3. After the expiration of the correction period the rights under the Warranty shall pass to the Owner for Owner's use of their facilities.

##### 1.3 SUBMITTAL OF WARRANTIES CALLED FOR IN THE CONTRACT DOCUMENTS.

- A. Warranties called for in the Contract documents shall be accepted as follows:

1. Engineer will review the Warranty only to verify that the Warranty defines the requirements called for in the Contract documents.
2. During the Correction Period of the project the Warranty shall be for the use of the Contractor as it relates to Contractor's responsibilities under the correction period.
3. After the expiration of the correction period the rights under the Warranty shall pass to the Owner for Owner's use of their facilities.

END OF SECTION

## SECTION 01810

### HYDROSTATIC TESTING OF PIPE SYSTEM

#### PART 1 - GENERAL

##### 1.01 DESCRIPTION

- A. This specification describes hydrostatic testing to be performed on the completed all pipeline.
- B. Reference: The Hydrostatic Test shall be conducted in general conformance with Plastic Pipe Institute TN-46/2013a: Guidance for Field Hydrostatic Testing of High Density Polyethylene Pressure Pipelines: Owner's Considerations, Planning, Procedures, and Checklists.
- C. Hydrostatic Test Fluid
  - 1. Testing shall be conducted using water as the test fluid.
  - 2. *Pneumatic testing of the installed pipe shall be strictly prohibited.*
- D. All piping, service saddles, check valves and butterfly valves shall be installed prior to testing. Tests may be performed against service saddles and closed ball valves (e.g. drains, isolation valves), but shall not be performed against air-release or air-vacuum valves. Alternatively, contractor may provide temporary watertight plugs at service saddle nipples until tests pass. After system passes hydrostatic testing, remove plugs and thrust restraint and install valves per plans.
- E. The following procedural items shall be observed, at a minimum:
  - 1. The contractor shall provide equipment and personnel to perform the hydrostatic test.
    - a. Pressure gauges shall have up-to-date calibrations, with documentation.
    - b. Test equipment shall be able to maintain a continuous internal pipe pressure of 230 psi and accurately measure pressure in the pipe over a 3-hour minimum test period.
    - c. The maximum allowable pressure gauge increment shall be 5 psi.
    - d. A water meter shall be used to measure the amount of water used in pressurizing and depressurizing the system.
  - 2. Owner's Engineer shall witness hydrostatic tests. Provide a minimum of 7 days' advanced notice prior to testing.

#### PART 2 – HYDROSTATIC TEST

##### 2.01 PRE-TEST PROCEDURES

- A. Hydrostatic testing of the exposed and above-ground piping for shall be conducted only after the entire piping system has been installed, including pipe supports, hangers, anchors, and/or other appurtenances, as shown on the Drawings.

- B. Prior to filling the pipe with water for hydrostatic testing, the pipe shall be backfilled according to the Specifications, except as follows:
  1. For sections where the pipe is to be buried, backfill the pipe everywhere except within 5 feet of either side of joints to allow for leak inspection.
  2. Joints shall be backfilled after a satisfactory hydrostatic test result.

C. Filling Procedures

1. Contractor shall pump water into each section of pipe.
  - a. Water will not be allowed to run unchecked onto the ground in the area of the pipeline Work. Draining of small volumes of water from the testing is acceptable.
2. During initial filling, the pipeline shall be filled at a rate which will not cause surges nor will it exceed the rate at which the air can be released.
  - a. The fill rate shall not exceed 55 gallons per minute, and shall be recorded in the test documentation.
  - b. Air in the line shall be properly purged. Where air-release valves are not available or effective in purging air from the line, the Owner shall require a tap to purge the line. The location and the size of the tap shall be at the Owner's discretion.
  - c. Pipe shall remain filled with water for a minimum of 24 hours prior to the hydrostatic test to facilitate thermal equilibrium.

D. Test Temperature

1. The water and pipe temperature shall be less than 80 degrees Fahrenheit during the test, and shall be recorded in the test documentation.
2. If the water and pipe temperature are higher than 80 degrees, Engineer shall be notified to determine if modifications are required for the test pressure.

E. Test Sections and Sequences

1. Pipe shall be constructed and tested in the following sequence
  - a. Construct the DR 9, 11, and 17 HDPE pipe and the steel pipe, connect them together, and perform hydrostatic test on the combined section.
2. Test pressures shall be as follows:

Pipe Section	Test Pressure (psi)	Pressure Measurement Location
DR 17 HDPE and steel pipe		
DR 11 HDPE and steel pipe		
DR 9 HDPE and steel pipe		

2.02 HYDROSTATIC TEST PROCEDURE

A. Stage I- Preliminary Pressurization

1. Fill, vent and purge the pipe system of trapped air to less than 4% trapped air by volume. Allow 24 hours prior to test for air bleed-off and thermal equilibrium.
2. Close all air valves and drain valves.
3. Start Test Timer to **T=0** minutes.

4. Rapidly pressurize the test section to the specified test pressure (STP), within 10 minutes, if possible.
5. Hold the test pressure for 30 minutes by repetitively injecting small volumes of makeup water into the test section to sustain, but not exceed, the STP. Inspect exposed joints and connections for visible leaks during this time.
6. At **T=30** minutes, valve-off to isolate the test section, and record the confined STP as **P<sub>30</sub>**.
7. Allow the test pressure to decay for an additional 60 minutes (**T=90** minutes), and measure and record the pressure as **P<sub>90</sub>**.
8. Evaluate the test pressure as follows:
  - a. If  $P_{90} > 70\%$  of the STP, Stage I passes- proceed to Stage II
  - b. If  $P_{90} \leq 70\%$  of the STP, Stage I *fails* either because of a leak or excessive trapped air dissolving into the system. Depressurize the system and check for and repair leaks, and/or bleed off excess air and repeat Stage I.

**B. Stage II- Air Volume Assessment**

1. Quickly (< 5 minutes) and safely bleed out water from the pipeline so as to reduce the pressure by 10% to 15% of  $P_{90}$ . Accurately measure and record the pressure drop as  $\Delta P$ .
2. Accurately and safely measure and record the water volume bled out as  $\Delta V$ .
3. Calculate and record the following:

$$\Delta V_{\text{max allowable}} = 1.2 * V * \Delta P * [(1/E_W) + (D/(t * E_R))] = \text{___ gallons.}$$

Where:

- 1.2 = air allowance factor
- V = test pipe section water volume (gallons)
- $\Delta P$  = measured pressure drop (psi)
- t = nominal pipe wall thickness (inches)
- D = pipe inside diameter (inches)
- $E_W$  = Bulk Modulus of water (psi) from PPI TN-46/2013a
- $E_R$  = HDPE Pipe Modulus (psi) from PPI TN-46/2013a

4. If  $\Delta V \leq \Delta V_{\text{max allowable}}$ , Stage II passes; proceed to Stage III.
5. If  $\Delta V > \Delta V_{\text{max allowable}}$ , the test has *failed* and the cause must be corrected. Upon correction, Stages I and II shall be repeated until they pass.

**C. Stage III- Stabilization**

1. After the pressure was dropped in Stage II by 10% to 15%, and while the  $\Delta V$  calculation is made, the pressure should stabilize and remain constant to within  $\pm 5\%$  of the reduced pressure ( $P_{90} - \Delta P$ ) within 30 to 60 minutes. The test shall pass when the Stage III reduced pressure rebounds or remains static for 30 minutes.
2. The test fails if *either* the Stage III reduced pressure does not reach a 30-minute static condition within 90 minutes of the Stage II pressure reduction, *or* if any measurable or visible leakage is detected.
3. In the event of test failure, the cause of failure shall be evaluated and corrected, and the test shall be repeated from the beginning.

**D. Following a successful test, the pipe section shall be safely depressurized and drained.**

1. Open isolation valves for air-vacuum and air-release valves.
2. Connect hoses to the drain valves and drain the pipe to locations as approved by Engineer.

## 2.03 PASSING CRITERIA

- A. Passing of the pressure test shall be on the basis of passing all three stages of the test.
- B. No leakage is allowed through the bonnet of any valve or appurtenance. Any valve or appurtenance that leaks will be removed and replaced.
- C. Visible leaks shall be repaired regardless of the results of the hydrostatic test.

END OF SECTION

## **DIV 2 – SITE CONSTRUCTION**

## SECTION 02100

### SITE CLEARING

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section covers the requirements for removal of existing surface soil materials; clearing of vegetation and organic soils; and removal of surface debris and rubble as necessary in preparation for construction.

#### PART 2 - PRODUCTS

- A. Not Used

#### PART 3 - EXECUTION

##### 3.1 PREPARATION

- A. Contractor shall verify the extent of clearing necessary for the conduct of the Work and shall ensure that existing plant life and features (if any) designated by the Owner or Engineer to remain are clearly tagged or otherwise identified.

##### 3.2 CLEARING

- A. Contractor shall clear only those areas required for access to the site and execution of Work, and shall minimize disturbance to adjacent land, subject to the approval of Engineer.
- B. Maintain cleared materials separate from other excavated materials.
- C. Cover materials to protect against blowing as needed.

END OF SECTION

## SECTION 02130

### SURFACE WATER CONTROL

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This specification section covers the requirements for controlling surface water and sediment during construction.

##### 1.2 QUALITY CONTROL

- A. Surface water control shall be conducted in such a manner that does not result in the release of sediments or other excavated materials into adjacent water courses.
- B. Engineer may direct the Contractor to provide additional stormwater control measures as necessary.

#### PART 2 - PRODUCTS

##### 2.1 EQUIPMENT

- A. Contractor shall ensure that appropriate equipment and materials are available on site, prior to commencement of work, such that operation of the surface water control systems can be constructed and continuously maintained in a timely manner. All equipment and materials shall be of good quality and in good working order.

##### 2.2 MATERIALS

- A. Hay or straw bales, silt fences, or other materials used to control erosion and sediment transport from surface run off and other work areas shall be new and appropriately sized to serve the intended purpose.
- B. Use 30- to 36-inch high silt fences including lath (posts) for stability.

#### PART 3 - EXECUTION

##### 3.1 SEDIMENT CONTROL AND DIVERSIONS

- A. Provide sedimentation control to prevent sediment loading to drainages.
- B. Provide silt fences with suitable posts and proper anchorage along the entire length of each silt fence, in accordance with the manufacturer's recommendations around the perimeter of the work area.
- C. Provide hay bale check dams at areas where concentrated surface drainage may exit the work area.
- D. Remove and dewater silt or sediment buildup behind silt fences, straw bales, and sedimentation control berms as necessary during construction and near the end of construction.

END OF SECTION

## SECTION 02200

### EARTHWORK AND TRENCHING

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section describes the requirements for earthwork associated with and required for construction of the Lampbright Far East Sump PLS collection system, storm water pond, and MSE wall. Earthwork includes excavation, regrading, compaction, and final grading.

##### 1.2 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
1. ASTM D 698-00 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
  2. ASTM D 2487-00 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
  3. ASTM D 2922-05 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  4. ASTM D 3017-05 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
  5. ASTM D 4253-00 Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
  6. ASTM C 4254-00 Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density

##### 1.3 SAMPLES

- B. Samples of onsite materials to be used in the progress of the work will be sampled by the Owner's testing laboratory.
- C. Samples of all imported materials shall be submitted to the Engineer for review and approval.
- D. Disregard sample submission if recent test results are available for materials being imported.

##### 1.4 DUST AND SEDIMENT CONTROL

- A. Contractor shall take adequate precautions to avoid dust emission resulting from earthwork operations. Use continual dust control procedures during dry or windy weather.

##### 1.5 QUALITY CONTROL

- A. Contractor shall establish elevations, lines, and grades, utilizing recognized engineering survey practices and protect existing survey control and reference points during construction activities.

- B. Contractor shall perform construction surveys, as needed, to ensure that the lines and grades of excavations, and graded surfaces are in accordance with the design requirements.
- C. Verify by survey the dimensions and grades prior to installation of foundations, piping, slabs, pavement, and other permanent structures.

## 1.6. PROTECTION

- A. Freezing Weather Restrictions
  - 1. Placement of soils shall not be performed during freezing weather except by written permission of the Engineer.
  - 2. Frozen materials, snow, or ice shall not be placed in the fill.
  - 3. Structures shall not be placed on frozen surfaces except by written permission of the Engineer.
- B. Sheeting and Shoring
  - 1. Except where banks are cut back on a stable slope, excavations shall be properly and substantially sheeted, braced, and shored, as necessary, to prevent caving or sliding and to provide protection for workmen and the work.
  - 2. Sheeting, bracing, shoring, or trench boxes shall be designed and built to withstand all loads that might be caused by earth movement or pressure, and shall be rigid, maintaining shape and position under all circumstances.
  - 3. Hazardous and dangerous conditions shall be prevented and the safety of personnel shall be maintained.
- C. Removal of Water
  - 1. The Contractor shall provide for and maintain adequate dewatering to remove and dispose of all water entering excavations or other parts of the work.
  - 2. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the construction required therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.
  - 3. Surface water shall be diverted or otherwise prevented from entering excavated areas to the greatest extent practicable.
- D. Temporary Diversion Works
  - 1. The Contractor shall construct and maintain all necessary water diversion and protective works and furnish all materials required therefore as required to construct the outlet works.
  - 2. The Contractor shall submit to the Engineer a proposed plan of diverting the surface runoff from the upstream drainage areas before beginning excavation for the outlet excavation.
    - a. The proposed plan shall cover temporary ditches, fills, embankments, or other components required to divert storm runoff during construction.
    - b. The plan shall not be placed in operation until it is accepted by the Engineer.
      - 1) Engineer review of the plan shall not relieve the contractor from full responsibility for the adequacy of diversion works.
  - 3. All temporary diversion or dewatering works shall be filled, leveled, graded, or otherwise removed by the Contractor to the satisfaction of the Engineer prior to completion of work.

### 1.7. HAUL ROADS, ACCESS ROADS, AND RAMPS

- A. Haul roads, access roads, and ramps shall be constructed where required to perform the work under this Contract.
- B. The haul roads and access roads shall not block or obstruct natural drainage channels.
- C. Ditches and culverts shall be installed where necessary to allow passage of stream flow or flow from storm run-off, and to prevent ponding of water.
  - 1. Where water is ponded for construction use, adequate overflow pipes shall be installed.
- D. The Contractor shall spray haul roads, access roads, and ramps with construction water at regular intervals during construction to minimize dust.

### 1.8. BLASTING

- A. No blasting or other use of explosive for excavation will be permitted for any of the onsite excavations or construction.

### 1.9. UNAUTHORIZED EXCAVATION

- A. Any material excavated below the elevation or otherwise beyond the limits indicated on the drawings, unless otherwise authorized by the Engineer, shall be replaced and compacted to the density indicated in Article 2.5.B.
- B. The unauthorized excavation of material and subsequent replacement and compaction shall be done by and at the expense of the Contractor.

### 1.10. STABILIZATION

- A. Subgrades for structures, fills, and backfills shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen or equipment in use.
- B. The finished elevation of stabilized structure subgrades shall not be above the subgrade elevations indicated on the drawings.
- C. All stabilization work shall be performed by and at the expense of the Contractor.
- D. Stabilization material shall be utilized where necessary and shall be approved by the Engineer.
- E. Where migration of fines is unacceptable, a layer of ASTM C33 sand and drain gravel per Article 3.4 or geotextile filter fabric may be required to isolate the fine soil from the stabilization material.

### 1.11. PROTECTION OF UNDERGROUND CONSTRUCTION

- A. The Contractor shall locate, protect, shore, brace, support, and maintain all existing underground pipes, conduits, drains, and other underground construction which may be uncovered or otherwise be affected by the work.

## PART – 2 – MATERIALS

### 2.1. CLASSIFICATION OF MATERIALS

- A. Soil identification shall be in accordance with ASTM D 2487.
- B. Identification and classification of materials will be based upon visual examination and simple manual tests performed under the direction of the Engineer by an independent testing laboratory.
- C. If visual examination and manual tests are inadequate for the required identification and classification, the Engineer will require the testing laboratory to determine definite index properties of the questionable material.

### 2.2. TEMPORARY TOPSOIL STOCKPILE

- A. The Contractor shall store topsoil removed under these specifications in an area acceptable to the Engineer.
- B. The Contractor shall use the stockpiled topsoil as required to comply with the requirements of these specifications.
- C. Stockpiles shall not exceed ten (10) feet in height.

### 2.3. BORROW AREAS

- A. Borrow areas shall be cleared and grubbed in accordance with Section 02100, SITE CLEARING, and the topsoil stockpiled for later use.
- B. The Contractor shall not begin borrow operations until the Engineer has inspected and approved the results of the clearing, grubbing and stripping.
- C. All material from the required excavations shall be utilized in portions of embankments as indicated on the drawings unless otherwise directed by the Engineer.
- D. The size, shape, depth, drainage, and dressing of all borrow areas shall be acceptable to the Engineer.
- E. All borrow areas shall be regular in shape, with finish graded surfaces when complete.
- F. Side slopes shall not be steeper than four horizontal to one vertical, and shall be uniform for the entire length of any one side, unless otherwise directed by the Engineer.
- G. The top of back slopes shall be rounded to provide uniform transitions.

### 2.4. SPOIL MATERIAL

- A. Material that is unsuitable for use in the required fills shall be spoiled in an area designated by the Engineer.

- B. Excess materials from the required excavations, or those materials that do not meet the specifications for material type, or materials too hard to break down shall be spoiled, or materials too saturated to work into the fills shall be spoiled.
- C. No materials shall be spoiled without the concurrence of the Engineer.

2.5. FILL MATERIAL

A. General

- 1. The suitability of all materials and their disposition shall be acceptable to the Engineer.
- 2. All materials considered objectionable from the standpoint of permeability or stability will be specifically designated by the Engineer at the time the material is excavated and shall be disposed of in designated spoil areas.
- 3. All excavated material shall be assumed to be usable in embankment construction. Only material designated by the Engineer shall be spoiled.
- 4. All material placed in embankment fill and drain materials drains shall be free from trash, brush, stumps, logs, roots, rocks, concrete, and other foreign material.
- 5. Fill materials shall be classified according to their geologic origin and physical properties as follows.

TABLE 02300.1  
FILL MATERIAL DESIGNATIONS

DESCRIPTION	USCS DESIGNATION (ASTM D 2487)
Structural Backfill	SC, SW
General Fill	SC, SW, SP

B. Compaction and Moisture Requirements.

- 1. Compacted earth materials shall meet the following compaction and moisture requirements.

TABLE 02300.2  
FILL REQUIREMENTS

MATERIALS	MINIMUM DENSITY AS A PERCENT OF MAXIMUM PER ASTM D 698	MOISTURE AS A PERCENT OF OPTIMUM PER ASTM D 698
Structural Backfill	95	-2 to +2
General Fill	95	-3 to +3

PART – 3 EXECUTION

### 3.1. EMBANKMENT SITE AND FOUNDATION PREPARATION

#### A. General

1. The entire areas to be covered by the embankment shall be cleared, grubbed, and stripped as specified in Section 02100, SITE CLEARING.
2. The Engineer will inspect and determine the final excavation limits of the outlet excavations.

#### B. Subgrade Preparation

1. Prior to placement of any backfill or embankment material, the upper eight inches (8") of the subgrade materials shall be compacted to ninety-five percent (95%) maximum density.
2. The moisture content of the subgrade, except where the subgrade materials are in-situ granite or other rock, shall be within the limits of minus two percent (-2%) to plus three (+3%) percent of optimum.
3. Any shale surfaces encountered shall be kept moist to prevent drying.
4. Soft or otherwise unsuitable in-place material shall be removed from the foundation and subgrade to the depth indicated on the drawings or as directed by the Engineer and replaced with material specified for the type of fill being placed.
5. Payment for such authorized excavation and backfill, outside the limits indicated on the drawings, will be made in accordance with the applicable unit adjustment prices.
6. No material shall be placed in any portion of the embankment until the subgrade has been properly prepared and is acceptable to the Engineer.
7. Protect bedrock from slaking as directed by the Engineer. This may require placement of a mud mat over bedrock exposed for a significant period of time and/or re-excavation to fresh rock as approved by the Engineer just prior to construction of improvements if exposed material is observed to be slaking.

### 3.2. STORM WATER POND FILL CONSTRUCTION

#### A. General

1. Fill placement on the embankments shall be constructed to the lines and grades indicated on the Drawings or as otherwise directed by the Engineer.
2. General requirements, the order of the excavation, the sources of materials, and the deposit and compaction of all excavated materials shall be as specified herein.
  - a. At the beginning of the embankment construction/fill, the Contractor shall set grade stakes to indicate the intersection of embankment slopes with the natural ground surfaces and the depth of fill to be made at various points on the site.
  - b. As the work proceeds, the Contractor shall set slope stakes in the slopes of the embankment.
  - c. These stakes shall be set on five foot (5') changes in elevation, or less if required and shall be located in cross planes at regular intervals of twenty-five feet (25').
  - d. The Contractor shall keep slopes dressed as the embankment construction proceeds.
  - e. The top of the slope on each lift should be completely compacted by the use of compaction equipment which can safely traverse the edge of the fill.

- f. The slopes shall be constructed full so that when the final grading is performed a compacted surface will be exposed.
- g. Placement and compaction of materials on slopes to correct the grades is not acceptable.

B. Embankment Fill Requirements.

1. All material placed in the embankment shall be free from rocks, stone, brush, stumps, logs, roots, and organic and other objectionable material.
2. All material placed in embankment shall meet the requirements of Structural fill as stated in Table 02300.1 unless otherwise noted on the Drawings or the Specifications.
3. The suitability of each part of the foundation for placing embankment materials thereon and of all materials for use in embankment construction shall be acceptable to the Engineer.
4. Excavation of material accepted for use in the embankment shall be performed in a manner that will segregate materials of different character.
5. Rocks and stones less than 6-inches in maximum dimension shall be allowed in the Embankment Fill provided they are well dispersed and not concentrated into pockets and no congregating of such stones or rocks shall be permitted.
6. Boulders, rock fragments, and stones larger than the specified dimensions shall be removed from otherwise acceptable fill materials, either at the site of the excavation or after the material has been placed on the embankment, but before compaction.
7. Such oversize boulders and rock fragments shall be disposed of in the designated spoil area.

C. Placing and Compacting Embankment Fill Materials.

1. The surface of the fill within any zone of the embankment shall be maintained approximately horizontal in the direction parallel to the axis of the embankment.
2. When placing new fill adjacent to an existing fill or the slope of the natural ground, a horizontal bench shall be cut into the existing slope surface.
  - a. This will be limited to those sections where earth fill is placed against earth subgrade.
3. The bench shall be of sufficient width to allow the compaction equipment to pass over the boundary between the new and existing surface.
4. Prior to constructing a new fill adjacent to an existing fill slope, all loose earth shall be removed from the existing slope until a compacted surface has been exposed.
5. All fill materials shall be placed in the embankment in approximately horizontal layers not to exceed eight inches (8") in uncompacted thickness over the prepared foundation or fill except as otherwise accepted by the Engineer.
6. Each layer shall be mechanically compacted, using appropriate equipment as determined by the engineer to a density between the minimum density listed in Table 02300.2 and the maximum density as determined by ASTM D 698.
7. The final in-place moisture content shall be within a range listed in Table 02300.2, for structural fill.
8. The extent to which hauling equipment must travel across a prepared fill surface shall be kept to a minimum whenever possible.
9. The embankment shall be constructed by placing the fill materials in zones as indicated on the drawings.

10. After dumping, the materials shall be spread and leveled by scrapers, dozers, motor graders, rock rakes, or combinations of this equipment to obtain uniform lift thickness prior to compaction.
  - a. The use of other equipment shall be subject to the acceptance of the Engineer.
11. The distribution of materials throughout the embankment shall be such that the embankment will be free from lenses, pockets, streaks, and layers of materials differing substantially in texture, gradation, and moisture content from surrounding material.
12. The entire surface of any section of embankment under construction shall be maintained in such condition that construction equipment can travel thereon.
13. Whenever a fill surface becomes excessively rutted from the travel of hauling equipment, fill operations shall be halted in this area.
  - a. The ruts shall be leveled and the entire affected area re-compacted.
14. Whenever the compacted surface of any layer of compacted fill has been made too smooth to bond properly with the succeeding layer, by the concentration of hauling equipment or for other reasons, the compacted surface shall be loosened by scarifying or equivalent methods and moisture conditioned as required before the succeeding layer is placed thereon.
15. After each layer has been properly spread, it shall be sprinkled, wetted, or dried as required to provide a uniform distribution of moisture within the specified range of moisture content after which the layer shall be compacted to the required density before the next layer is placed thereon.
16. Should the compacted or partly compacted surface of any portion of the embankment fill surface become excessively wet above the maximum specified moisture content, the surface shall be re-compacted after drying.
17. The Contractor shall break up the earth fill materials, either at the place of excavation or on the embankment, to such maximum size as is determined necessary to secure specified density of the material in the embankment.
18. Immediately before rolling, the new lift of fill shall be processed by disking to the full uncompacted depth.
19. Prior to and during the compacting operations, the material in each layer of the embankment shall have the moisture content within the range specified.
20. The moisture content shall be uniform throughout the layer.
21. Material having a moisture content greater than the maximum specified limit shall be spread on the embankment or such other location as approved by the Engineer and permitted to dry, assisted by disking or harrowing, if necessary, until the moisture content is reduced to within the specified limits.
22. Mixing a dry material with the material in the lift in an attempt to modify the moisture content of the lift will not be permitted.
23. Each layer of material that has moisture content less than the minimum specified shall be sprinkled and worked with harrows, discs or other acceptable methods until the moisture content is within the specified range and uniform distribution of moisture is obtained.
24. The Contractor may be required to use a layer thickness less than the maximum permissible if the disc or harrow will not turn the entire layer thickness.
25. When applying water to the material in the layer, power sprayers or other equally suitable equipment shall be used.
  - a. Gravity flow perforated header pipes will not be permitted.
  - b. The amount of water applied on a layer of fill shall be controlled so that free water will not appear on the surface during or subsequent to rolling.
  - c. Dry and muddy areas will not be permitted.

- d. Should too much water be added to any part of the embankment, so that the material is too wet over the entire layer or in local spots to obtain the desired compaction, the rolling and all work on that section of the embankment shall be delayed until the moisture content of the material is reduced to a uniformly distributed amount within the specified limits.
  - e. If it is found impracticable to add sufficient moisture to materials which have been spread on the fill so as to obtain a uniformly moistened layer, the Contractor shall pre-wet materials in the excavation or borrow areas sufficiently in advance of excavation for placement on the fill so that the moisture is permitted to uniformly permeate the borrow material.
26. If, in the opinion of the engineer, the top or contact surfaces of a partial fill section become too dry to permit suitable bond with additional fill to be placed thereon, the Contractor shall loosen the dried materials by scarifying or disking to a depth that will reach through the dried materials.
  27. The Contractor shall add moisture to the loosened material to obtain an acceptable moisture content, and shall compact this layer in accordance with the applicable requirements of these specifications.

### 3.3. STRUCTURAL FILL

#### A. General

1. Structural foundation fill pertains only to fill placed beneath foundations at structure locations or as indicated on the Drawings.

#### B. Subgrade Preparation

1. The structural subgrade site shall be stripped to a depth of twelve inches (12") below the ground surface and all roots and organic materials removed.
2. Prior to placement of structural foundation fill, the subgrade shall be thoroughly compacted and proof-rolled.
3. After compaction, the areas shall be proof-rolled by a single pass of a roller to test for uniformity and any loose soils detected shall be recompacted.
4. Soft or otherwise unsuitable material shall be removed from the subgrade and replaced with material specified hereinafter for structural foundation fill.
5. No material shall be placed until the subgrade has been properly prepared and acceptable to the Engineer.

#### C. Materials

1. To the maximum extent available, suitable earth or materials obtained from permanent excavations shall be used for construction of structural foundation fill.
2. Additional material, if any, shall be obtained from borrow areas as designated on the Drawings.
3. No silts classified as ML or MH shall be used for structural foundation fills.
4. Granular materials shall not be utilized as foundation fill unless so directed by the Engineer or as allowed by these specifications.

#### D. Placement and Compaction

1. The designated structural foundation fill material shall be placed in layers not to exceed eight inches (8") in uncompacted thickness.
2. Material deposited in windrows or piles by excavating or hauling equipment shall be spread and leveled before compaction.
3. Each layer of material being compacted shall be uniformly compacted using equipment and materials which shall achieve the specified density and moisture content.

4. The Contractor shall add water and harrow, disc, blade, or otherwise work the material in each layer as required to insure uniform moisture content and specified compaction.
5. If the moisture and density requirements are not met, the lift shall be broken up and recompacted until the specified requirements are met.
6. Each layer shall be thoroughly compacted by rolling or other acceptable methods to a density between the minimum density listed in Table 02300.2, structural fill, and the maximum density as determined by ASTM D 698.
7. The final in-place moisture content shall be within the range listed in Table 02300.2, structural fill.
8. The optimum moisture content shall be as determined in accordance with ASTM D 698.
9. For sands and gravels, deviations from the maximum moisture content limit will be permitted provided the specified density is obtained.
10. Also, for sands and gravels with less than twelve percent (12%) fines, the minimum density shall be seventy-five percent (75%) Relative Density as determined by ASTM D 4253 and D 4254.

#### 3.4. EQUIPMENT

- A. The Contractor shall be responsible to provide the size and type of equipment best suited to perform the various tasks required for the project.
- B. Insufficient size and weight of compacting equipment will not be an excuse for not obtaining compaction.
- C. Smooth drum rollers will not be allowed for compacting the clay type materials.
- D. Only sheepsfoot type or segmented pad rollers will be allowed for compaction of clay type materials.
- E. For compaction of granular materials, vibratory steel drum or plate type vibratory compactors will be allowed.
  1. No segmented pad, sheepsfoot rollers, or other rollers that would create high contact stresses on the granular particles will be allowed.
- F. The use of rubber tired vehicles to provide compaction will not be allowed except at the direction of the Engineer.
- G. Disks used on the project shall be of sufficient size and weight to fully penetrate the lift.

#### 3.5. GENERAL FILLS

- A. Earth fill for general purposes shall follow the requirements for placement and compaction as set forth throughout this section.
- B. Compaction of general fills shall be to a density between the minimum density listed in Table 02300.2, general fill, and the maximum density as determined by ASTM D 698.
- C. The final in-place moisture content of general fills shall be within a range listed in Table 02300.2, for general fill.

- D. For granular materials with less than twelve percent (12%) fines, compaction shall be a minimum of seventy percent (70%) Relative density as defined in ASTM D 4253 and D 4254.

### 3.6. ROAD GRAVEL

- A. Road base gravel shall be applied to all roadways.
- B. Compaction of road gravel shall be to a minimum of ninety-five percent (95%) of maximum density by ASTM D 698 at a moisture content near optimum moisture.

### 3.7. MAINTENANCE AND RESTORATION OF FILLS, EMBANKMENTS, ROADWAYS

- A. Fills, embankments, and backfills that settle or erode before final acceptance of the work under these specifications, and pavement, structures, and other facilities damaged by such settlement or erosion, shall be repaired at the Contractor's expense.
- B. The settled or eroded areas shall be refilled, compacted, and graded to conform to the elevations indicated on the drawings or to the elevation of the adjacent ground surface.
- C. Damaged facilities shall be repaired in a manner acceptable to the Engineer.
- D. Exiting roadways used during construction shall be regraded and gravel applied as necessary to return the roadways back to their original condition prior to construction.
- E. Roadways constructed under these specifications and used in the process of the construction, shall be regraded and re-graded as necessary to return them to their original condition.
- F. Earth slopes of the roads constructed under these specifications shall be maintained to the lines and grades indicated on the drawings until the final acceptance by the Engineer.

### 3.8. FINAL GRADING

- A. After all construction work under these specifications has been completed; all ground surface areas disturbed by the construction operations shall be graded.
- B. Grading shall be finished to the contours and elevations indicated on the drawings or, if not indicated, to the matching contours and elevations of the original, undisturbed ground surface.
- C. In any event, the final grading shall provide smooth uniform surfacing and effective drainage of the ground areas.

### 3.9. DISPOSITION OF MATERIALS

- A. The Contractor shall assume that all earth materials excavated for performance of work under these specifications is suitable for construction of various earth fills specified for the work unless exceptions are so noted in the bid.
- B. The Contractor will be required to work materials by breaking down to the maximum specified sizes and by wetting and drying in order to meet moisture content specifications.

- C. Large easily segregated rocks and stones shall be dumped in random piles on the lake bottom.

### 3.10. CONTROL TESTING

- A. All control testing required to assess compliance with the requirements of this section, except for the gradation, soundness and abrasion tests required on the filter materials, will be provided by the Owner.
- B. The testing will be performed by an independent testing laboratory retained by the Owner and the Contractor's employees shall cooperate with the Owner's control testing representatives.
- C. Maximum density for cohesive and noncohesive compacted materials placed under this section shall be determined in accordance with ASTM D 698, Method A or C, unless otherwise specified.
- D. The terms "maximum density" and "optimum moisture content" shall be as defined in ASTM D 698 unless otherwise specified.
- E. The Owner has secured samples and made moisture density tests on embankment materials from potential borrow areas, the results of these tests are contained in the geotechnical data report.
- F. Additional moisture-density relationships shall be determined in accordance with the specified procedure when required by the Engineer or when materials with different compaction characteristics are encountered.
- G. Density testing will be according to ASTM D 2922 and D 3017.
- H. In addition, maximum density for noncohesive compacted materials containing less than twelve percent (12%) fines (-No. 200 sieve) placed under this section shall be determined in accordance with ASTM D 4253 and D 4254.
- I. At least one field moisture and density test will be performed for every 500 cubic yards of the compacted materials.
- J. Each lift placed will be tested independent of the number of cubic yards placed.
- K. Each lift of backfill materials for the outlet conduit and gate tower shall tested for moisture and density with the test frequency varied depending on the variability of the fill and compaction methods.
- L. If determined to be necessary by the Engineer to ensure the quality of the fill and backfill, additional field control tests will be conducted at a frequency determined by the Engineer to fit the conditions.
- M. Testing being conducted by the Owner will not relieve the Contractor of his responsibility to ensure all materials being placed are at the proper moisture content before compaction begins.

- N. The testing by the Owner is to determine that the requirements of the Specifications are being met and are not intended to provide the Quality Control for the Contractor's operation.
- O. Testing should be expected to take up to several hours and the Contractor shall plan his work to have more than one area available for fill placement such that testing will not impede the operations.

### 3.11. CLEANUP

- A. Upon completion of the work associated with this Contract the Contractor shall perform a cleanup of the temporary facilities.
- B. The cleanup shall include obliteration of temporary fills and excavations associated with access roads, haul roads, construction, water holding ponds, shop and mechanics' areas, and other facilities used in construction.
- C. The cleanup should return the disturbed areas as much as practicable to the original ground surface contours.

END OF SECTION

## SECTION 02300

### LINER INSTALLATION AND QA/QC

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section describes the requirements for geosynthetic Liner installation and work associated with and required for construction of the Lampbright Far East Sump stormwater and settling ponds.
- B. Reseeding and landscaping is not a part of this Contract.

##### 1.3 SUBGRADE PREPERATION FOR LINER INSTALLATION

- A. The following work related to the Liner placement is described in this specification section:
  - a. Foundation preparation;
  - b. Construction of fills and backfills;
  - c. Compaction requirements; and
  - d. Site grading.
- B. Work shall be done in strict accordance with these specifications and as shown on the drawings.
- C. Work includes furnishing all labor, tools, materials, equipment, and supervision as may be required to construct the project as described in contractual documents.
- D. All final backfill and grading should be constructed within a tolerance shown on the drawings, except where dimensions or grades are shown as minimum or maximum. All grading shall be performed to maintain sloped and drainages as shown in the drawings.
- E. Liner – 60-mil smooth HDPE geomembrane Liner as specified in the drawings.
- F. Any earthen surface upon which the Liner is installed shall be prepared and compacted in accordance with the project contract documents. The surface shall be smooth, firm, unyielding, and free of;
  - a. Vegetation;
  - b. Construction Debris;
  - c. Sticks;
  - d. Sharp rocks;
  - e. Void spaces;
  - f. Abrupt elevation changes;
  - g. Standing Water;
  - h. Cracks larger than 0.25 inch in width; and
  - i. Any other foreign matter that could contact the Liner.

- G. Subgrade surfaces consisting of granular soils or gravel may not be acceptable due to their large void fraction and puncture potential
- H. Immediately prior to Liner deployment, the subgrade shall be final-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the Liner. At completion of this activity, no wheel ruts, footprints or other irregularities shall exist in the subgrade. Furthermore, all protrusions extending more than 0.5 inches from the surface shall either be removed, crushed, or pushed into the surface with a smooth-drum compactor.
- I. On a continuing basis, the Engineer shall certify acceptance of the subgrade before Liner placement.
- J. It shall be the Installer's responsibility thereafter to indicate to the Engineer any change in the condition of the subgrade that could cause the subgrade to be out of compliance with any of the requirements listed in this specification section.
- K. At the top of sloped areas of the job site, an anchor trench for the Liner shall be excavated or an equivalent runout shall be utilized in accordance with the Contract Documents and as approved by the Engineer. When utilizing an anchor trench design, the trench shall be excavated and approved by the Engineer prior to Liner placement. No loose soil shall be allowed at the bottom of the trench and no sharp corners or protrusions shall exist anywhere within the trench
- L. Prior to and during all compacting operations, maintain moisture content within the limits specified herein. Maintain uniform moisture content throughout the lift. Add water, as practicable, to the materials that are too dry at the site of excavation. Supplement, if required, by sprinkling and mixing into the fill material prior to compaction.
- M. Do not attempt to compact fill material that contains excessive moisture. Aerate material by blading, disking, harrowing, or other methods, to dry the material to acceptable moisture content.
- N. Compact all materials by mechanical means. Flooding or jetting will not be permitted. If tests indicate that compaction or moisture content is not as specified, material placement shall be terminated and corrective action shall be taken by the Contractor prior to continued placement.<sup>3</sup>
- O. Compaction and moisture requirements for the backfill materials used in the WORK are as follows:
  - a. Immediately prior to Liner placement, subgrade shall be scarified to a depth of 9- inches and compacted to 95% of Standard Proctor dry density as determined by ASTM D698, with moisture between -3% and +1% of optimum.

#### 1.4 GEOTEXTILES

A. ASTM Standards Shall be Followed:

- a. ASTM D1621 – Standard Test Method for Compressive Properties of Rigid Cellular Plastics;
- b. ASTM D1777 – Standard Test Method for Thickness of Textile Materials;
- c. ASTM D4354 – Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing;
- d. ASTM D4355 – Standard Test Method for Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus;
- e. ASTM D4439 – Standard Terminology for Geotextiles;
- f. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity;
- g. ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles;
- h. ASTM D4595 – Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method;
- i. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles;
- j. ASTM D4716 – Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head;
- k. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile;
- l. ASTM D4759 – Standard Practice for Determining the Specification Conformance of Geosynthetics;
- m. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products;
- n. ASTM D4873 – Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; and
- o. ASTM D5141 – Standard Test Method to Determine Filtering Efficiency and Flow Rate of the Filtration Component of a Sediment Retention Device;
- p. ASTM D5261 – Standard Test Method for Measuring the Mass per Unit Area of Geotextiles;
- q. ASTM D5494 – Standard Test Method for the Determination of Pyramid Puncture Resistance of Unprotected and Protected Geomembranes;
- r. ASTM D6241 – Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe; and
- s. ASTM D7238 – Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.

B. Submittals

- a. At least 14 days prior to installation, the Contractor shall provide to the Engineer the product data, stating the name of the Manufacturer, product name, style number, chemical composition of the filaments or yarns, and other pertinent information to fully describe the geotextile. This includes meeting the minimum values specified in Table 02771-1.

C. Delivery Storage and Handling

- a. Geotextiles labeling, shipment, and storage shall follow ASTM D4873. Product labels shall clearly show the Manufacturer or supplier name, style name, and roll number.
- b. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight, and contaminants.
- c. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames (including welding sparks), excess temperatures, and any other environmental conditions that may damage the physical property value of the geotextile.

**D. Material Standards**

- a. Geotextile shall be manufactured with fibers consisting of long-chain synthetic polymers composed of at least 95% by weight of polyfins or polyesters. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.
- b. Woven slit film geotextiles (i.e., geotextiles made from yarns of a flat, tape-like character) shall not be allowed.
- c. Geotextile shall meet the requirements of Table 02771-1. All numeric values in Table 02771-1 except AOS represent MARV in the weakest principal direction. Values for AOS represent maximum average roll values.

**Table 02771-1: Geotextile Requirements**

Property	Test Method	Units	Geotextile Properties					
Mass per unit Area	ASTM D5261	oz/yd <sup>2</sup>	12	16	20	24	28	32
Grab Tensile Strength	ASTM D4632	lbs	300	370	380	450	475	500
Grab Tensile Elongation	ASTM D4632	%	50	50	50	50	50	50
Trapezoid Tear Strength	ASTM D4533	lbs	115	140	140	200	200	215
Puncture (Pin) Strength	ASTM D4833	lbs	120	140	170	250	275	300
Static (CBR) Puncture	ASTM D6241	lbs	800	900	1000	1100	1200	1700
Permittivity	ASTM D4491	sec <sup>-1</sup>	0.8	N/A	N/A	N/A	N/A	N/A
Apparent Opening Size	ASTM D4751	U.S. Sieve	100	100	N/A	N/A	N/A	N/A
Ultraviolet Stability <sup>[1]</sup>	ASTM D4355	%	70	70	70	70	70	70

**1.5 QUALITY ASSURANCE AND CONTROL**

- A. Manufacturing QC: Testing shall be performed at a laboratory accredited by GAI-LAP and A2LA for test required for the geotextile, at frequency meeting or exceeding ASTM D4354.
- B. Geotextile properties, other than Sewn Seam Strength, Puncture Strength, and Ultraviolet Stability shall be tested by NTPEP to verify conformance with this specification.
- C. Sewn Seam Strength shall be verified based on testing of either conformance samples obtained using Procedure A of ASTM D4354, or based on Manufacturer’s certifications and testing of QA samples obtained using Procedure B of ASTM D4354. A lot size for

conformance or QA sampling shall be considered the shipment quantity of the given product or a truckload of the given product, whichever is smaller

- D. Ultraviolet Stability shall be verified by an independent laboratory on the geotextile or a geotextile of similar construction and yarn type.
- E. Anchor trench excavation shall be done in accordance with details of the contract documents. In all instances, excavation shall be done in such a way to prevent large voids from occurring in the sides and bottom of the trench. The graded surface shall be smooth and free of debris.
- F. Geotextile shall be placed loosely with no wrinkles or folds, and with no void spaces between the geotextile and the ground surface. Successive sheets of geotextiles shall be overlapped a minimum of 12 inches, with the upstream sheet overlapping the downstream sheet.
- G. Geotextiles should be heat seamed where necessary, as determined by the Engineer.
- H. Should the geotextile be damaged during installation or drainage aggregate placement, a geotextile patch shall be placed over the damaged area extending beyond the damaged area a minimum of 12 inches, or the specified seam overlap, whichever is greater.

## 1.6 POLYETHYLENE GEOMEMBRANE LINER

- A. WORK described in this SPECIFICATION section includes specifications and guidelines for manufacturing and installing HDPE Liner (herein referred to as Liner).
- B. ASTM Standards Shall be Followed
  - a. ASTM D792 – Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement;
  - b. ASTM D1004 – Standard Test Method for Initial Tear Resistance (Graves Tear) of Plastic Film and Sheeting;
  - c. ASTM D1238 – Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer;
  - d. ASTM D1505 – Standard Test Method for Density of Plastics by the Density- Gradient Technique;
  - e. ASTM D3895 – Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry;
  - f. ASTM D4218 – Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique;
  - g. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products;
  - h. ASTM D5199 – Standard Test Method for Measuring the Nominal Thickness of Geomembrane;

- i. ASTM D5397 – Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test;
- j. ASTM D5596 – Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics;
- k. ASTM D5641 – Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber;
- l. ASTM D5820 – Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes;
- m. ASTM D5994 – Standard Test Method for Measuring Core Thickness of Textured Geomembrane;
- n. ASTM D6392 – Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods;
- o. ASTM D6693 – Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes; and
- p. ASTM D7466 – Standard Test Method for Measuring the Asperity Height of Textured Geomembrane.

#### A. Submittals

- a. LINER INSTALLER shall furnish the following product data, in writing, to the ENGINEER and OWNER prior to installation of the Liner material:
- b. Resin
  - i. Certification stating that the resin meets the SPECIFICATION requirements (Paragraph 2.01); and
  - ii. Statement certifying no recycled polymer and no more than 10% rework of the same type of material is added to the resin.
- c. Liner Manufacturer's QC Plan for documenting compliance to Paragraphs 2.01 and 2.02 of these SPECIFICATIONS.
- d. LINER INSTALLER shall furnish the following information for approval to the ENGINEER and OWNER prior to installation:
- e. Installation layout drawings:
  - i. Must show proposed panel layout including field seams and details;
  - ii. Must be approved prior to installing the Liner; and
  - iii. Approved drawings will be for concept only and actual panel placement will be determined by site conditions.
- f. LINER INSTALLER'S Geosynthetic Field Installation QC Plan.
- g. LINER INSTALLER'S Deployment Plan, including:
  - i. Details for ballasting leading edge during deployment:
    - 1. Average weight of sandbags;
    - 2. Maximum spacing between sandbags after deployment; and
    - 3. Provisions for pre-staging sandbags (to minimize exposure time).
  - ii. Details for ballasting anchor trench:

- iii. Maximum length of panels that can be deployed prior to backfilling; and
- iv. Amount of material to be placed in anchor trench during initial backfilling.
- h. Special weather considerations.
- i. Upon shipment, the Liner Manufacturer shall furnish to the ENGINEER the Liner Manufacturer's QA/QC certifications to verify that each roll supplied for the project are in accordance with the requirements of this SPECIFICATION.
- j. LINER INSTALLER will submit the following to the ENGINEER upon completion of installation:
  - i. Certificate stating the Liner has been installed in accordance with the contract documents;
  - ii. Material and installation warranties (material shall be warranted, on a pro-rated basis, against Liner Manufacturer's defects for a period of 5 years from the date of Liner installation. Installation shall be warranted against defects in workmanship for a period of 1 year from the date of Liner completion); and
  - iii. As-Built drawings showing actual Liner placement and seams including typical anchor trench detail, with at least one known survey point (in the OWNER'S specified coordinate system and datum) at each panel corner.

#### B. Qualifications

- a. Liner Manufacturer:
  - i. Liner shall be manufactured by the following:
    - 1. Agru; or
    - 2. Approved equal.
  - ii. Liner Manufacturer shall have manufactured a minimum of 1,000,000 yd<sup>2</sup> of HDPE Liner during the last year.
- b. Contractor
  - i. LINER INSTALLER shall have installed a minimum of 1,000,000 yd<sup>2</sup> of HDPE Liner during the last 3 years.
  - ii. LINER INSTALLER shall have worked in a similar capacity on at least three projects similar in complexity to the project described in the contract documents, and with at least 200,000 yd<sup>2</sup> of HDPE Liner installation on each project.
  - iii. Installation Supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the contract documents.
  - iv. LINER INSTALLER shall provide a minimum of one master seamer to work on the project:
    - 1. Must have completed a minimum of 100,000 yd<sup>2</sup> of HDPE Liner seaming work using the type of seaming apparatus proposed for the use on this project.
- c. Material Labeling, Delivery, Storage and Handling
  - i. Labeling – Each roll of Liner delivered to the site shall be labeled by the Manufacturer. The label will identify:
    - 1. Liner Manufacturer's name;
    - 2. Product identification;
    - 3. Thickness;

4. Length;
  5. Width; and
  6. Roll number.
- ii. Delivery – Rolls of Liner will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.
  - iii. Storage – The on-site storage location for Liner material, provided by the CONTRACTOR or LINER INSTALLER to protect the Liner from punctures, abrasions and excessive dirt and moisture, should have the

Property	Test Method	HDPE
Density [g/cm <sup>3</sup> ]	ASTM D1505	0.939 (MAX)
Melt Flow Index [g/10 min]	ASTM D1238 (190/2.16)	§ 1.0

owing characteristics:

1. Level (no wooden pallets);
  2. Smooth;
  3. Dry;
  4. Protected from theft and vandalism;
  5. Adjacent to the area being lined; and
  6. Liner shall not be stacked higher than three rolls.
- iv. Handling – Materials are to be handled to prevent damage.
- d. Warranty
- i. Material shall be warranted, on a pro-rata basis, against Manufacturer’s defects for a period of 5 years from the date of Liner installation.
  - ii. Installation shall be warranted against defects in workmanship for a period of 1-year from the date of Liner completion.

C. Materials

a. Resin

- i. Resin shall be new, first quality, compounded, and manufactured specifically for producing HDPE Liner.

b. 60-mil HDPE Liner

- i. For smooth HDPE Liner, material shall be 60-mil Agru (or equivalent) HDPE Liner as shown on the DRAWINGS.

ii. Liner Rolls:

1. Liner rolls must not exceed a combined maximum total of 1% by weight of additives other than carbon black;
2. Liner shall be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges;
3. Liner material is to be supplied in roll form. Each roll is to be identified with labels indicating roll number, thickness, length, width, and Liner Manufacturer; and
4. All Liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical property requirements listed in Paragraph 2.01.C of this SPECIFICATION and be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified and

indicated during manufacturing, these pinholes may be corrected during installation.

- iii. Liner shall meet the requirements shown in Tables 02778-2 and 02778-4.
- iv. Extrudate Rod or Bead:
  - 1. Extrudate material shall be made from the same type of resin as the Liner;
  - 2. Additives shall be thoroughly dispersed; and
  - 3. Materials shall be free of contamination by moisture or foreign matter.
- v. Texturing shall be shown on the DRAWINGS (i.e. smooth, single-sided texture, double- sided texture).

#### D. Equipment

- a. Welding equipment and accessories shall meet the following requirements:
  - i. Gauges showing temperatures in apparatus (extrusion welder) or wedge (wedge welder) shall be present;
  - ii. An adequate number of welding apparatus shall be available to avoid delaying work; and
  - iii. Power source must be capable of providing constant voltage under combined line load.

#### E. Execution

- a. Preparation of surfaces to be lined shall be completed by the CONTRACTOR. The LINER INSTALLER will be responsible for inspecting the prepared surfaces to verify that the surfaces are acceptable for Liner placement and free from any rocks, sticks, surface irregularities, or debris which could damage the Liner. Any surface areas or other conditions requiring correction shall be brought to the attention of the ENGINEER and will be corrected by the CONTRACTOR at no additional cost.
- b. Upon notification by the ENGINEER of release of area or areas for Liner installation, the LINER INSTALLER shall verify in writing that the surface on which the Liner will be installed is acceptable. The initiation of installation indicates acceptance of existing conditions. The LINER INSTALLER shall be responsible for maintenance of the subgrade surface in the accepted area or areas once installation of Liner begins. The maintenance of the surface includes repair or replacement of any surface damaged following acceptance.

#### F. Deployment

- a. Assign each panel a simple and logical identifying code. The coding system shall be subject to approval and shall be determined at the Work Site
- b. LINER INSTALLER must visually inspect the Liner during deployment for imperfections and mark faulty or suspect areas.
- c. Deployment of Liner panels shall be performed in a manner that will comply with the following guidelines:
  - i. Unroll Liner using methods that will not damage Liner and will protect underlying surface from damage (spreader bar, protected equipment bucket);
  - ii. Place ballast on Liner which will not damage Liner to prevent wind uplift. Any ballast material must have a maximum particle size and appropriate underlying geotextile for the loading conditions as determined by the ENGINEER, including material placed in sandbags

- and used for ballast. Sandbags filled with material that does not confirm to Liner Ballast gradation requirements (Section 02222) or have an appropriate underlying geotextile must be removed from the Liner surface prior to final acceptance;
- iii. Personnel walking on Liner shall not engage in activities or wear shoes that could damage it. Smoking will not be permitted on the Liner;
  - iv. Do not damage the underlying geosynthetic installations. Repair damaged geosynthetic installations;
  - v. Do not allow heavy vehicular traffic directly on Liner; and
  - vi. Protect Liner in areas of heavy traffic by placing protective cover over the Liner as approved by the ENGINEER and OWNER.
- d. Sufficient material (slack) shall be provided to allow for thermal expansion and contraction of the material. This practice will be used to prevent excessive tension (trampolines) from developing. All resulting excessive tension will be removed by the LINER INSTALLER at no additional cost to the OWNER.

#### G. Field Seaming

- a. Seams shall meet the following requirements:
  - i. To the maximum extent possible, orient seams parallel to line of slope, i.e., down and not across slope;
  - ii. Minimize number of field seams in corners, odd-shaped geometric locations and outside corners;
  - iii. No horizontal seams will be allowed on slopes steeper than 7%. In lieu of horizontal seams, seams may be constructed at a 45-degree angle as approved by the OWNER or ENGINEER. 45-degree angle seams shall also be avoided in areas of potential stress concentrations. Horizontal seams (at 45-degree angles) shall be staggered a minimum of 10 feet unless authorized for special circumstances by the OWNER or ENGINEER;
  - iv. Slope seams (panels) shall extend a minimum of 5 feet beyond the grade break into the flat area;
  - v. Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the QC PROVIDER, QA PROVIDER and LINER INSTALLER; and
  - vi. All seam overlaps shall be aligned consistent with the requirements of the welding equipment being used. Seams shall be made by lapping the uphill material over the downhill material with sufficient overlap. Extrusion seaming shall have a minimum overlap of 6 inches. Wedge-welded seaming shall have a minimum overlap of 6 inches.
- b. During Welding Operations:
  - i. Provide at least one master seamer who shall provide direct supervision over other welders as necessary.
- c. Extrusion Welding:
- d. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the Liner installation. The LINER INSTALLER shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds.
- e. Defects and Repairs:

- i. Examine all seams and non-seam areas of the Liner for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter; and
- ii. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover Liner at locations that have been repaired until test results with passing values are available.

#### H. Field QA

- a. Liner Manufacturer and LINER INSTALLER shall participate in and conform to all terms and requirements of the OWNER'S QA program. The LINER INSTALLER shall be responsible for assuring this participation.
- b. QA requirements are as specified in this SPECIFICATION section and in the CQA Manual.
- c. Field Testing:
  - i. Non-destructive testing shall be carried out by the LINER INSTALLER as the seaming progresses, not at completion of all field seaming:
    1. Vacuum Testing:
      - a. Shall be performed in all extrusion welds performed during installation and in accordance with ASTM D5641;
      - b. The vacuum box assembly shall consist of the following:
        - Rigid housing;
        - Transparent viewing window;
        - Soft rubber gasket attached to bottom of housing;
        - Porthole or valve assembly;
        - Vacuum gauge; and
        - A vacuum pump capable of delivering a minimum of 27 psi of a vacuum.
    - c. When vacuum testing, the Installer shall:
      - Carefully Trim all overlapped material using an approved cutting instrument. The "pull-tear" method of overlap removal shall not be accepted;
      - Clean windows, gasket surfaces, and check for leaks;
      - Wet a strip of Liner approximately 1X2.5 feet (length of box with soapy solution);
      - Place the vacuum box over the wetted area;
      - Ensure that a leak-tight seal is created;
      - Apply a minimum vacuum pressure of 5 psi;
      - For a period of not less than 15 seconds,

- examine the length of weld through the viewing window for the presence of soap bubbles;
- If no bubbles appear after 15 seconds, move the box over the next adjoining area with a minimum 3 inches of overlap and repeat the process;
- Areas where soap bubbles appear shall be marked repaired, and re-tested;
- Vacuum testing shall be performed in accordance with ASTM D5641; and
- All vacuum testing will be documented by the Liner QC provider and submitted to the QC provider at the end of each work shift. The Liner shall be indelibly marked near the seam to indicate passing or failing test results accordingly.

A. Air pressure Testing

- a. Shall be performed in all hot wedge welds performed during installation and in accordance with ASTM D5820;
- b. The equipment for pressure testing shall include the following:
  - i. Air pumps equipped with a pressure gauge capable of generating and sustaining a pressure of 30 psi; and
  - ii. Sharp hollow needles or other pressure feed devices approved by the QA PROVIDER. The Liner shall be indelibly marked near the tested area to indicate passing or failing test results accordingly.
- c. To perform the air pressure test, the LINER QC PROVIDER shall:
  - i. Pass air through the channel to guarantee a clear pathway;
  - ii. Seal both ends of the seam to be tested;
  - iii. Insert a needle or other approved pressure feed device into the tunnel created by double hot wedge seaming;
  - iv. Energize the air pump to 30 psi;
  - v. Close the valve while sustaining the air pressure and allow the air to reach ambient Liner temperature;
  - vi. Read the pressure gauge;
  - vii. Sustain the test for a minimum of 5 minutes and re-read the pressure gauge;
  - viii. If the loss of pressure exceeds 3 psi after a 5-minute period or does not stabilize, faulty areas shall be located and repaired. After testing, pressure feed devices shall be removed and insertion points sealed; and
  - ix. All pressure testing shall be documented by the LINER QC PROVIDER and submitted to the QC PROVIDER at the end of each WORK shift. The Liner shall be indelibly marked near the seam to indicate passing or failing test results accordingly.
- d. Alternative testing methods other than vacuum or pressure testing may be proposed by the LINER INSTALLER and will be subject to the approval of the ENGINEER prior to their use.

- e. At locations where seams cannot be non-destructively tested, the LINER INSTALLER shall:
  - i. Cap-strip seams with the same Liner when possible; and
  - ii. If the seam is accessible to testing equipment prior to final installation, non-destructively test the seam prior to final installation.
  - iii.
- f. Seaming and cap-stripping operations will be observed by the QC PROVIDER for uniformity and completeness.
- g. Destructive Testing (performed by the LINER INSTALLER, duplicate testing performed by the QC PROVIDER, and witnessed by the QA PROVIDER):
  - i. Location and Frequency of Testing:
    - 1. Collect destructive test samples at a frequency of one per every 750 lineal feet of seam length per machine used;
    - 2. Test locations will be determined after seaming; and
    - 3. Exercise Method of Attributes as described by GRI GM14 to minimize test samples taken.
  - ii. Sampling Procedures are performed as follows:
    - 1. LINER INSTALLER shall cut samples at locations designated by the QA PROVIDER, QC PROVIDER, or OWNER as the seaming progresses in order to obtain field laboratory test results before the Liner is covered;
    - 2. LINER QC PROVIDER will number each sample, and the location will be noted on the installation as-built;
    - 3. Samples shall be 12 inches wide by 36 inches long with the seam centered lengthwise (length may vary to minimize cutting of the Liner);
    - 4. Cut ten 1-inch wide by 6-inch long test strips from each end of the sample for field testing;
    - 5. The remaining sample shall be distributed as follows:
      - a. One portion for LINER INSTALLER, 12×12 inches;
      - b. One portion for the third-party laboratory (if required by the OWNER), 12×18 inches; and
      - c. Additional samples may be archived if required.
    - 6. LINER INSTALLER shall repair all holes in the Liner resulting from destructive sampling; and
    - 7. Repair and test the continuity of the repair in accordance with these SPECIFICATIONS.
- h. Destructive testing procedures:
  - i. Destructive testing shall be performed in accordance with ASTM D6392;
  - ii. Quantitatively test five specimens for peel adhesion, and then five specimens for shear strength;
  - iii. Destructive testing specimens shall pass when the results shown in Tables 02778-3, 02778-5, or 02778-7 are achieved in both peel and shear test;
  - iv. The break, when peel testing, occurs in the Liner material itself, not through peel separation (FTB);
  - v. The break is ductile; and

- vi. A test will be considered a failure if one specimen on either peel or shear testing does not meet the requirements on Tables 02778-3, 02778-5, or 02778-7 or does not achieve an FTB break.
- i. Failed Seam Procedures:
  - i. If the seam fails, the LINER INSTALLER shall follow one of two options:
    - 1. Reconstruct the seam between any two passed test locations; or
    - 2. Trace the weld to intermediate locations at least 10 feet minimum or where the seam ends in both directions from the location of the failed test. If necessary, the failed seam shall be traced to previous days of seaming for the particular machine.
  - ii. All tracing events shall be recorded by the QC PROVIDER;
  - iii. An additional sample is required for the next seam welded using the same welding device regardless of the length of the next seam;
  - iv. If the new sample passes, then the failed seam shall be reconstructed or capped between the test sample locations; and
  - v. If any sample fails, the process shall be repeated to establish the zone in which the seam shall be reconstructed or capped.
- B. Repair Procedures
  - a. Remove damaged Liner and replace with acceptable Liner materials if damage cannot be satisfactorily repaired.
  - b. Repair any portion of unsatisfactory Liner or seam area failing a destructive or non-destructive test.
  - c. Install additional Liner anywhere that excessive tension (trampolines) exist as determined by the ENGINEER, OWNER, or QC PROVIDER.
  - d. LINER INSTALLER shall be responsible for repair of defective areas.
  - e. Agreement upon the appropriate repair method shall be decided between the QC PROVIDER, QA PROVIDER, and LINER INSTALLER by using one of the following repair methods:
    - i. Patching – Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter. Patch materials shall be of the same material type and thickness as the material being repaired. A patch shall be a minimum of 6 inches larger in all directions than the area requiring repair. All patches shall have rounded corners;
    - ii. Abrading and Re-welding – Used to repair short section of a seam;
    - iii. Spot Welding – Used to repair pinholes or other minor, localized flaws or where Liner thickness has been reduced;
    - iv. Capping – Used to repair long lengths of failed seams;
    - v. Flap Welding – Used to extrusion weld the flap (excess outer portion) of a fusion-weld in lieu of a full cap; and
    - vi. Remove the unacceptable seam and replace with new material.
  - f. The following procedures shall be observed when a repair method is used:
    - i. All Liner surfaces shall be clean and dry at the time of repair;
    - ii. Surfaces of the Liner which are to be repaired by extrusion welds shall be lightly abraded to assure cleanliness; and
    - iii. Extend patches or caps at least 6 inches for extrusion welds and 6 inches for wedge welds beyond the edge of the defect, and around all corners of patch material.
  - g. Repair Verification

- i. Number and log each patch repair; and
  - ii. Non-destructively test each repair using methods specified in this SPECIFICATION.
- C. Quality Control
  - a. Perform all QC procedures and testing in accordance with the CQA Manual, except where amended or modified by the ENGINEER or this SPECIFICATION section.
    - i. LINER QC PROVIDER should submit QC records weekly to the QC PROVIDER. This includes the following:
      - 1. Deployment Log;
      - 2. Seaming Log;
      - 3. Defect/Repair Log; and
      - 4. Startup Seaming Log.
    - ii. QC PROVIDER shall review weekly records from the LINER QC PROVIDER in detail, including verifying the following:
      - 1. All startup seams were satisfactorily performed and recorded;
      - 2. Total amount of Liner deployed and seam length matches the QC PROVIDER'S records;
      - 3. All testing meets the minimum test frequencies; and
      - 4. All defects were repaired and recorded.
    - iii. QC PROVIDER shall provide a weekly report to the ENGINEER that includes the following:
      - 1. Total amount of Liner deployed;
      - 2. Total seaming length; and
      - 3. Total number of duplicate tests performed by the QC PROVIDER (if required by the OWNER).
- D. Acceptance
  - a. LINER INSTALLER retains Ownership and responsibility of Liner until acceptance by OWNER.
  - b. OWNER accepts Liner installation when:
    - i. Liner installation is complete and covered with the appropriate road treatment, where applicable;
    - ii. All required documentation, from the Liner Manufacturer and LINER INSTALLER
    - iii. is received and accepted;
    - iv. All required testing reports from the Liner Manufacturer and LINER INSTALLER
    - v. are received and accepted; and
    - vi. All required QA/QC testing is complete and accepted.

Table 02778-2: Minimum Values for 60-Mil Smooth HDPE Liner

Table 02778-3: Minimum Weld Values for 60-Mil Smooth HDPE Liner

Tested Property	Test Method	Frequency	Minimum Average Values
Thickness, mil Lowest individual reading	ASTM D5199	every roll	60 54
Density, g/cm <sup>3</sup> , (min.)	ASTM D1505	200,000 lbs	0.940
Tensile Properties (each direction) Strength at Break, lb/in-width Strength at Yield, lb/in-width Elongation at Break, % Elongation at Yield, %	ASTM D6693, Type IV Dumbbell, 2 ipm  G.L. 2.0 in G.L. 1.3 in	20,000 lbs	228 126 700 12
Tear Resistance, lb	ASTM D1004	45,000 lbs	42
Puncture Resistance, lb	ASTM D4833	45,000 lbs	108
Carbon Black Content, % (Range)	ASTM D1603*/4218	20,000 lbs	2.0 - 3.0
Carbon Black Dispersion	ASTM D5596	45,000 lbs	Note <sup>[1]</sup>
Notch Constant Tensile Load (NCTL), hr	ASTM D5397, Appendix	200,000 lbs	300
Oxidative Induction Time, min	ASTM D3895, 200°C; O <sub>2</sub> , 1 atm	200,000 lbs	>100
<i>Typical Roll Dimensions</i>			
Roll Length <sup>[2]</sup> , ft			560
Roll Width <sup>[2]</sup> , ft			22.5
Roll Area, ft <sup>2</sup>			12,600

Property	Test Method	Minimum Value
Peel Strength (extrusion), ppi	ASTM D6392	91
Peel Strength (fusion), ppi	ASTM D6392	78
Shear Strength (fusion & ext.), ppi	ASTM D6392	120

END OF SECTION

## **DIV 3 – CONCRETE**

## SECTION 03300

### CONCRETE

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This Section covers cast-in-place concrete for construction of the liner ballast, and vault.
- B. Work includes furnishing materials, transporting, placing, finishing, curing and other appurtenant items of construction.
- C. Inform Engineer at least 48 hours in advance of time and places at which Contractor intends to place concrete, exclusive of weekends and holidays.

##### 1.2 QUALITY ASSURANCE

- A. Reference standards.
  - 1. Except as noted or modified in this Section concrete materials, transporting, placing, finishing and curing shall conform to the requirements of the following standard specifications:
    - a. American Concrete Institute Standards (ACI).
      - i. 301 Specifications for Structural Concrete for Buildings
      - ii. 304 Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
      - iii. Committee 304 Placing Concrete by Pumping Methods
      - iv. 305 Recommended Practice for Hot Weather Concreting
      - v. 306 Recommended Practice for Cold Weather Concreting
- B. Contractor shall keep at least one copy of above-listed ACI publications, latest edition, in project field office.

##### 1.3 SUBMITTALS

- A. Test Results
  - 1. Perform and submit test reports for the following products in accordance with above general reference standards and specific standards of these specifications.
- B. Mix Design
  - 1. Prior to commencing concrete Work, submit and obtain Engineer's approval of certified test reports describing proposed concrete mix design, including:
    - a. Fine aggregates - source, type, gradation, deleterious substances and bulk specific gravity on basis of weight of saturated surface - dry aggregate. ASTM C128.
    - b. Coarse aggregate - source, type, gradation, deleterious substances and bulk specific gravity on basis of weight of saturated surface -dry aggregate, ASTM C127.

- c. Ratio of fine to total aggregates
  - d. Weight (surface dry) of each aggregate per cubic yard
  - e. Total water content in gallons per cubic yard and proposed source
  - f. Slump on which design is based
  - g. Brand, type, and quantity of cement
  - h. Brand, type, descriptive data, and quantity of admixtures
  - i. Air content
  - j. Four trial mix test cylinders, two cylinders per set, shall be made for each proposed mix or provide field experience basis for evaluation per ACI 301. Test one set of two cylinders at seven (7) days and the other set at 28 days. The fourth cylinder shall be labeled 'HOLD', and shall be tested at 56 days should the average compressive strength of the two 28-day cylinders be below the required 28-day compressive strength.
2. Pre-mixed concrete
- a. Pre-mixed concrete (such as Quikrete brand) may be used in lieu of hand-batching concrete. Contractor to submit concrete specifications to Engineer for approval prior to delivery to Site.

#### C. Cylinder Compression Test Reports

1. Submit 2 copies of certified test reports to Engineer for 1.3 B.1.j. and 2 copies of each of test results required under 3.9A.

### 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

#### A. Cement

1. Store in weathertight enclosures and protect against dampness, contamination and warehouse set.
2. Do not use cement that has become caked or lumpy.

#### B. Aggregates

1. Stockpile to prevent excessive segregation, or contamination with other materials or other sizes of aggregates.
2. Use only one supply source for each aggregate stock pile.

#### C. Admixtures.

1. Store to prevent contamination, evaporation, or damage.
2. Protect liquid admixtures from freezing or harmful temperature ranges.
3. Agitate emulsions prior to use.

#### D. Rubber and Plastic Materials.

1. Store in cool place away from direct sunlight.

### 1.5 JOB CONDITIONS

#### A. Environmental Requirements.

1. Do not place concrete during rain, sleet or snow unless adequate protection is provided and Engineer's approval is obtained.
2. Do not allow rainwater to increase mixing water or damage surface finish.

B. Cold Weather Concreting - Conform to ACI 306, "Recommended Practice for Cold Weather Concreting."

1. Temperature of concrete when placed shall not be less than following:

Air Temp (deg. F)	Minimum Concrete Temp. (deg. F) Sections With Least Dimension	
	Under 12"	12" and Over
30 to 45	60	50
0 to 30	65	55
Below 0	70	60

2. When placed, heated concrete shall not be warmer than 80 degrees F.
3. Prior to placing concrete, ice, snow, surface and subsurface frost shall be removed, and temperature of surfaces to be in contact with new concrete shall be raised to temperature specified for placing.
4. Protect concrete from freezing during specified curing period.
5. Heated enclosures shall be strong and windproof to ensure adequate protection of corners, edges and thin sections.
6. Do not permit heating units to locally heat or dry concrete.
7. Do not use combustion heaters during first 24 hours unless concrete is protected from exposure to exhaust gases which contain carbon dioxide.
8. Refer to ACI 306 for further requirements.

C. Hot Weather Concreting - Conform to ACI 305, "Recommended Practice for Hot Weather Concreting".

1. Take precautions when ambient air temperature is 80 degrees F or above.
2. Temperature of concrete when placed shall not exceed 85 degrees F.
3. Cool forms and reinforcing to a maximum of 90 degrees F by spraying with water prior to placing concrete.
4. Do not use cement which has reached a temperature of 170 degrees F or more.
5. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.
6. Do not place concrete when evaporation rate (actual or anticipated) equals or exceeds 0.20 pounds per square foot per hour, as determined by Figure 2.1.4 of ACI 305.
7. Set-retarding and water-reducing admixtures may be used to offset accelerating effects of high temperatures (with Engineer's approval) when ambient air temperature is 90 F or above.
8. Refer to ACI 305 for further requirements.

## PART 2 - PRODUCTS

### 2.1 CONCRETE MATERIALS

A. Cement: ASTM 150, Type II

B. Aggregates.

1. Fine aggregate - ASTM C33
2. Course aggregate - ASTM C33 except that air-cooled blast furnace slag will not be allowed.
  - a. Nominal maximum size of coarse aggregate shall not be larger than:
    - i. 1/5 narrowest dimension between sides of forms, nor
    - ii. 3/4 minimum clear spacing between reinforcing bars, bundles or bars, minimum cover on form work for columns, beams, girders and walls.

C. Water.

1. Clean, fresh and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete reinforcement.

D. Admixtures.

1. Use only as specified or approved in writing by Engineer.
2. Do not use admixtures which cause accelerated setting of cement.
3. Calcium chloride is not permitted.
4. Air-entraining Agent: ASTM C260.
5. Water-Reducing & Retarding: ASTM C494, Type D.
6. Water Reducing: ASTM C494, Type A.
7. Fly Ash: ASTM C618, Class F, with less than 5 percent ignition loss. Use less than 15 percent of cement quantity based upon 1.5 pounds of fly ash for each pound of cement reduction.

## 2.2 REINFORCING STEEL

- A. ASTM A615, 60 ksi (414 MPa) yield grade, deformed billet steel bars
- B. Uncoated finish
- C. Tie Wire: Minimum 16 gage annealed type.
- D. Chairs, Bolsters, Bar Supports and Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.

## 2.3 CONCRETE PRODUCTION

- A. Ready-Mixed Concrete
  1. Mixed and delivered, ASTM C94.
- B. Batching and Mixing Equipment.
  1. "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete", ACI 304.
- C. Proportioning.
  1. Proportion ingredients for concrete to produce a well-graded mix of high density and maximum workability consistent with approved mix designs as follows:

- a. Minimum 28-day Compressive Strength: 3000 psi
  - b. Minimum cement content:
    - cement bag/cubic yard 6
    - pounds/cubic yard 564
  - c. Maximum water/cement ratio:
    - non-air entrained -
    - air entrained 0.44
  - d. Fine to total aggregate ratio:
    - 3/4 inch coarse 0.35-0.50
    - larger than 3/4 inch 0.35-0.46
2. Entrained Air
- a. Minimum for concrete exposed to elements including watertight structures containing water, 5±1 percent.
3. Slump
- a. Keep as low as possible consistent with proper handling and thorough compaction.
  - b. For chute or manual (e.g. rail and shovel) placement, slump shall not exceed 4 inches at the point of placement.
  - c. A tolerance of 1 inch above maximum will be allowed provided average for batches or most recent 10 batches, whichever is fewer, does not exceed the maximum.
  - d. For concrete placed by pumping, a maximum slump loss of 2 inches.
4. Mixing - Minimum time
- a. Truck-mixed concrete, 100 revolutions after introduction of ingredients. Maximum 300 revolutions.
  - b. Do not place concrete until Engineer has had the opportunity to check the load for air entrainment and slump requirements. He may exercise this right for any load he so chooses.

## PART 3 - EXECUTION

### 3.1 INSPECTION

#### A. General

- 1. Assure that excavations and form work are completed.
- 2. Check that fill under slabs are of the type, depth and degree of compaction specified.
- 3. Assure that dirt, mud, encrusted concrete, debris and excess water has been removed.
- 4. Engineer to conduct a subgrade inspection prior to pouring concrete. Engineer to be given a minimum of 48 hours' notice prior to concrete pour. Contractor shall plan accordingly with ordering concrete in the event that Engineer requires additional subgrade preparation prior to pouring.

### 3.2 PREPARATION

A. General.

1. Remove any hardened concrete and foreign material from inner surface of conveying equipment.
2. Prepare subgrades in accordance with ACI 301, Chapter 11.
3. Moisten subgrade prior to placement, but do not cause water to pond, nor muddy or soft spots to appear.
4. Designate limits of each placement and obtain Engineer's approval of entire installation prior to proceeding.

### 3.3 PLACEMENT

A. Conveyance

1. Convey concrete from mixer to final position as rapidly as practicable without segregation or loss of material.

B. Deposition

1. Deposit concrete in a continuous operation until section is completed.
2. Regulate rate of placement so concrete remains plastic and flows into position.
3. Place concrete in approximately horizontal layers.
4. Each layer of concrete shall still be plastic when covered with the following layer.
5. Maximum height of concrete free fall shall be 4 feet.
6. Do not allow concrete to fall on reinforcement or other objects that would cause segregation.

### 3.4 CURING

A. General

1. Keep concrete continuously moist and insulated from excessive hot or cold temperatures for at least 7 days after placement by use of insulated concrete blankets.

### 3.5 QUALITY CONTROL

A. Concrete tests

1. Shall be in accordance with requirements of ACI 301, Chapter 16 - Testing, except as noted or modified in this Section.
  - a. Strength tests
    - i. Mold and cure four cylinders from each sample.
    - ii. Test one at 7-days for information and two at 28-days for acceptance.
    - iii. One cylinder shall remain on hold in the cure tank.
  - b. Minimum samples
    - i. Collect the following minimum samples for each 28-day strength concrete pour used in the Work for each days placing:

<u>Quantity</u>	<u>Number of Samples</u>
50 cubic yards or less	two
50 to 100 cubic yards	four
100 cubic yards or more	four plus one sample for each additional 50 cubic yards

- c. Sample marking
  - i. Mark or tag each sample of compression test cylinders with date and time of day cylinders were made.
  - ii. Identify location in Work where concrete represented by cylinders was placed.
  - iii. Identify delivery truck or batch number, air content, and slump.
- d. Slump test
  - i. Conduct test for each strength test sample and whenever consistency of concrete appears to vary.
- e. Air content
  - i. Conduct test from one of first three batches mixed each day and for each strength test sample.

B. Acceptance of concrete

1. Strength level of concrete will be considered satisfactory so long as average of sets of two consecutive strength test results equals or exceeds specified 28-day strength and no individual strength test result falls below specified strength by more than 500 psi.

C. Failure of test cylinder results

1. Upon failure of test cylinder results, Engineer may require Contractor, at Contractor's expense, to obtain and test at least three cored samples from area in question.
2. Conform to ASTM C42.
3. Concrete will be considered adequate if average of two cores is at least 85% of, and if no single core is less than 75% of the specified 28-day strength.
4. Upon failure of core test results, Engineer may require Contractor, at Contractor's expense, to perform load tests as specified in ACI 318, Chapter 20.
5. Fill core holes as specified for repairing defective concrete.

END OF SECTION

# **DIV 15 – MECHANICAL**

## SECTION 15223

### HIGH DENSITY POLYETHYLENE (HDPE) PIPE

#### PART 1 – GENERAL

##### 1.1 DESCRIPTION

- A. This specification covers high-density polyethylene (PE 4710) pressure pipe primarily intended for the transportation of PLS water either buried or above grade.

##### 1.2 REFERENCED STANDARD

- A. AWWA C906 – Polyethylene (PE) Pressure Pipe and Fittings, 4” through 63” for Water Distribution.
- B. ASTM D2683 – Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- C. ASTM D3261 – Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
- D. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- E. PPI TR-3 – Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.
- F. PPI TR-4 – Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds.
- G. NSF Standard #14 – Plastics Piping Components and Related Materials.

##### 1.3 QUALIFICATION OF MANUFACTURERS

- A. The Manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications.
- B. The pipe and fitting manufacturer shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier. Incoming materials shall be approved by Quality Control before processing into finished goods. Outgoing products shall be tested as required in AWWA C906.
- C. The Manufacturer shall maintain permanent Quality Control (QC) and Quality Assurance (QA) records. Certification or copy of these records shall be made available to the purchaser on request.

## 1.4 SUBMITTALS

- A. Certification: Submit manufacturer's certification that products meet the referenced standards.
- B. Shop Drawings
  - 1. Submit complete Shop Drawings, reference Section 01340, Shop Drawings, and Operation and Maintenance Manuals.
- C. Submit complete layout drawings and details of connections for piping installed within the limits of structures.
- D. Supply an Installation Manual which outlines guidelines for prefabrication, handling, joining, installing, supporting, flanging, anchoring, embedding, and testing of polyethylene piping.

## PART 2 – PRODUCTS

### 2.1 MATERIAL

- A. Materials used for the manufacturing of polyethylene pipe and fittings shall be PE 4710 High Density Polyethylene (HDPE) meeting the ASTM D3350 cell classification of 445474C.
- B. The material used in the production of potable water pipe shall be approved by the National Sanitation Foundation (NSF).
- C. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meet the requirements of this specification.

### 2.2 PIPE

- A. Polyethylene pipe shall be manufactured in accordance with AWWA C906 for sizes 4” through 54”.
- B. Pipe shall be DR 9, DR 11, and DR 17, as specified on the drawings.
- C. Pipe shall be new and contain no recycled compounds from the manufacturing process.

### 2.3 FITTINGS

- A. Polyethylene fittings shall be made from material meeting the same requirements as the pipe. Polyethylene fittings shall be molded or fabricated by the same manufacturer of the pipe.
- B. Where applicable fittings shall meet the requirements of AWWA C906.
- C. Molded fittings shall be manufactured in accordance with either ASTM D2683 (socket fused) or ASTM D3261 (butt fused) and shall be so marked.

- D. Flanges and Mechanical Joint Adapters – Flanges and Mechanical Joint Adapters shall have a material designation code of PE4710 or higher and a minimum ASTM D3350 cell classification of 445474C. Flanges and Mechanical Joint Adapters shall have a manufacturing standard meeting ASTM D 3261. Flanges and Mechanical Joint Adapters shall meet or exceed the pressure rating of the pipe.

Van-stone style, metallic and stainless steel, convoluted or flat-plate, backup rings, and bolt materials shall follow the guidelines of the Plastic Pipe Institute Technical Note #38, and shall have the bolt holes and bolt circles conforming to ASME B-16.5, Class 150. The backup rings shall have a long-term pressure rating equal to or greater than 160 psi. All bolts, nuts, washers and backup ring shall be stainless steel.

#### E. Expansion Joints

1. Expansion joints shall be installed in the locations indicated on the Drawings and shall be manufactured of ductile iron conforming to the material properties of ANSI/AWWA C153/A21.53. Expansion joints shall be capable of expanding or contracting to the amounts shown on the drawings, or indicated in the specifications, but in no case shall there be less than 4” total axial movement. Separation beyond the maximum extension of the expansion joint shall be prevented without the use of external tie rods. Each expansion joint shall be pressure-tested against its own restraint to a minimum of 150 psi. MEGALUG joint restraint shall be provided with each mechanical joint connection. Internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16. Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.
2. All expansion joints shall be EX-TEND 200, as manufactured by EBAA Iron, Inc., or approved equal.
3. Expansion joints are to be installed per manufacturer’s recommended procedures.
4. Installation preset to be based on the HDPE pipe temperature at the time and date of installation. Contractor to confirm preset with Engineer prior to installation.

### PART 3 – EXECUTION

#### 3.1 INSTALLATION AND TESTING

- A. The pipe shall be fit up while pipe and ambient temperatures are between 40° F and 80° F and the pipe is dry. Fabricate shop spools with pipe and ambient temperatures of 66-74° F. Install pipe on grade and on a stable foundation. Pipe to be fully supported and will not bridge high or low spots.
- B. Joints between plain ends of polyethylene pipe shall be made by butt fusion. Electrofusion couplings will not be allowed. The Pipe Manufacturer’s fusion procedures shall be followed at all times as well as the recommendations of the

Fusion Machine Manufacturer. The fusion operator shall be trained in the operation of the specific fusion machine utilized.

- C. The wall thickness of the adjoining pipes shall have the same DR at the point of fusion. For connection of sections having the same outside diameter but different inside diameter (e.g. different DR rating), HDPE flanges and stainless steel backing rings shall be used.
- D. When saddle connections are fusion welded, the Manufacturer's recommended saddle fusion procedures shall be used.
- E. If mechanical fittings (which are designed for, or tested and found acceptable for use with polyethylene pipe) are utilized for transitions between pipe materials, repairs, joining pipe sections, saddle connections, or at other locations, the recommendation of the Mechanical Fitting Manufacturer must be followed. These procedures may differ from other pipe materials. Flanges to be tightened per the manufacturer's recommendations.
- F. Trial fusion testing shall be conducted at the beginning of every week for favorable weather conditions, and every day for inclement conditions (i.e. periods of cold (< 40 degrees F/rain/snow)). The trial fusion shall be allowed to cool completely, then fusion test straps shall be cut out. The test strap shall be 12 inches or 30 times the wall thickness in length (minimum), and 1 inches or 1.5 times the wall thickness in width (minimum). Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely, and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test. All test procedures and results shall be recorded and reported to Engineer.
- G. Socket and Saddle fusions shall be tested by bent strap test as described by the pipe manufacturer. The pipe manufacturer shall provide visual guidelines for inspecting the butt, saddle, and socket fusion joints.
- H. Hydrostatic testing shall be conducted in accordance with Section 01810 HYDROSTATIC TESTING OF PIPE SYSTEM.

### 3.2 PIPE PACKAGING, HANDLING, & STORAGE

- A. The manufacturer shall package the pipe in a manner designed to deliver the pipe to the project neatly, intact, and without physical damage. The transportation carrier shall use appropriate methods and intermittent checks to insure the pipe is properly supported, stacked, and restrained during transport such that the pipe is not nicked, gouged, or physically damaged.
- B. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment.

- C. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the butt-fusion method.
- D. Fused segments of pipe shall be handled so as to avoid damage to the pipe. Chains or cable type chokers must be avoided when lifting fused section of pipe. Nylon slings are preferred. Spreader bars are recommended when lifting long fused sections.

END OF SECTION

# Description of the project

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# TECHNICAL MEMORANDUM

**DATE:** February 15, 2024      **Telesto #** 200448-001-01  
**TO:** Tyler Johnson – Chino Environmental – Chief Engineer  
**FROM:** Jonathan Cullor, P.E. – Senior Engineer  
**SUBJECT:** Chino LFES – Design Basis Memorandum

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Due to its history, age, and its current importance in operations as a PLS, and stormwater management collection system, Freeport-McMoRan Chino Mines Company (Chino) is in the process of designing an upgrade to, and replacement of, the Lampbright Far-East Sump (LFES, Project). The proposed new system will be designed to:

- improve the capture and management of fugitive pregnant leach solutions (PLS) issuing from the east side of the Lampbright Leach Stockpile (LLS)
- improve the capture and management of LLS sediments produced in the LFES stormwater catchment
- provide for management of stormwater runoff and incidental PLS from the planned North Lampbright Leach Stockpile (NLLS) via the East Headwall Impoundment (EHI)

This technical memorandum has been drafted to provide the parameters to be followed during final design of the LFES replacement system. These design parameters include:

- Regulatory requirements including:
  - design storms
  - maximum holding times
  - containment design
  - pipeline design
  - stockpile stability
- Incoming and outgoing flow rates

## 1.0 REGULATIONS

The design of the LFES replacement is regulated by the New Mexico Environment Department (NMED) under 20.6.7 New Mexico Administrative Code (NMAC; NM Copper Rule, 2024). Depending on pond dimensions and capacity, the LFES replacement may also be regulated as a jurisdictional dam by the New Mexico Office of the State Engineer (NMOSE) under 19.25.12 NMAC (NMOSE, 2010).

## 1.1 New Mexico Environment Department

NMAC 20.6.7 provides Project relevant engineering requirements for water management infrastructure (Infrastructure) for new:

- Impoundments
- Pipelines
- Tanks

Infrastructure engineering regulations within 20.6.7 NMAC are generally divided into three classifications: process water, impacted stormwater, and non-impacted stormwater.

### ***Process Water***

NMAC 20.6.7.7 defines process water as “Any water containing water contaminants in excess of the standards of 20.6.2.3103 NMAC that is generated, managed or used within a copper mine facility including raffinate; PLS; leachate collected from waste rock stockpiles, leach stockpiles, and tailings impoundments; tailings decant water; pit dewatering water; intercepted ground water; laboratory or other waste discharges containing water contaminants; and domestic wastes mixed with process water.”

### ***Impacted Stormwater***

NMAC 20.6.7.7 defines impacted stormwater as “Direct precipitation and runoff that comes into contact with water contaminants within a copper mine facility which causes the stormwater to exceed one or more of the standards of 20.6.2.3103 NMAC and includes overflow from a primary process solution impoundment or other collection system resulting from a precipitation event.”

### ***Non-Impacted Stormwater***

NMAC 20.6.7.7 defines non-impacted stormwater as “Stormwater run-off generated as a result of direct precipitation at a copper mine facility that does not exceed the standards of 20.6.2.3103 NMAC.”

### **1.1.1 Impoundments**

Engineering design requirements for new impoundments (excluding tailing impoundments) are detailed in NMAC 20.6.7.17 Subsection D. Impoundments discussed under this section include:

- Leach solution impoundments
- Process water impoundments (other than leach solution impoundments)
- Impacted stormwater impoundments
- Solid settling impoundments
- Open channel conveyance structures

Requirements covered in this section include but are not limited to impoundment/structure:

- Embankment heights
- Outslopes
- Access and maintenance
- Liners
- Leak collection systems
- Capacities
- Ground water separation
- Spillways

### **1.1.2 Pipelines and Tanks**

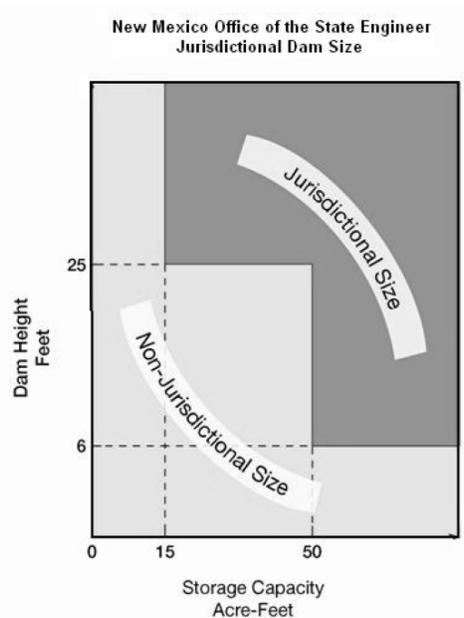
Engineering design requirements for new pipelines and tanks are detailed in 20.6.7.23 NMAC.

Requirements covered in this section include but are not limited to:

- Materials
- Foundations
- Monitoring systems
- Secondary containments
- Fluid management

## **1.2 New Mexico Office of the State Engineer**

NMOSE jurisdictional dam regulations are defined in 19.25.12 NMAC. NMAC 19.25.12.7 Subsection D.(1) defines a jurisdictional dam as “a dam 25 feet or greater in height, which impounds more than 15 acre-feet of water or a dam that impounds 50 acre-feet or more of water and is 6 feet or greater in height” (Figure 1).



**Figure 1 NMOSE Jurisdictional Criteria**

Further, NMAC 19.25.12.7 Subsection D.(1) defines dam height as “the vertical distance from the lowest point on the downstream toe to the lowest point on the dam crest.”

NMAC 19.25.12.7 Subsection D.(1) also states that the NMOSE does not regulate the “design, construction, and operation of a non-jurisdictional dam unless the dam is unsafe and there is a threat to life or property, as determined by the state engineer.”

## 2.0 DESIGN CRITERIA

The design criteria outlined in this section will be used for final design of the LFES replacement system.

### 2.1 Impoundments

#### 2.1.1 Embankment Height

Chino desires that any impoundments designed for the Project be kept under jurisdictional dam status as defined in Section 1.2. Therefore, all impoundment embankments will be:

- Any height for storage capacities under 15 acre-feet,
- Less than 25 feet in height for storage capacities between 15 acre-feet and 50 acre-feet

- less than 6 feet in height for storage capacities over 50 acre-feet

Note, Chino requested that any proposed LFES replacement have a minimum storage capacity of 10 acre-feet.

### 2.1.2 Outslopes

NMAC 20.6.7.17 Subsection D.(1)(a) requires that “The **outside slopes of an impoundment shall be a maximum of two (horizontal) to one (vertical)** and shall meet **a minimum static factor of safety of 1.3** with water impounded to the maximum capacity design level, except where an impoundment is bounded by rock walls or is below the surrounding surface grade.

### 2.1.3 Access and Maintenance

NMAC 20.6.7.17 Subsection D.(1)(b) requires that “The dikes of an impoundment shall be **designed to allow for access for maintenance** unless otherwise approved by the department.”

### 2.1.4 Liners

#### ***Impacted Stormwater Impoundments (< 30 Days Storage)***

For impacted stormwater impoundments with storage durations of less than 30 days, NMAC 20.6.7.17 Subsection D.(4) states:

- (a) “At a minimum, an impacted stormwater impoundment subject to this paragraph shall be constructed as an engineered liner system consisting of **a compacted subbase overlain by a synthetic liner.**”
- (b) “The liner system shall be prepared and placed upon a **stable subgrade**. The top surface of the subgrade shall be **smooth and free of sharp rocks or any other material that could penetrate the overlying liner bedding or synthetic liner.** **Liner bedding** shall be placed atop the subgrade and **shall consist of a minimum of six inches of sand or fine soil** to allow for good contact between liner and liner bedding.”
- (c) “**Synthetic liners** for an impacted stormwater impoundment shall provide the same or greater level of containment, including permeability, as **a 60 mil HDPE geomembrane liner system**. The liner system’s tensile strength, tear and puncture resistance and resistance to degradation by ultraviolet light shall be compatible with design loads, exposure and conditions.”
- (d) “Liner systems for impacted stormwater impoundments shall be designed and constructed with **a weighting system to secure the liner and limit liner damage during periods of extreme wind events when the impoundment is empty.**”

### ***All Impoundments***

NMAC 20.6.7.17 Subsection D.(1)(c) through (f) states the following for all impoundments regardless of classification:

- (c) “Liners shall be installed with **sufficient slack in the liner material to accommodate expansion and contraction** due to temperature changes. **Folds in the liner material shall not be present in the completed liner** except to the extent necessary to provide slack.”
- (d) “Liners shall be **anchored in an anchor trench**. The trench shall be of a **size and setback distance sufficient for the size of the impoundment.**”
- (e) “Liner panels shall be oriented such that **all sidewall seams are vertical.**”
- (f) “Any opening in the liner through which a pipe or other fixture protrudes shall be sealed in accordance with the liner manufacturer’s requirements. **Liner penetrations shall be detailed in the construction plans and as-built drawings.**”

### **2.1.5 Capacities**

NMAC 20.6.7.17 Subsection D.(2) states that “Capacity requirements **may be satisfied by a single impoundment or by the collective capacity of multiple interconnected impoundments and any interconnected tanks.**” Capacity requirements are further defined in Subsection D.(2) based on the following impoundment classifications:

#### ***Impacted Stormwater Impoundments***

NMAC 20.6.7.17 Subsection D.(2)(e) states that “Impacted stormwater impoundment systems shall be designed to **prevent overflow resulting from a 100 year return interval storm event while maintaining two feet of freeboard** and **may use interconnected impoundments, gravity flow conveyances and pumping systems designed to remove water from individual impoundments at rates to prevent overflow during the design storm event.** The appropriate overflow capacity design **shall consider system redundancies such as backup power systems and pumps.** For impacted stormwater impoundments located within the open pit surface drainage area, the open pit bottom may be utilized for a portion of the permitted impoundment capacity.”

#### ***Stormwater Conveyances***

NMAC 20.6.7.17 Subsection D.(2)(f) states that “Open channel conveyance structures intended to transport stormwater to an impoundment shall be designed to convey, at a minimum, the **peak flow from a 100 year return interval storm event** while preserving adequate freeboard, but **not less than six inches of freeboard.** Conveyances shall be designed to minimize ponding and infiltration of stormwater.”

### ***Solids Settling Impoundments***

NMAC 20.6.7.17 Subsection D.(2)(g) states that “An impoundment designed and used for solids settling **shall not be used to satisfy the impoundment capacity requirements.**”

#### **2.1.6 Ground Water Separation**

NMAC 20.6.7.17 Subsection D.(6) states that “Impoundments that require a liner pursuant to this subsection **shall not be constructed in a location where the vertical distance between the seasonal high ground water level and the finished grade of the floor of the impoundment is less than or equal to four feet.**”

#### **2.1.7 Spillways**

NMAC 20.6.7.17 Subsection D.(7) states that “**Impacted stormwater** impoundments shall have spillways to safely **discharge the peak runoff of a 25-year, 24-hour precipitation event,** or an event with a **90-percent chance of not being exceeded for the design life of the impoundment.** Impoundments intended as primary containment for **process water shall not be designed with a spillway that empties onto the ground surface.**”

## **2.2 Tanks**

### **2.2.1 Materials**

NMAC 20.6.7.23 Subsection A.(2)(a) requires that new tanks shall “be designed and constructed of **steel, concrete or impermeable materials that are compatible with the particular contents** that are contained within the tank and **resistant to degradation by ultraviolet light** where exposed to sunlight.”

### **2.2.2 Foundations**

NMAC 20.6.7.23 Subsection A.(2)(b) requires that new tanks shall “have a constructed foundation consisting of a **stable, level base free of rocks, debris, sharp edges or irregularities** that could puncture, crack or indent the tank materials.”

### 2.2.3 Fluid Management

NMAC 20.6.7.23 Subsection A.(2)(c) requires that new tanks shall “be designed to **prevent overflow and the collection of surface water run-on.**”

### 2.2.4 Secondary Containment

#### *Above Ground Tanks*

NMAC 20.6.7.23 Subsection A.(2)(d) requires that an above-ground tank system shall “be **bermed to contain 110 percent of the volume of the largest tank** within the system or the largest interconnected tanks.”

## 2.3 Pipelines

### 2.3.1 Materials

NMAC 20.6.7.23 Subsection A.(1)(a) requires that new pipelines shall “be constructed of **impermeable materials that are compatible with the particular contents** that are contained and carried in the pipeline and are **resistant to degradation by ultraviolet light** if they will be exposed to sunlight.”

### 2.3.2 Integrity Monitoring

NMAC 20.6.7.23 Subsection A.(1)(b) requires that new pipelines shall “incorporate a **mechanism for monitoring the integrity of the pipeline system** including visual inspections, pressure change sensors, or other appropriate means.”

### 2.3.3 Secondary Containment

NMAC 20.6.7.23 Subsection A.(1)(c) requires that new pipelines shall “incorporate a mechanism of secondary containment to contain and control leaks and spills including **berms, placement within or drainage toward areas authorized for discharge of the conveyed fluids, and impoundments.**”

## 2.4 Calculated Capacities and Flow Rates

### 2.4.1 Hydrology

This Project will utilize the 100-year return interval storm events as defined in the Colorado-New Mexico Regional Extreme Precipitation Study, Regional Precipitation-Frequency Estimation (CO-NM REPS RPFE, 2018) to calculate the 100-year peak flow rates and runoff volumes for capacity sizing as defined in Section 2.1.6. The CO-NM REPS RPFE defines three 100-year storm events for the Project site: Local Storm (LS; 2-hr duration), Mesoscale Storm with Embedded Convection (MEC; 6-hr duration), and Mid-Latitude Cyclone (MLC; 48-hr duration). The CO-NM REPS GIS tool also provides a precipitation depth for the 100-year, 24-hour storm event. The 100-year, 24-hour depth provided by CO-NM REPS RPFE is scaled from the 48-hr MLC event and doesn't correspond to a real world storm type. Additionally, the CO-NM REPS tool explicitly states that the 24-hr storm is not to be used for design. However, depending on impoundment classification, the Project is required to size impoundments for either the 100-year, 24-hour storm event or the 100-year storm event with an undefined duration (Section 2.1.6). Because Chino is committed to size the LFES replacement system to manage the 100-year event, the following durations will be used to size LFES replacement system capacities:

- Storage Capacities: The highest runoff volume produced by either the 2-hr LS, 6-hr MEC, 24-hour MLC, or the 48-hr MLC storm event
- Conveyance Structures: The highest peak flow rate resulting from the 2-hr LS, 6-hr MEC, or the 48-hr MLC storm event as attenuated by any impoundments or tanks (if applicable)

Note, if the 48-hour MLC storm event produces larger storage capacities or peak flow rates than the 24-hour MLC event, Chino will review the resulting infrastructure sizing and make the final decision as to if the impoundments will be sized to the 24-or 48-hour event.

### 2.4.2 Heap Leach Drain Down

The LFES replacement system will be designed to manage an expected Lampbright Leach Stockpile PLS effluent peak flow rate of 9,000 gpm as defined by Chino. Sources of PLS are solely from the LLS via the LFES collection system, and the East Headwall Impoundment.

## 3.0 SUMMARY

In summary, the proposed LFES replacement system infrastructure will be designed as follows:

## TECHNICAL MEMORANDUM

To: Tyler Johnson

Date: February 15, 2024

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- East Headwall to LFES PLS Tank/Stormwater Pond Pipelines
  - Functional Classification:
    - ◇ Process Water (containing PLS)
  - General Arrangement:
    - ◇ Pass impacted stormwater or PLS process water from the East Headwall containment to:
      - The Stormwater Pond before construction of the NLLS
      - The PLS Tank after construction of the NLLS
    - ◇ Include a sediment capture bagging system just prior to discharge into the PLS Tank or Stormwater Pond
    - ◇ Cleanouts to allow for pipeline maintenance (periodic or located at low points [if any])
  - Design Flow Rate:
    - ◇ Pass the peak flow rate from the 100-year runoff event (greatest of the 2-, 6- or 48-hour event as defined by CO-NM REPS) from the East Headwall basin under either the existing stormwater catchment or the NLLS stormwater catchment
  - Material:
    - ◇ HDPE
  - Secondary Containment:
    - ◇ Berms placed along pipeline to provide secondary containment for any breach in the pipeline and/or positive drainage towards Reservoir 8
  - Access:
    - ◇ Designed to allow for maintenance access
- Non-Impacted Stormwater Diversion Channel
  - Functional Classification:
    - ◇ Non-impacted stormwater
  - General Arrangement:
    - ◇ Divert non-impacted stormwater (non-contact stormwater) around the LFES replacement system to Tributary 2
  - Discharge Location:
    - ◇ Tributary 2
  - Design Flow Rate:
    - ◇ Pass the peak flow rate from the 100-year runoff event (greatest of the 2-, 6- or 48-hour event as defined by CO-NM REPS) from non-impacted stormwater catchments to Tributary 2
  - Access:
    - ◇ Designed to allow for maintenance access
- Stormwater Solids Settling Impoundment:

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- Functional Classification:
  - ◇ Impacted stormwater
- General Arrangement:
  - ◇ Capture and provide primary treatment to stormwater runoff from the LLS
- Discharge Location:
  - ◇ Stormwater Impoundment
- Design Flow Rate:
  - ◇ Contain and pass the peak flow rate and runoff volume from the 100-year runoff event (greatest of the 2-, 6- or 48-hour event as defined by CO-NM REPS) from impacted stormwater catchments without discharge to Tributary 2
- Design Volume:
  - ◇ As needed for proper particulate settlement
  - ◇ Volume shall not be used to satisfy impoundment capacity requirements
- Access:
  - ◇ Designed to allow for maintenance access
- PLS French Drain
  - Functional Classification:
    - ◇ Process Water (containing PLS)
  - General Arrangement:
    - ◇ Must capture all sub-surface flows from the LLS reporting to the LFES
    - ◇ Cleanouts to allow for drain maintenance
  - Discharge Location:
    - ◇ PLS Tank
  - Design flow rate:
    - ◇ 9,000 gpm leaching rate
  - Filter Material:
    - ◇ Dual porous media for long-life
  - Pipeline Material:
    - ◇ HDPE
- PLS Tank
  - Functional Classification:
    - ◇ Process Water (containing PLS)
  - General Arrangement:
    - ◇ Designed to prevent collection of surface water run-on
    - ◇ Designed to prevent tank overflow

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- Storage Volume:
  - ◇ Designed to allow for adequate storage during an upset condition (time to be determined with Chino)
- Material:
  - ◇ Stainless steel
- Secondary Containment Volume:
  - ◇ 110% of the volume of the tank
- Access:
  - ◇ Designed to allow for maintenance access
- Stormwater Pond
  - Functional Classification:
    - ◇ Impacted Stormwater Impoundment
  - General Arrangement:
    - ◇ Modeled after Rustler Canyon Impoundment
  - Storage Volume:
    - ◇ Contain the 100-year runoff event (greatest of the 2-, 6- or 48-hour event as defined by CO-NM REPS) from impacted stormwater catchments without discharge to either the primary or secondary lines while maintaining 2 foot of freeboard
    - ◇ 10 acre-foot minimum
  - Storage Duration:
    - ◇ < 30 days
  - Embankment Height:
    - ◇ Any height for storage capacities under 15 acre-feet
    - ◇ Less than 25 feet in height for storage capacities between 15 acre-feet and 50 acre-feet
  - Embankment Slopes:
    - ◇ 2:1 (H:V) maximum with minimum static factor of safety of 1.3
  - Spillway:
    - ◇ Safely discharge the 25-year, 24-hour event, or an event with a 90-percent chance of not being exceeded for the design life of the impoundment
  - Liner:
    - ◇ Single lined 60 mil HDPE weighted to prevent damage during wind events
    - ◇ Vertical seams
    - ◇ Terminated in anchor trenches
    - ◇ Minimum 4 feet above seasonal high ground water elevation
  - Liner Subgrade:

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- ◇ Minimum of 6" sand or fine soil free of sharp rocks
- Access:
  - ◇ Designed to allow for maintenance access
- Groundwater Capture French Drain
  - Functional Classification:
    - ◇ Impacted Stormwater
  - General Arrangement:
    - ◇ Must capture all sub-surface flows downgradient of the LFES area reporting to Tributary 2
    - ◇ Cleanouts to allow for drain maintenance
  - Discharge Location:
    - ◇ Gravity fed to Stormwater Pond Secondary Discharge Line
  - Design flow rate:
    - ◇ To be determined
  - Filter Material:
    - ◇ Dual porous media for long-life
  - Pipeline Material:
    - ◇ HDPE
- PLS Tank Primary Discharge Line (Pump Fed)
  - Functional Classification:
    - ◇ Process Water (containing PLS)
  - General Arrangement:
    - ◇ Cleanouts to allow for pipeline maintenance (periodic or located at low points [if any])
  - Discharge Location:
    - ◇ TBD, Flemming Pond 2 or Lampbright Booster Tank as directed by Chino
  - Design Pumping Rate:
    - ◇ 9,000 gpm leaching rate + peak East Headwall discharge pipeline flow rate under proposed conditions (current catchment or NLLS catchment)
  - Material:
    - ◇ HDPE
  - Secondary Containment:
    - ◇ Berms placed along pipeline to provide secondary containment for any breach in the pipeline
- Stormwater Pond Primary Discharge Line (Pump Fed)

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- Functional Classification:
  - ◇ Impacted Stormwater
- General Arrangement:
  - ◇ Cleanouts to allow for pipeline maintenance (periodic or located at low points [if any])
- Discharge Location:
  - ◇ Reservoir 7
- Design Pumping Rate:
  - ◇ As feasible while allowing for maximum pond detention time of 30 days
- Material:
  - ◇ HDPE
- Secondary Containment:
  - ◇ Berms placed along pipeline to provide secondary containment for any breach in the pipeline
- PLS Tank Secondary Discharge Line (Gravity Fed)
  - Functional Classification:
    - ◇ Process Water (containing PLS)
  - General Arrangement:
    - ◇ Overflow inlet designed to prevent tank overflow
    - ◇ Valved spur at bottom of tank to allow for gravity draining of tank
    - ◇ Cleanouts to allow for pipeline maintenance (periodic or located at low points [if any])
  - Discharge Location:
    - ◇ Stainless Steel Tank near Reservoir 8
  - Design Flow Rate:
    - ◇ As required to prevent tank overflow
  - Material:
    - ◇ HDPE
  - Secondary Containment:
    - ◇ Berms placed along pipeline to provide secondary containment for any breach in the pipeline and/or positive drainage towards Reservoir 8
- Stormwater Pond Secondary Discharge Line (Gravity Fed)
  - Functional Classification:
    - ◇ Impacted Stormwater
  - General Arrangement:
    - ◇ Overflow inlet with invert elevation at maximum design storage stage (2' below embankment crest)

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- ◇ Valved spur at bottom of stormwater pond to allow for gravity draining of pond
- ◇ Cleanouts to allow for pipeline maintenance (periodic or located at low points [if any])
- Discharge Location:
  - ◇ Reservoir 8
- Design Flow Rate:
  - ◇ As required to meet impoundment spillway requirements (when combined with embankment crest spillway)
- Material:
  - ◇ HDPE
- Secondary Containment:
  - ◇ Berms placed along pipeline to provide secondary containment for any breach in the pipeline and/or positive drainage towards Reservoir 8

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## 4.0 REFERENCES

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# Estimated Timeline of Construction

Far East Lampbriht Construction Schedule												Date	4/28/2025																																										
Work	January			February			March			April			May			June			July			August			September			October			November			December			January																		
	6	13	20	27	3	10	17	24	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19
Civil																																																							
Clearing and Grubbing																																																							
Earthwork																																																							
Grading and Compaction																																																							
Pond Lining																																																							
Aggregate and Concrete																																																							
Piping																																																							
Lead Time																																																							
Installation																																																							
PLS Tank																																																							
Lead Time																																																							
Erection																																																							
Valves																																																							
Lead Time																																																							
Installation																																																							
PLS Pumps																																																							
Lead Time																																																							
Installation																																																							