Purchasing Division

ADDENDUM NO. 2

DATE: June 7, 2021
FROM: City of Grand Junction Purchasing Division
TO: All Interested Parties
RE: Construction Inspection Services for Hogchute Dam Improvements RFP-4916-21-SH

Firms responding to the above referenced solicitation are hereby instructed that the requirements have been clarified, modified, superseded and supplemented as to this date as hereinafter described.

Clarification:

Section 4.8 Attached Documents:

1. Project location maps: See Sheets G01 and G03 of Construction Plans in Appendix D of Design Report (Page 3)
2. Photos of site; See Appendix H of Design Report (Page 47)
3. Geotechnical Report: See Appendix C of Design Report (Page 65)
4. Project Manual: Appendix D of Design Report (Page 394)

These attachments were omitted from the original RFP document. They are included in at the end of this Addendum.

Please make note of the following:

Question 1: Section 4.3 states that the consultant responsibilities are for observation of materials testing. Please clarify: will materials testing be required under this contract? Or will materials testing be the responsibility of a QA hired by the city or the responsibility of QC hired by the construction team?
Answer: Section 4.3 states the Consultant shall observe testing of materials. It also states the Consultant shall measure and monitor quantities of materials used for verification and take samples as appropriate. The Consultant shall determine if materials meet regulatory compliance and document problems or concerns and alert City representatives.

Question 2: What is the funding source for this contract? Are there specifications other than City of Grand Junction that we need to be aware of?
Answer: Funding will be provided by the City of Grand Junction. Inspectors shall ensure all work adheres to the Colorado Division of Water Resources, Department of Natural Resources Dam Safety Program Rules (2CC4-402.1), contract documents such as Construction Specifications and City of Grand Junction Standard Contract Documents.

Question 3: Is there a DBE requirement?
Answer: No.

Question 4: What do you see as the biggest challenges on this project?
Answer: Your response should include what your firm considers the biggest challenge and how you intend to address it.

Question 5: What is most important about handling this project as an inspector?
Answer: The City would like you to address what you think is the most important issue/s in handling this project.

Question 6: With limited service/internet at the jobsite, what is the frequency of contact with the City representatives/project engineer that you expect and will there be regular visits from the city representatives/project engineer?
Answer: The awarded consultant must establish reliable communication while on site (i.e. satellite phone, internet, etc.) in order to provide regular updates to City Staff. The awarded consultant should expect daily frequency of contact and regular visits.

Question 7: In the contractor RFP, it states the hours are 7AM – 6PM on normal work days while the inspector RFP only states full time. Are these working hours the expected hours for the inspector as well?
Answer: Yes. An inspector shall be on-site full time, so expect to be there whenever the contractor is working.

The original solicitation for the project referenced above is amended as noted.

All other conditions of subject remain the same.

Respectfully,

Susan J. Hyatt

Susan Hyatt, Senior Buyer
City of Grand Junction, Colorado

Attachment 1

CONSTRUCTION DRAWINGS FOR
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION

DAM ID NO. 420127 CONSTRUCTION NO. C-0454A

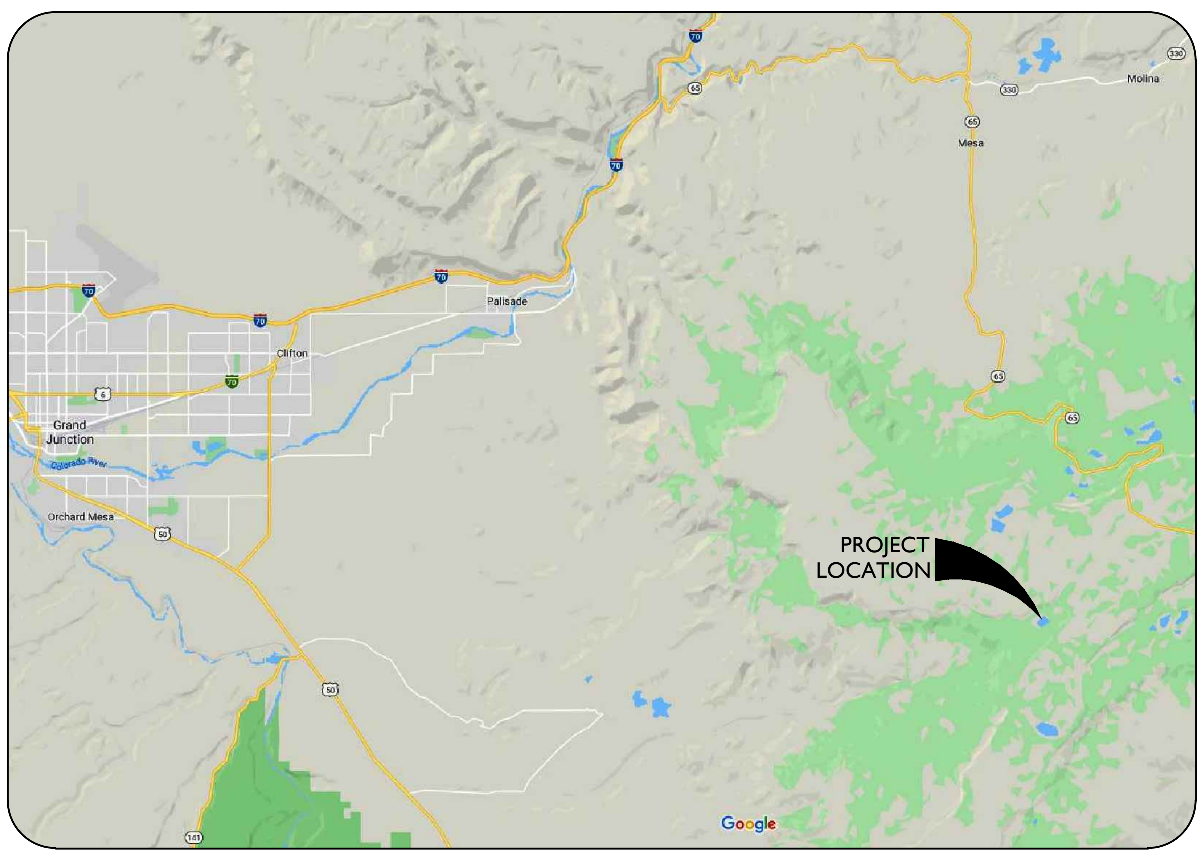
PREPARED FOR THE

CITY OF GRAND JUNCTION, MESA COUNTY, COLORADO
WATER DIVISION 4, WATER DISTRICT 42

MAY 2021

VICINITY MAP

NOT TO SCALE



ALSO SEE DRAWING G03 FOR PROJECT LOCATION

CONTACT INFORMATION

OWNER

City of Grand Junction
John Eklund, P.E., C.F.M.
333 West Avenue, Building C
Grand Junction, Colorado 81501
(970) 244-1558

CIVIL ENGINEER

Ayres Associates
Todd Rudolph, P.E.
3433 Oakwood Hills Parkway
Eau Claire, Wisconsin 54701-7698
(715) 834-3161

Ayres Associates
Dustin Robinson, P.E.
3665 JFK Parkway, Building 2, Suite 100
Fort Collins, Colorado 80525
(970) 223-5556

COLORADO DIVISION OF WATER RESOURCES

Department of Natural Resources
District 5 Dam Safety Engineer
Jackie Blumberg, PE
2768 Compass Drive, #102
Grand Junction, Colorado 81506
(303) 505-6469

UNITED STATES FOREST SERVICE

Grand Valley Ranger District
Loren Paulson, Realty Specialist
2777 Crossroads Blvd.
Grand Junction, Colorado 81506
(970) 242-8211 x4112

COLORADO 811
KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

THESE PLANS HAVE BEEN PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.

Todd M. Rudolph

TODD M. RUDOLPH
COLORADO P.E. NO. 58436

COLORADO LICENSED
TODD M. RUDOLPH
58436
PROFESSIONAL ENGINEER
2/20/2021

APPROVED ON THE ______ DAY OF ____________ 2021

STATE ENGINEER

BILL McCORMICK, CHIEF, COLORADO DAM SAFETY
COLORADO P.E. NO. 29127

THESE PLANS REPRESENT THE AS-CONSTRUCTED CONDITIONS OF HOGCHUTE DAM REPAIRS TO THE BEST OF MY KNOWLEDGE AND JUDGMENT, BASED IN PART ON INFORMATION FURNISHED BY OTHERS, AS OF THE _____ DAY OF __________ 2021

TODD M. RUDOLPH
COLORADO P.E. NO. 58436

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Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

TITLE SHEET

HOGCHUTE (AKA CARSON)
RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. G01
SHEET 1 OF 44

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 COVER.DWG Tuesday, June 01, 2021 2:07 PM By: RIEDER, AUSTIN

SHEET INDEX		
SHEET	DRAWING	DESCRIPTION
1	G01	TITLE SHEET
2	G02	INDEX TO DRAWINGS, SURVEY NOTES, AND GENERAL NOTES
3	G03	SITE ACCESS AND BORROW AREAS PLAN
4	G04	EXISTING SITE, STAGING, AND STOCKPILE AREAS PLAN
5	G05	GEOTECHNICAL INFORMATION
6	G06	RATING CURVES 1 OF 2
7	G07	RATING CURVES 2 OF 2
8	C01	EXISTING CONDITIONS, EXCAVATION, AND DEMOLITION PLAN - 1 OF 2
9	C02	EXISTING CONDITIONS, EXCAVATION, AND DEMOLITION PLAN - 2 OF 2
10	C03	DEWATERING PLAN - PHASE 1
11	C04	DEWATERING PLAN - PHASE 2
12	C05	EROSION CONTROL PLAN
13	C06	EROSION CONTROL DETAILS
14	C07	EROSION CONTROL DETAILS
15	C08	EROSION CONTROL DETAILS
16	C09	EROSION CONTROL DETAILS
17	C10	EROSION CONTROL DETAILS
18	C11	DAM PROPOSED CONDITIONS AND COFFERDAM
19	C12	DAM PROPOSED CONDITIONS ENLARGED PLAN
20	C13	DAM PROFILE AND DETAIL
21	C14	DAM DRAIN PIPE PROFILES
22	C15	DAM DETAILS 1 OF 2
23	C16	DAM DETAILS 2 OF 2
24	C17	DAM SECTIONS 1 OF 3
25	C18	DAM SECTIONS 2 OF 3
26	C19	DAM SECTIONS 3 OF 3
27	C20	SPILLWAY PLAN 1 OF 3
28	C21	SPILLWAY PLAN 2 OF 3
29	C22	SPILLWAY PLAN 3 OF 3
30	C23	SPILLWAY ROCK BERM PROFILES 1 OF 2
31	C24	SPILLWAY ROCK BERM PROFILES 2 OF 2
32	C25	SPILLWAY DETAILS AND SECTIONS
33	C26	SPILLWAY OVERFLOW WIER PLAN AND DETAILS
34	C27	SPILLWAY PRIMARY AND SECONDARY CHANNEL PLAN AND WATTLE DETAIL
35	C28	SPILLWAY PLANTING PLAN
36	C29	DAM INSTRUMENTATION
37	C30	INSTRUMENTATION DETAILS
38	C31	WETLAND IMPACT
39	C32	CONCRETE BUTTRESS REINFORCEMENT
40	C33	STEEL PIPE DETAILS
41	C34	TRASH RACK DETAILS
42	C35	TRASH RACK DETAILS
43	C36	IMPACT BASIN DETAILS
44	C37	MISCELLANEOUS DETAILS

GENERAL NOTES:

1. THESE CONSTRUCTION DRAWINGS ARE SUPPLEMENTED WITH THE TECHNICAL SPECIFICATIONS FOR HOGCHUTE DAM REHABILITATION. AN ENGINEER SEALED COPY OF BOTH DOCUMENTS MUST BE MAINTAINED AT THE JOBSITE DURING ALL PHASES OF CONSTRUCTION.

2. THIS PROJECT FALLS UNDER THE COLORADO STATE ENGINEER'S OFFICE RULE 5 OF DAM SAFETY RULES AND REGULATIONS FOR DAM SAFETY AND DAM CONSTRUCTION. THE CONTRACTOR, BY STARTING THIS PROJECT, ACKNOWLEDGES THAT THEY ARE FULLY AWARE OF THE CURRENTLY ADOPTED RULES AND REGULATIONS AND HOW THEY PERTAIN TO THEIR CONSTRUCTION PRACTICES AND SCHEDULING.

3. THIS PROJECT FALLS UNDER THE COLORADO STATE ENGINEER'S OFFICE RULE 8 FOR DAM SAFETY RULES AND REGULATIONS FOR JURISDICTIONAL EMBANKMENT DAMS. UNDER CONTRACT WITH THE OWNER, ENGINEER SHALL ENDEAVOR TO DETERMINE IN GENERAL IF SUCH WORK IS PROCEEDING IN ACCORDANCE WITH CONTRACT DOCUMENTS.

4. ALL CONSTRUCTION CHANGE ORDERS MUST BE APPROVED BY THE STATE ENGINEER'S OFFICE OF COLORADO PER RULE 8.2.5 OF DAM SAFETY RULES AND REGULATIONS FOR DAM SAFETY AND DAM CONSTRUCTION AS WELL AS THE PROJECT ENGINEER. THIS WILL NECESSITATE A LONGER PERIOD FOR REVIEW AND APPROVALS.

SURVEY NOTES:

BENCHMARK:

THE HORIZONTAL AND VERTICAL CONTROL SHOWN IS BASED ON UNADJUSTED GPS STATIC OBSERVATIONS TIED TO THE GRAND MESA AREA (GMA) GEOID ESTABLISHED BY MESA COUNTY. THE NORTHERLY CONTROL POINT (POINT 2) IS A PK NAIL AND WASHER EMBEDDED IN ROCK AND IS THE BENCHMARK FOR THIS PROJECT. THE SOUTH POINT (POINT 3) IS A ROUND HEAD BOLT EMBEDDED IN ROCK.

VERTICAL DATUM: NAVD88 - 5.187 FT

TRANSLATION FROM VERTICAL DATUM TO HISTORICAL DATUM SHOWN ON 1947 DRAWINGS: -9,751 FT (APPROXIMATE)

SURVEY CONTROL POINT TABLE				
POINT NUMBER	DESCRIPTION	ELEVATION	NORTHING	EASTING
1	CP /PK-W/	9902.462	15722.80	45752.48
2	CP /PK-W/	9903.882	16393.64	45673.48
3	CP /BOLT/	9905.415	15477.14	45781.19
10	CP /BOLT/	9901.937	16157.18	45763.76
11	CP /BOLT/	9902.010	15831.42	45734.61
12	CP /BOLT/	9902.091	15606.47	45772.61

SEE DRAWING G04 FOR LOCATION OF SURVEY CONTROL POINTS.

LEGEND:

LIMITS OF DISTURBANCE

BORROW, STOCKPILE, OR STAGING AREA

EXISTING WETLANDS

APPROXIMATE LIMITS OF EXISTING SPILLWAY

9870

EXISTING MAJOR CONTOUR

EXISTING MINOR CONTOUR

PRIMARY FLOW PATH

SECONDARY FLOW PATH

EXISTING CHANNEL OR STREAM

SURVEY CONTROL POINT

GEOTECHNICAL BORE LOCATION (ORIGINAL 1947 DESIGN)

GEOTECHNICAL BORE AND PIEZOMETER LOCATION (2018)

TEST PIT

EMBANKMENT FILL

EXISTING COBBLE/ROCK SHELL

RIPRAP

TYPE 1 DRAIN FILL

TYPE 2 DRAIN FILL

EXISTING GROUND

EXISTING CHANNEL FILL

EXISTING CHANNEL CUT

APPROXIMATE LIMITS OF CLEARING AND GRUBBING

COLORADO LICENSED
TODD M. RUDOLPH
58436
PROFESSIONAL ENGINEER

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
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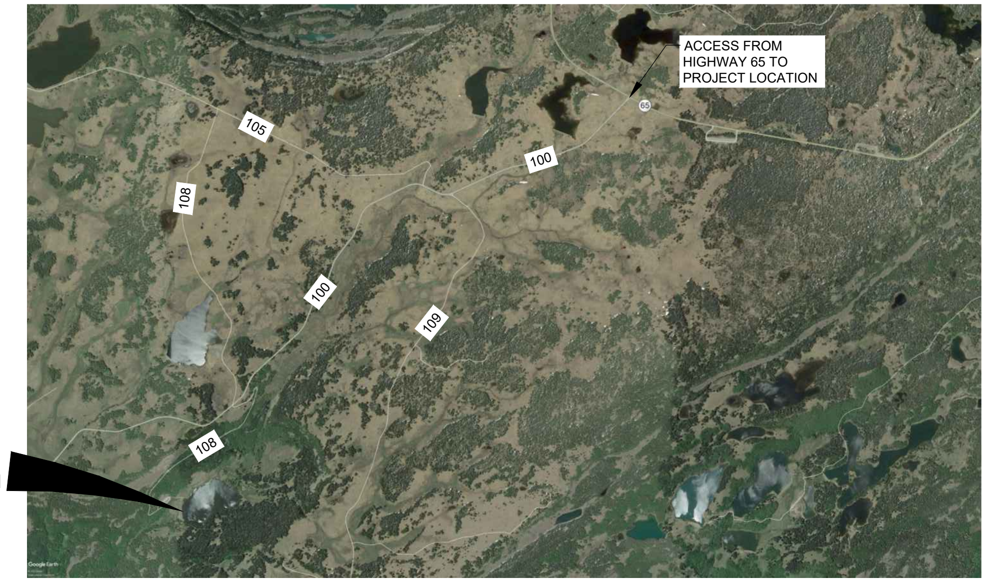
INDEX TO DRAWINGS, SURVEY NOTES, AND GENERAL NOTES

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

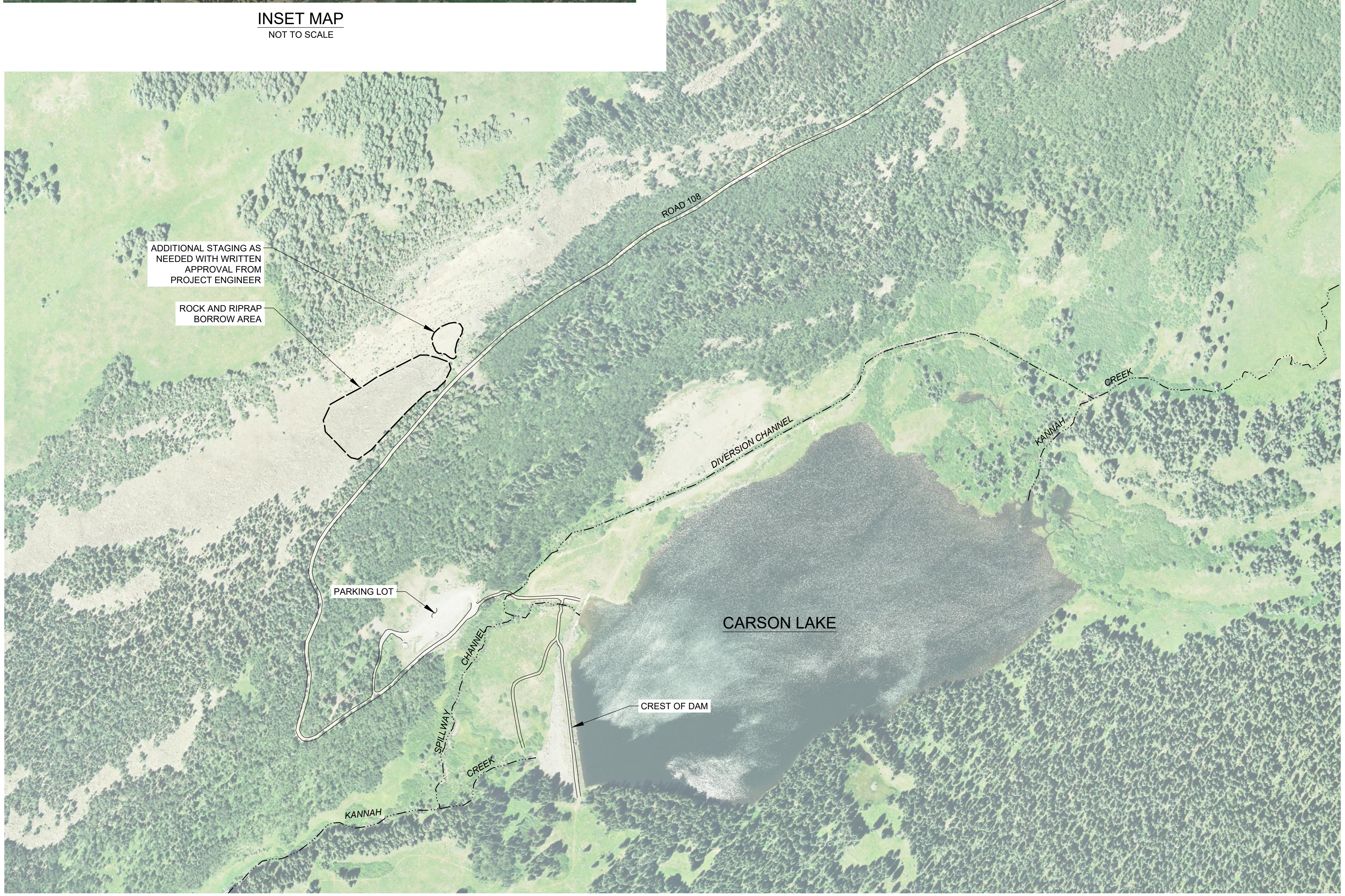
Date | Revisions

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. G02



INSET MAP
NOT TO SCALE



N

0 125' 250' 500'

ONE INCH - IF NOT, SCALE ACCORDINGLY

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TODD M. RUDOLPH
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PROFESSIONAL ENGINEER
5/10/2021

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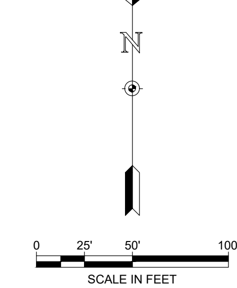
SITE ACCESS AND BORROW AREAS PLAN

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO.
26-1144.00
DRAWING NO.
G03



NOTE:

CONTRACTOR TO PROVIDE PORTABLE FACILITIES FOR DURATION OF PROJECT. USE OF EXISTING VAULT SHALL NOT BE PERMISSIBLE.

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PROFESSIONAL ENGINEER
5/20/2021

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 STAGING AND BORROW AREAS.DWG Thursday, May 20, 2021 1:32 PM By: RIEDER, AUSTIN

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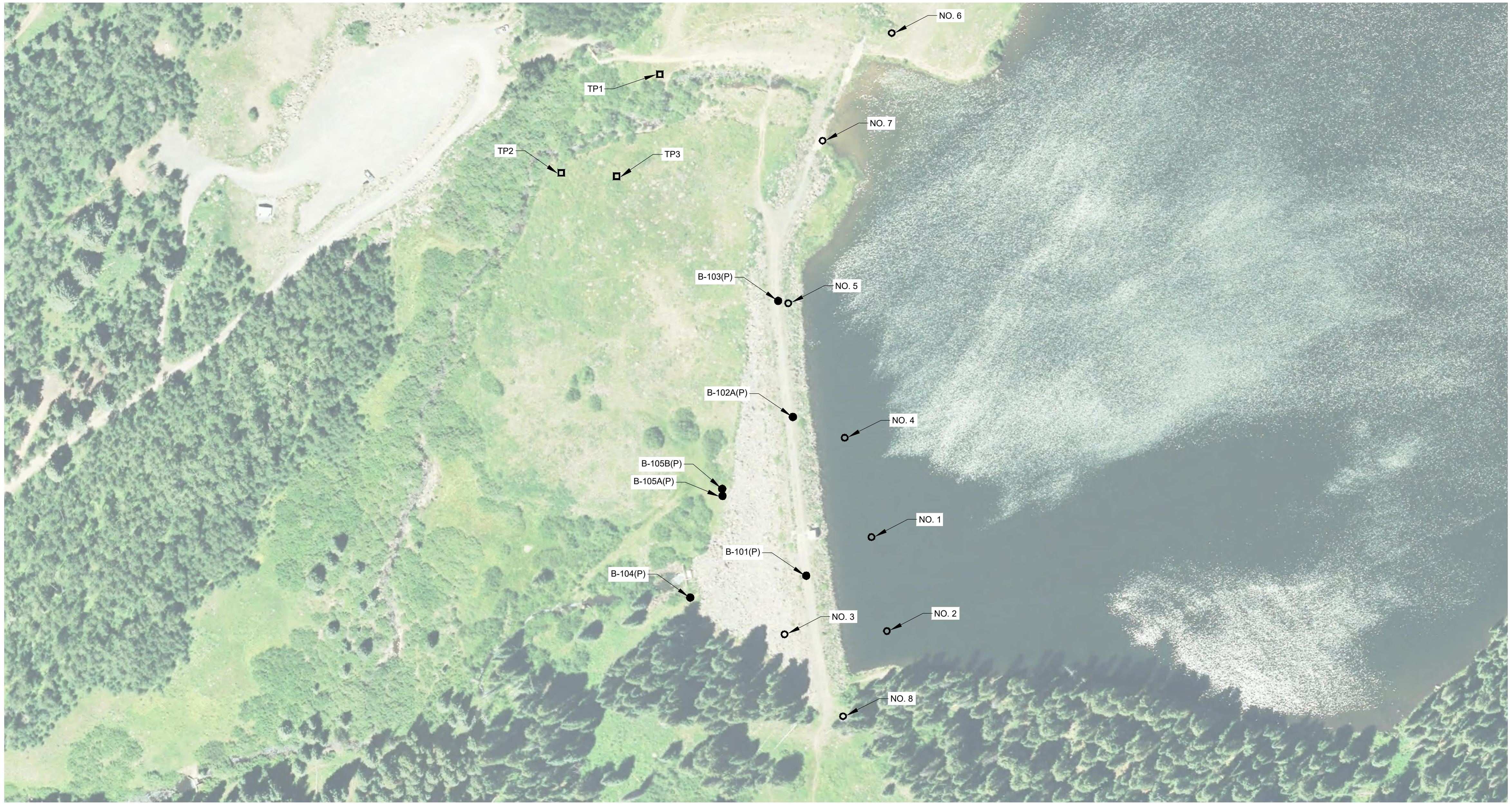
EXISTING SITE, STAGING, AND STOCKPILE AREAS PLAN

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. G04

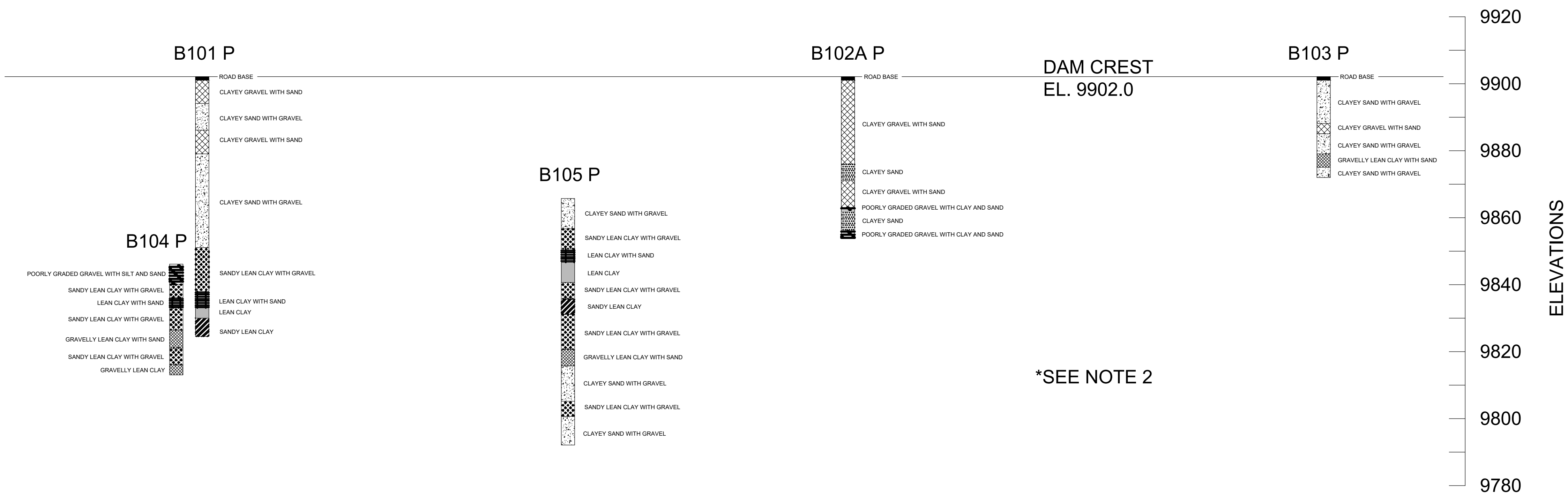


N

0 37.5' 75' 150'
SCALE IN FEET

NOTES:

1. TEST PITS 1 THROUGH 3 INSTALLED AND LOGGED UNDER DIRECTION OF HUDDLESTON-BERRY ENGINEERING AND TESTING LLC. SEE DESIGN REPORT FOR BORING LOGS.
2. SOIL BORINGS B-101(P) THROUGH B-103(P) INSTALLED AND LOGGED UNDER DIRECTION OF RJH CONSULTANTS INC IN 2018. SEE DESIGN REPORT FOR BORING LOGS.
3. SOIL BORINGS 1 THROUGH 8 TAKEN FROM 1947 PLAN SET 'IMPROVEMENTS TO WATER SUPPLY SYSTEM, HOGCHUTE RESERVOIR' PRODUCED BY R.J. TIPTON AND ASSOCIATES, INC., ENGINEERS. SEE DESIGN REPORT FOR BORING LOGS.



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PROFESSIONAL ENGINEER
5/20/2021

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GEOTECHNICAL INFORMATION

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

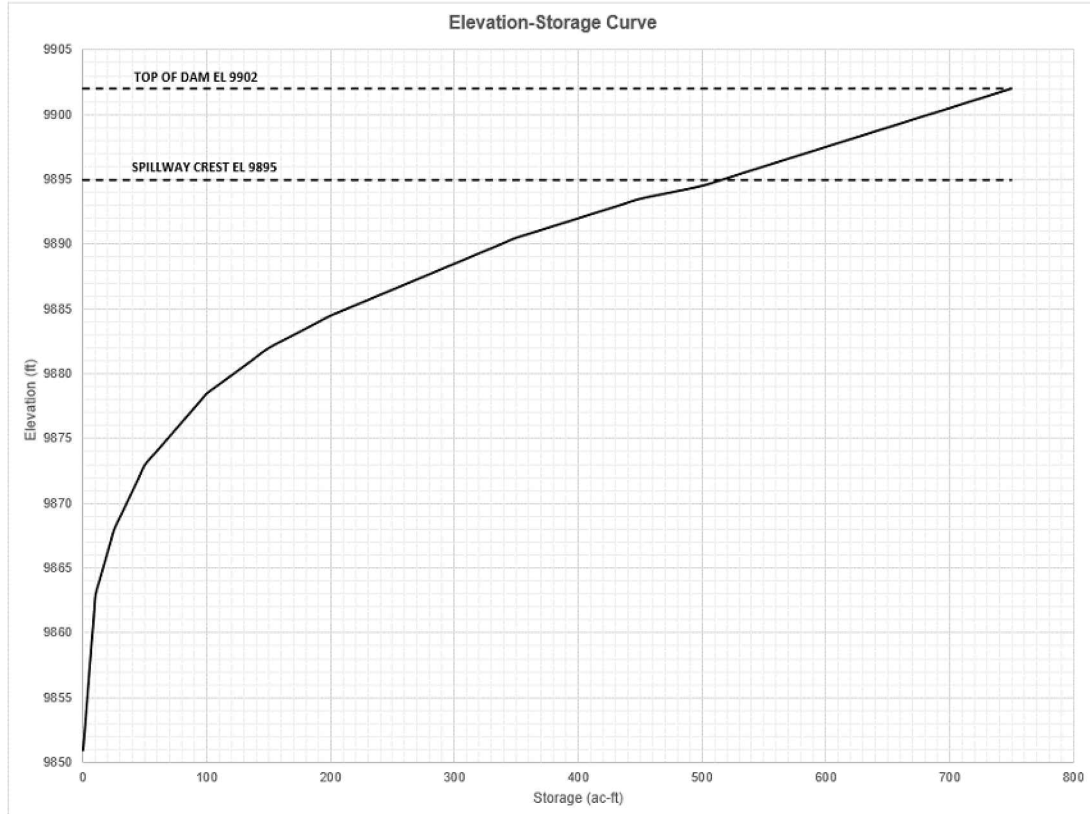
Revisions	Date

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. G05
SHEET 5 OF 44

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 GEOTECHNICAL INFORMATION.DWG Friday, May 14, 2021 3:40 PM By: RIEDER, AUSTIN

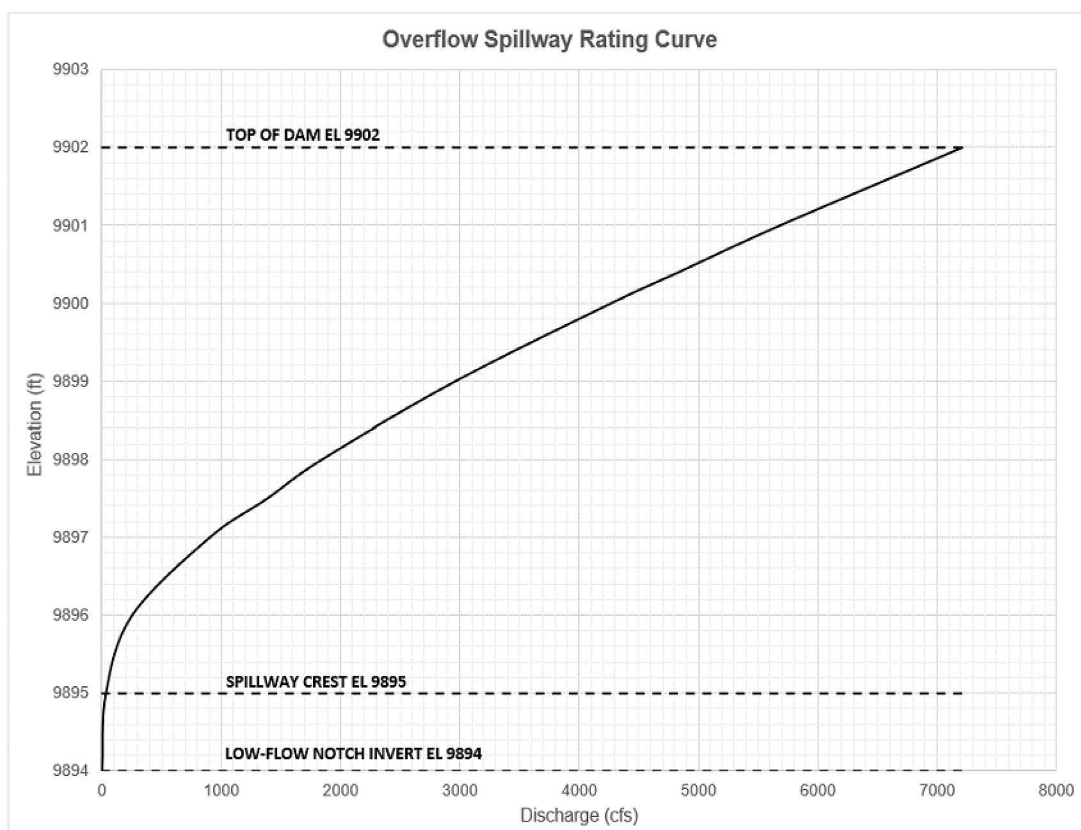
Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 RATING CURVES.DWG Tuesday, May 18, 2021 10:35 AM By: RIEDER, AUSTIN



RESERVOIR STAGE-STORAGE CURVE

Elevation-Storage Table

Elevation (ft)	Storage (ac-ft)	
9851	0	
9852	0.8	
9853	1.7	
9854	2.5	
9855	3.3	
9856	4.2	
9857	5.0	
9858	5.8	
9859	6.7	
9860	7.5	
9861	8.3	
9862	9.2	
9863	10	
9864	13	
9865	16	
9866	19	
9867	22	
9868	25	
9869	30	
9870	35	
9871	40	
9872	45	
9873	50	
9874	59	
9875	68	
9876	77	
9877	86	
9878	95	
9879	107	
9880	121	
9881	136	
9882	150	
9883	170	
9884	190	
9885	213	
9886	238	
9887	263	
9888	288	
9889	313	
9890	338	
9891	367	
9892	400	
9893	433	
9894	475	(Low-Flow Notch)
9895	517	(Spillway Crest)
9896	550	
9897	583	
9898	617	
9899	650	
9900	697	
9901	717	
9902	750	(Top of Dam)



SPILLWAY RATING CURVE

Spillway Rating Table

Elevation (ft)	Discharge (cfs)	
9894	0	(Low-Flow Notch)
9895	31	(Spillway Crest)
9896	250	
9897	900	
9897.5	1382	
9898	1840	
9899	2960	
9900	4264	
9900.4	4830	
9901	5680	
9902	7207	(Top of Dam)

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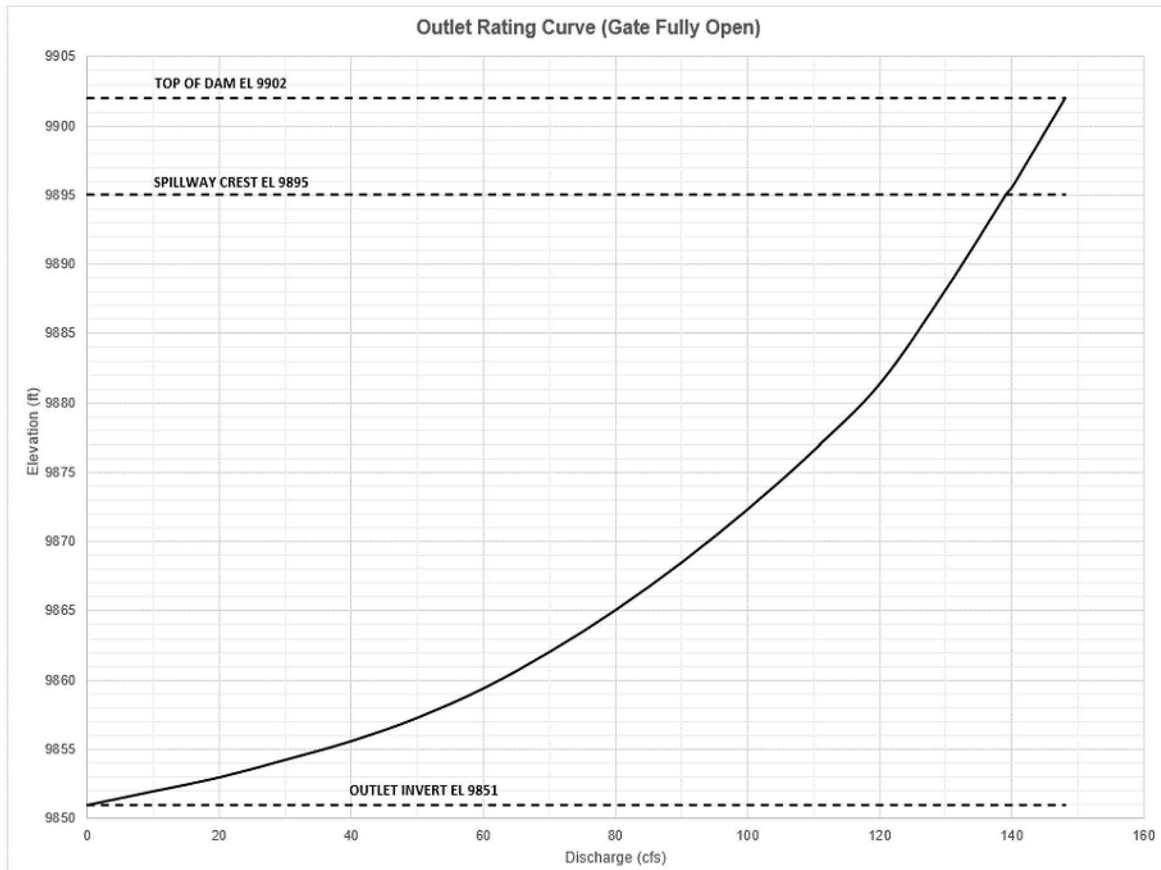
RATING CURVES 1 OF 2

HOGCHUTE (AKA CARSON)
RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. G06



OUTLET WORKS RATING CURVE

Outlet Rating Table (Gate Fully Open)

Elevation (ft)	Discharge (cfs)	
9851	0.0	(Invert)
9852	10.0	
9853	20.0	
9854	27.0	
9855	34.5	
9856	41.0	
9857	47.0	
9858	52.5	
9859	57.5	
9860	62.0	
9861	66.3	
9862	70.0	
9863	74.0	
9864	77.3	
9865	80.5	
9866	83.5	
9867	86.5	
9868	89.3	
9869	92.0	
9870	94.5	
9871	97.0	
9872	99.3	
9873	101.5	
9874	103.8	
9875	105.9	
9876	108.2	
9877	110.4	
9878	112.6	
9879	114.6	
9880	116.6	
9881	118.3	
9882	120.0	
9883	121.8	
9884	123.0	
9885	124.4	
9886	126.2	
9887	127.5	
9888	128.8	

Elevation (ft)	Discharge (cfs)	
9889	130.3	
9890	131.8	
9891	133.0	
9892	134.5	
9893	136.0	
9894	137.3	(Low-Flow Notch)
9895	139.0	(Spillway Crest)
9896	140.0	
9897	141.3	
9898	142.5	
9899	143.8	
9900	145.0	
9901	146.3	
9902	148.0	(Top of Dam)

COLORADO LICENSED
TODD M. RUDOLPH
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PROFESSIONAL ENGINEER

ONE INCH - IF NOT, SCALE ACCORDINGLY

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RATING CURVES 2 OF 2

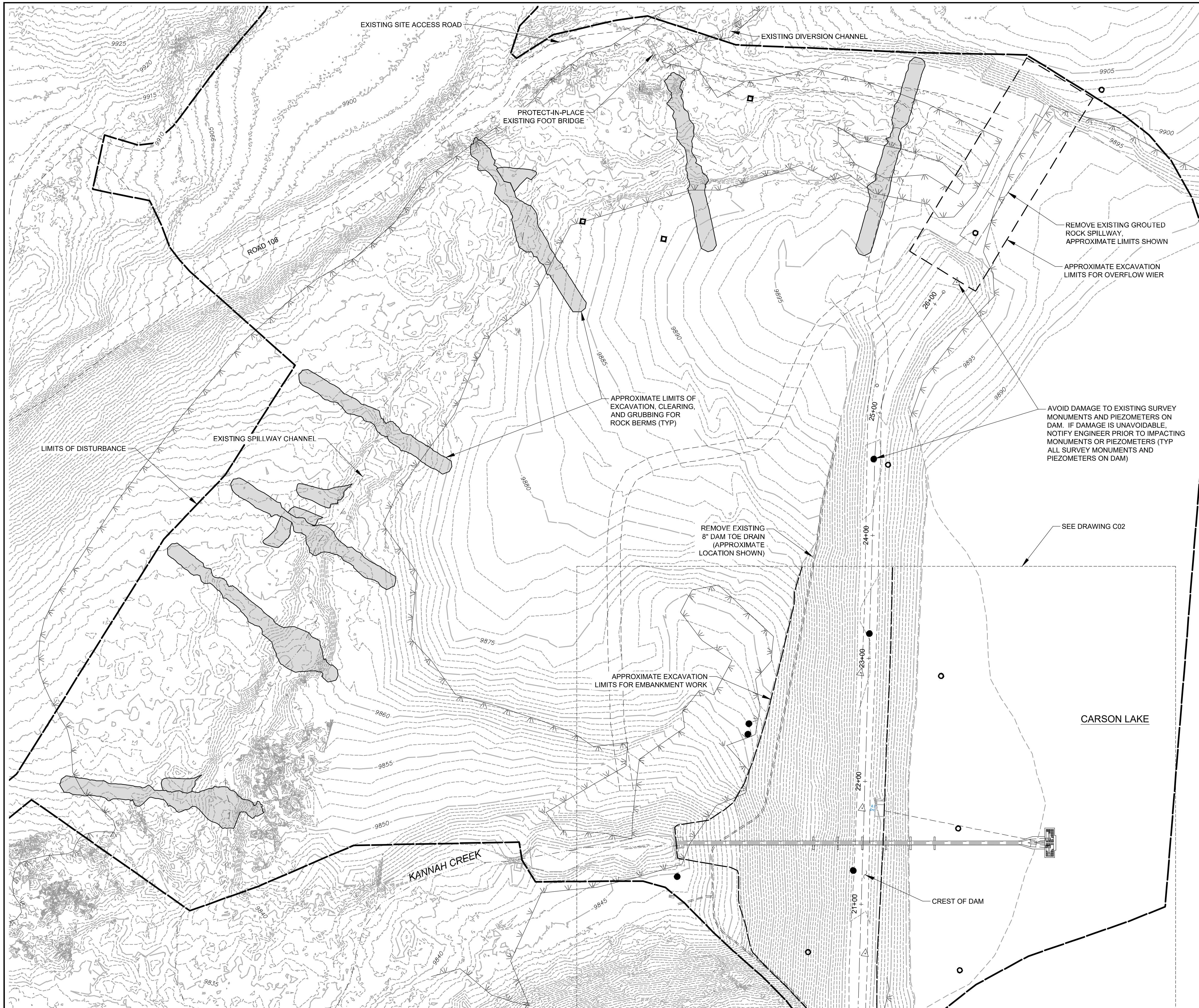
HOGCHUTE (AKA CARSON)
RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

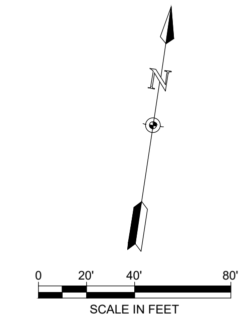
Date
Revisions

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. G07

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 EXISTING CONDITIONS AND DEMOLITION PLAN 2.DWG Tuesday, May 18, 2021 3:24 PM By: RIEDER, AUSTIN





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EXISTING CONDITIONS, EXCAVATION, AND DEMOLITION PLAN - 1 OF 2

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

COLORADO LICENSED
TODD M. RUDOLPH
58436
PROFESSIONAL ENGINEER
2/20/2021

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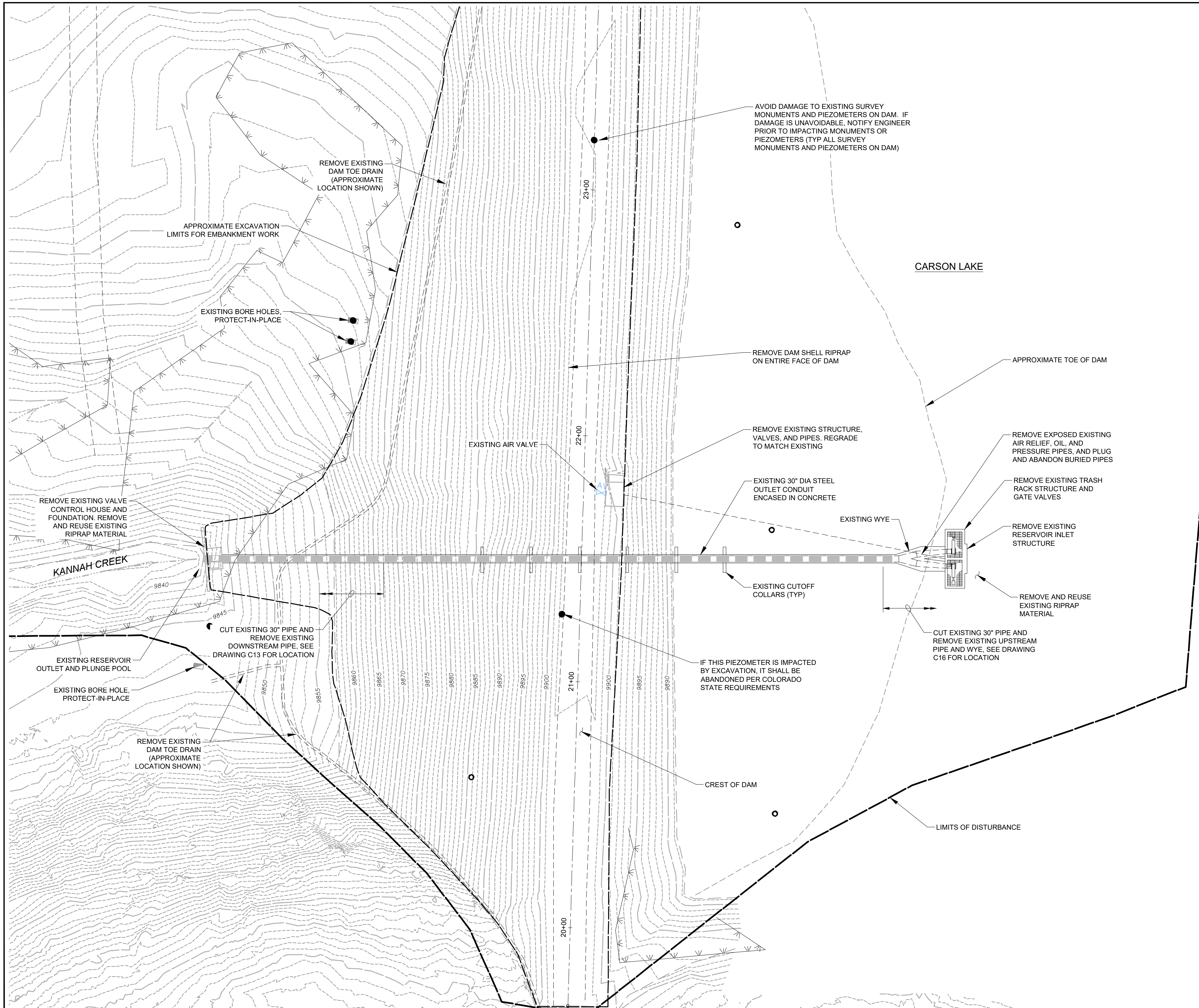
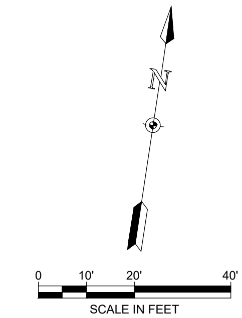
PROJECT NO. 26-1144.00
DRAWING NO. C01
SHEET 8 OF 44





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EXISTING CONDITIONS, EXCAVATION, AND DEMOLITION PLAN - 2 OF 2

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr.: CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

COLORADO LICENSED
TODD M. RUDOLPH
58436
PROFESSIONAL ENGINEER
5/20/2021

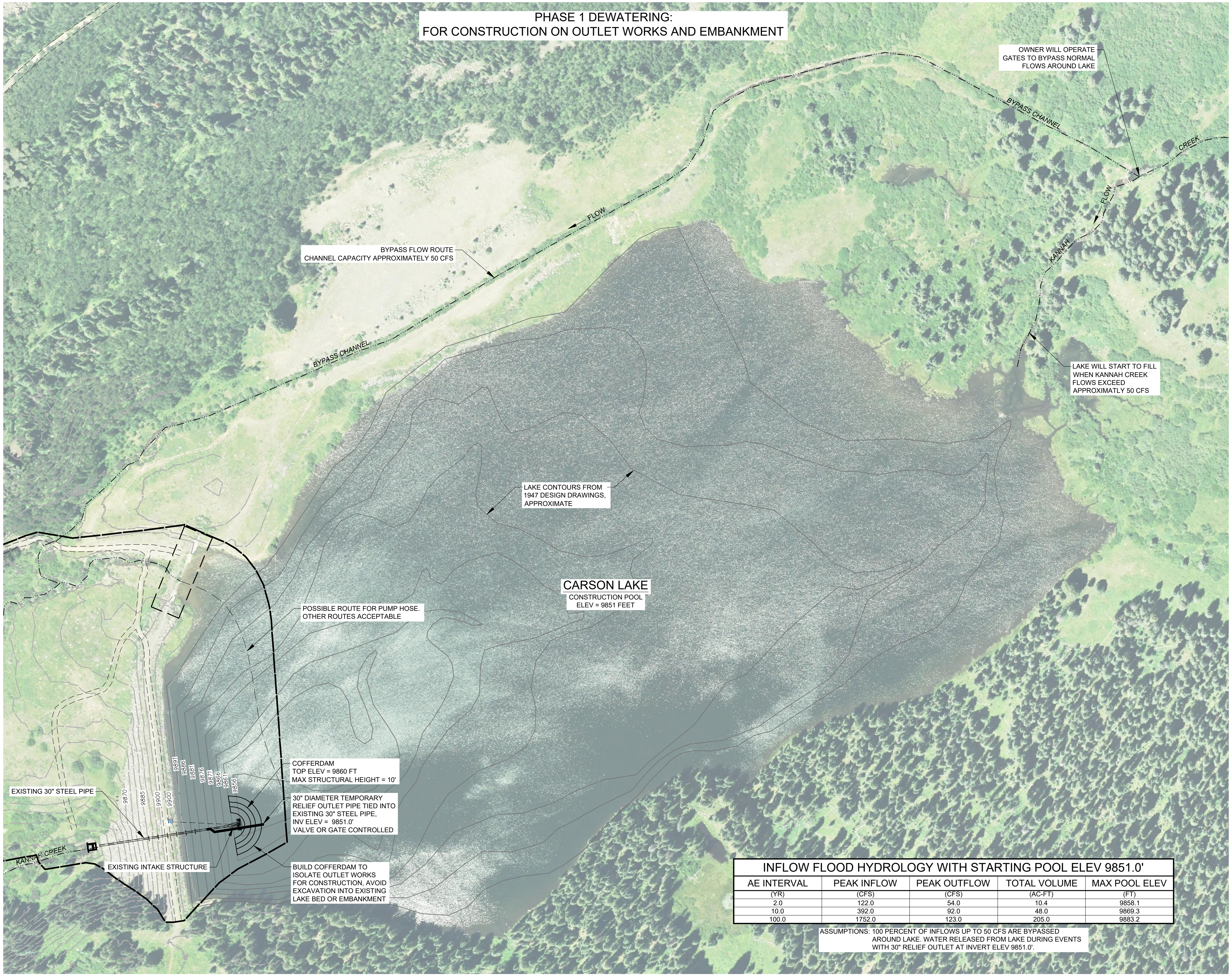
ONE INCH - IF NOT, SCALE ACCORDINGLY

PROJECT NO. 26-1144.00
DRAWING NO. C02

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 EXISTING CONDITIONS AND DEMOLITION PLAN.DWG Tuesday, May 18, 2021 3:19 PM By: RIEDER, AUSTIN

Drawing Name: I:\36\26-11400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 DEWATERING PLAN PHASE 1.DWG Monday, May 10, 2021 4:55 PM By: RIEDER, AUSTIN

PHASE 1 DEWATERING:
FOR CONSTRUCTION ON OUTLET WORKS AND EMBANKMENT



INFLOW FLOOD HYDROLOGY WITH STARTING POOL ELEV 9851.0'				
AE INTERVAL	PEAK INFLOW	PEAK OUTFLOW	TOTAL VOLUME	MAX POOL ELEV
(YR)	(CFS)	(CFS)	(AC-FT)	(FT)
2.0	122.0	54.0	10.4	9858.1
10.0	392.0	92.0	48.0	9869.3
100.0	1752.0	123.0	205.0	9883.2

ASSUMPTIONS: 100 PERCENT OF INFLOWS UP TO 50 CFS ARE BYPASSED AROUND LAKE. WATER RELEASED FROM LAKE DURING EVENTS WITH 30" RELIEF OUTLET AT INVERT ELEV 9851.0'.

N

0 50' 100' 200'
SCALE IN FEET

NOTES:

1. THE COFFERDAM WILL NOT PROTECT THE WORKSITE FROM THE 10-YR FLOOD. CONTRACTOR SHALL MONITOR WEATHER FORECASTS AND EVACUATE PERSONNEL AND EQUIPMENT FROM THE LAKE IF STORM ACTIVITY IS EXPECTED OR IF BYPASS CHANNEL IS APPROACHING CAPACITY.
2. PUMPING FROM LAKE TO MAINTAIN CONSTRUCTION POOL MAY BE REQUIRED IF NORMAL, NON-FLOOD FLOWS EXCEED THE BYPASS CHANNEL'S 50 CFS CAPACITY. AVERAGE MONTHLY INFLOWS PROVIDED ON SHEET C03.
3. CONTRACTOR MUST COORDINATE WITH WATER SUPPLY SUPERVISOR TO DIVERT UPSTREAM INFLOWS TO DIVERSION CHANNEL.

EXPECTED CONSTRUCTION SEQUENCING DURING PHASE 1 DEWATERING:

1. DRAW DOWN LAKE TO CONSTRUCTION POOL ELEVATION.
2. CONSTRUCT COFFERDAM WITH RELIEF OUTLET TIED INTO EXISTING 30" PIPE.
3. COMPLETE CONSTRUCTION ON OUTLET WORKS, EMBANKMENT, IMPACT BASIN, AND PRIMARY STATION INSTRUMENTATION.
4. REMOVE COFFERDAM.
5. COMMENCE PHASE 2 DEWATERING.

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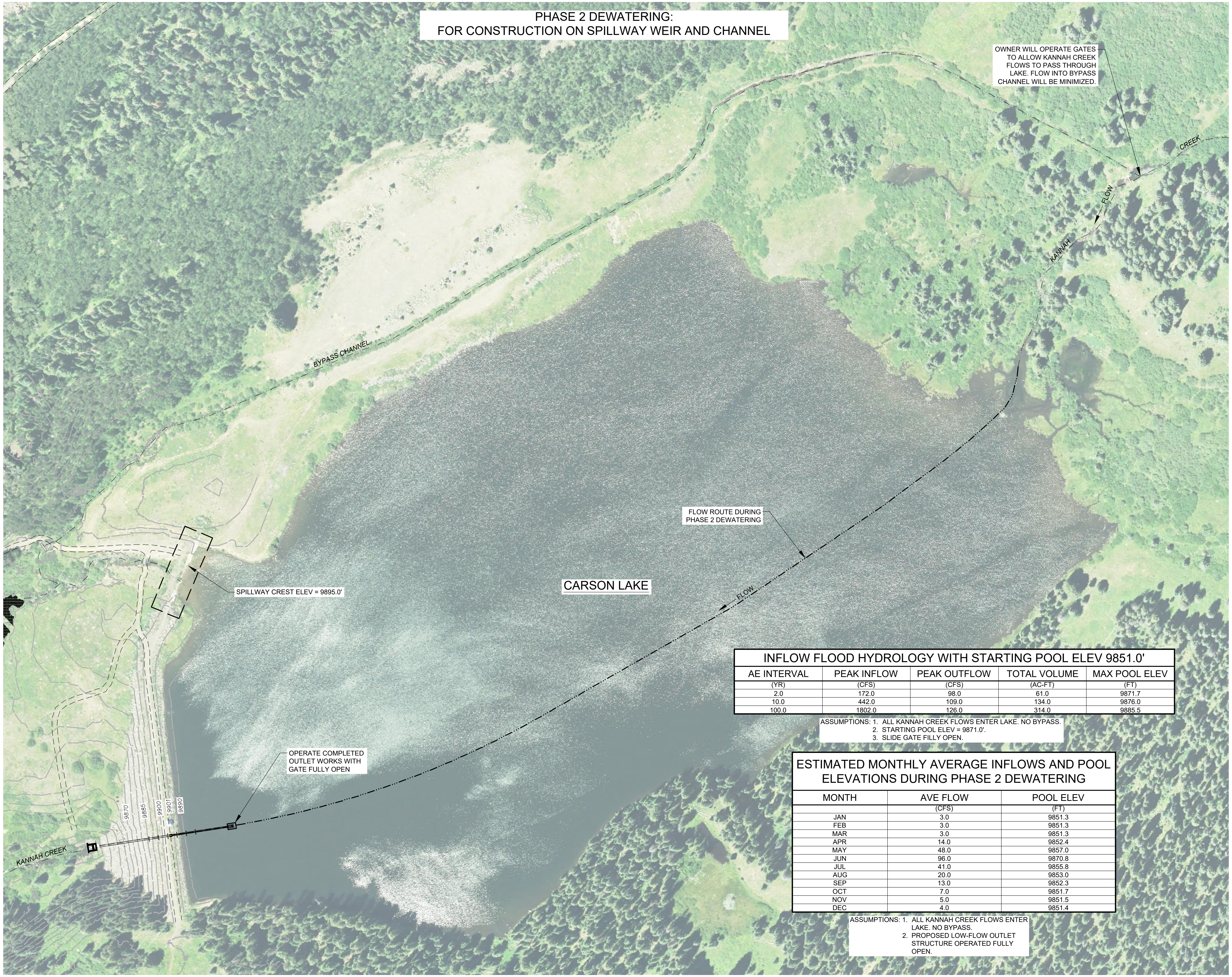
DEWATERING PLAN - PHASE 1

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C03



INFLOW FLOOD HYDROLOGY WITH STARTING POOL ELEV 9851.0'				
AE INTERVAL	PEAK INFLOW	PEAK OUTFLOW	TOTAL VOLUME	MAX POOL ELEV
(YR)	(CFS)	(CFS)	(AC-FT)	(FT)
2.0	172.0	98.0	61.0	9871.7
10.0	442.0	109.0	134.0	9876.0
100.0	1802.0	126.0	314.0	9885.5

ASSUMPTIONS: 1. ALL KANNAH CREEK FLOWS ENTER LAKE. NO BYPASS.
2. STARTING POOL ELEV = 9871.0'.
3. SLIDE GATE FILLY OPEN.

ESTIMATED MONTHLY AVERAGE INFLOWS AND POOL ELEVATIONS DURING PHASE 2 DEWATERING		
MONTH	AVE FLOW	POOL ELEV
	(CFS)	(FT)
JAN	3.0	9851.3
FEB	3.0	9851.3
MAR	3.0	9851.3
APR	14.0	9852.4
MAY	48.0	9857.0
JUN	96.0	9870.8
JUL	41.0	9855.8
AUG	20.0	9853.0
SEP	13.0	9852.3
OCT	7.0	9851.7
NOV	5.0	9851.5
DEC	4.0	9851.4

ASSUMPTIONS: 1. ALL KANNAH CREEK FLOWS ENTER LAKE. NO BYPASS.
2. PROPOSED LOW-FLOW OUTLET STRUCTURE OPERATED FULLY OPEN.

N

0 50' 100' 200'
SCALE IN FEET

EXPECTED CONSTRUCTION SEQUENCING DURING PHASE 2 DEWATERING:

1. OPERATE COMPLETED OUTLET WORKS WITH SLIDE GATE FULLY OPEN.
2. COMPLETE WORK ON SPILLWAY WEIR AND CHANNEL.

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2-26-2021

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DEWATERING PLAN - PHASE 2

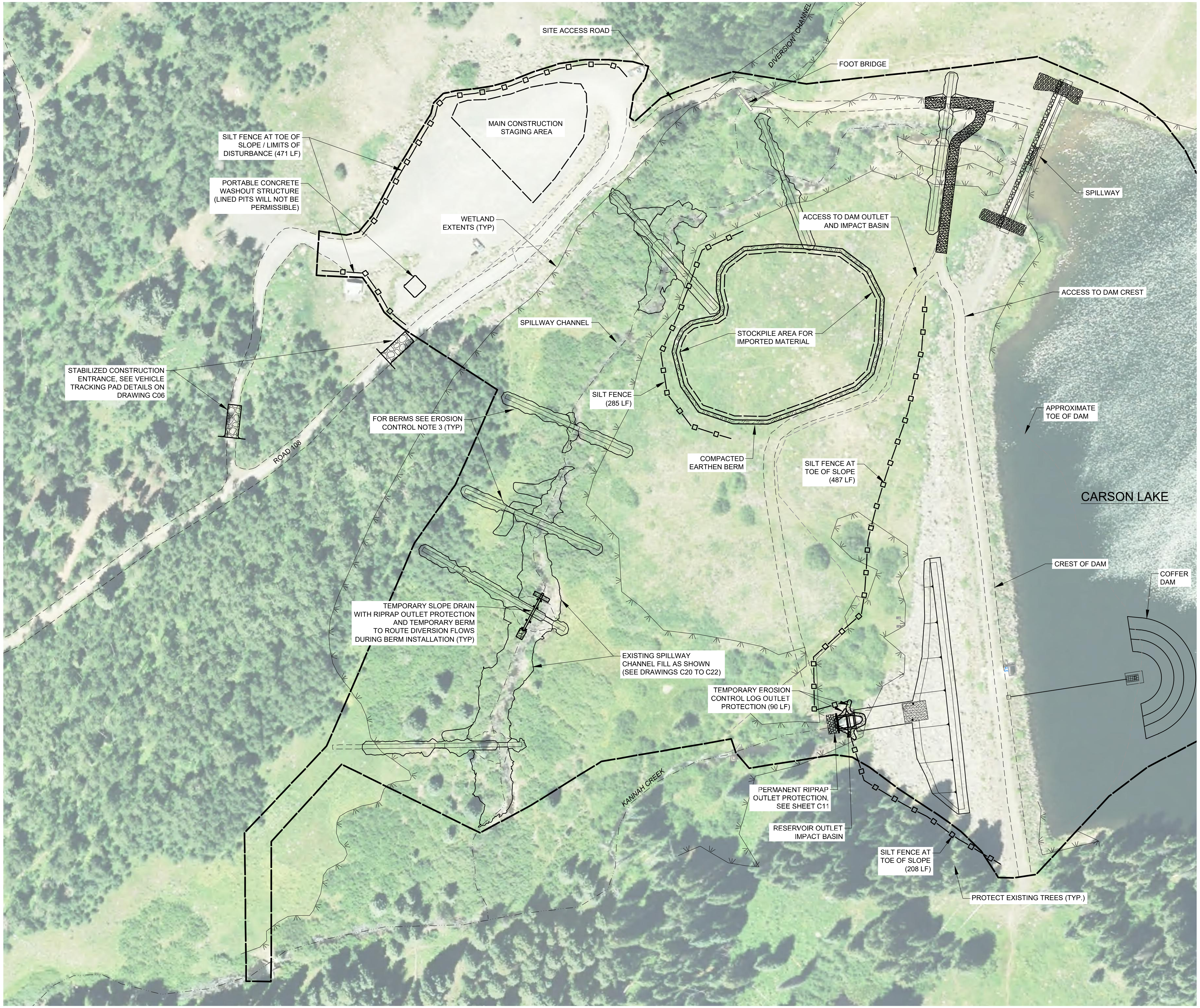
HOGCHUTE (AKA CARSON)
RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

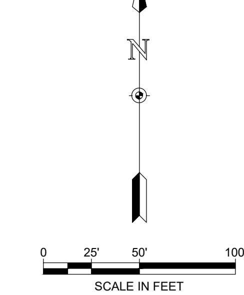
Revisions	Date

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO.
26-1144.00
DRAWING NO.
C04

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 DEWATERING PLAN PHASE 2.DWG Friday, February 26, 2021 6:40 PM By: RIEDER, AUSTIN





NOTES:

1. ALL TEMPORARY AND PERMANENT EROSION CONTROL SHALL COMPLY WITH THE MOST RECENT CDOT M&S STANDARDS.
2. THE CONTRACTOR SHALL STABILIZE DISTURBED AREAS BY SURFACE ROUGHENING, VERTICAL TRACKING, OR A COMBINATION THEREOF.
3. FOR EROSION CONTROL AT THE SPILLWAY CHANNEL BERMS SEE TYPICAL SECTIONS ON SHEET C25.
4. A PALLIATIVE SHALL BE USED TO CONTROL DUST PRODUCED BY CONSTRUCTION ACTIVITIES.
5. THE CONTRACTOR SHALL PROTECT EXISTING VEGETATION AND LIMIT IMPACT TO WETLAND AREAS.
6. THE CONTRACTOR SHALL CHECK EROSION CONTROL MEASURES AFTER EVERY PRECIPITATION EVENT. IF REPAIRS ARE NEEDED, REPAIRS SHALL BE PERFORMED IMMEDIATELY.
7. THE CONTRACTOR IS RESPONSIBLE TO REPAIR ANY DAMAGE TO FS ROAD 108 AT CONTRACTOR'S EXPENSE PRIOR TO ISSUANCE OF FINAL ACCEPTANCE.

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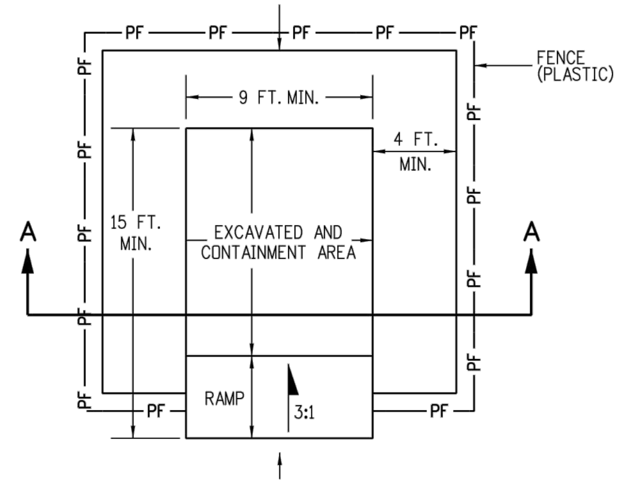
EROSION CONTROL PLAN

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

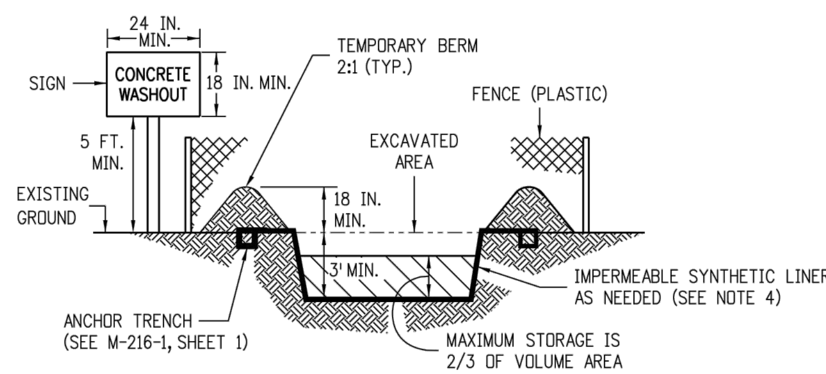
Revisions	Date

Project Mgr.: CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C05



PLAN VIEW

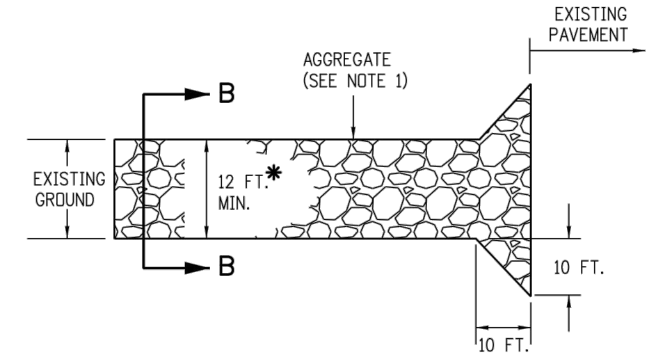


SECTION A-A

NOTES:

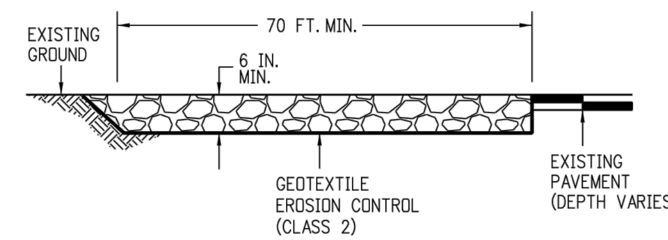
1. A FENCE (PLASTIC) CONFORMING TO SECTION 607 SHALL BE INSTALLED AROUND THE CONCRETE WASHOUT AREA, EXCEPT AT THE OPENING.
2. THE CONCRETE WASHOUT SIGN SHALL HAVE LETTERS AT LEAST 3 INCHES HIGH AND CONFORM TO SUBSECTION 630.02.
3. ALL MATERIALS AND LABOR TO COMPLETE THE CONCRETE WASHOUT STRUCTURE SHALL BE INCLUDED IN THE COST OF WORK AND NOT PAID FOR SEPARATELY.
4. THE BOTTOM OF EXCAVATION SHALL BE A MINIMUM OF FIVE FEET ABOVE GROUND WATER. IF NOT, THE BOTTOM OF EXCAVATION SHALL BE IN ACCORDANCE WITH 208.02 (j).
5. THE PAY ITEM NUMBER FOR CONCRETE WASHOUT STRUCTURE (EACH) IS 208-00045.

PORTABLE CONCRETE WASHOUT STRUCTURE

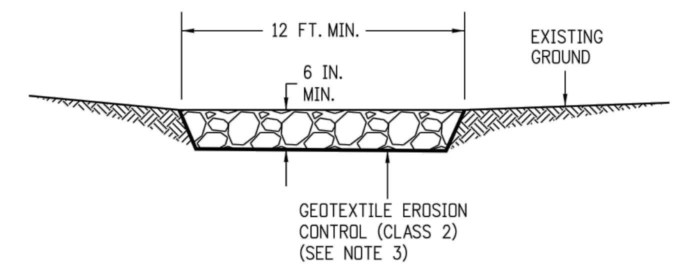


PLAN VIEW

* SHALL EXTEND FULL WIDTH OF INGRESS AND EGRESS OPERATION.



ELEVATION SECTION



SECTION B-B

NOTES:

1. AGGREGATE SHALL CONFORM TO SUBSECTION 208.02 (l).
2. THE CONTRACTOR SHALL PROTECT CURB AND GUTTER THAT CROSSES THE ENTRANCE FROM DAMAGE, WHILE NOT BLOCKING FLOW OF WATER THRU STRUCTURE. PROTECTION OF THE CURB AND GUTTER SHALL BE INCLUDED IN THE COST OF WORK AND NOT PAID FOR SEPARATELY.
3. GEOTEXTILE SHALL CONFORM TO SUBSECTION 712.08.
4. ALL MATERIALS AND LABOR TO COMPLETE THE VEHICLE TRACKING PAD SHALL BE INCLUDED IN THE COST OF WORK AND NOT PAID FOR SEPARATELY.
5. THE PAY ITEM NUMBER FOR VEHICLE TRACKING PAD (EACH) IS 208-00070.

VEHICLE TRACKING PAD

Computer File Information		Sheet Revisions	
Creation Date: 07/31/19		Date:	Comments
Designer Initials: JBK	(R-X)		
Last Modification Date: 07/31/19	(R-X)		
Detailer Initials: LTA	(R-X)		
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)		

Colorado Department of Transportation
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Project Development Branch JBK

TEMPORARY EROSION CONTROL

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.
M-208-1
Standard Sheet No. 1 of 11
Project Sheet Number:

COLORADO LICENSED TODD M. RUDOLPH 58436 PROFESSIONAL ENGINEER
5/7/2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

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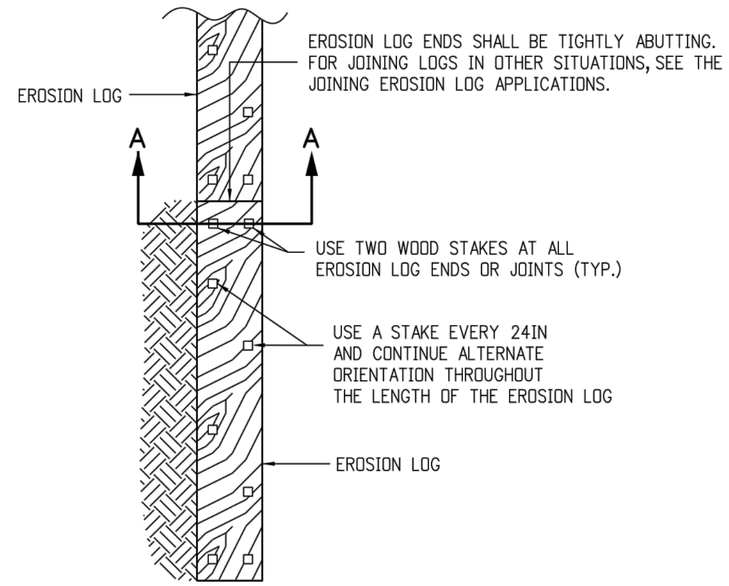
EROSION CONTROL DETAILS

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

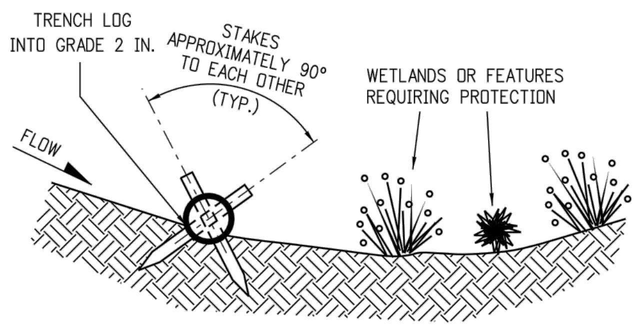
Date
Revisions

Project Mgr.: CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C06
SHEET 13 OF 44

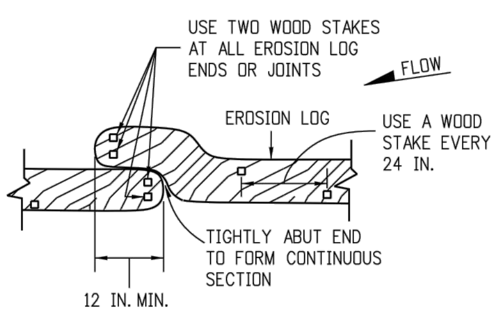


PLAN VIEW

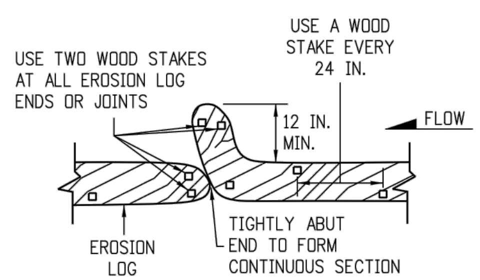


SECTION A-A

TYPICAL STAKE INSTALLATION



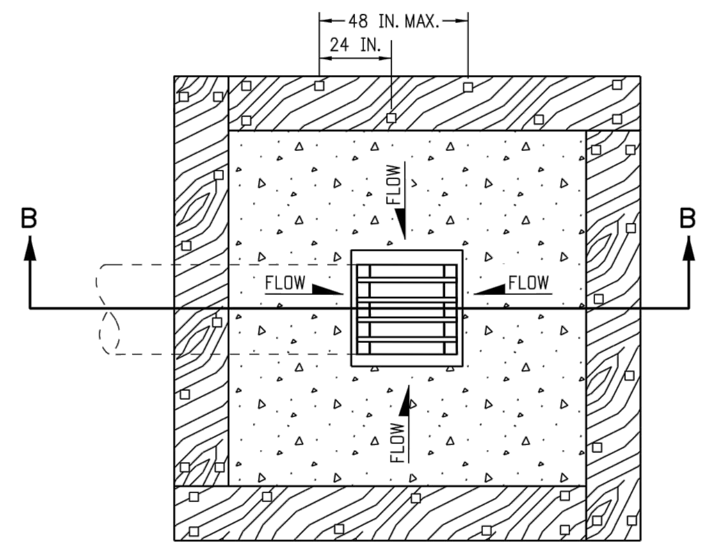
OVERLAP JOINING DETAIL



J-HOOK JOINING DETAIL

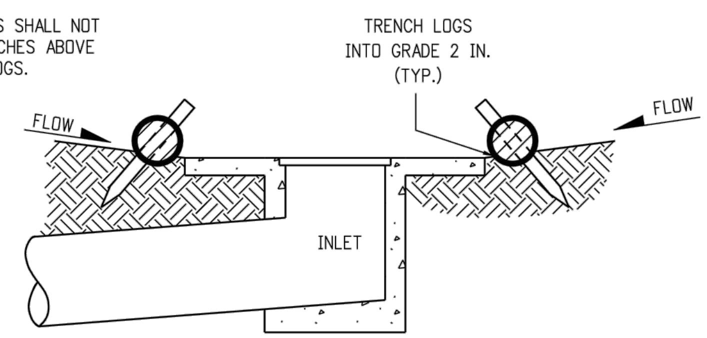
JOINING EROSION LOG APPLICATIONS

EROSION LOGS PAY ITEMS	
NUMBER	DESCRIPTION
208-00012	TYPE 1 (9 IN.)
208-00002	TYPE 1 (12 IN.)
208-00013	TYPE 1 (20 IN.)
208-00007	TYPE 2 (8 IN.)
208-00008	TYPE 2 (12 IN.)
208-00009	TYPE 2 (18 IN.)
208-00022	TYPE 3 (9 IN.)
208-00023	TYPE 3 (12 IN.)
208-00024	TYPE 3 (20 IN.)



PLAN VIEW

NOTE: THE TOPS OF ALL STAKES SHALL NOT EXTEND MORE THAN 2 INCHES ABOVE THE TOPS OF EROSION LOGS.

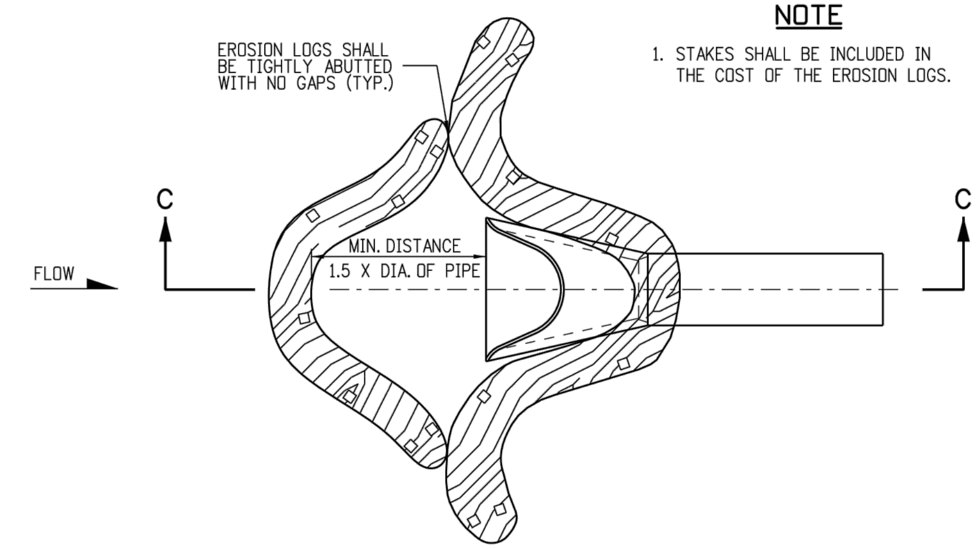


SECTION B-B

NOTE: LOCATE EROSION LOGS AT THE OUTSIDE EDGE OF THE CONCRETE APRON.

EROSION LOG FILTER AT DROP INLET

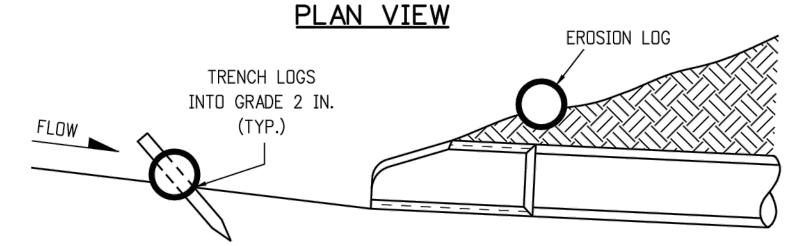
EROSION LOG APPLICATIONS



NOTE

1. STAKES SHALL BE INCLUDED IN THE COST OF THE EROSION LOGS.

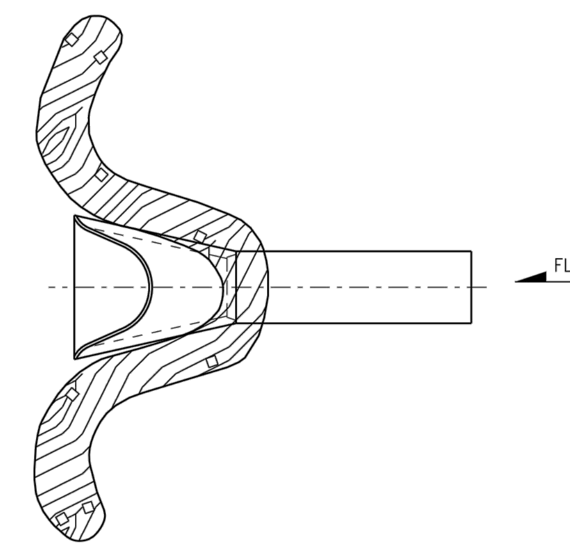
PLAN VIEW



SECTION C-C
(NOT ALL LOGS SHOWN)

NOTE: TOP OF STAKE SHALL NOT EXTEND PAST TOP OF EROSION LOG MORE THAN 2 IN.

EROSION LOG CULVERT INLET PROTECTION



EROSION LOG CULVERT OUTLET PROTECTION

Computer File Information	
Creation Date: 07/31/19	(R-X)
Designer Initials: JBK	(R-X)
Last Modification Date: 07/31/19	(R-X)
Detailer Initials: LTA	(R-X)
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)

Sheet Revisions	
Date:	Comments

Colorado Department of Transportation
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Project Development Branch JBK

TEMPORARY EROSION CONTROL

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.
M-208-1
Standard Sheet No. 2 of 11
Project Sheet Number:

COLORADO LICENSED TODD M. RUDOLPH 58436 PROFESSIONAL ENGINEER
2/26/2021

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EROSION CONTROL DETAILS

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Date
Revisions

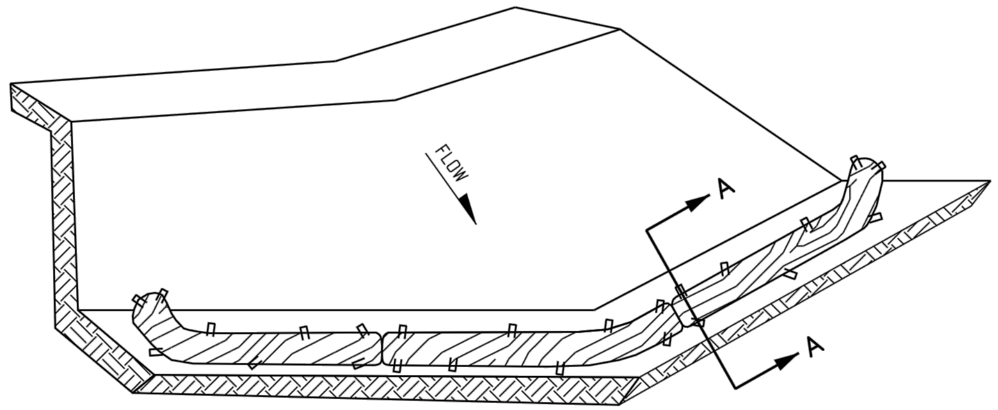
Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C07
SHEET 14 OF 44

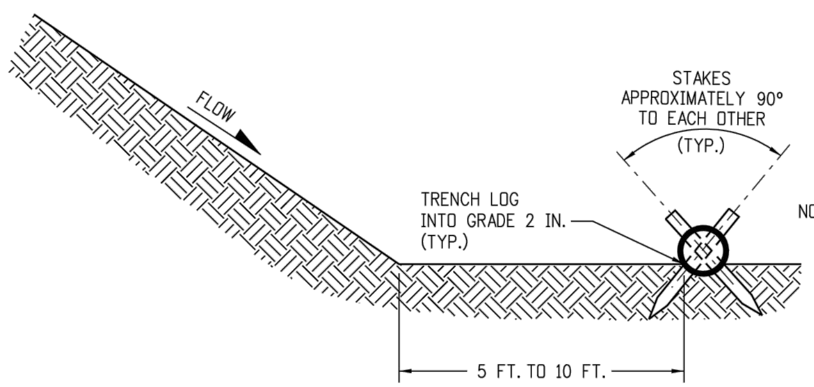
Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 EROSION CONTROL DETAILS.DWG Friday, May 07, 2021 10:30 AM By: RIEDER, AUSTIN

NOTES

1. SILT FENCE SHALL HAVE A MAXIMUM DRAINAGE AREA OF ONE-QUARTER ACRE PER 100 FEET OF SILT FENCE LENGTH; MAXIMUM SLOPE LENGTH BEHIND BARRIER IS 100 FEET.
2. SILT FENCE USED AT TOE OF SLOPE SHALL BE PLACED 5 TO 10 FEET BEYOND TOE OF SLOPE TO PROVIDE STORAGE CAPACITY.
3. SILT FENCE SHALL BE PLACED PARALLEL TO THE CONTOUR WITH ENDS FLARED UP SLOPE.
4. THE MAXIMUM LENGTH OF EROSION LOGS OR SILT FENCES WITHOUT A FLARED END TURNING UPSLOPE IS 150 FEET.



ISOMETRIC VIEW



NOTE: THE TOPS OF ALL STAKES SHALL NOT EXTEND MORE THAN 2 INCHES ABOVE THE TOPS OF EROSION LOGS.

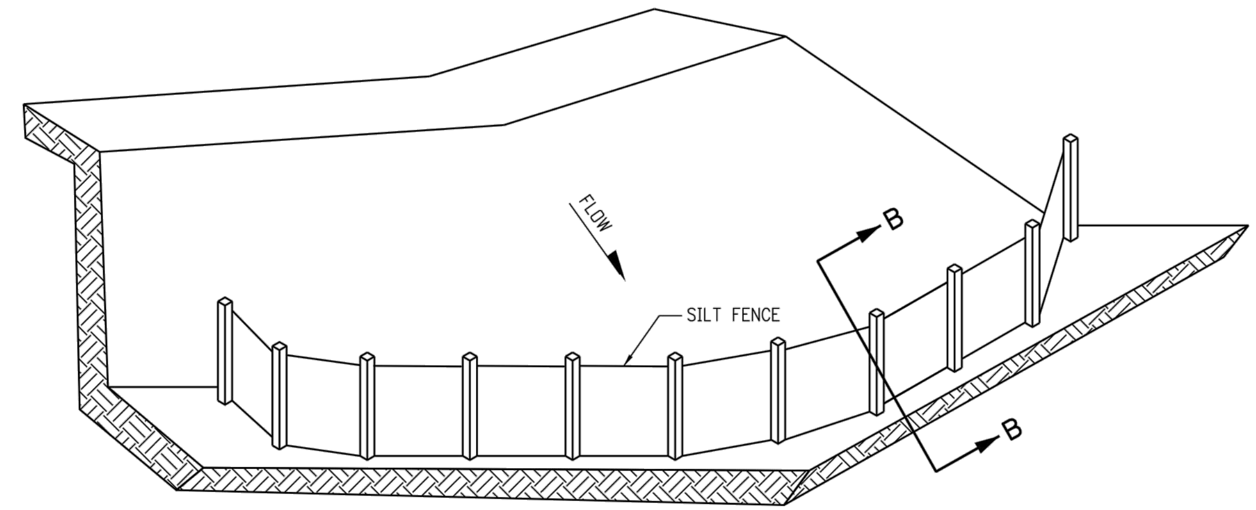
SECTION A-A

NOTES:

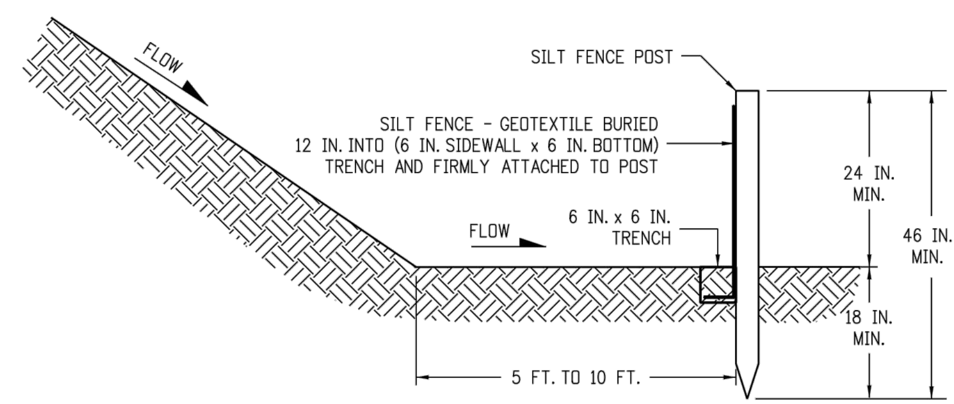
1. EROSION LOGS USED AT TOE OF SLOPE SHALL BE PLACED 5 TO 10 FEET BEYOND TOE OF SLOPE TO PROVIDE STORAGE CAPACITY.
2. EROSION LOGS SHALL BE PLACED ON THE CONTOUR WITH ENDS FLARED UP SLOPE.
3. SEE SHEET 2 OF 11 FOR JOINING LOGS DETAIL.

EROSION LOGS PAY ITEMS	
NUMBER	DESCRIPTION
208-00012	TYPE 1 (9 IN.)
208-00002	TYPE 1 (12 IN.)
208-00013	TYPE 1 (20 IN.)
208-00007	TYPE 2 (8 IN.)
208-00008	TYPE 2 (12 IN.)
208-00009	TYPE 2 (18 IN.)
208-00022	TYPE 3 (9 IN.)
208-00023	TYPE 3 (12 IN.)
208-00024	TYPE 3 (20 IN.)

EROSION LOG TOE OF SLOPE PROTECTION



ISOMETRIC VIEW



SECTION B-B

SILT FENCE TOE OF SLOPE PROTECTION

NOTE: THE PAY ITEM NUMBER FOR SILT FENCE (LF) IS 208-00020.

TOE OF SLOPE PROTECTION APPLICATIONS

Computer File Information		Sheet Revisions	
Creation Date: 07/31/19		Date:	Comments
Designer Initials: JBK	(R-X)		
Last Modification Date: 07/31/19	(R-X)		
Detailer Initials: LTA	(R-X)		
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)		

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Project Development Branch JBK

TEMPORARY EROSION CONTROL

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.
M-208-1
Standard Sheet No. 3 of 11
Project Sheet Number:

COLORADO LICENSED PROFESSIONAL ENGINEER TODD M. RUDOLPH 58436

5/7/2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

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EROSION CONTROL DETAILS

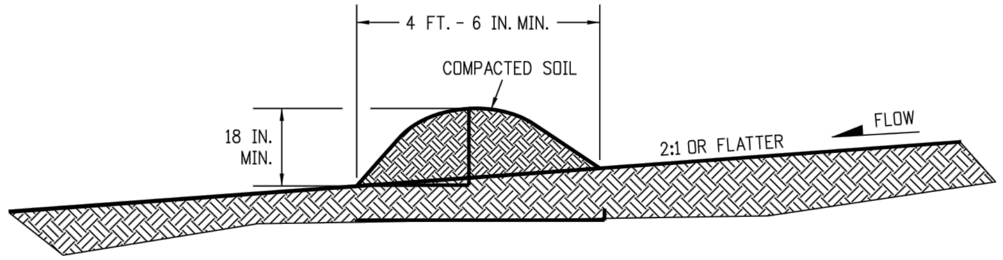
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Date | Revisions

Project Mgr. CTG | Designed By: AJS | Drawn By: RBR | Approved By: TMR | Date: 05/10/21

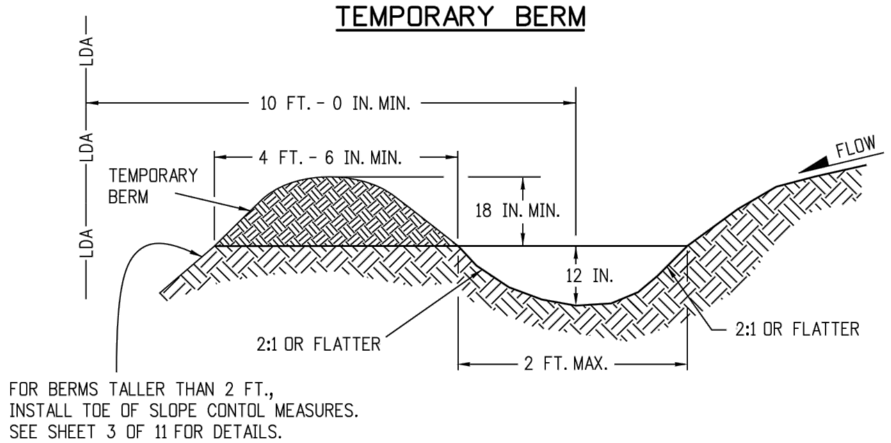
PROJECT NO. 26-1144.00
DRAWING NO. C08
SHEET 15 OF 44

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 EROSION CONTROL DETAILS.DWG Friday, May 07, 2021 10:30 AM By: RIEDER, AUSTIN



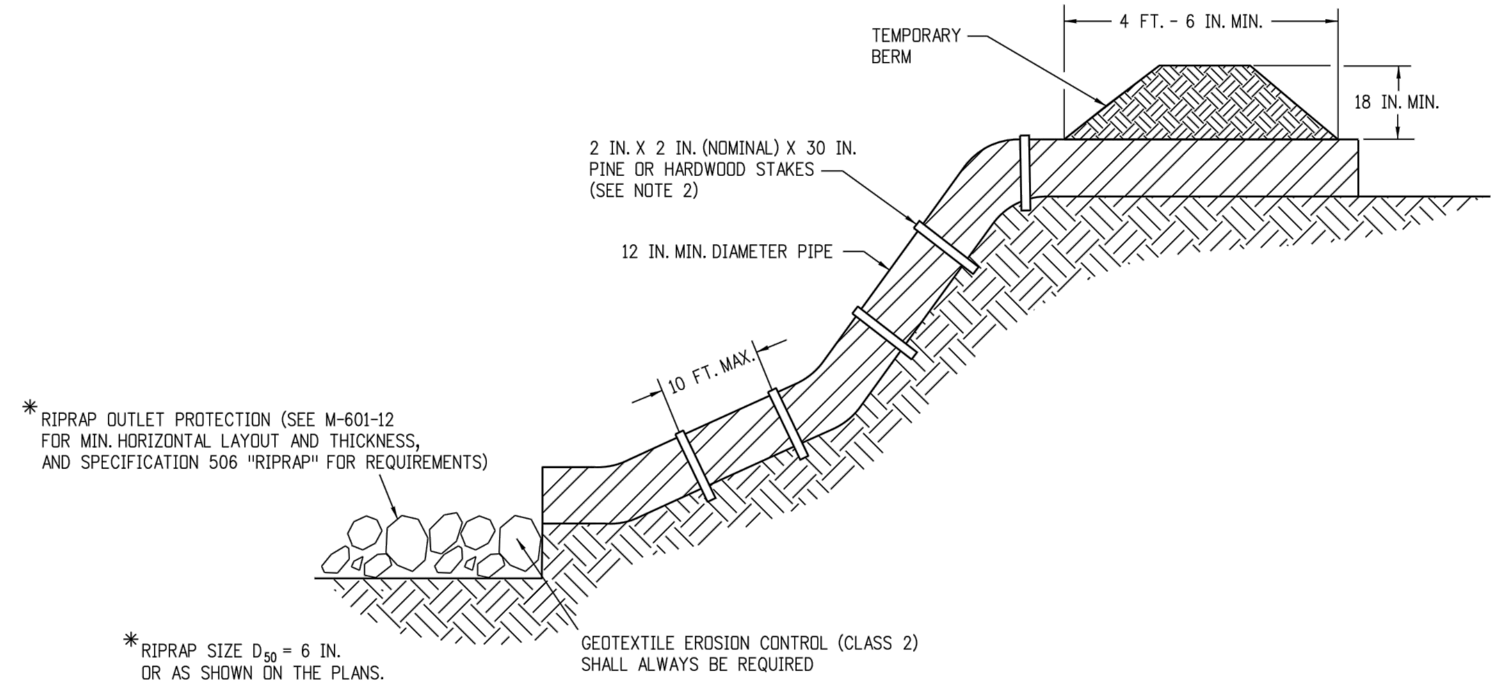
NOTES:
1. BERMS SHALL HAVE A HEIGHT OF 18 INCHES, SIDE SLOPES OF 2:1 OR FLATTER AND A MINIMUM BASE WIDTH OF 4 FT. -6 IN.
2. BERMS SHALL BE USED TO INTERCEPT AND DIVERT DRAINAGE TO A DESIGNATED OUTLET.
3. BERMS SHALL NOT BE USED WHERE DRAINAGE AREA EXCEEDS 10 ACRES.
4. BERMS SHALL BE CONSTRUCTED OUT OF ACCEPTABLE MATERIAL THAT CAN BE COMPACTED AND RECEIVE AT A MINIMUM HEAVY EQUIPMENT WHEEL ROLLED COMPACTION.
5. TEMPORARY BERMS SHALL BE CONSTRUCTED OUT OF EMBANKMENT (SUBSOIL) AND IN NO CIRCUMSTANCE CONSTRUCTED OUT OF SALVAGED TOPSOIL.
6. THE PAY ITEM NUMBER FOR TEMPORARY BERM (LF) IS 208-00300.

TEMPORARY BERM



NOTES:
1. TEMPORARY DIVERSION DITCHES SHALL BE CONSTRUCTED ACROSS THE SLOPE TO INTERCEPT RUNOFF AND DIRECT IT TO A STABLE OUTLET OR SEDIMENT TRAP.
2. USE THE TEMPORARY DIVERSION DITCH IMMEDIATELY ABOVE A NEW CUT, FILL SLOPE, OR AROUND THE PERIMETER OF A DISTURBED AREA.
3. THE GRADIENT ALONG THE FLOW PATH SHALL HAVE A POSITIVE GRADE TO ASSURE DRAINAGE, BUT SHALL NOT BE SO STEEP AS TO RESULT IN EROSION DUE TO HIGH VELOCITY.
4. THE DIVERSION FLOWLINE SHALL ALWAYS BE LOCATED A MINIMUM 10 FEET FROM THE OUTSIDE LIMITS OF DISTURBED AREA BOUNDARY.
6. DIVERSION BERMS SHALL BE CONSTRUCTED OUT OF EMBANKMENT (SUBSOIL) AND IN NO CIRCUMSTANCE CONSTRUCTED OUT OF SALVAGED TOPSOIL.
5. THE PAY ITEM NUMBER FOR TEMPORARY DIVERSION (LF) IS 208-00301.

TEMPORARY DIVERSION



NOTES:
1. ANCHOR SIZE VARIES ACCORDING TO PIPE SIZE
2. TO SECURE THE PIPE, DRIVE STAKES INTO GROUND, THEN TIE A 12 GUAGE WIRE BETWEEN THEM ABOVE AND ACROSS THE PIPE'S WIDTH.
3. THE OUTLET SHALL BE ALIGNED WITH THE FLOW DIRECTION OF THE EXISTING GRADE. PERPENDICULAR DISCHARGE TO A CHANNEL SHALL NOT BE ACCEPTABLE.
4. THE GRADE AROUND THE INLET TO THE PIPE SHALL BE COMPACTED.
5. THE PAY ITEM NUMBER FOR TEMPORARY SLOPE DRAINS (LF) IS 208-00060.

TEMPORARY SLOPE DRAINS

GRADING APPLICATIONS

Computer File Information		Sheet Revisions	
Creation Date: 07/31/19		Date:	Comments
Designer Initials: JBK	(R-X)		
Last Modification Date: 07/31/19	(R-X)		
Detailer Initials: LTA	(R-X)		
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)		

Colorado Department of Transportation
2829 West Howard Place
CDOT HQ, 3rd Floor
Denver, CO 80204
Phone: 303-757-9021 FAX: 303-757-9868
Project Development Branch JBK

TEMPORARY EROSION CONTROL

Issued by the Project Development Branch: July 31, 2019

STANDARD PLAN NO.
M-208-1
Standard Sheet No. 7 of 11
Project Sheet Number:

COLORADO LICENSED TODD M. RUDOLPH 58436 PROFESSIONAL ENGINEER
5/7/2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

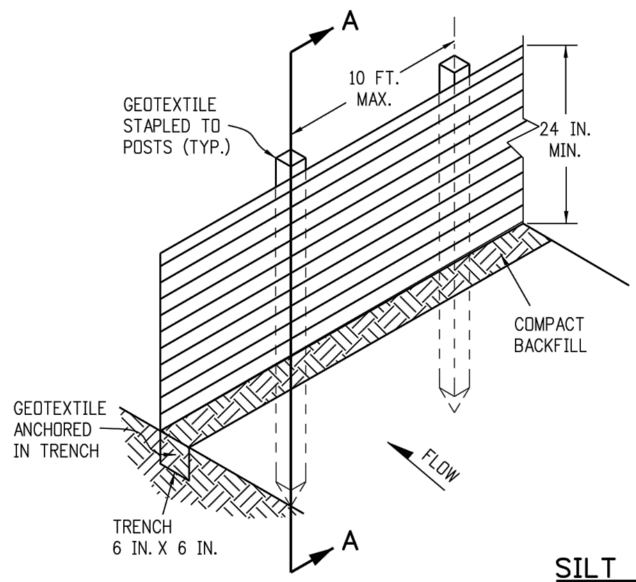
EROSION CONTROL DETAILS

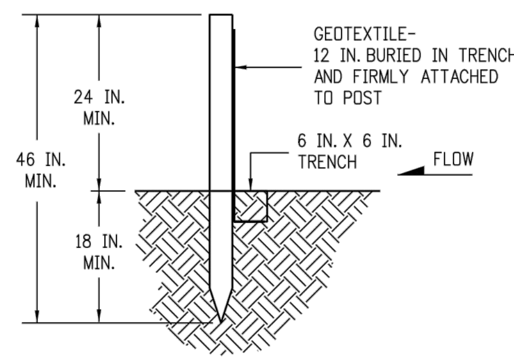
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr.: CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C09



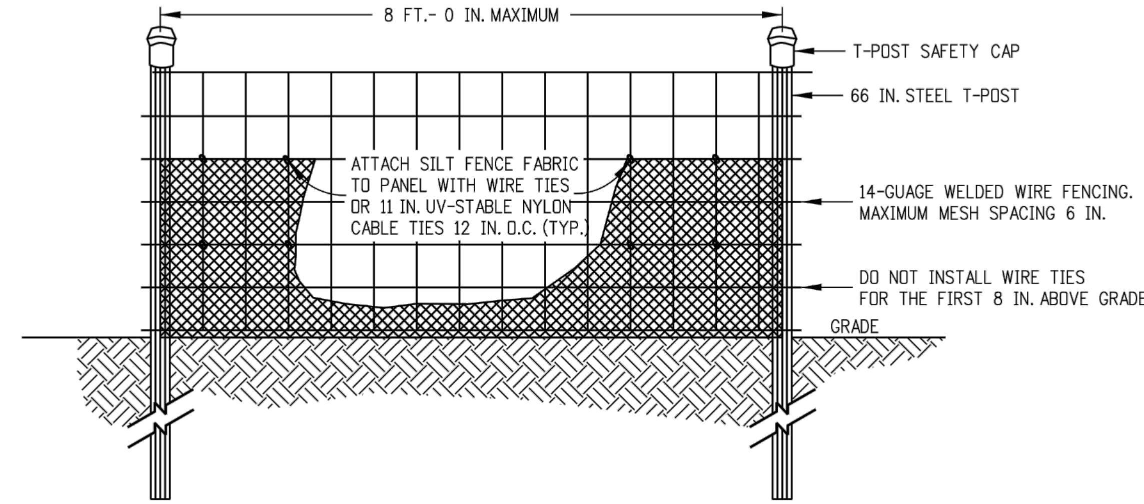


SECTION A-A

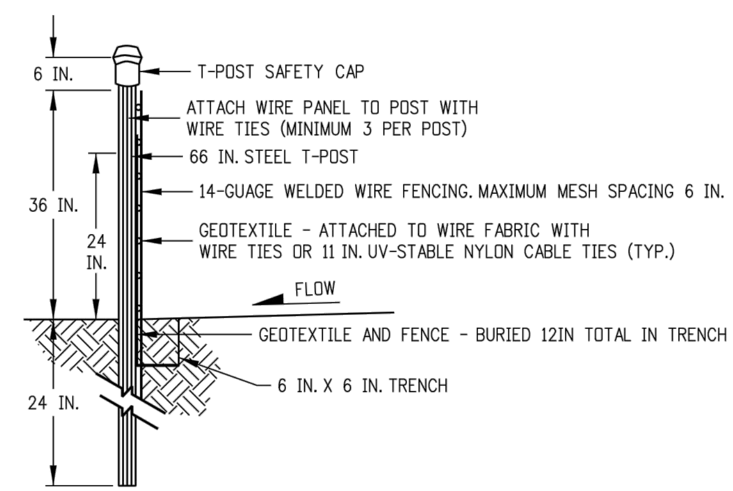
SILT FENCE

NOTES:

1. GEOTEXTILE SHALL BE ATTACHED TO WOOD POSTS WITH THREE OR MORE STAPLES PER POST. STAPLES SHALL BE HEAVY DUTY WIRE AND AT LEAST 1 INCH LONG.
2. WOOD POST SHALL BE 1 IN. X 1 IN. NOMINAL.
3. THE PAY ITEM NUMBER FOR SILT FENCE (LF) IS 208-00020.
4. THE SILT FENCE SHALL BE PLACED ON THE CONTOUR (AT THE SAME ELEVATION ±6 IN.). THE ENDS SHALL BE FLARED UP SLOPE (MINIMUM ELEVATION GAIN OF 18 IN.).



ELEVATION VIEW

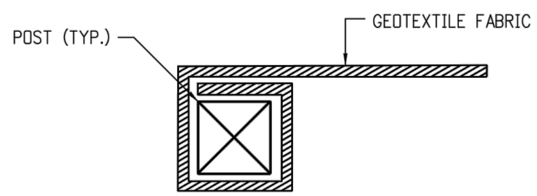


SIDE VIEW

NOTES:

1. THE ENDS OF THE SILT FENCE FABRIC SHALL BE JOINED TOGETHER BY WRAPPING APPROX. 6 INCHES OF EACH END AROUND A STEEL T-POST, THEN SECURED ALONG THE POST WITH WIRE TIES (MINIMUM 3 PER POST).
2. POSTS SHALL BE TIGHTLY ABUTTED WITH NO GAPS TO PREVENT POTENTIAL FLOW-THROUGH OF SEDIMENT AT JOINT.
3. SILT FENCES SHALL NOT BE USED FOR CHECK DAMS.
4. THE PAY ITEM NUMBER FOR SILT FENCE (REINFORCED) (LF) IS 208-00021.

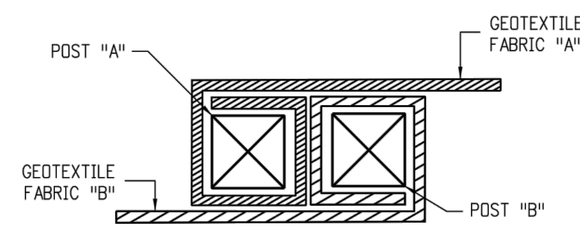
SILT FENCE (REINFORCED)



END SECTION DETAIL (PLAN VIEW)

NOTE:

1. THE END OF THE SILT FENCE FABRIC SHALL BE WRAPPED APPROX. 6 INCHES AROUND A WOODEN POST ONE FULL TURN, THEN SECURED ALONG THE POST WITH 6 HEAVY DUTY WIRE STAPLES AT LEAST 1 INCH LONG.



JOINING SECTION DETAIL (PLAN VIEW)

NOTES:

1. THE ENDS OF THE SILT FENCE FABRIC SHALL BE JOINED TOGETHER BY WRAPPING APPROX. 6 INCHES OF EACH END AROUND A WOODEN POST ONE FULL TURN, THEN SECURED ALONG THE POST WITH 6 HEAVY DUTY WIRE STAPLES AT LEAST 1 INCH LONG.
2. POSTS SHALL BE TIGHTLY ABUTTED WITH NO GAPS TO PREVENT POTENTIAL FLOW-THROUGH OF SEDIMENT AT JOINT.

SILT FENCE APPLICATIONS

Computer File Information		Sheet Revisions		Colorado Department of Transportation	TEMPORARY EROSION CONTROL	STANDARD PLAN NO.
Creation Date: 07/31/19		Date:	Comments	2829 West Howard Place		M-208-1
Designer Initials: JBK	(R-X)			CDOT HQ, 3rd Floor		Standard Sheet No. 8 of 11
Last Modification Date: 07/31/19	(R-X)			Denver, CO 80204		
Detailer Initials: LTA	(R-X)			Phone: 303-757-9021 FAX: 303-757-9868		
CAD Ver.: MicroStation V8 Scale: Not to Scale Units: English	(R-X)			Project Development Branch JBK	Issued by the Project Development Branch: July 31, 2019	Project Sheet Number:

COLORADO LICENSED TODD M. RUDOLPH 58436 PROFESSIONAL ENGINEER

2/26/2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
3665 JFK Parkway
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(970) 223-5556

EROSION CONTROL DETAILS

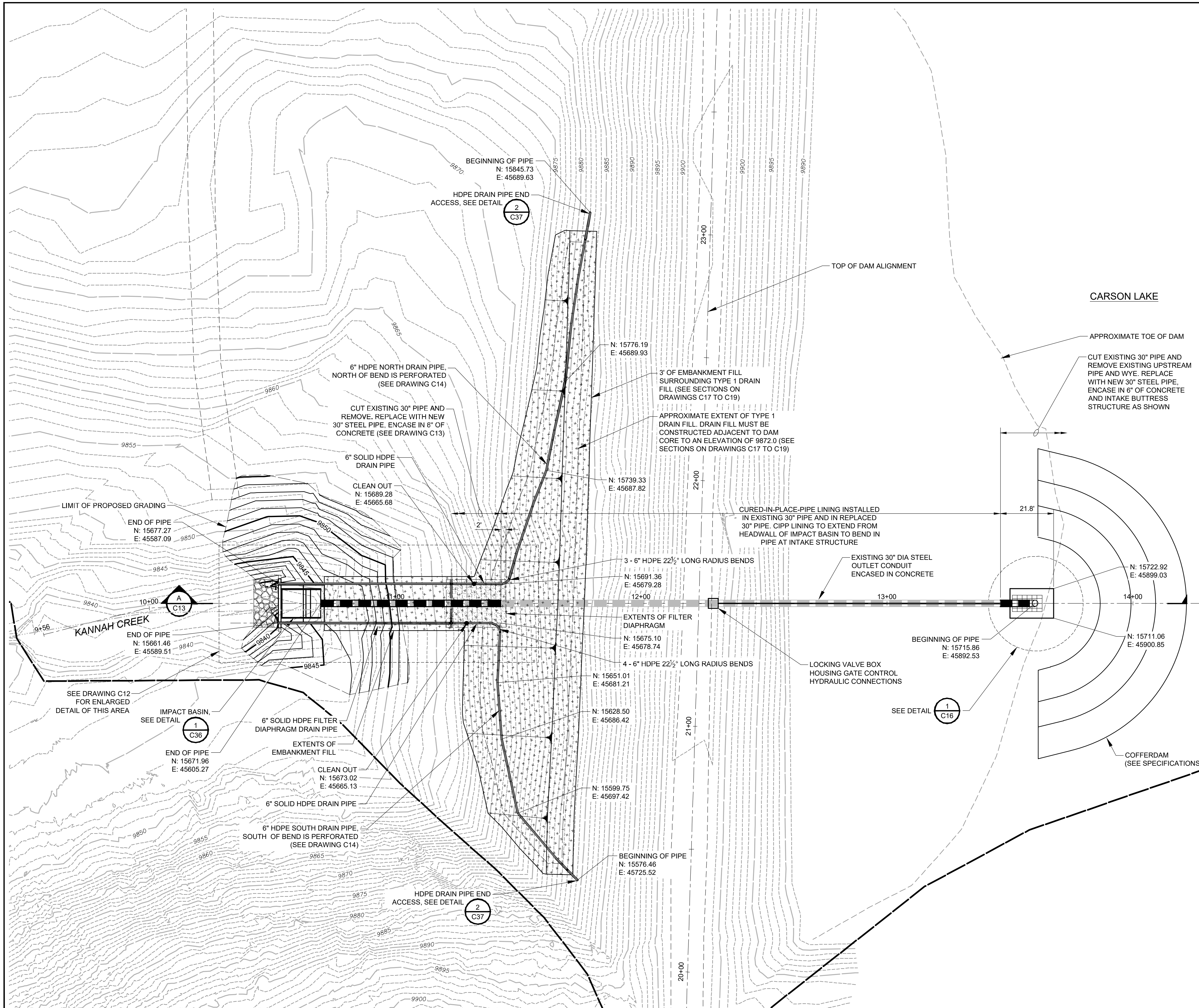
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

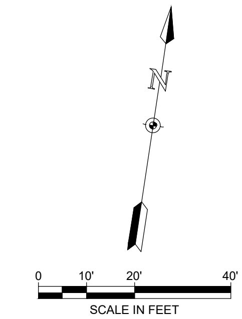
Date | Revisions

Project Mgr.: CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C10
SHEET 17 OF 44

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 EROSION CONTROL DETAILS.DWG Friday, May 07, 2021 10:30 AM By: RIEDER, AUSTIN





AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

DAM PROPOSED CONDITIONS AND COFFERDAM

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr.: CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

COLORADO LICENSED TODD M. RUDOLPH 58436 PROFESSIONAL ENGINEER
5/14/2021

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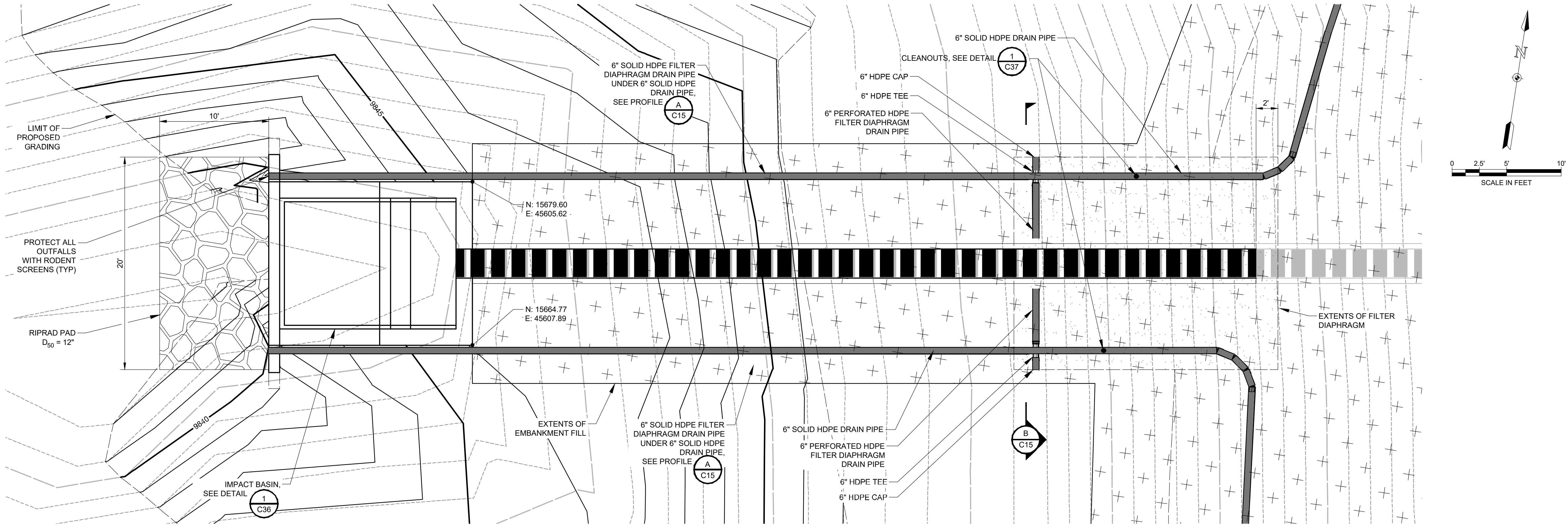
PROJECT NO. 26-1144.00
DRAWING NO. C11



FILTER DIAPHRAGM AND IMPACT BASIN AREA ENLARGED PLAN

SCALE: AS SHOWN

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 DAM PLAN ENLARGED.DWG Monday, May 10, 2021 4:37 PM By: RIEDER, AUSTIN

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

DAM PROPOSED CONDITIONS
ENLARGED PLAN

HOGCHUTE (AKA CARSON)
RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

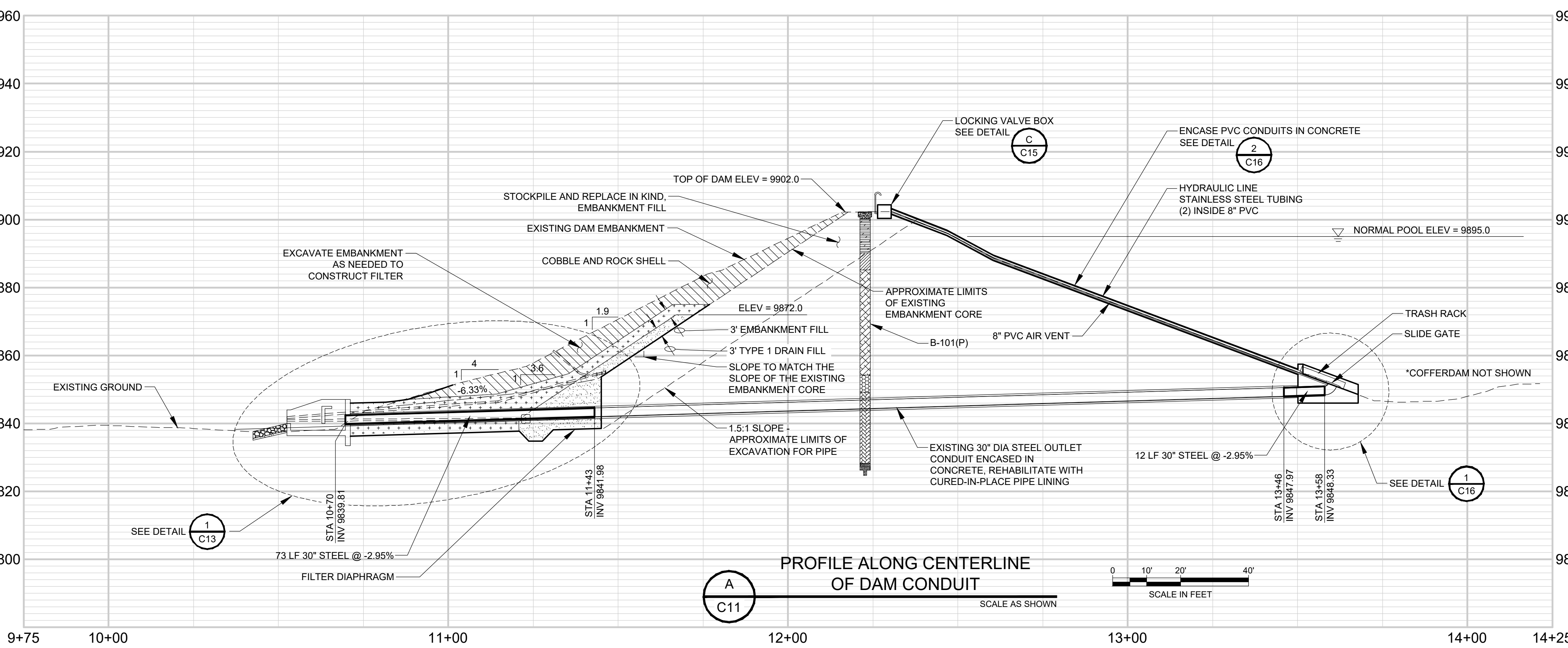
Revisions	Date

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

COLORADO LICENSED PROFESSIONAL ENGINEER
TODD M. RUDOLPH
58436
2/26/2021

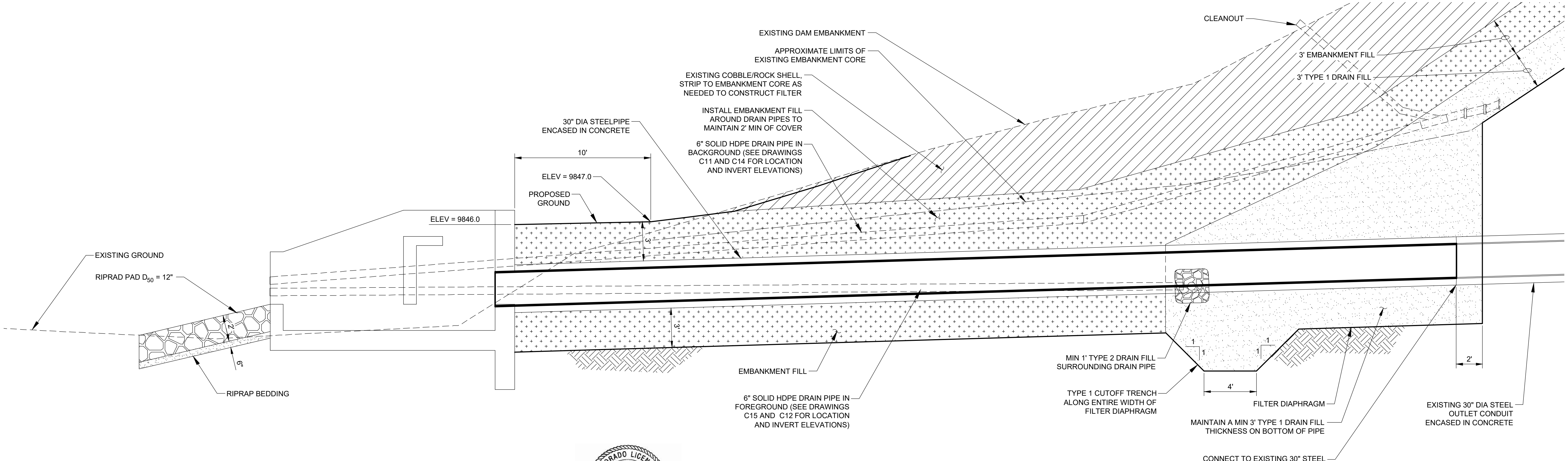
ONE INCH - IF NOT, SCALE ACCORDINGLY

PROJECT NO. 26-1144.00
DRAWING NO. C12
SHEET 19 OF 44



A C11 PROFILE ALONG CENTERLINE OF DAM CONDUIT

SCALE AS SHOWN



COLORADO LICENSED
TODD M. RUDOLPH
58436
PROFESSIONAL ENGINEER
2/26/2021

1 C13 DIAPHRAGM FILTER AND OUTLET DETAIL

SCALE AS SHOWN

ONE INCH - IF NOT, SCALE ACCORDINGLY

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 DAM PROFILE AND DETAIL.DWG Friday, May 14, 2021 1:42 PM By: RIEDER, AUSTIN

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

DAM PROFILE AND DETAIL

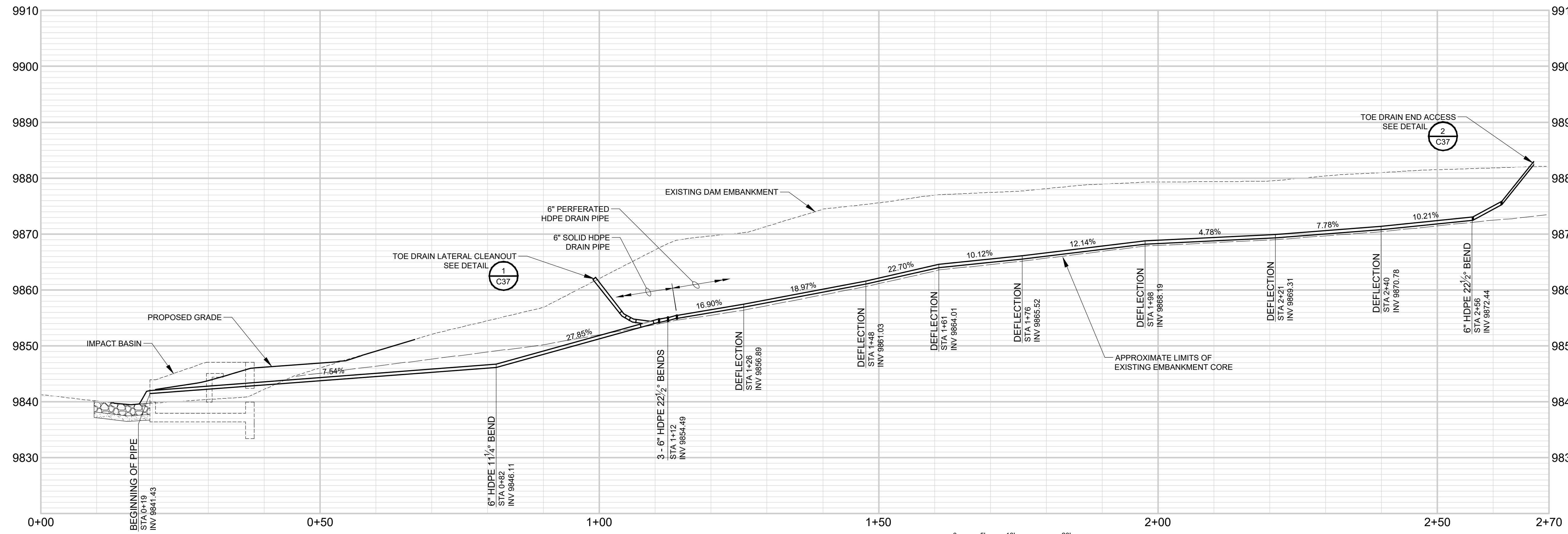
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Date	Revisions

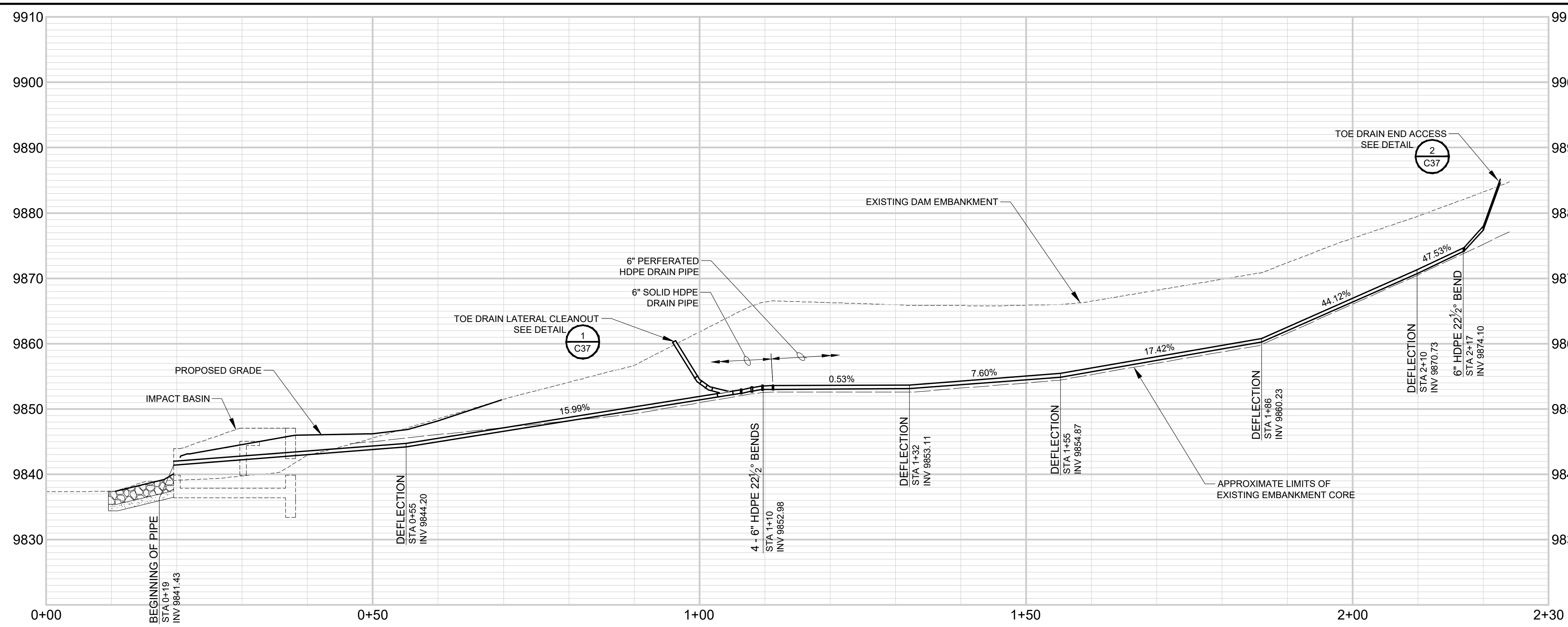
Project Mgr.: CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00

DRAWING NO. C13



NORTH DRAIN PIPE PROFILE
SCALE: AS SHOWN



SOUTH DRAIN PIPE PROFILE
SCALE: AS SHOWN

COLORADO LICENSED
TODD M. RUDOLPH
58436
PROFESSIONAL ENGINEER
5/10/2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
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DAM DRAIN PIPE PROFILES

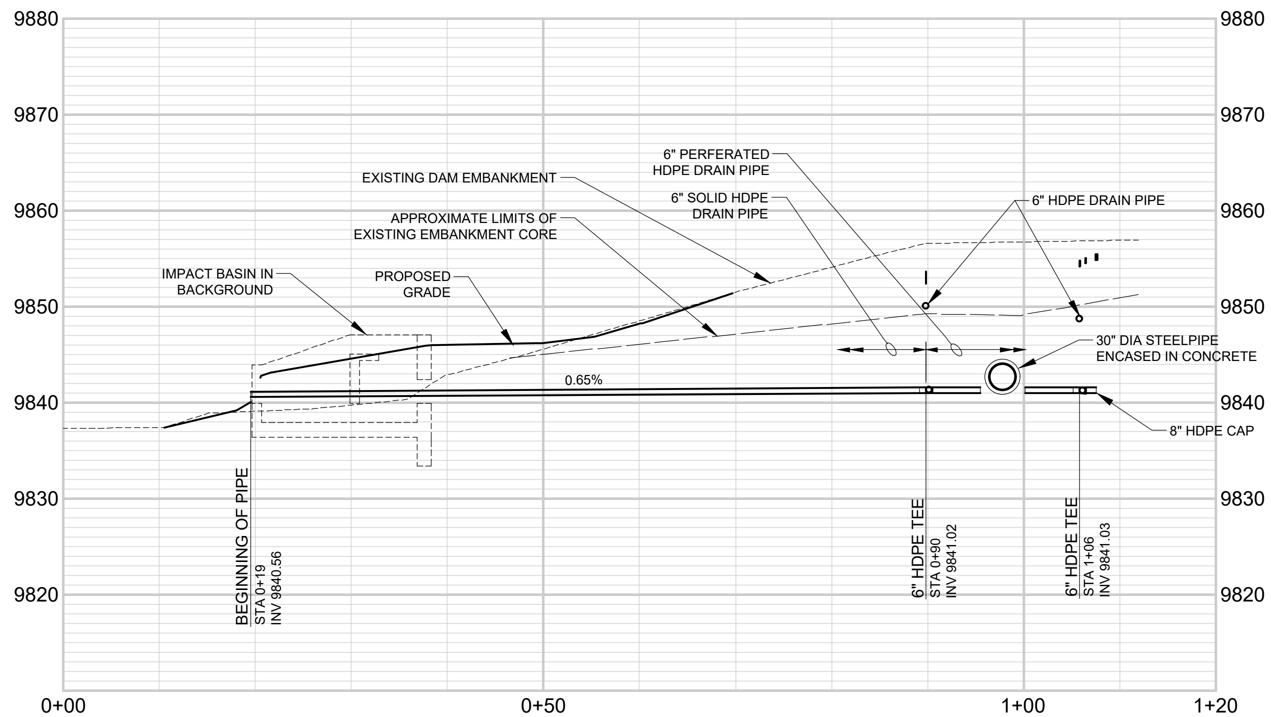
HOGCHUTE (AKA CARSON)
RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Date	Revisions

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C14
SHEET 21 OF 44

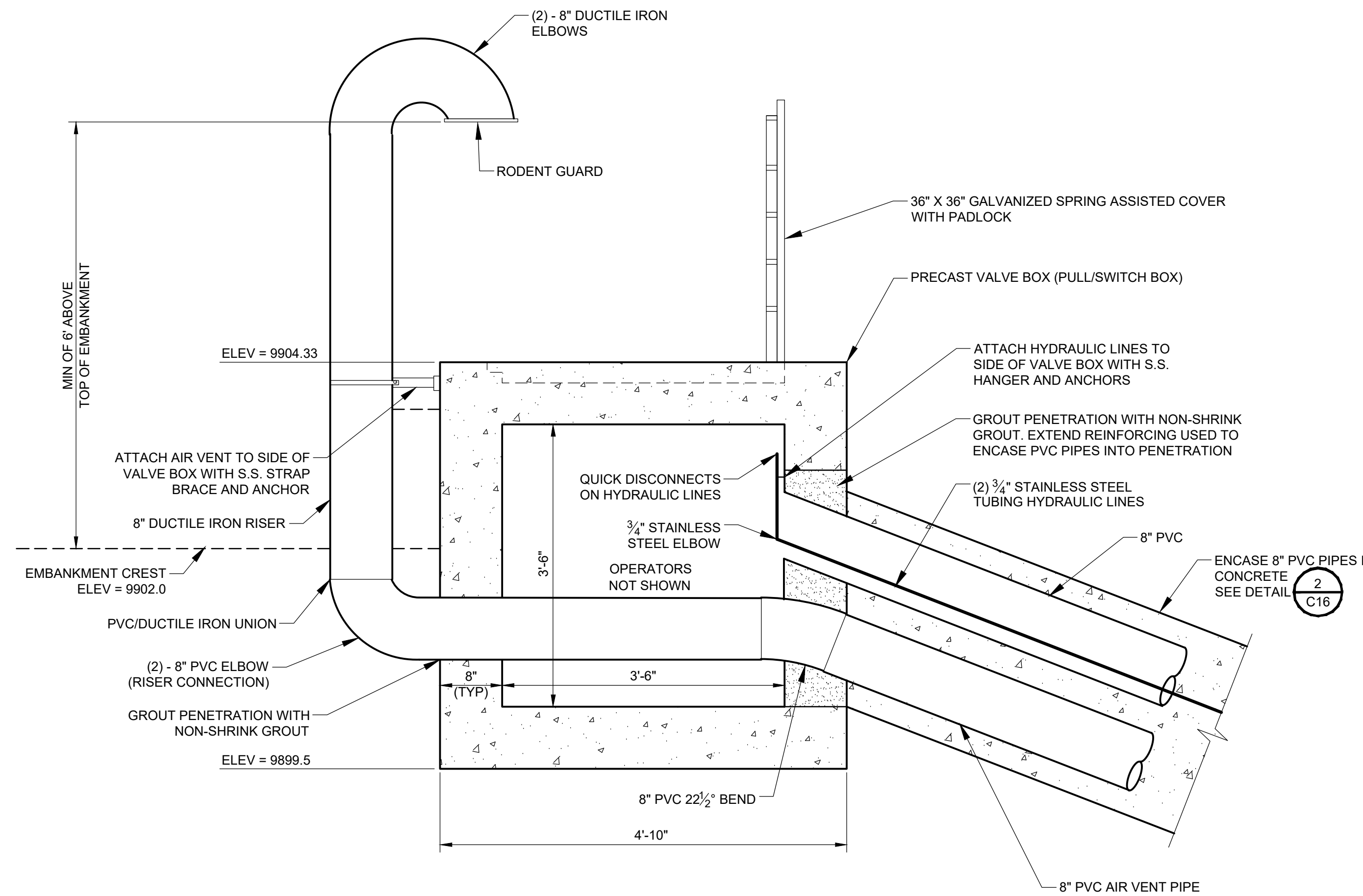
Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 DRAIN PIPE PROFILES.DWG Saturday, May 08, 2021 2:41 PM By: RIEDER, AUSTIN



A
C12

FILTER DIAPHRAGM DRAIN PIPE PROFILE (NORTH & SOUTH)

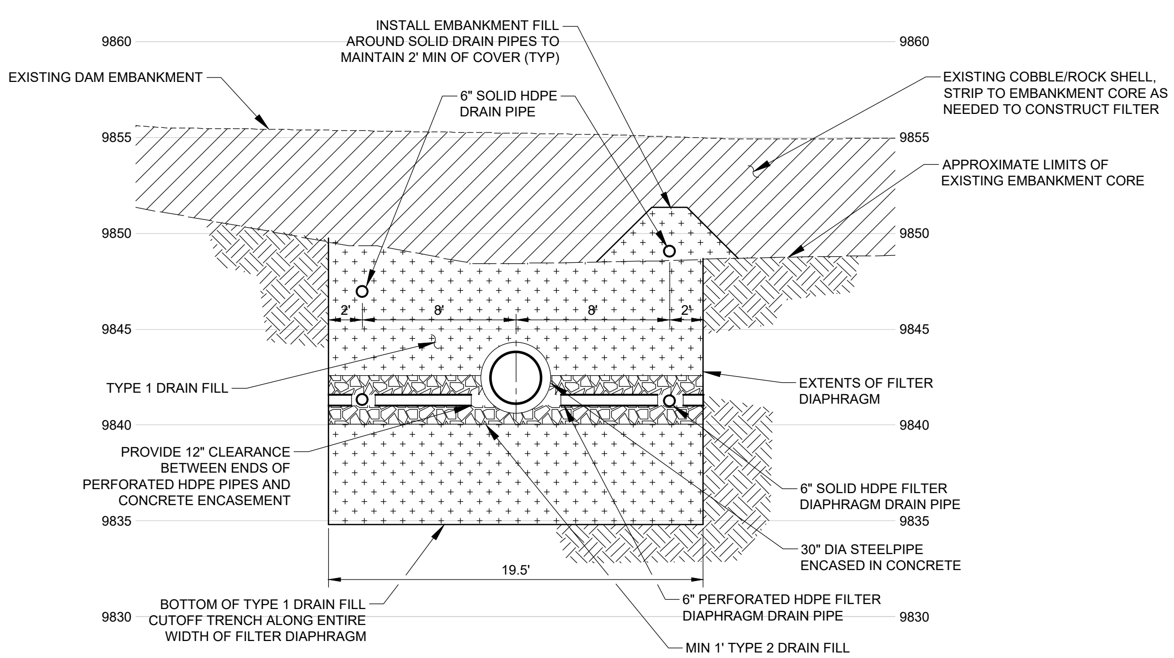
SCALE: AS SHOWN



C
C13

LOCKING VALVE BOX DETAIL

NOT TO SCALE



B
C12

SECTION

SCALE: AS SHOWN

COLORADO LICENSED TODD M. RUDOLPH 58436 PROFESSIONAL ENGINEER

ONE INCH - IF NOT, SCALE ACCORDINGLY

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 DAM DETAILS 1 OF 2.DWG Friday, June 04, 2021 11:57 AM By: RIEDER, AUSTIN

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

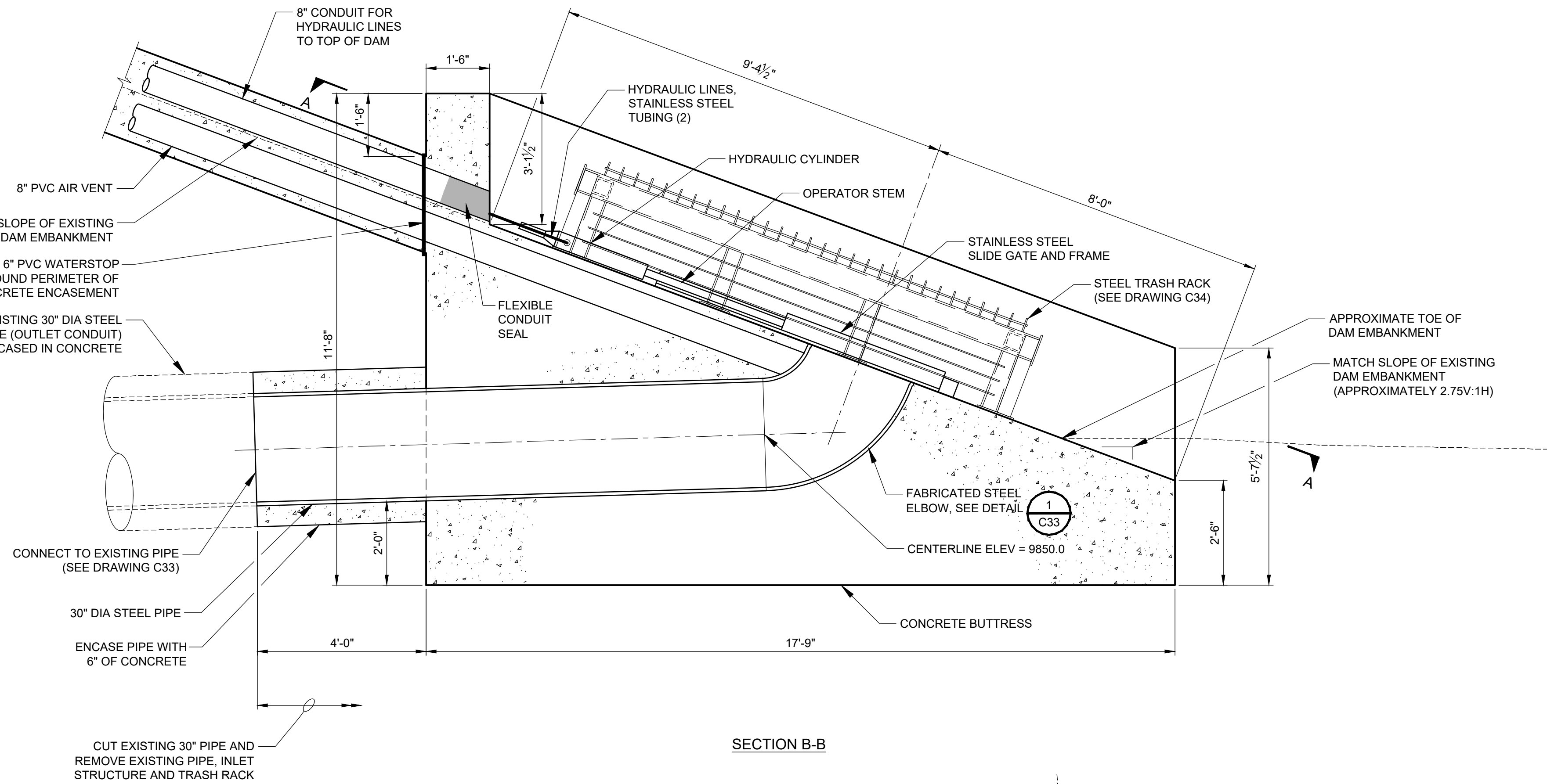
DAM DETAILS 1 OF 2

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

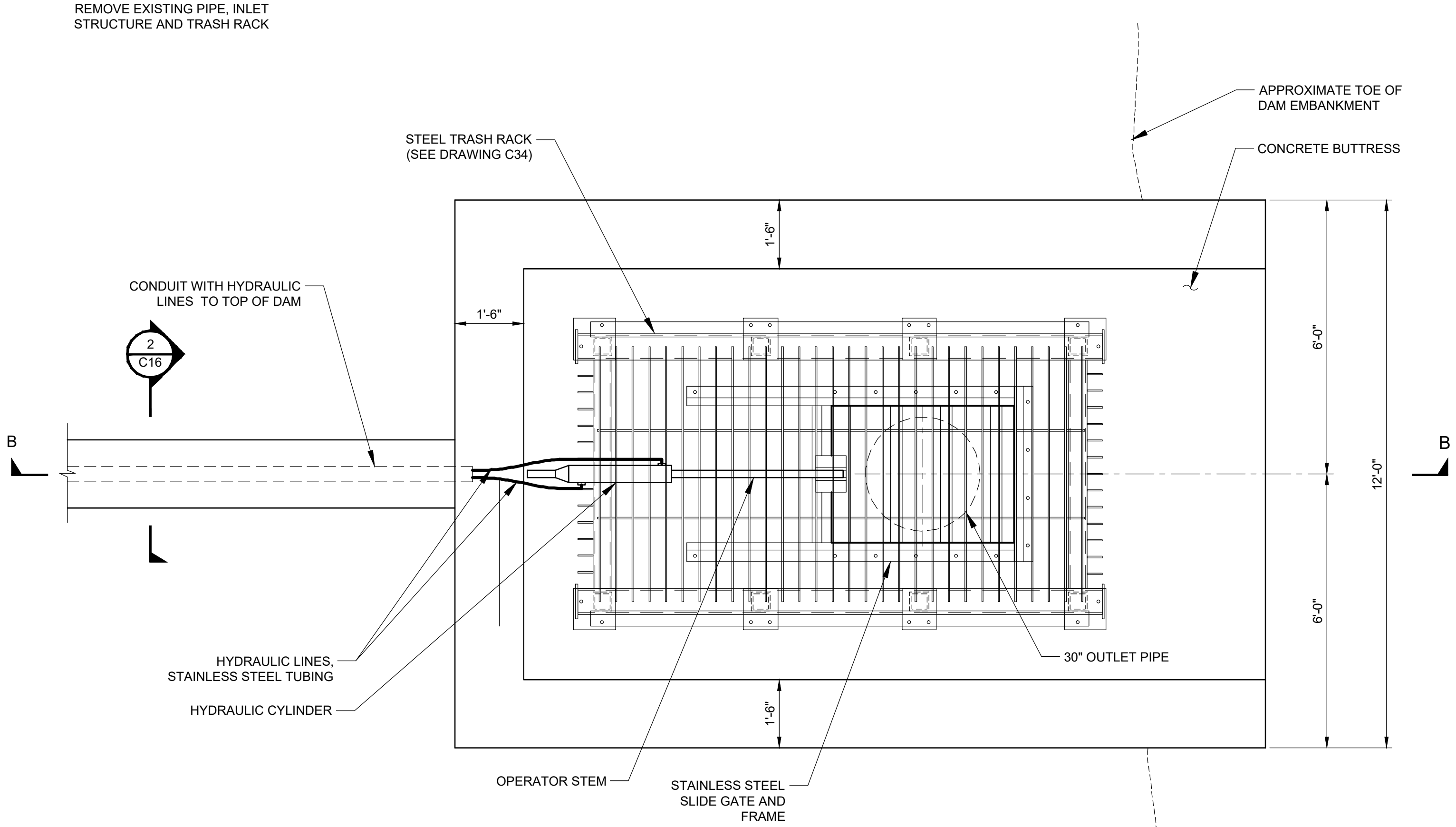
Date	Revisions

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C15



SECTION B-B

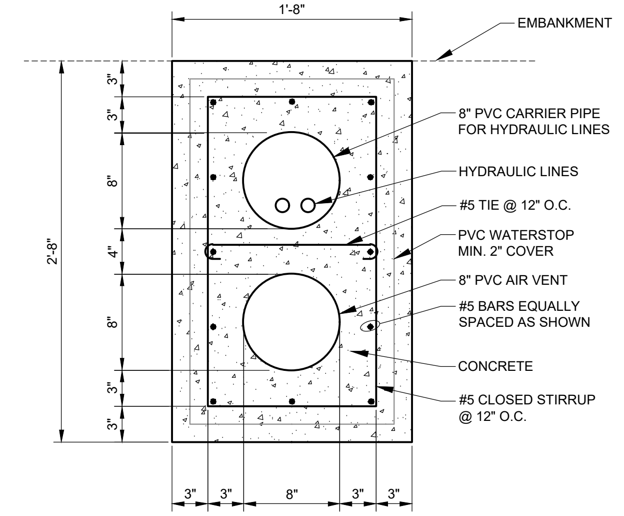


NOTES:
1. CONCRETE REINFORCEMENT NOT SHOWN (SEE DRAWING C32).

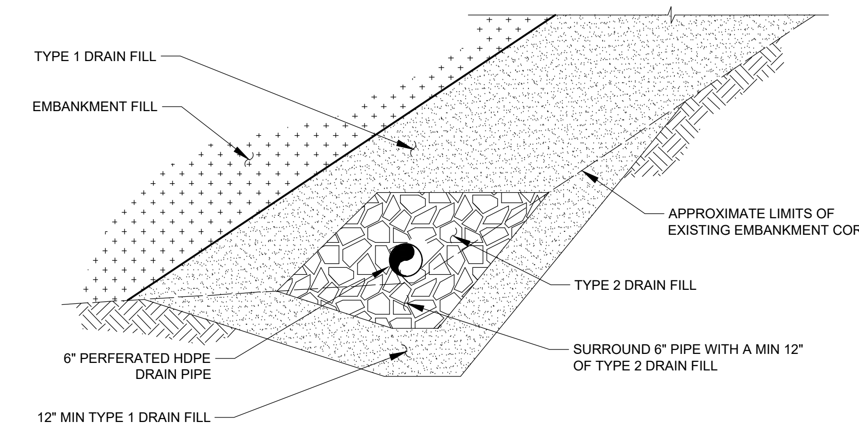
PLAN A-A

1 CONCRETE BUTTRESS DETAIL
C11,C13, C32
SCALE: 1/2"=1'-0"

NOTES:
1. PROVIDE CONTINUOUS PVC WATERSTOPS AT ALL JOINTS.



2 CONDUIT ENCASEMENT
C13,C15,C16
NOT TO SCALE



3 PERFORATED DRAIN PIPE TRENCH DETAIL
C17,C18
SCALE: 1"=2'

COLORADO LICENSED PROFESSIONAL ENGINEER TODD M. RUDOLPH 58436
5/27/2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

DAM DETAILS 2 OF 2

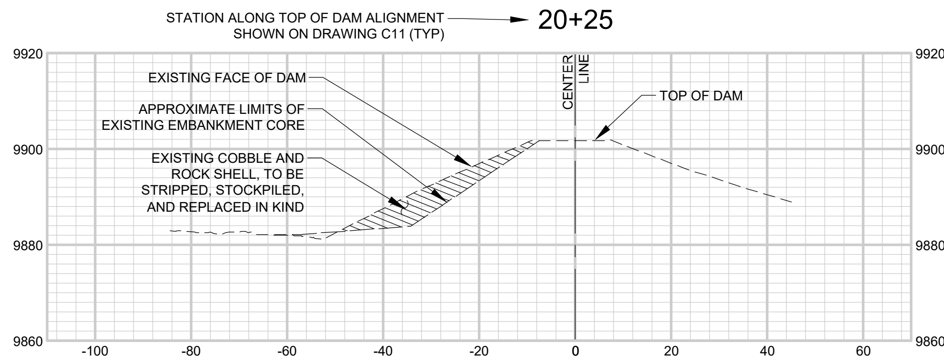
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

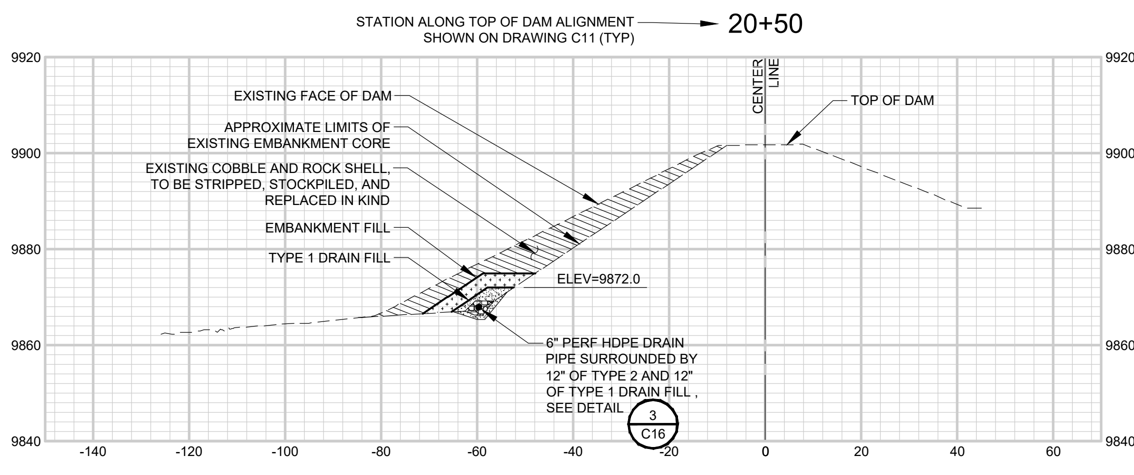
Date	Revisions

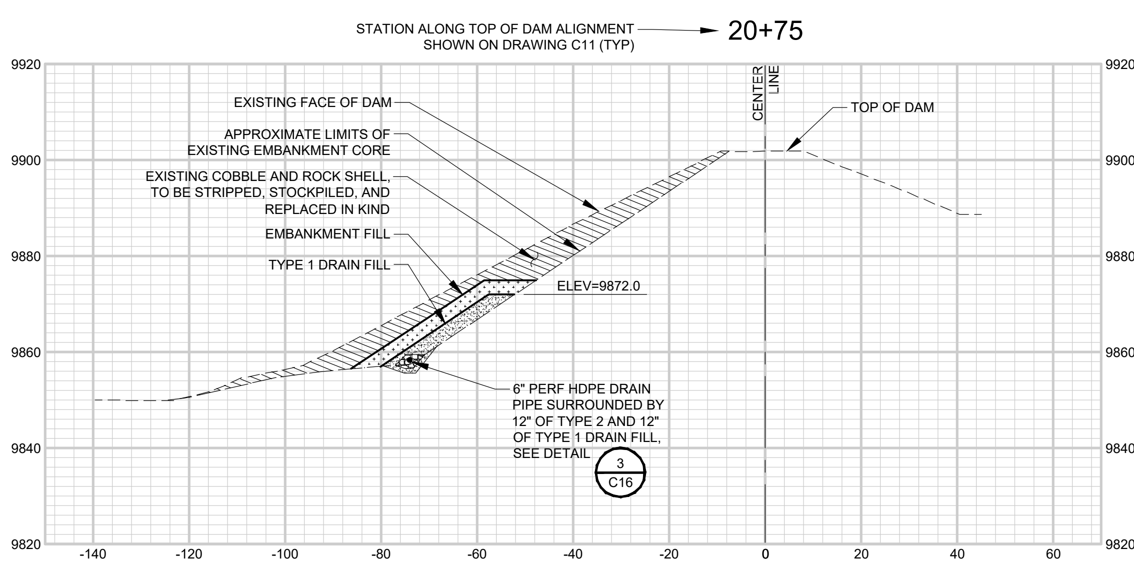
Project Mgr.: CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

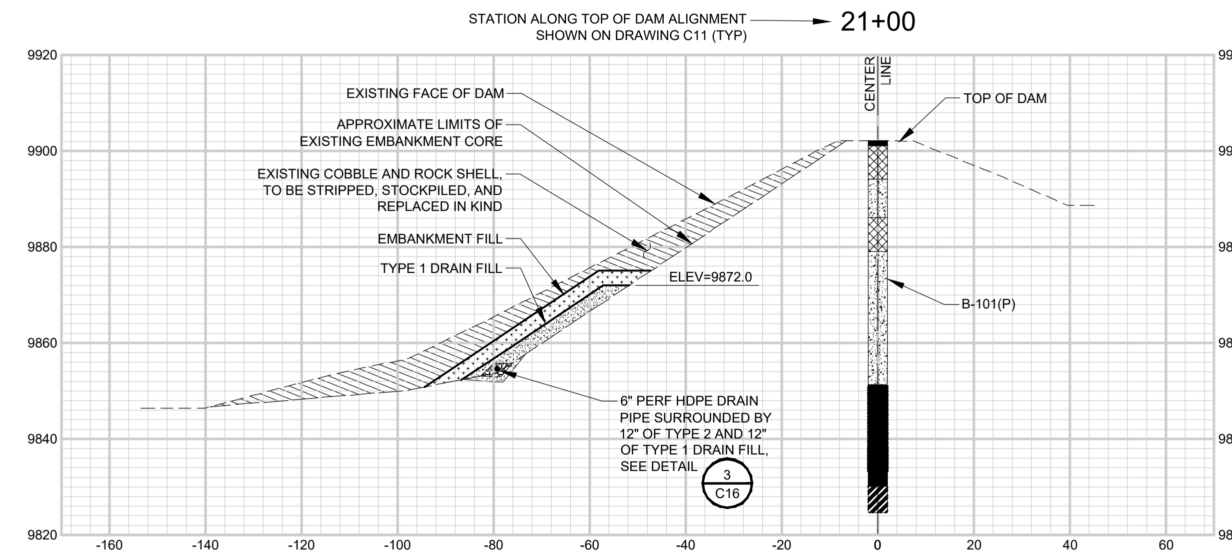
PROJECT NO. 26-1144.00
DRAWING NO. C16
SHEET 23 OF 44

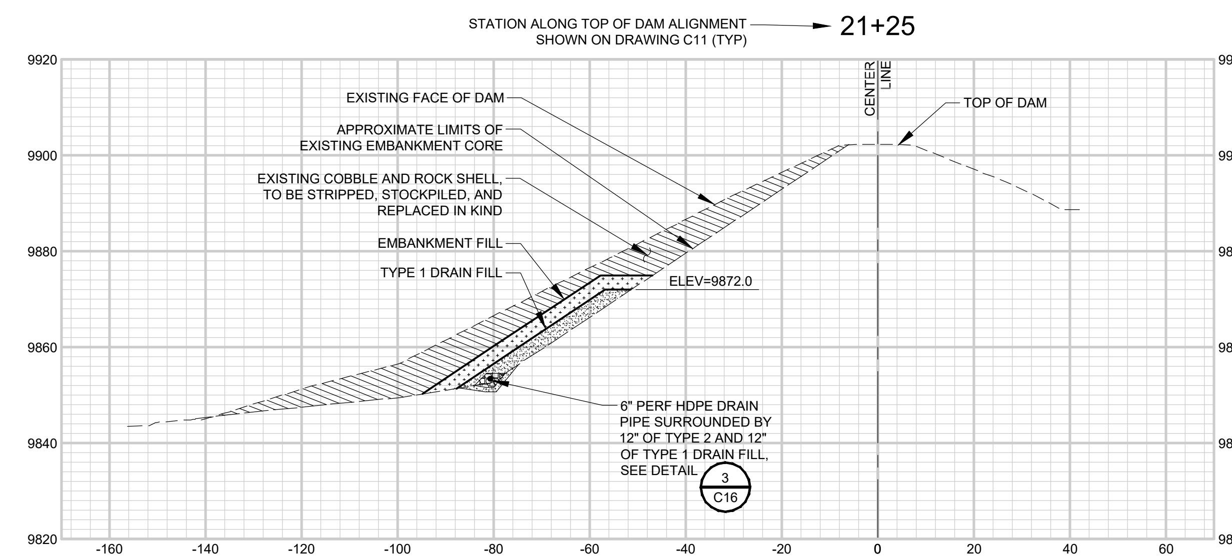
Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 IMPACT BASIN DETAILS.DWG Thursday, June 03, 2021 9:08 AM By: RIEDER, AUSTIN

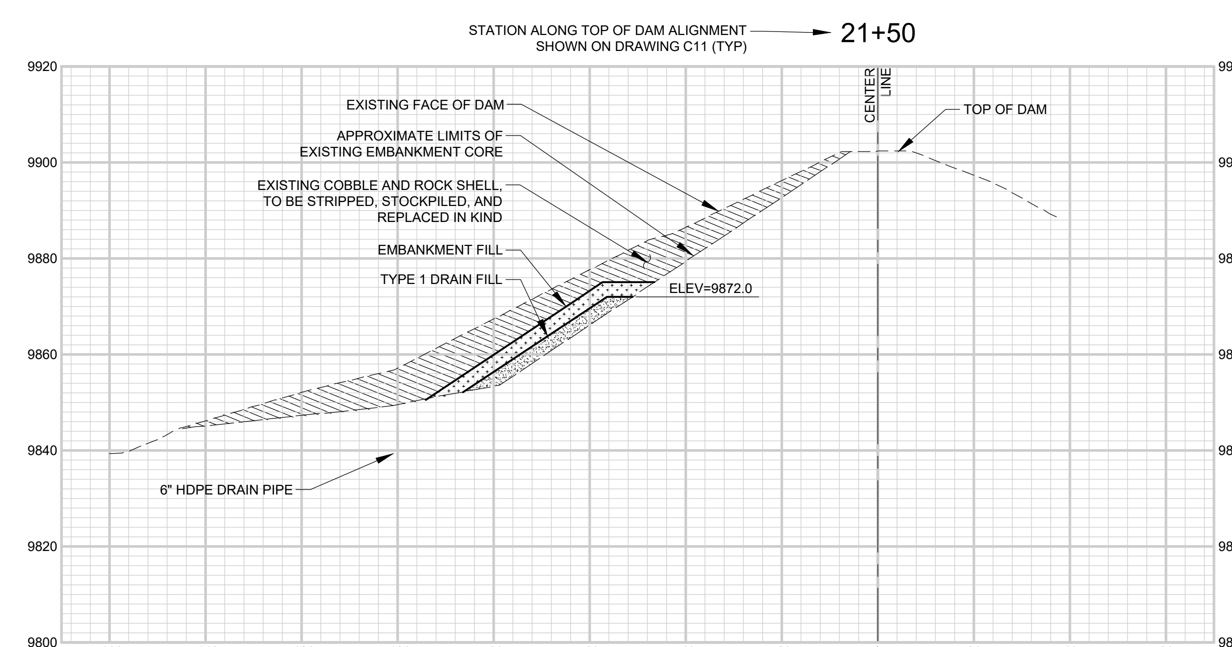












0 10' 20' 40'
SCALE IN FEET

COLORADO LICENSED
TODD M. RUDOLPH
58436
PROFESSIONAL ENGINEER
5/20/2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

DAM SECTIONS 1 OF 3

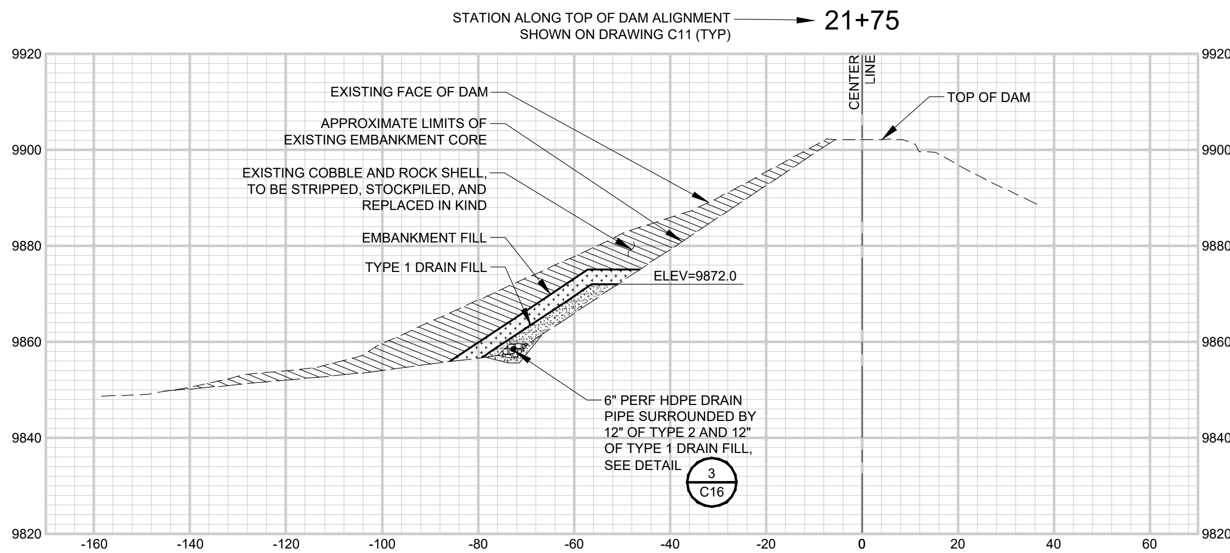
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

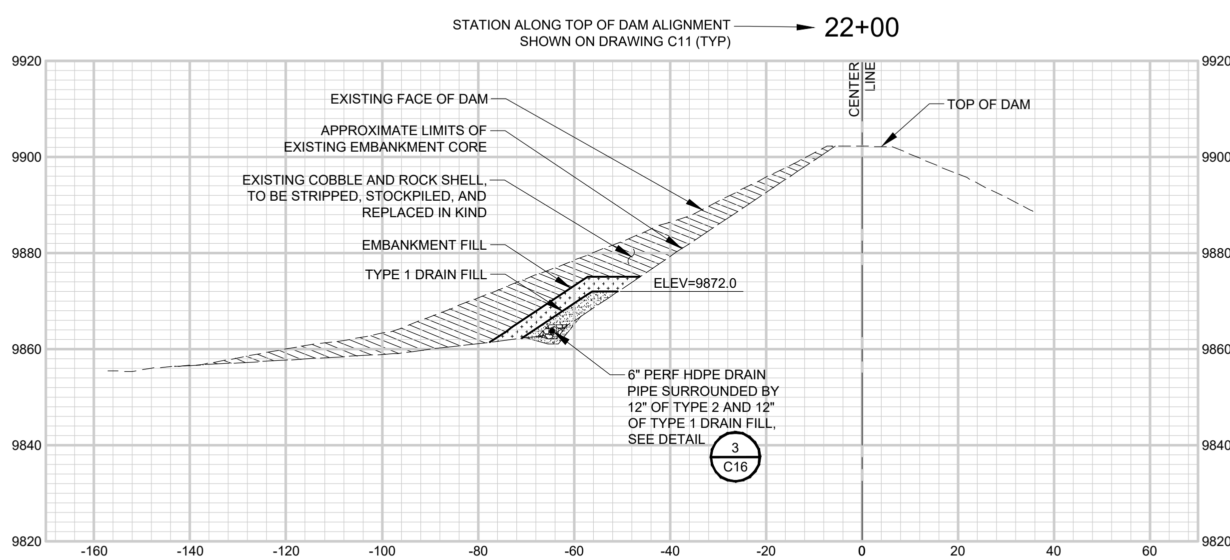
Revisions	Date

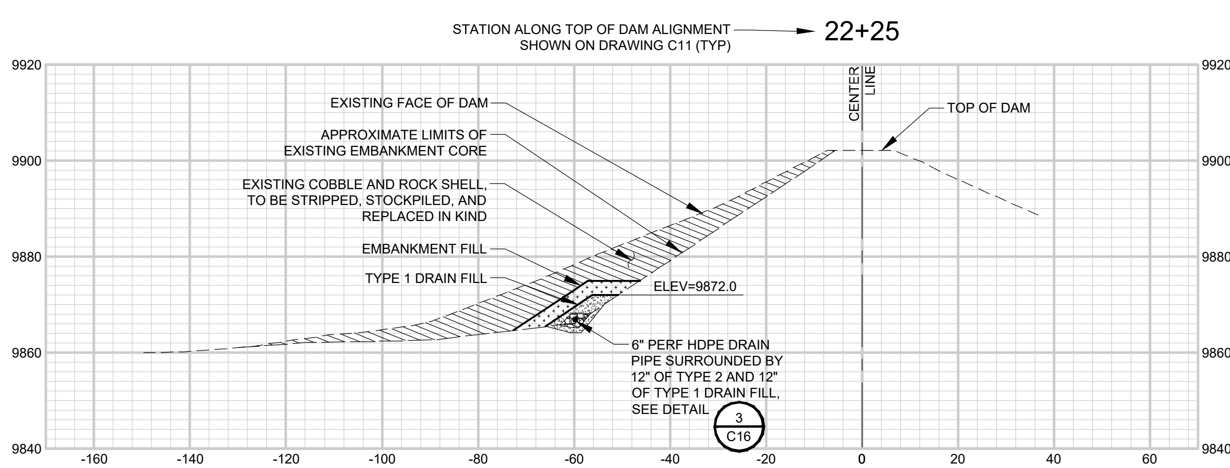
Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

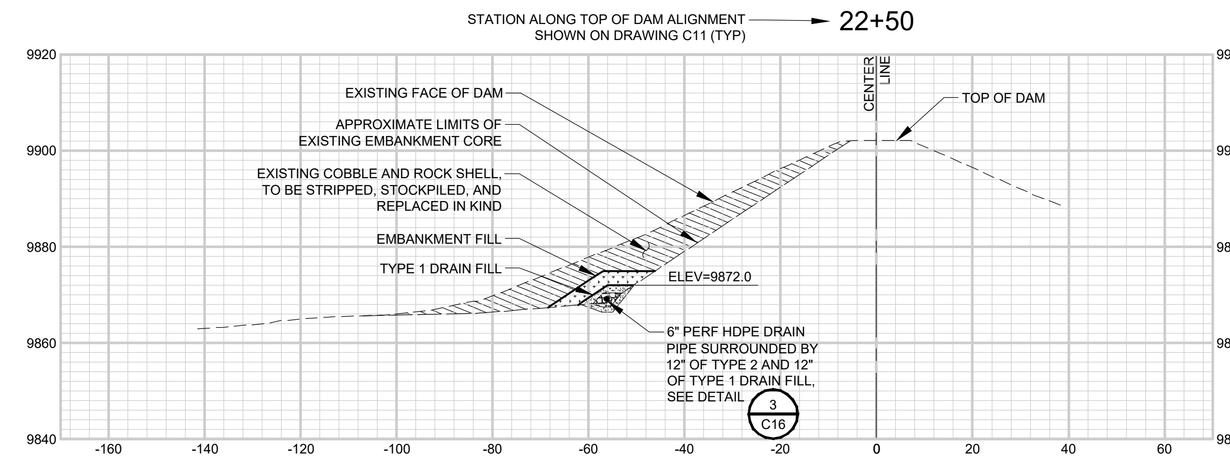
PROJECT NO. 26-1144.00
DRAWING NO. C17
SHEET 24 OF 44

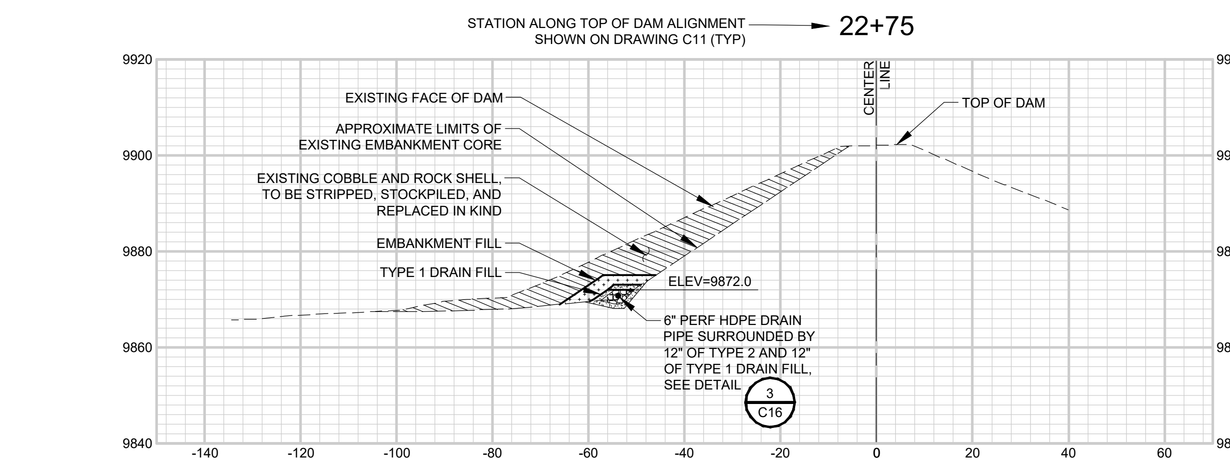
Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 DAM SECTIONS 3 OF 3.DWG Friday, May 14, 2021 2:52 PM By: RIEDER, AUSTIN

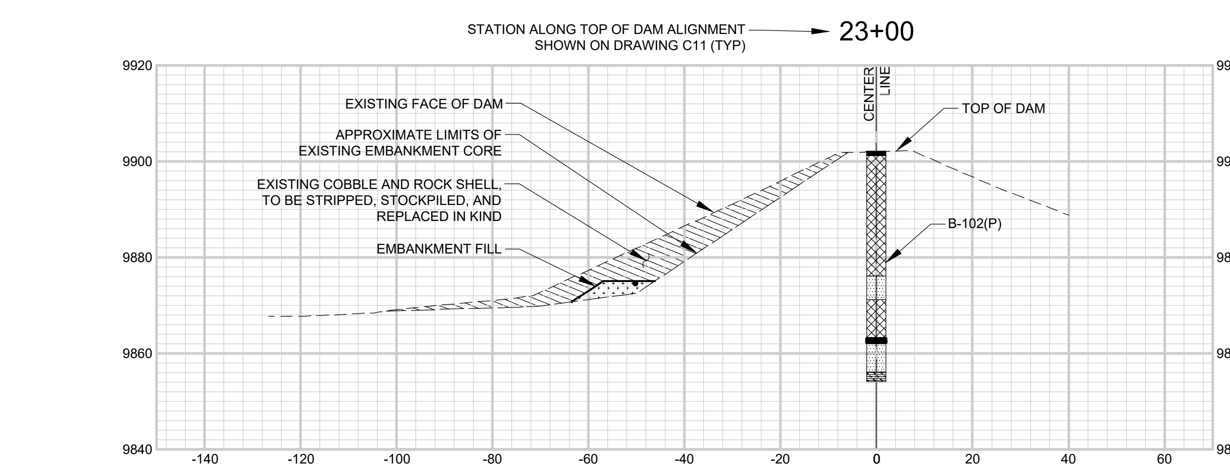












0 10' 20' 40'
SCALE IN FEET

COLORADO LICENSED PROFESSIONAL ENGINEER
TODD M. RUDOLPH
58436
5/14/2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

DAM SECTIONS 2 OF 3

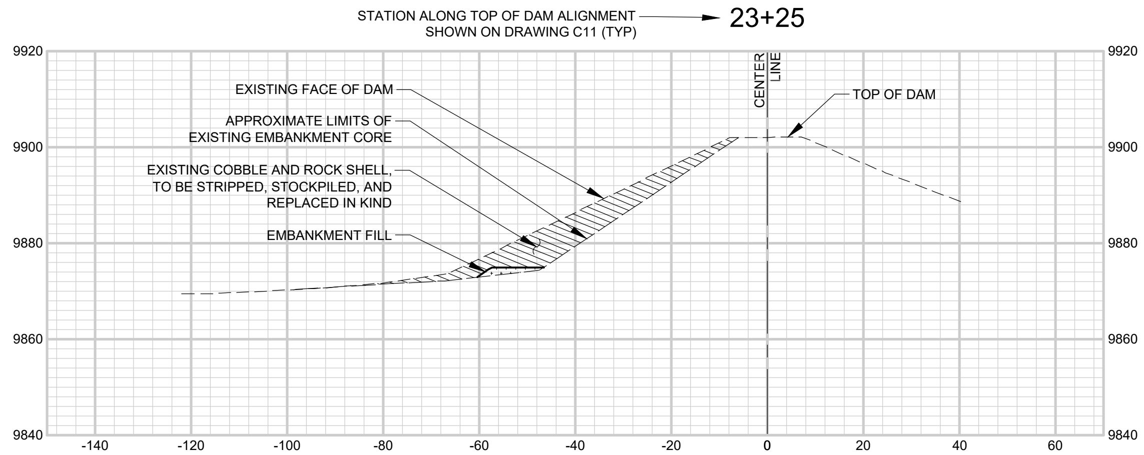
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

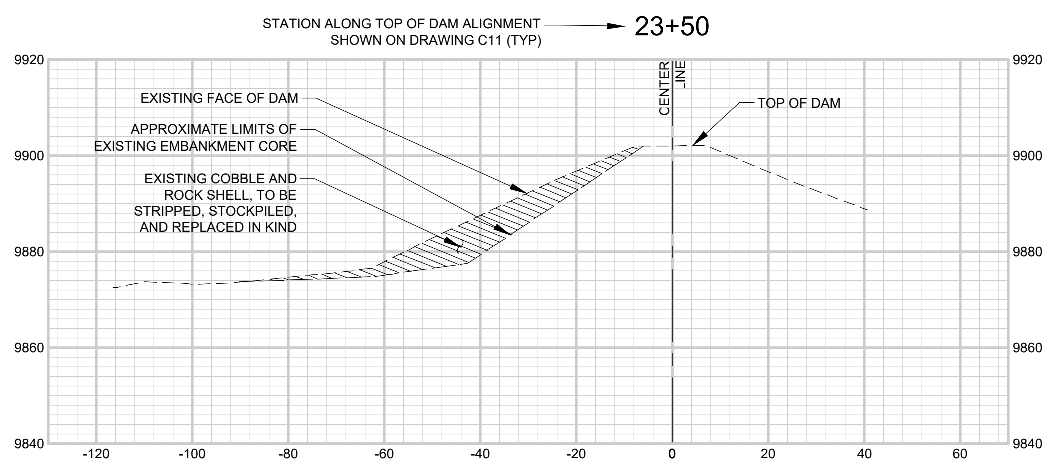
Date
Revisions

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO.
26-1144.00
DRAWING NO.
C18

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 DAM SECTIONS 3 OF 3.DWG Friday, May 14, 2021 2:52 PM By: RIEDER, AUSTIN





0 10' 20' 40'
SCALE IN FEET

COLORADO LICENSED
TODD M. RUDOLPH
58436
PROFESSIONAL ENGINEER
2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

DAM SECTIONS 3 OF 3

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C19
SHEET 26 OF 44

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 DAM SECTIONS 3 OF 3.DWG Friday, May 14, 2021 2:52 PM By: RIEDER, AUSTIN

N

0 10' 20' 40'
SCALE IN FEET

NOTES:

1. FILL N-VEGETATED AREA OF EXISTING CHANNEL APPROXIMATELY TO THE LIMITS AND ELEVATIONS SHOWN. FILL UP TO ADJACENT VEGETATED FLOOD PLAIN. FILL ELEVATION ADJACENT TO THE BERM SHOULD BE A MINIMUM 1' BELOW TOP OF BERM ELEVATION.
2. FILL ELEVATIONS SHOWN ARE APPROXIMATE AND MAY BE FIELD ADJUSTED DURING CONSTRUCTION.
3. FILL MATERIAL MAY INCLUDE COBBLE AND BOULDERS, BUT SHALL HAVE A MINIMUM OF 18" SOIL COVER.
4. WATTLES TO BE PLACED ON CHANNEL FILL AREAS. SEE DRAWING C27 FOR DETAILS.

COLORADO LICENSED PROFESSIONAL ENGINEER 37109 JUSTIN WAYNE ROBINSON

2-26-2021

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Fort Collins, CO 80525
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SPILLWAY PLAN 1 OF 3

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr.: CTG
Designed By: DWR
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C20

N

0 10' 20' 40'
SCALE IN FEET

NOTES:

1. FILL UN-VEGETATED AREA OF EXISTING CHANNEL APPROXIMATELY TO THE LIMITS AND ELEVATIONS SHOWN. FILL UP TO ADJACENT VEGETATED FLOOD PLAIN. FILL ELEVATION ADJACENT TO THE BERM SHOULD BE A MINIMUM 1' BELOW TOP OF BERM ELEVATION.
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COLORADO LICENSED PROFESSIONAL ENGINEER 37109

2-26-2021

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SPILLWAY PLAN 2 OF 3

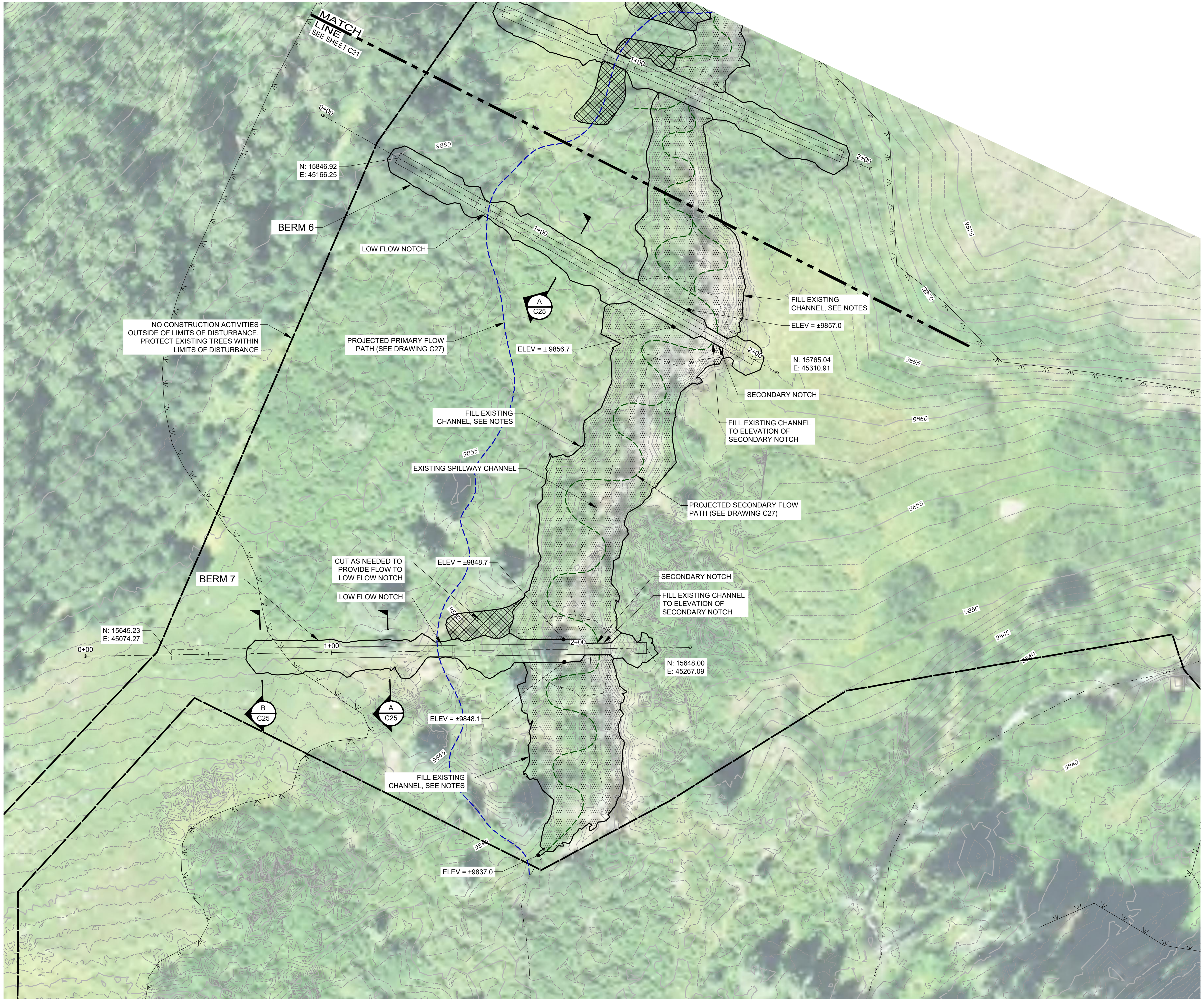
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr.: CTG
Designed By: DWR
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C21

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 SPILLWAY PLAN 3 OF 3.DWG Thursday, May 06, 2021 7:14 PM By: RIEDER, AUSTIN



N

0 10' 20' 40'
SCALE IN FEET

NOTES:

1. FILL UN-VEGETATED AREA OF EXISTING CHANNEL APPROXIMATELY TO THE LIMITS AND ELEVATIONS SHOWN. FILL UP TO ADJACENT VEGETATED FLOOD PLAIN. FILL ELEVATION ADJACENT TO THE BERM SHOULD BE A MINIMUM 1' BELOW TOP OF BERM ELEVATION.
2. FILL ELEVATIONS SHOWN ARE APPROXIMATE AND MAY BE FIELD ADJUSTED DURING CONSTRUCTION.
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4. WATTLES TO BE PLACED ON CHANNEL FILL AREAS. SEE DRAWING C27 FOR DETAILS.

COLORADO LICENSED PROFESSIONAL ENGINEER 37109 JUSTIN WAYNE ROBINSON

2-26-2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

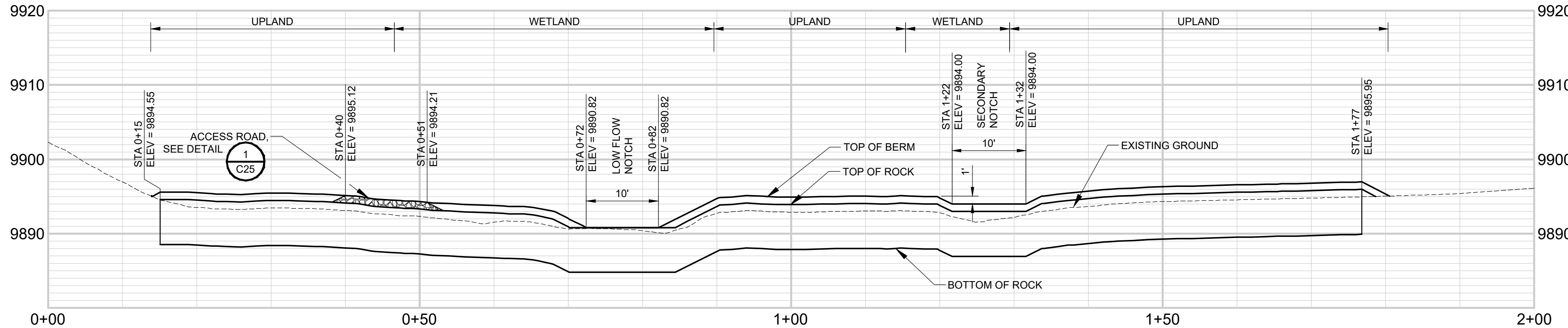
SPILLWAY PLAN 3 OF 3

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Date
Revisions

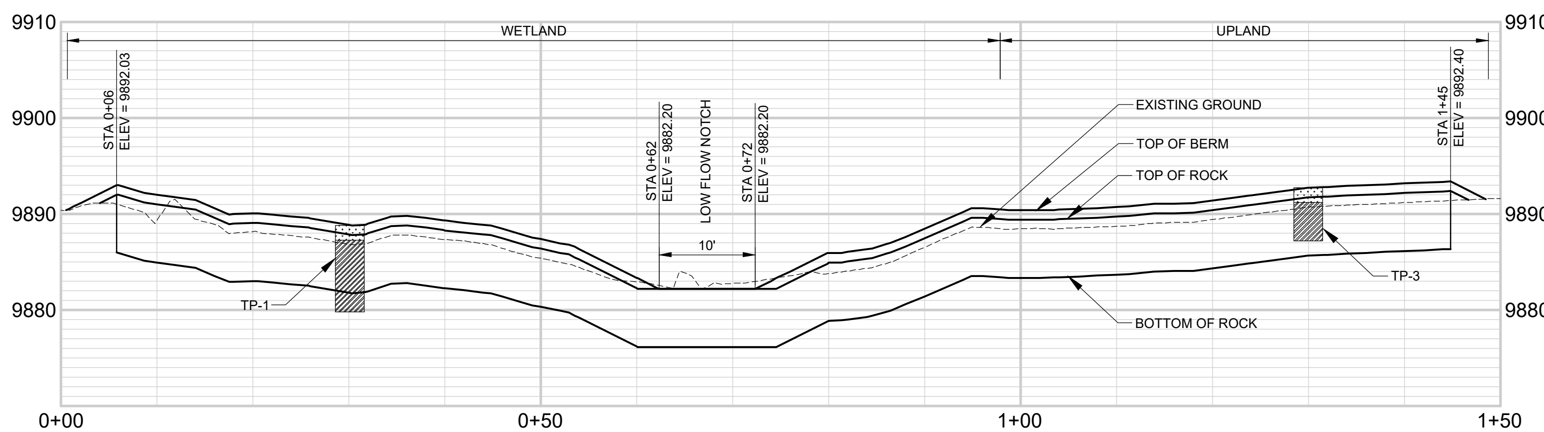
Project Mgr. CTG
Designed By: DWR
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C22



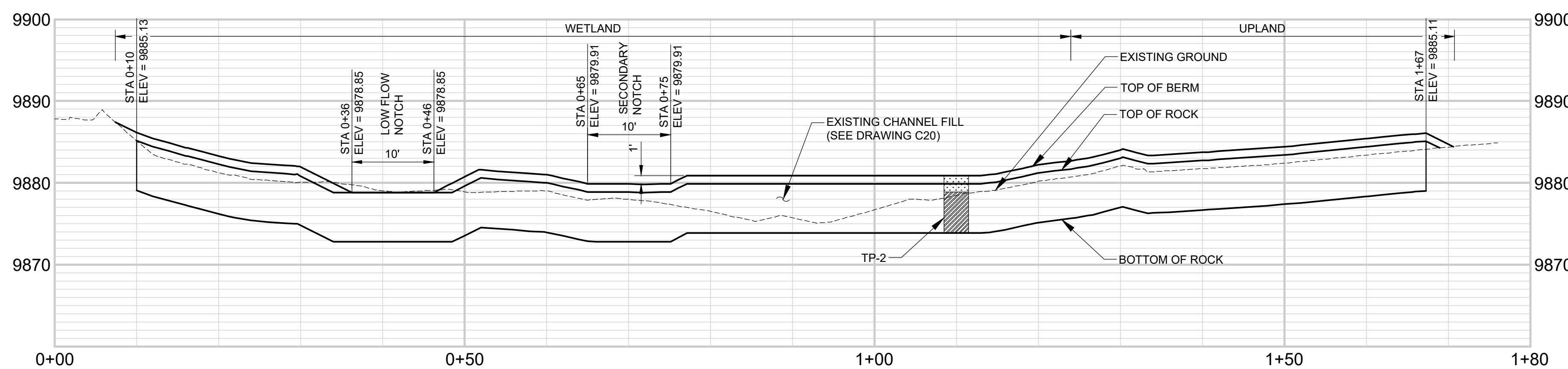
BERM 1 PROFILE

SCALE: AS SHOWN



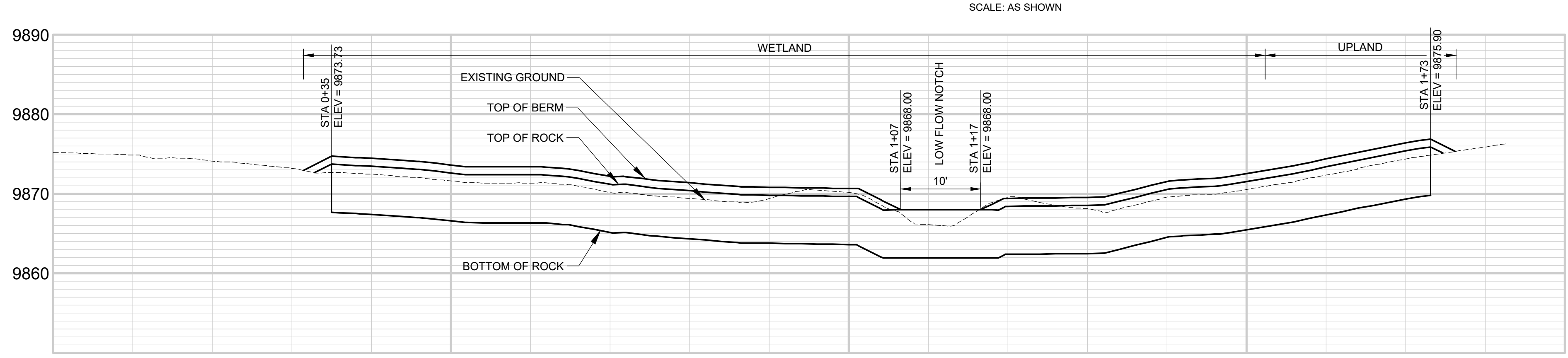
BERM 2 PROFILE

SCALE: AS SHOWN



BERM 3 PROFILE

SCALE: AS SHOWN



BERM 4 PROFILE

SCALE: AS SHOWN

0 5' 10' 20'
SCALE IN FEET

NOTES:

1. BERM PROFILES ARE LOOKING UPSTREAM.
2. TP-1, TP-2, AND TP-3 SHOW EXISTING SOIL PROFILE AT TEST PIT LOCATIONS.
3. ALL LOW FLOW NOTCH SIDE SLOPES SHALL BE 2:1.

TEST PIT LEGEND:

- CLAYEY SAND WITH GRAVEL AND ORGANICS (TOPSOIL)
- CLAYEY SAND WITH GRAVEL TO CLAYEY GRAVEL WITH SAND, SOME COBBLES, TRACE BOULDERS, BROWN, MOIST, DENSE TO VERY DENSE.

COLORADO LICENSED
AUSTIN WAYNE ROBINSON
37109
PROFESSIONAL ENGINEER
2-26-2021

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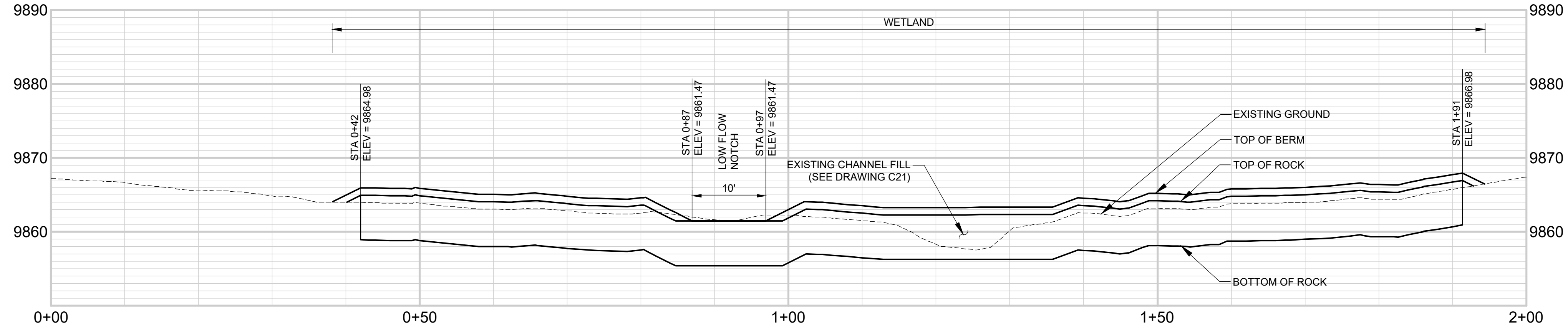
SPILLWAY ROCK BERM
PROFILES 1 OF 2

HOGCHUTE (AKA CARSON)
RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date
NOT FOR CONSTRUCTION	JAN 2021

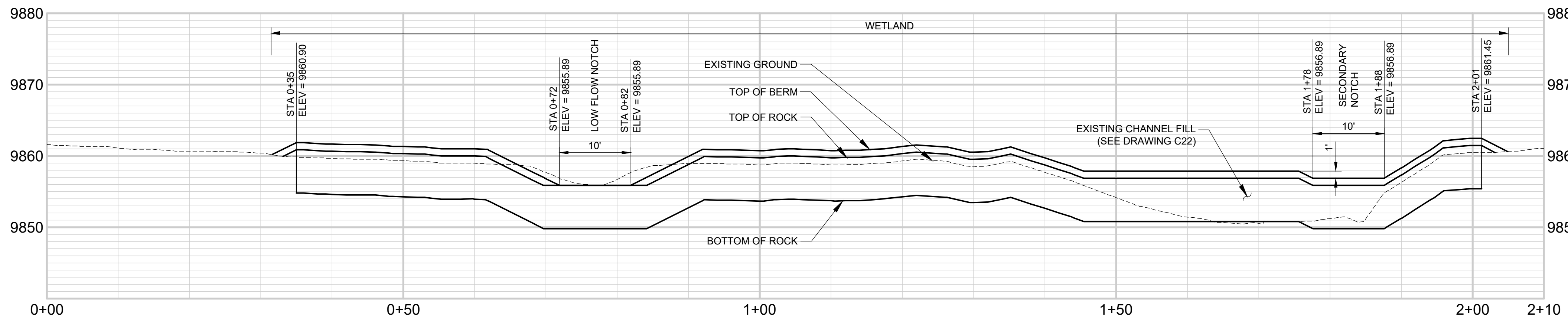
Project Mgr.: CTG
Designed By: DWR
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO.
26-1144.00
DRAWING NO.
C23
SHEET 30 OF 44



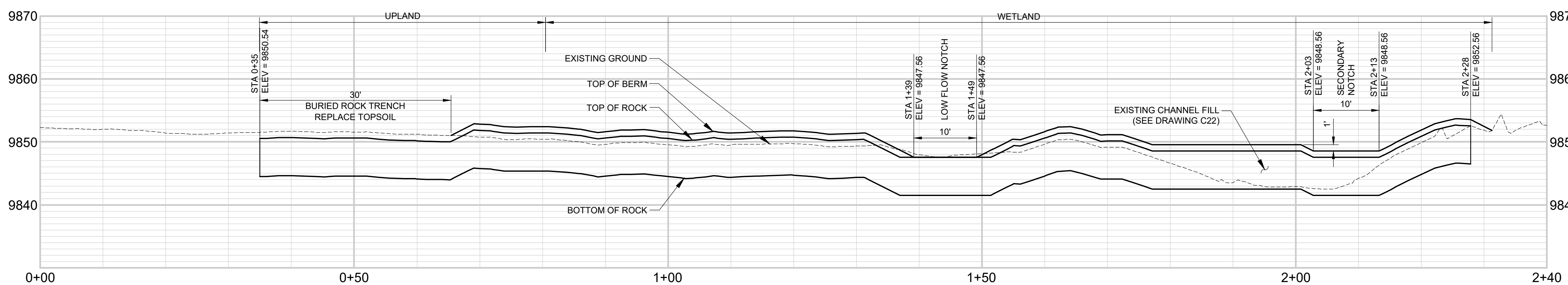
BERM 5 PROFILE

SCALE: AS SHOWN



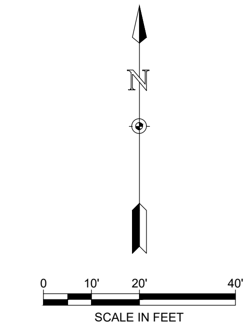
BERM 6 PROFILE

SCALE: AS SHOWN



BERM 7 PROFILE

SCALE: AS SHOWN



NOTES:

1. BERM PROFILES ARE LOOKING UPSTREAM.
2. ALL LOW FLOW NOTCH SIDE SLOPES SHALL BE 2:1.

COLORADO LICENSED PROFESSIONAL ENGINEER
JUSTIN WAYNE ROBINSON
37109

2-26-2021

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Fort Collins, CO 80525
(970) 223-5556

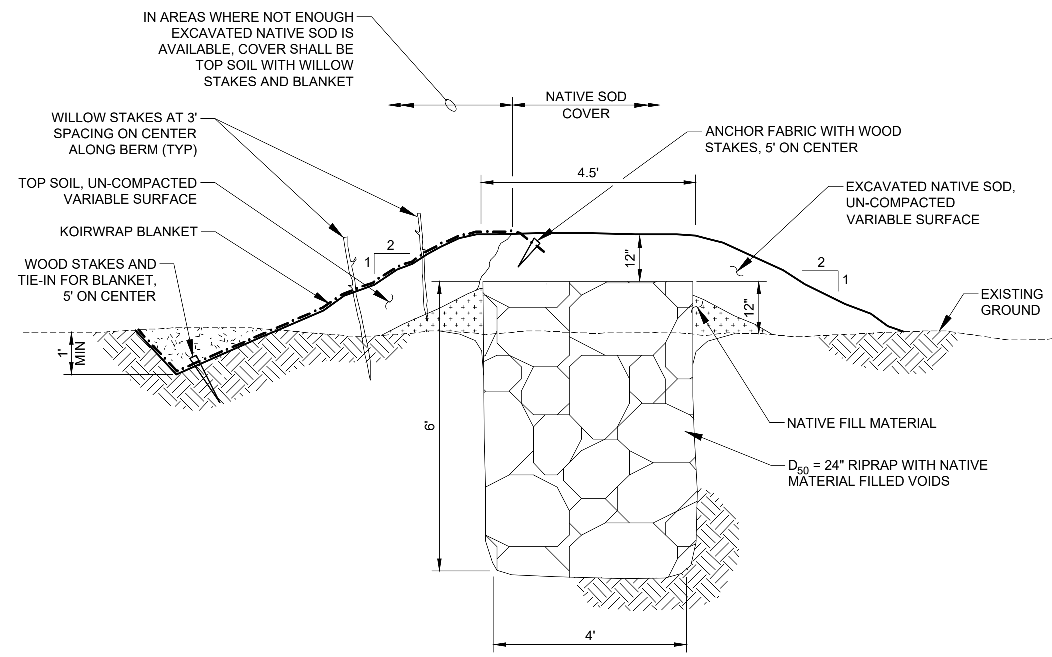
SPILLWAY ROCK BERM PROFILES 2 OF 2

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date
NOT FOR CONSTRUCTION	JAN 2021

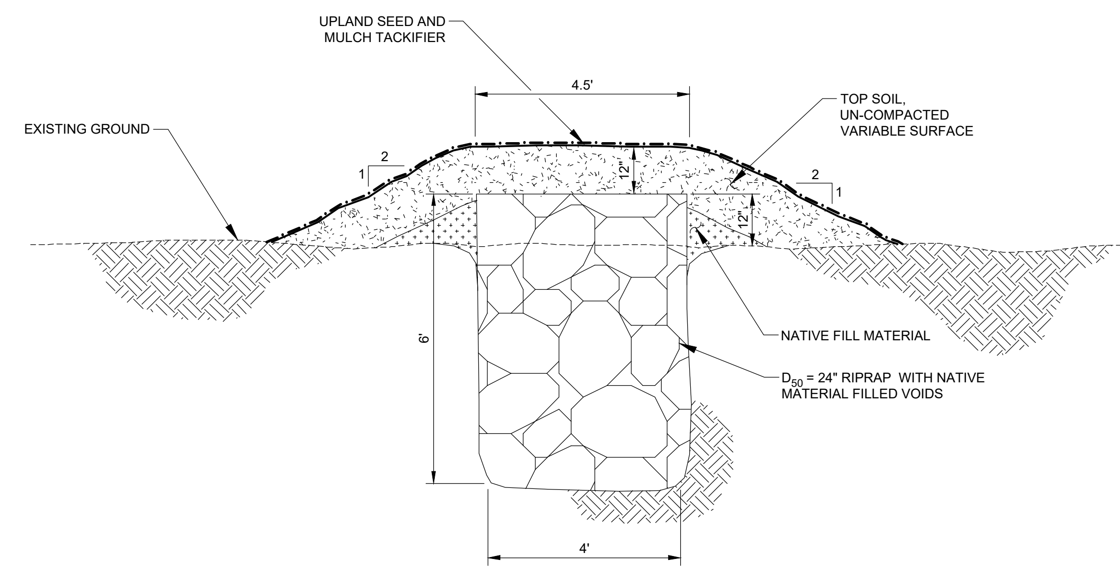
Project Mgr.: CTG
Designed By: DWR
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C24



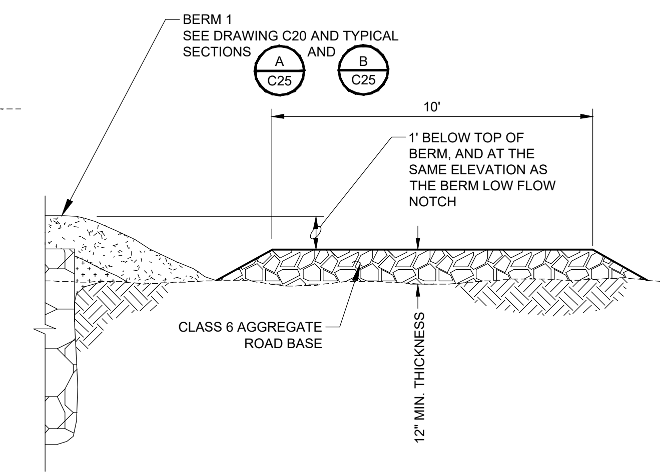
WETLAND TYPICAL BERM SECTION

A
C20,C21,C22,C25
NOT TO SCALE



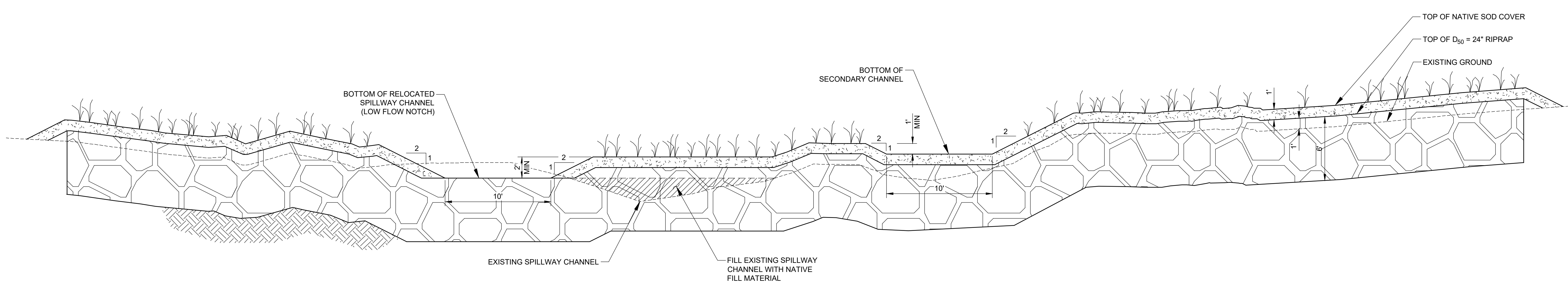
UPLAND TYPICAL BERM SECTION

B
C20,C21,C22,C25
NOT TO SCALE



ACCESS ROAD AT BERM 1 DETAIL

1
C20,C23
NOT TO SCALE



TYPICAL BERM PROFILE

C
C25
SCALE: 1"=5'

COLORADO LICENSED PROFESSIONAL ENGINEER
AUSTIN WAYNE ROBINSON
37109
2-26-2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
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Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

SPILLWAY DETAILS AND SECTIONS

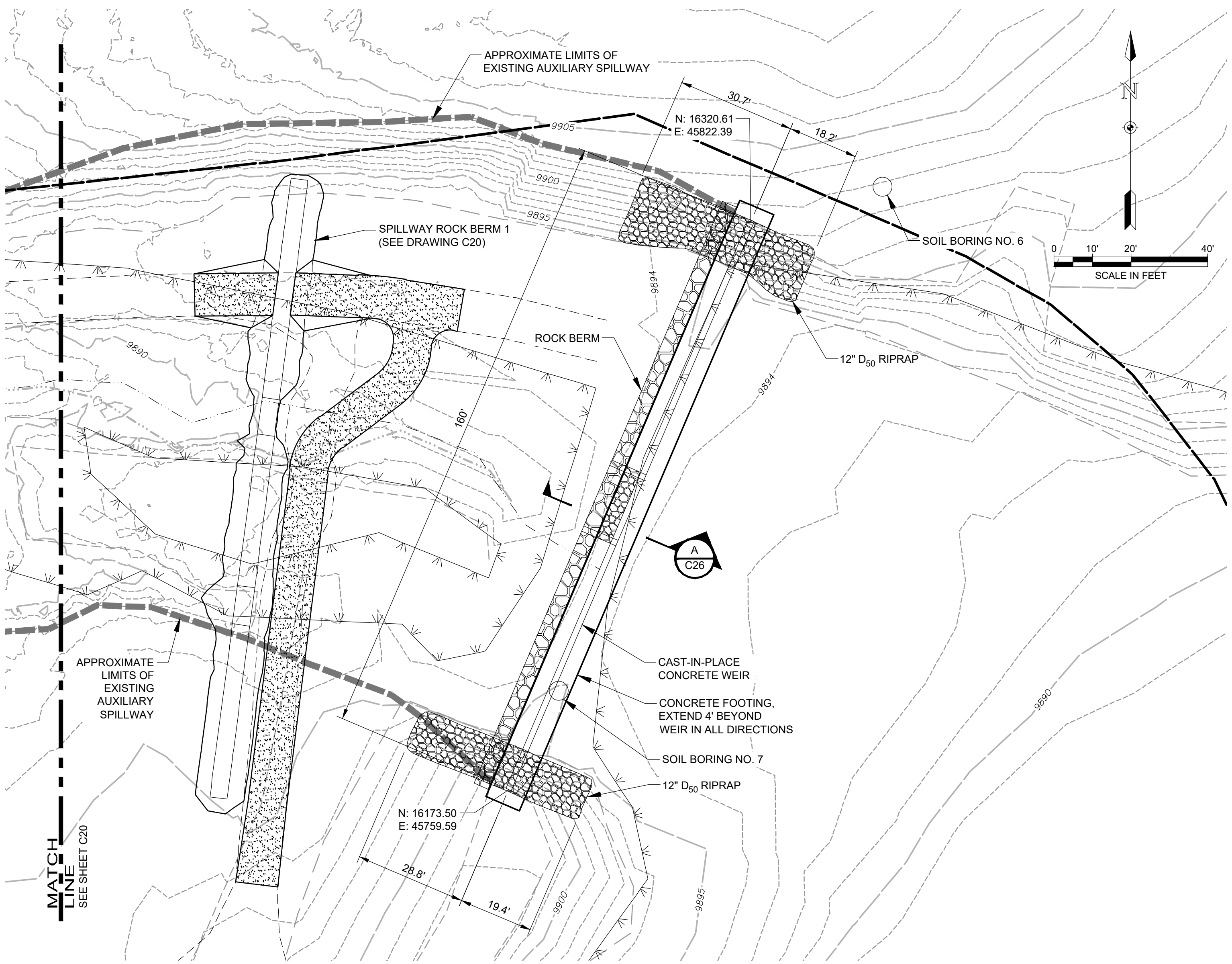
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Date
Revisions

Project Mgr.: CTG
Designed By: DWR
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C25
SHEET 32 OF 44

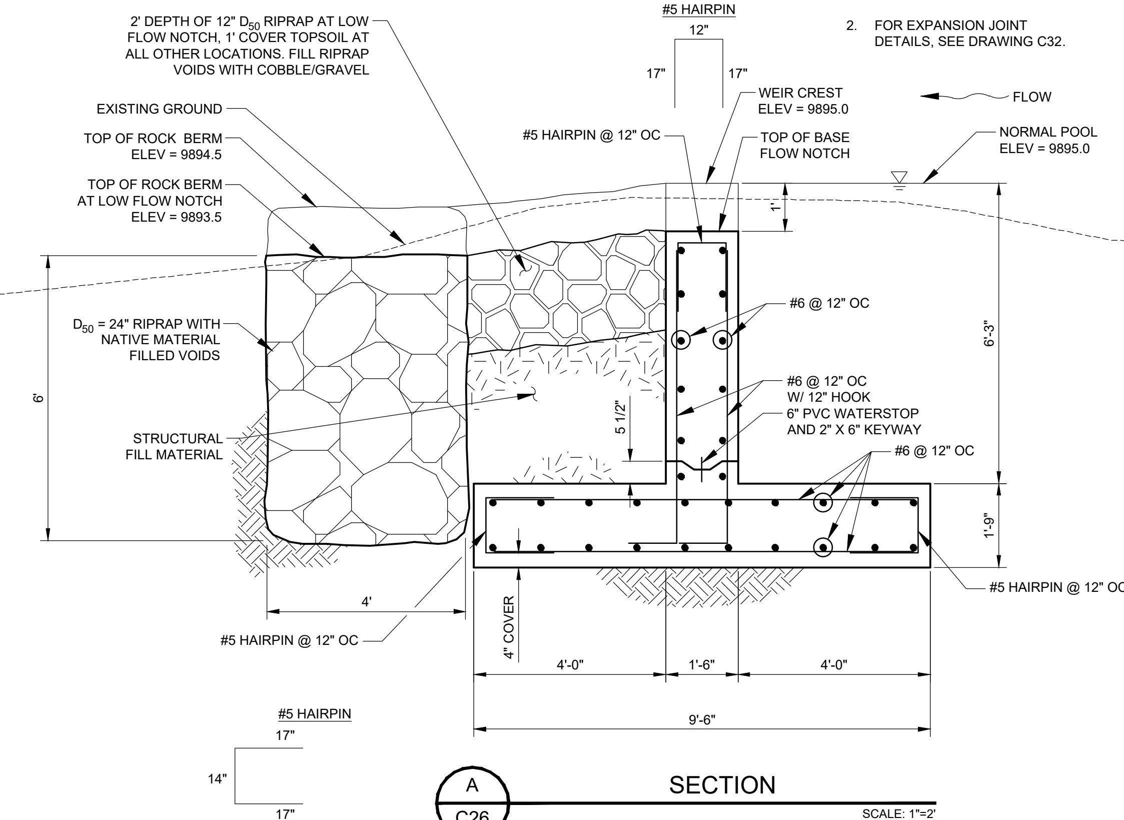
Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 SPILLWAY DETAILS AND SECTIONS.DWG Thursday, May 20, 2021 1:42 PM By: RIEDER, AUSTIN



OVERFLOW WEIR PLAN

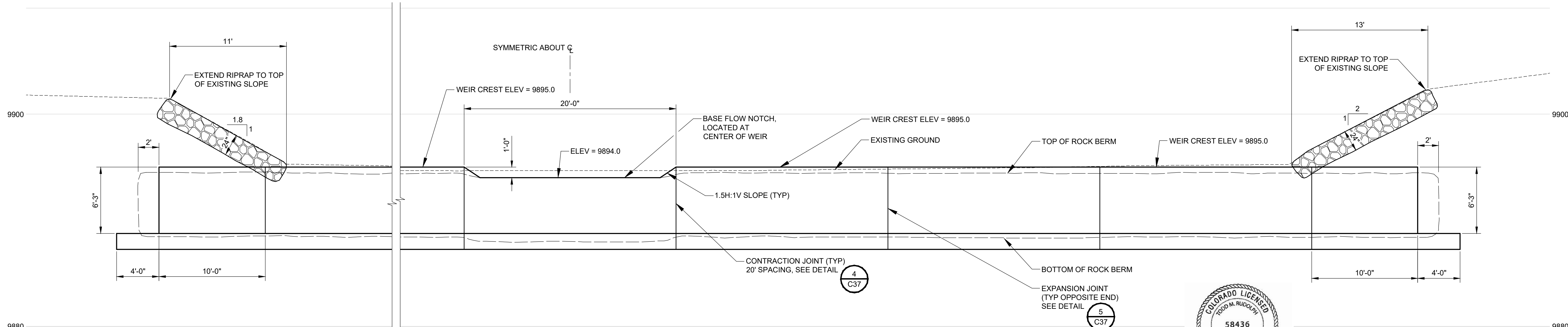
SCALE: AS SHOWN

NOTES:
1. 3" COVER UNLESS NOTED
2. FOR EXPANSION JOINT DETAILS, SEE DRAWING C32.



A C26 SECTION

SCALE: 1"=2'



FRONT ELEVATION

SCALE: 1"=5'

COLORADO LICENSED PROFESSIONAL ENGINEER TODD M. RUDOLPH 58436

5/20/2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

AMRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

SPILLWAY OVERFLOW WIER PLAN AND DETAILS

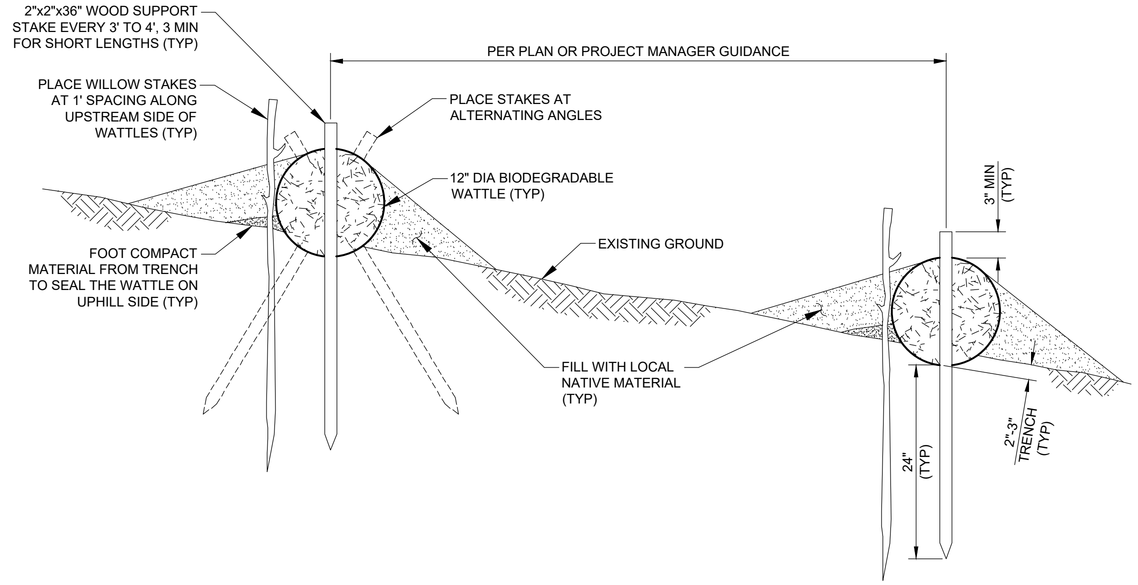
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Date | Revisions

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C26
SHEET 33 OF 44

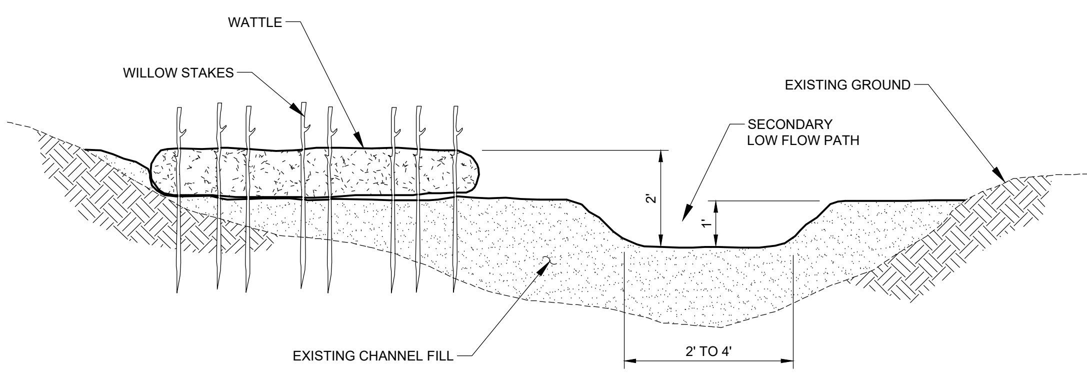
Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 SPILLWAY OVERFLOW WEIR PLAN AND DETAILS.DWG Thursday, May 20, 2021 1:44 PM By: RIEDER, AUSTIN



1
C27
WATTLE DETAIL
NOT TO SCALE

NOTES:

1. WATTLES MAY ALSO BE CALLED FIBER ROLLS, SEDIMENT LOGS, OR EROSION LOGS.
2. PLACE WATTLES WORKING DOWNWARD FROM THE HIGHEST POINT.
3. INSTALL WATTLE IN A SHALLOW TRENCH AS SHOWN IN THE DETAIL. FOOT COMPACT EXCAVATED MATERIAL ON THE UPHILL SIDE OF WATTLE. WHEN JOINING ENDS OF WATTLES, FIT THE ENDS TIGHTLY TOGETHER OR OVERLAP THEM. STAKE WATTLES ON EACH END AND EVERY 3' TO 4' FEET ON CENTER.
4. USE WEED-FREE BIODEGRADABLE MATERIALS WITH A FUNCTIONAL LIFE OF AT LEAST 2 YEARS. THE DENSITY OF THE MATERIAL SHALL BE IN THE RANGE OF 2.7 TO 4.5 LBS PER CUBIC FOOT.
5. INSPECT THE WATTLES AFTER ANY STORMS (DURING CONSTRUCTION) THAT PRODUCE RUNOFF AT THE SITE. REPAIR DAMAGED WATTLES, RESTORE SEAL ON THE UPHILL SIDES, REPLACE STAKES, AND ADD MORE STAKES IF NEEDED.

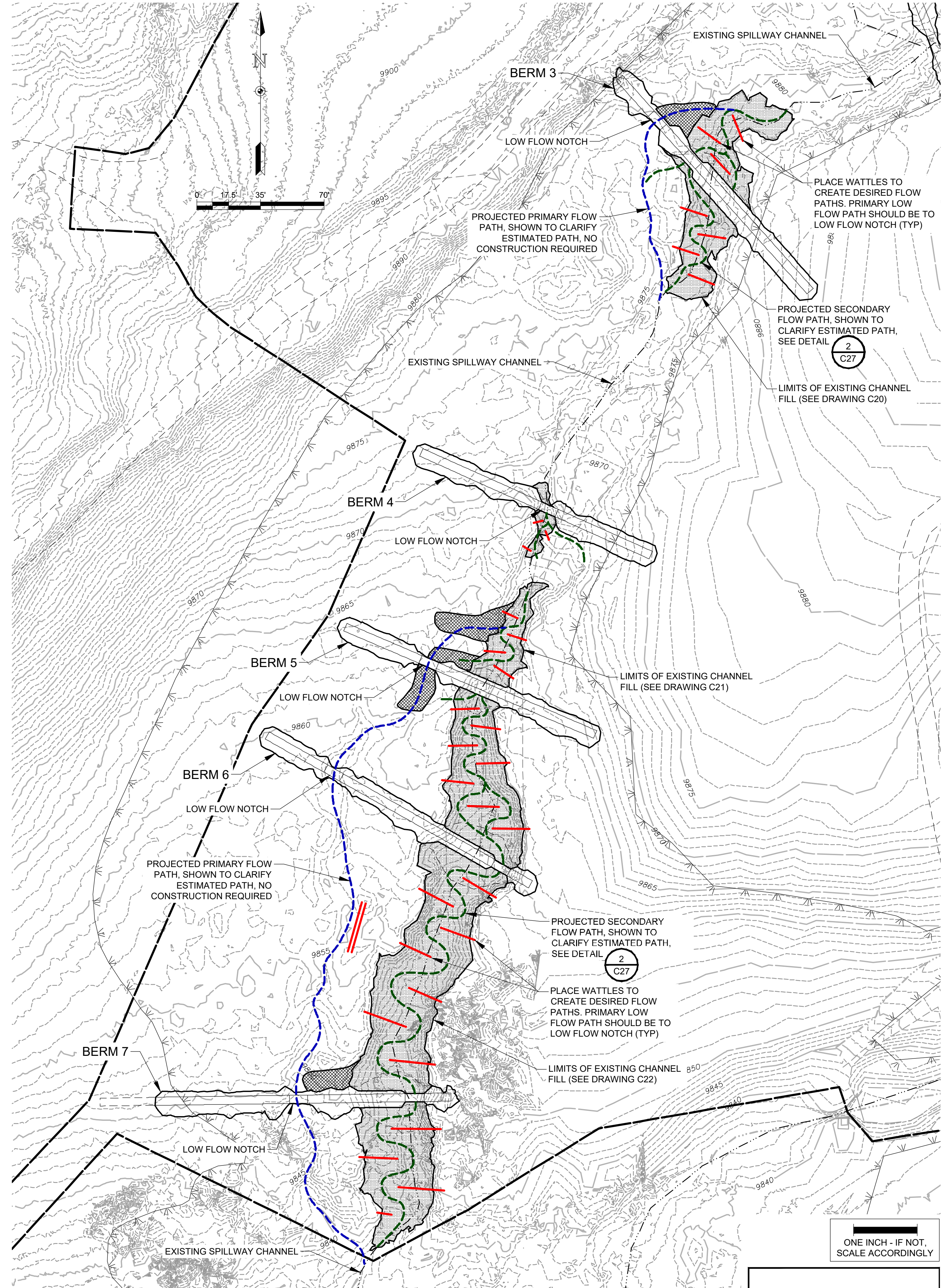


2
C27
WATTLE, SECONDARY FLOW LOW PATH DETAIL
NOT TO SCALE

LEGEND:

WATTLE
PRIMARY FLOW PATH
SECONDARY FLOW PATH
EXISTING SPILLWAY CHANNEL

COLORADO LICENSED
JUSTIN WAYNE ROBINSON
37109
PROFESSIONAL ENGINEER
2-26-2021



ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
3665 JFK Parkway
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Fort Collins, CO 80525
(970) 223-5556

SPILLWAY PRIMARY AND SECONDARY CHANNEL PLAN AND WATTLE DETAIL

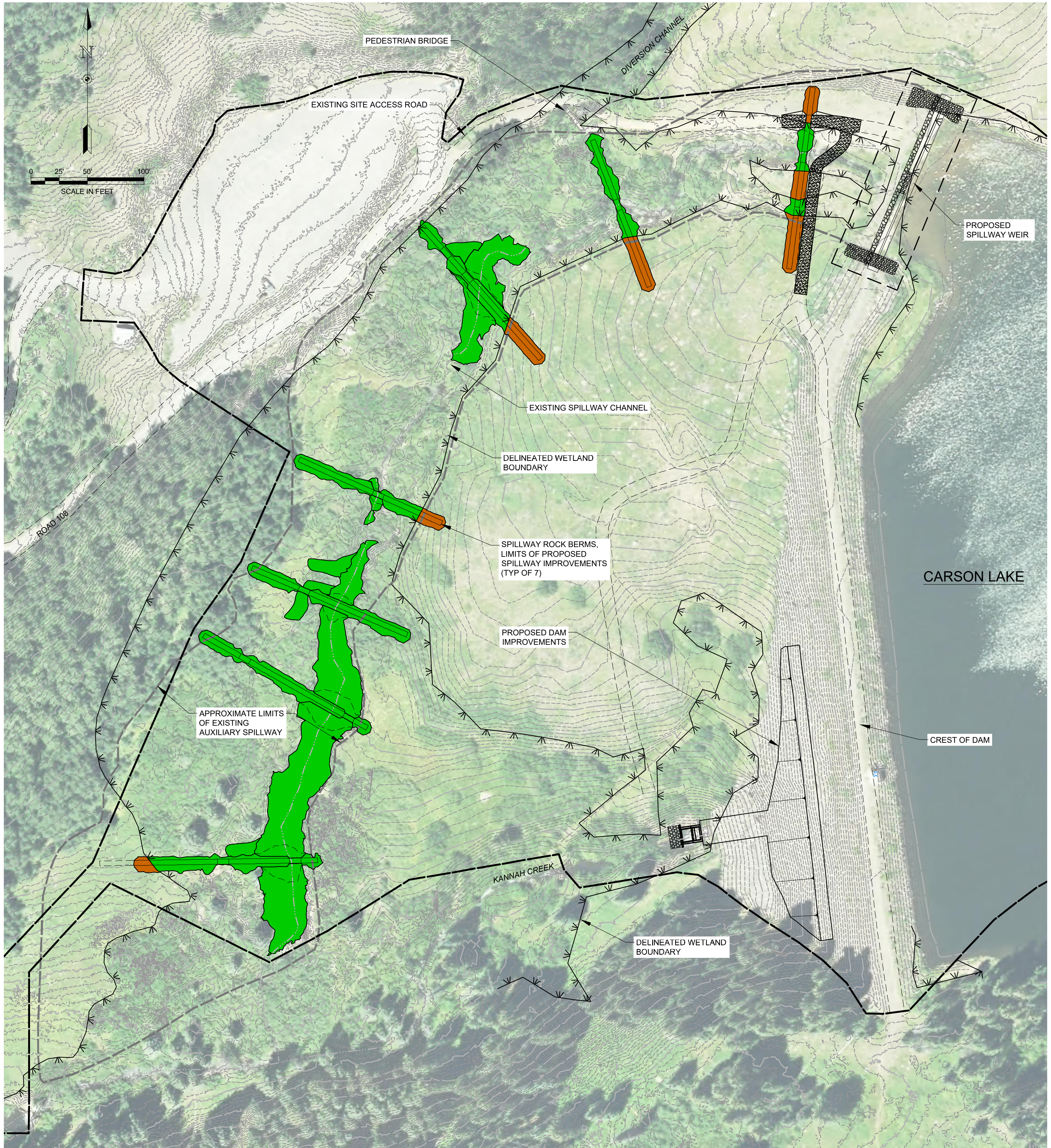
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr. CTG
Designed By: DWR
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C27
SHEET 34 OF 44

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 SPILLWAY WATTLE PLAN AND DETAIL.DWG Friday, February 26, 2021 6:49 PM By: RIEDER, AUSTIN



REVEGETATION NOTES:

1. TOPSOIL WILL BE SALVAGED AND REUSED IN ALL AREAS.
2. WETLAND AREA TOPSOIL WILL BE REMOVED AS A SOD LAYER AND STORED AND WATERED ONSITE. WETLAND SOD WILL BE PLACED ON TOP OF BERMS WITHIN THE WETLAND ZONE FOLLOWING CONSTRUCTION. EXISTING WILLOWS CAN BE TRIMMED AND INCLUDED IN SOD OR EXCAVATED WITH ROOT MASS, STORED AND WATERED, AND REPLANTED ALONG BERM.
3. WETLAND LOCATIONS THAT ARE NOT ABLE TO BE COVERED IN HARVESTED WETLAND SOD WILL BE SEEDED AND PLANTED WITH WILLOW CUTTINGS.
4. THE DEPTH OF TOPSOIL SALVAGE IS APPROXIMATELY 6 INCHES, BUT MAY VARY DEPENDING ON ACTUAL SITE CONDITIONS. TOPSOIL GENERALLY INCLUDES THE UPPER PART OF THE SOIL PROFILE WITH THE FOLLOWING CHARACTERISTICS (NRCS 1993, 1999; HECKMAN 2003).
   A. WHERE PLANTS HAVE MOST OF THEIR ROOTS
   B. WHERE THE SOIL IS DARKENED FROM THE PRESENCE OF ORGANIC MATTER
   C. WHERE THERE IS A COMBINATION OF PARTICLE SIZES WITH GENERALLY NO MORE THAN APPROXIMATELY 10 PERCENT GRAVEL, 65 PERCENT SAND, 60 PERCENT SILT, OR 20 PERCENT CLAY.
5. ALL FINISH GRADES TO BE SEEDED/PLANTED WILL BE LOOSE AND ROUGH WITH SUBSTANTIAL "MICROTOPOGRAPHY" (PLUS OR MINUS 4 INCHES). STRAIGHT EDGES AND RIGHT ANGLES ARE TO BE AVOIDED. SOIL WILL BE LOOSENED TO A DEPTH OF 12 INCHES BEFORE PLANTING OR SEEDING.
6. ALL AREAS DISTURBED BY THE PROJECT WILL RECEIVE 4 INCHES OF TOPSOIL. ANY DISTURBED AREAS OUTSIDE THE PROJECT LIMITS SHALL BE REPLACED AT THE CONTRACTORS EXPENSE.
7. LIVE CUTTINGS SHOULD BE HARVESTED FROM SITES WITHIN 1,000 VERTICAL FEET OF THE PROJECT SITE ELEVATION. CUTTINGS SHALL BE 3-4 FEET IN LENGTH.
8. LIVE CUTTINGS WILL BE HARVESTED WHEN DORMANT (BEFORE LEAVES EMERGE OR AFTER THEY ARE DROPPED) FROM LIVE PLANTS 0.5 TO 1.0 INCH IN DIAMETER. THE STEM WILL BE STRIPPED OF ALL BRANCHES BEFORE CUTTING AND THEN TRIMMED TO THE DESIRED LENGTH. THE LOWER (ROOTING) END OF THE STEM WILL BE CUT AT A 45-DEGREE ANGLE AND THE UPPER END WILL BE CUT AT A 90-DEGREE ANGLE. THE LOWER END OF THE CUTTINGS WILL BE PLACED INTO COLD WATER (<50-DEGREES F) WITHIN ONE MINUTE OF CUTTING AND THEN TRANSFERRED TO A STORAGE VESSEL WITHIN 1 HOUR WHERE THEY WILL REMAIN COMPLETELY SUBMERGED FOR AT LEAST 72 HOURS, BUT NOT MORE THAN 14 DAYS, PRIOR TO PLANTING. DURING PLANTING, THE CUTTINGS WILL BE KEPT WET UNTIL PLACED INTO THE GROUND AND WILL NOT BE ALLOWED OUT OF WATER FOR MORE THAN 10 MINUTES.
9. CUTTINGS SHALL BE INSTALLED SO THAT 2/3 OF THE CUTTING ARE BELOW GRADE.
10. NO EQUIPMENT SHALL BE ALLOWED IN THE RESTORATION AREA AFTER THE SOIL IS LOOSENED.
11. ALL BLANKETED AREAS WILL BE LOOSENED, SEEDED, AND MULCHED ACCORDING TO THE REVEGETATION PLAN PRIOR TO BLANKET OR MULCH INSTALLATION.
12. SEEDING WILL ONLY BE PERFORMED BETWEEN SEPTEMBER 1 AND WHEN THE GROUND FREEZES, OR WITHIN 30 DAYS AFTER GROUND THAWS.
13. SEEDED AREAS WILL BE HYDRO MULCHED TO ACHIEVE APPROXIMATELY 80 PERCENT GROUND COVER.
14. WETLAND SEED MIX SHALL BE MONTANE WET MEADOW MIX BY WESTERN NATIVE SEED (COALDALE, CO, 719-942-3935, westernnativeseed.com), OR APPROVED EQUAL.
15. UPLAND SEED MIXTURE SHALL BE HIGH ALTITUDE NATIVE GRASS MIX BY BEAUTY BEYOND BELIEF WILDFLOWER SEED (BOULDER, COLORADO, 303.530.1222, www.bbbseed.com), OR APPROVED EQUAL.
16. WILLOW CUTTINGS SHALL BE INSTALLED WHEN LOCAL WILLOWS ARE DORMANT. CONTAINER STOCK MAY BE SUBSTITUTED FOR CUTTINGS. WILLOWS WILL BE COMPOSED OF THE FOLLOWING SPECIES, WITH EACH SPECIES EVENLY DISTRIBUTED THROUGHOUT THE PLANTING AREAS:
   - SANDBAR WILLOW (SALIX EXIGUA) - 60%
   - BEBB WILLOW (SALIX BEBBIANA) - 20%
   - DRUMMOND WILLOW (SALIX DRUMMONDIANA) - 20%

LEGEND:

- WETLAND PLANTING
- UPLAND PLANTING

COLORADO LICENSED PROFESSIONAL ENGINEER 37109

2-26-2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
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SPILLWAY PLANTING PLAN

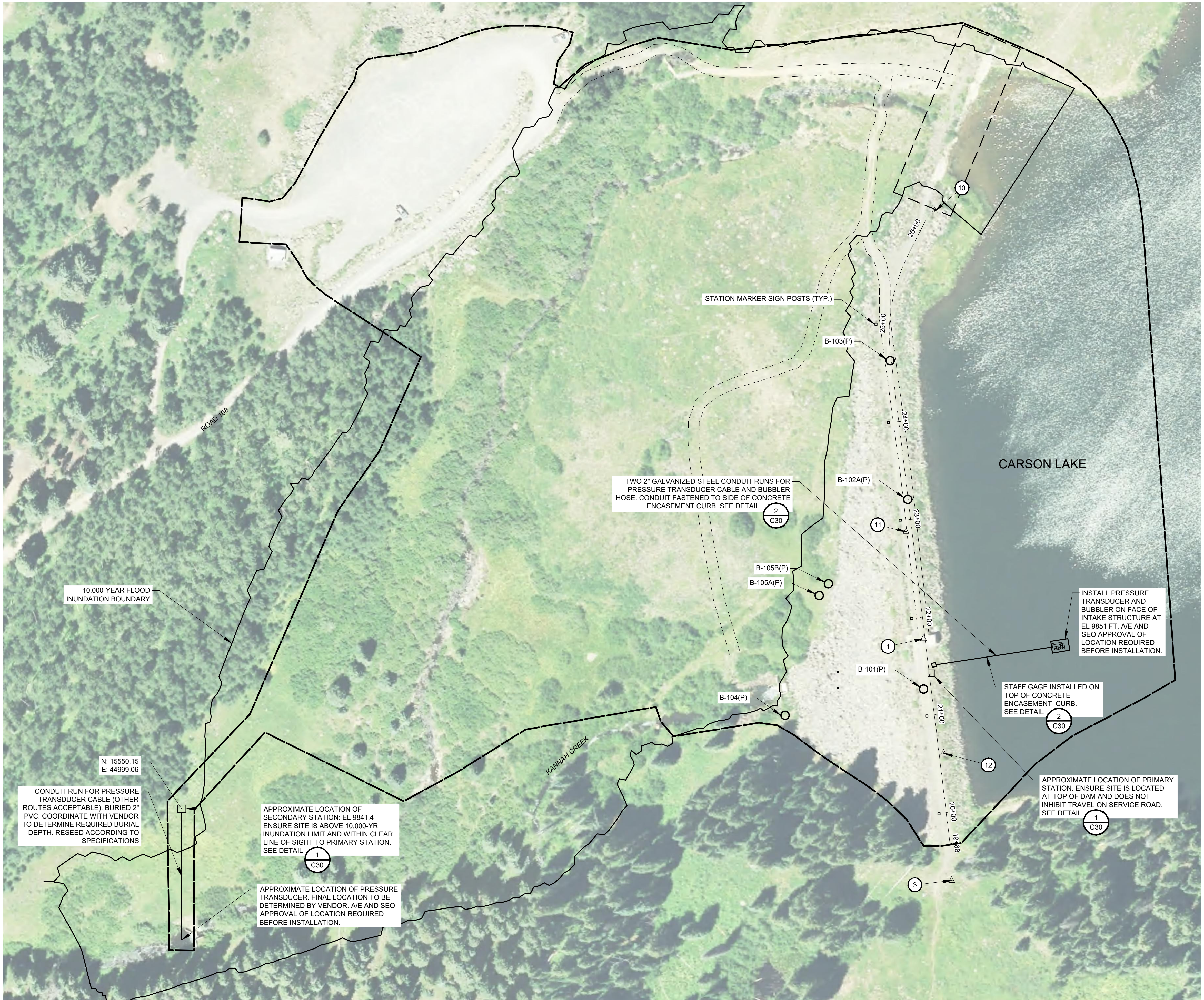
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Date	Revisions

Project Mgr. CTG
Designed By: DWR
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C28

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 SPILLWAY PLANTING PLAN.DWG Friday, February 26, 2021 6:49 PM By: RIEDER, AUSTIN



N

0 25' 50' 100'
SCALE IN FEET

NOTES:

COORDINATE WITH EARLY WARNING SYSTEM VENDOR TO CONFIRM LOCATION AND DESIGN OF REQUIRED APPURTENANCES.

PRIMARY STATION COMPONENTS:
1) BULLET-RESISTANCE ENCLOSURE
2) BUBBLER WATER LEVEL SENSOR
3) PRESSURE TRANSDUCER
4) TIPPING BUCKET
5) DATA LOGGER
6) SOLAR PANEL
7) BATTERY (2)
8) REGULATOR
9) INTRUSION SENSOR

SECONDARY STATION COMPONENTS:
1) BULLET-RESISTANCE ENCLOSURE
2) PRESSURE TRANSDUCER
3) DATA LOGGER WITH SPREAD-SPECTRUM WIRELESS CONNECTION TO PRIMARY STATION
4) SOLAR PANEL
5) BATTERY (2)
6) REGULATOR
7) INTRUSION SENSOR

LEGEND:

EXISTING PIEZOMETERS

SURVEY MONUMENTS

1

PROTECT AND AVOID DISTURBING EXISTING PIEZOMETERS AND SURVEY MONUMENTS. IF EITHER MUST BE DISTURBED, NOTIFY A/E.

COLORADO LICENSED TODD M. RUDOLPH 58436 PROFESSIONAL ENGINEER

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

DAM INSTRUMENTATION

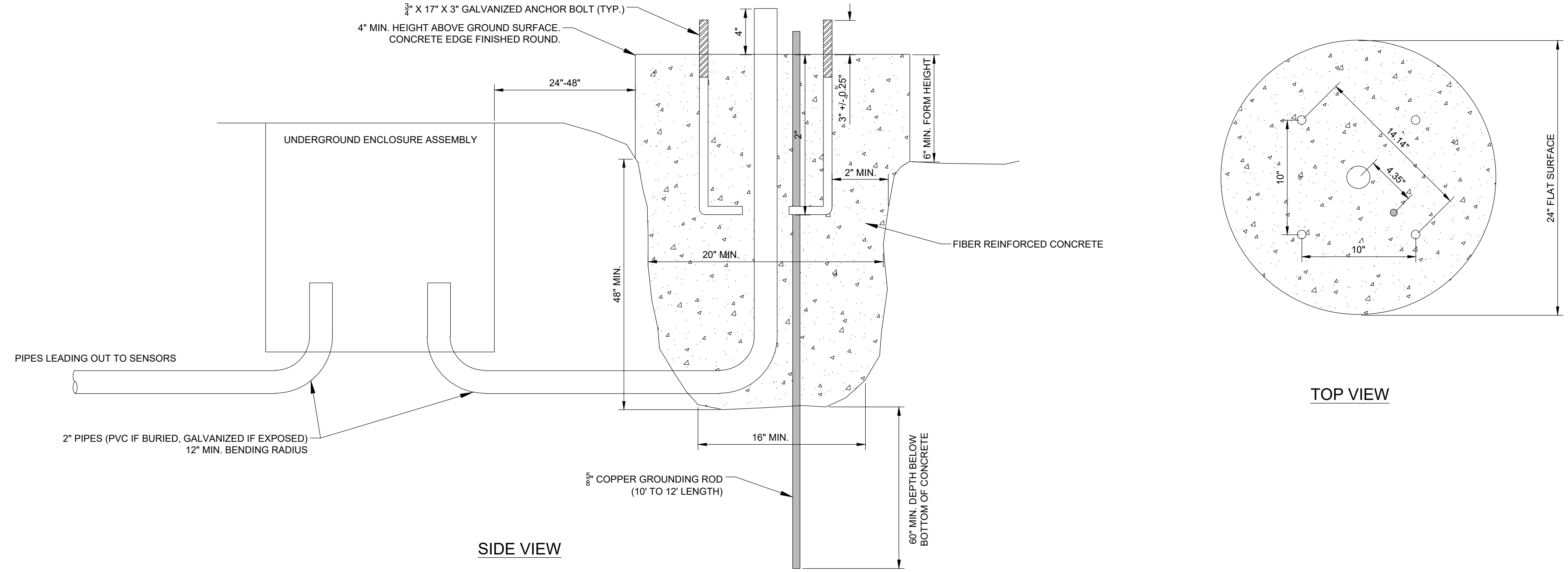
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Date	Revisions

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C29
SHEET 36 OF 44

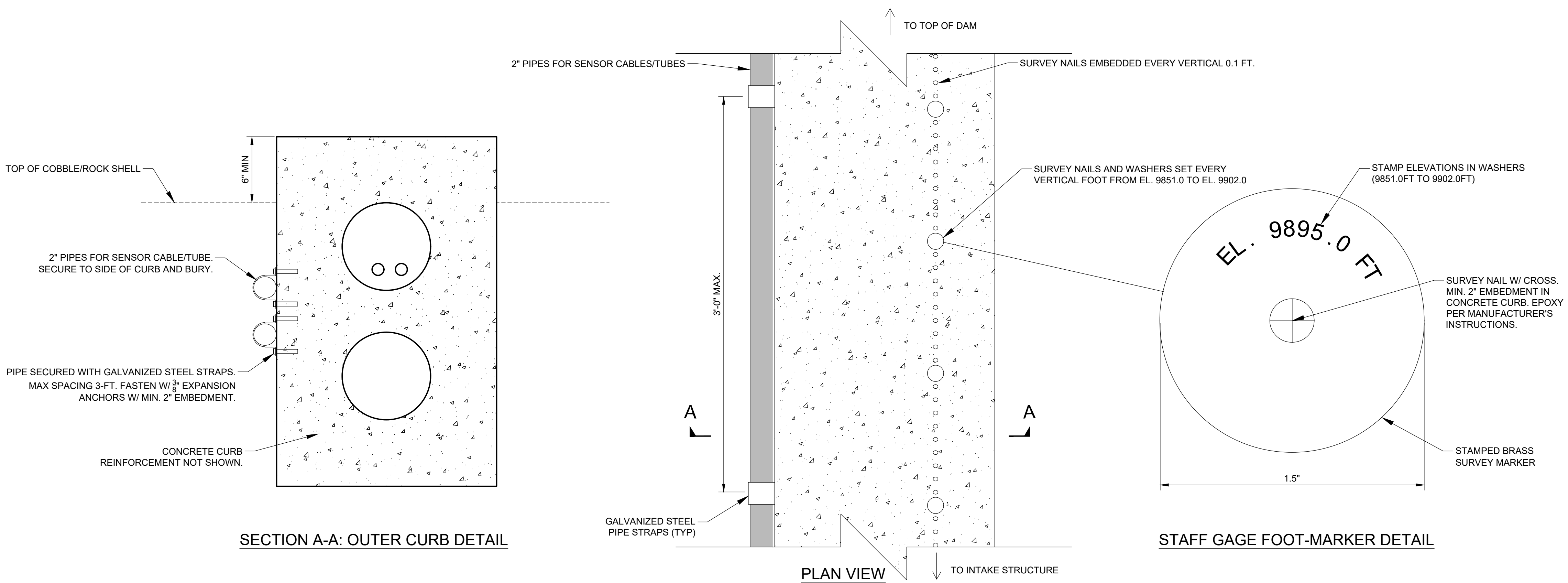
Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 DAM INSTRUMENTATION.DWG Friday, May 14, 2021 3:23 PM By: RIEDER, AUSTIN



INSTRUMENTATION FOUNDATION PRIMARY & SECONDARY STATIONS DETAIL

1 / C29

NOT TO SCALE



STAFF GAGE & PIPE RUN DETAIL

2 / C29

NOT TO SCALE

COLORADO LICENSED PROFESSIONAL ENGINEER TODD M. RUDOLPH 58436 5/14/2021

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INSTRUMENTATION DETAILS

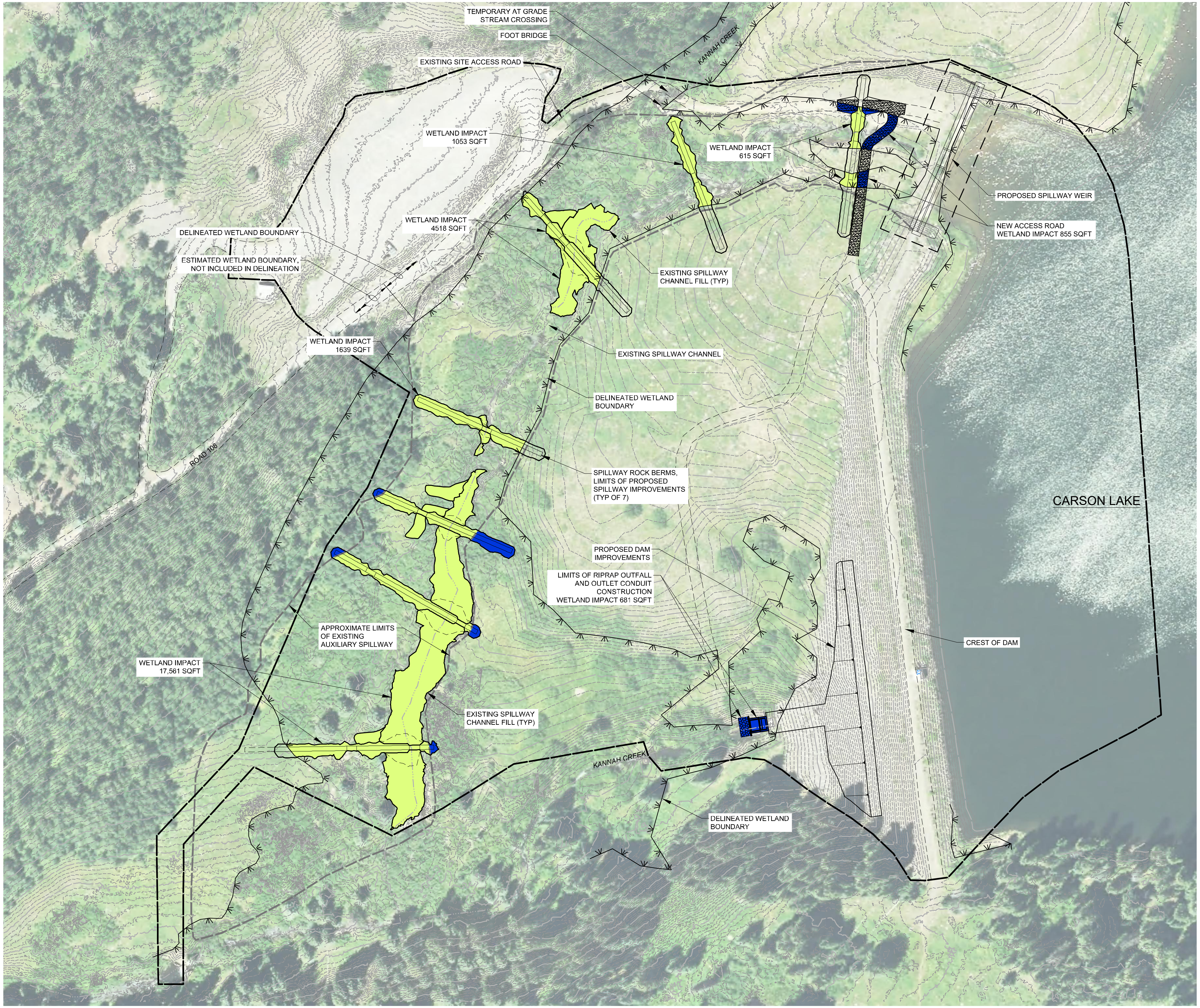
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr.: CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C30
SHEET 37 OF 44

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 DAM INSTRUMENTATION.DWG Friday, May 14, 2021 3:23 PM By: RIEDER, AUSTIN



N

0 25' 50' 100'

SCALE IN FEET

NOTES:

1. THE TOTAL ESTIMATED WETLAND IMPACT OF THE SPILLWAY CHANNEL CONSTRUCTION AND THE OUTFALL RIPRAP BASIN IS 26,922 SQFT (0.62 ACRES).
   - 24,582 SQFT (0.56 ACRES) ARE TEMPORARY IMPACTS
   - 2,339 SQFT (0.05 ACRES) ARE CONSIDERED PERMANENT IMPACTS
   - THEREFORE, COMPENSATORY WETLAND MITIGATION IS NOT REQUIRED.

LEGEND:

- LIMITS OF WETLAND BOUNDARY
- APPROXIMATE LIMITS OF EXISTING AUXILIARY SPILLWAY
- TEMPORARY WETLAND IMPACT
- PERMANENT WETLAND IMPACT

COLORADO LICENSED TODD M. RUDOLPH 58436 PROFESSIONAL ENGINEER

2/20/2021

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WETLAND IMPACT

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Date	Revisions

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

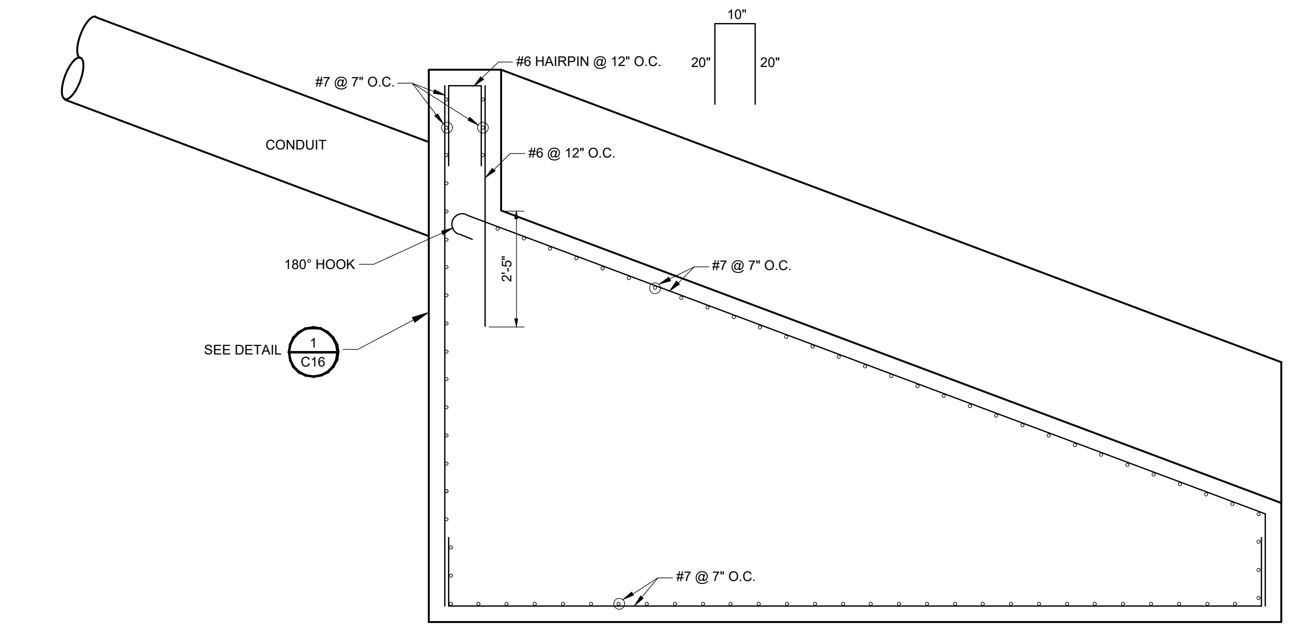
PROJECT NO. 26-1144.00

DRAWING NO. C31

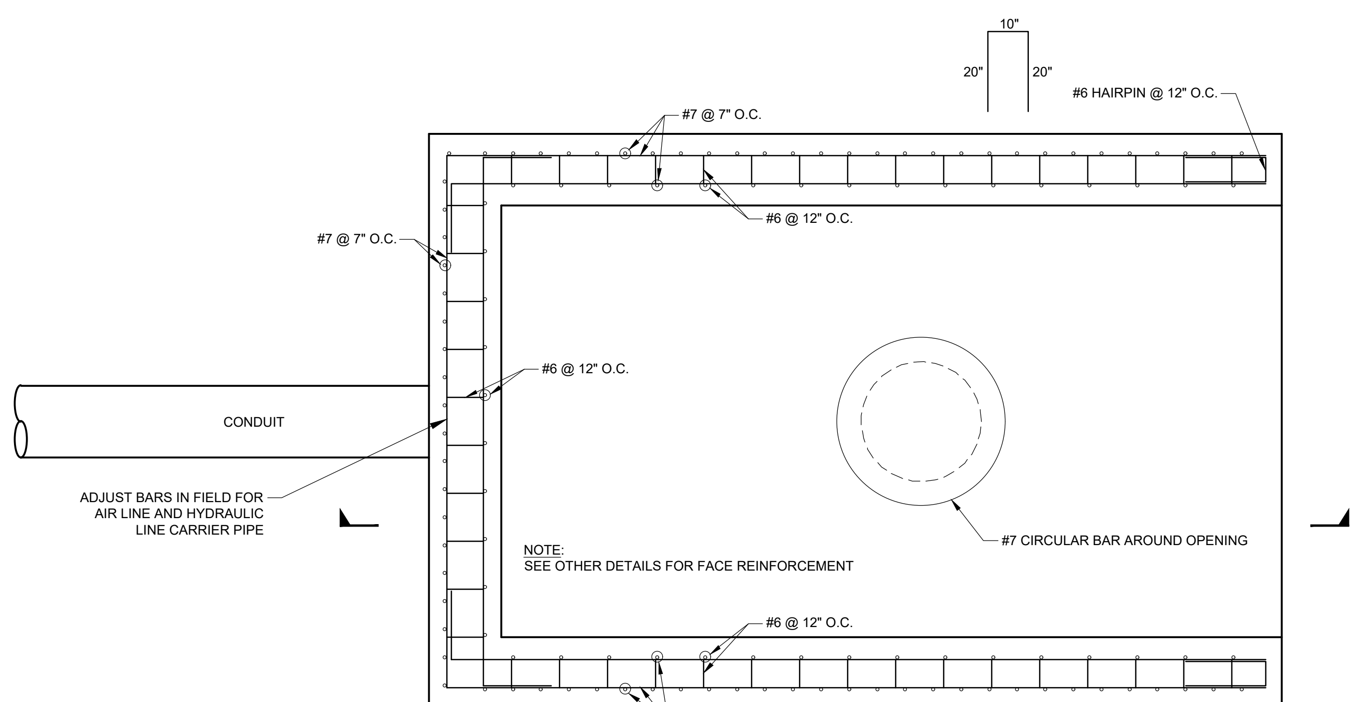
Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 WETLAND IMPACT.DWG Tuesday, June 01, 2021 4:15 PM By: RIEDER, AUSTIN

NOTES:

1. 4" COVER UNLESS NOTES.
2. ¾" CHAMFER ALL EXPOSED CONCRETE EDGES (TYP).



SECTION



PLAN

1 / C32 — CONCRETE BUTTRESS DETAIL

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

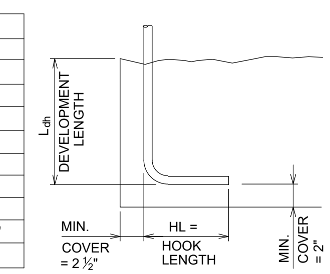
MINIMUM DEVELOPMENT AND SPLICE LENGTHS				
f'_c = 4500 psi clear spacing ≥ $2d_b$ & clear cover ≥ d_b				
Bar Size Grade 60	Minimum Straight Tension Development Length, l_d		Minimum Lap Splice For Center To Center Bar Spacing	
	TOP BARS	OTHER BARS	TOP BARS	OTHER BARS
#3	1'-6"	1'-2"	1'-11"	1'-6"
#4	2'-0"	1'-6"	2'-7"	2'-0"
#5	2'-6"	1'-11"	3'-2"	2'-6"
#6	2'-11"	2'-3"	3'-10"	2'-11"
#7	4'-3"	3'-4"	5'-7"	4'-3"
#8	4'-11"	3'-9"	6'-4"	4'-11"
#9	5'-6"	4'-3"	7'-2"	5'-6"
#10	6'-2"	4'-9"	8'-0"	6'-2"
#11	6'-10"	5'-4"	8'-11"	6'-10"

NOTES:

1. TOP BARS ARE HORIZONTAL BARS SO PLACED THAT MORE THAN 12" OF CONCRETE IS CAST IN THE MEMBER BELOW THE BAR.
2. EXCEPT AS OTHERWISE INDICATED ON THE DRAWINGS, LAP SPLICE LENGTH AND TENSION DEVELOPMENT l_d SHALL BE NO LESS THAN (NO MINUS TOLERANCE) SHOWN ABOVE.
3. LAP SPLICES SHALL NOT BE MADE AT POINTS OF MAXIMUM STRESS AS DETERMINED BY THE ENGINEER.
4. WHERE BARS OF DIFFERENT SIZE ARE LAP SPLICED, SPLICE LENGTH SHALL BE THE SPLICE LENGTH OF THE LARGER BAR.
5. ALL SPLICES SHALL BE CONTACT SPLICES AND WIRED TOGETHER.
6. APPLIES TO ALL REINFORCING SHOWN ON ALL SHEETS.

MINIMUM DEVELOPMENT & SPLICE LENGTH FOR REBARS

BAR SIZE GRADE 60	f'_c = 4500 psi	
	L_{dh}	HL
#3	6"	6"
#4	7"	8"
#5	8"	10"
#6	10"	1'-0"
#7	11"	1'-2"
#8	1'-1"	1'-4"
#9	1'-3"	1'-8"
#10	1'-4"	1'-10"
#11	1'-6"	2'-0"



COMPLYING WITH MINIMUM COVER REQUIREMENTS OF ACI 318, OTHERWISE L_{dh} MUST BE RE-CALCULATED. APPLIES TO ALL REINFORCING SHOWN ON ALL SHEETS.

TYPICAL 90 DEGREE HOOK FOR REBAR

COLORADO LICENSED PROFESSIONAL ENGINEER TODD M. RUDOLPH 58436

ONE INCH - IF NOT, SCALE ACCORDINGLY

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(970) 223-5556

CONCRETE BUTTRESS REINFORCEMENT

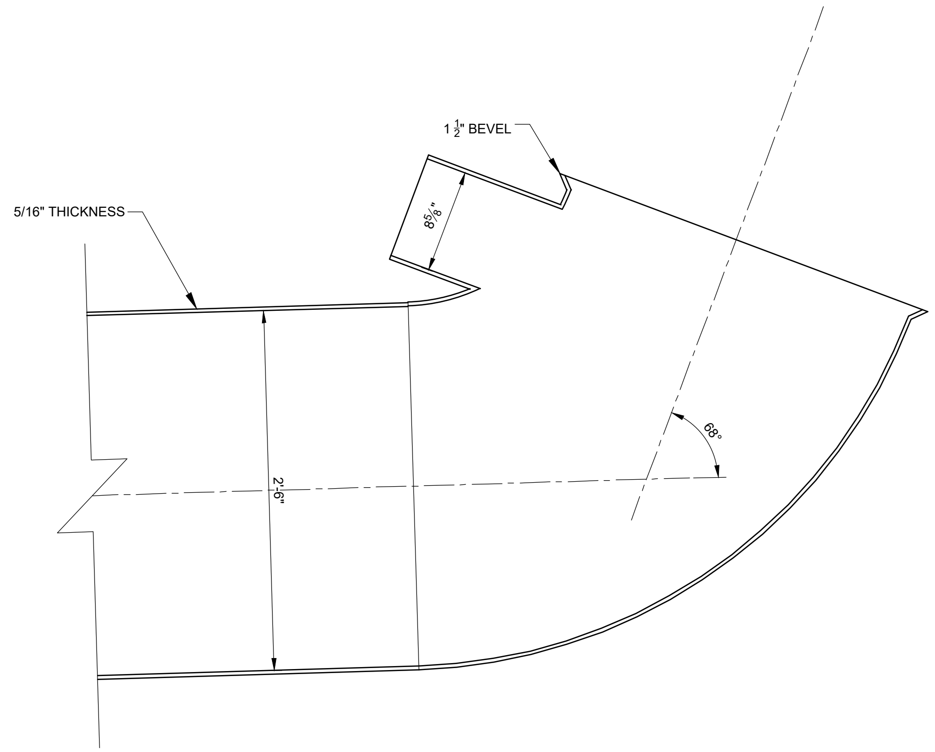
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

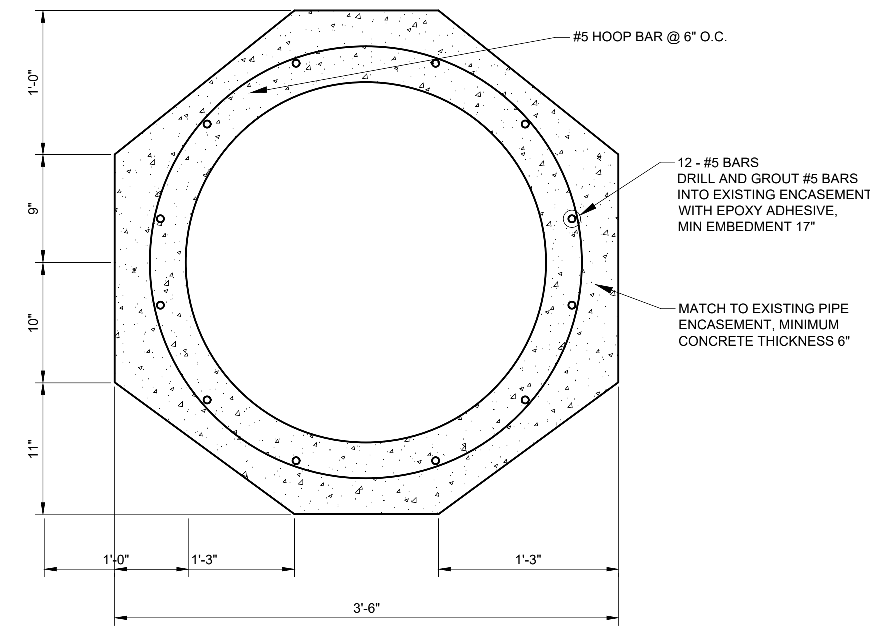
Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C32
SHEET 39 OF 44

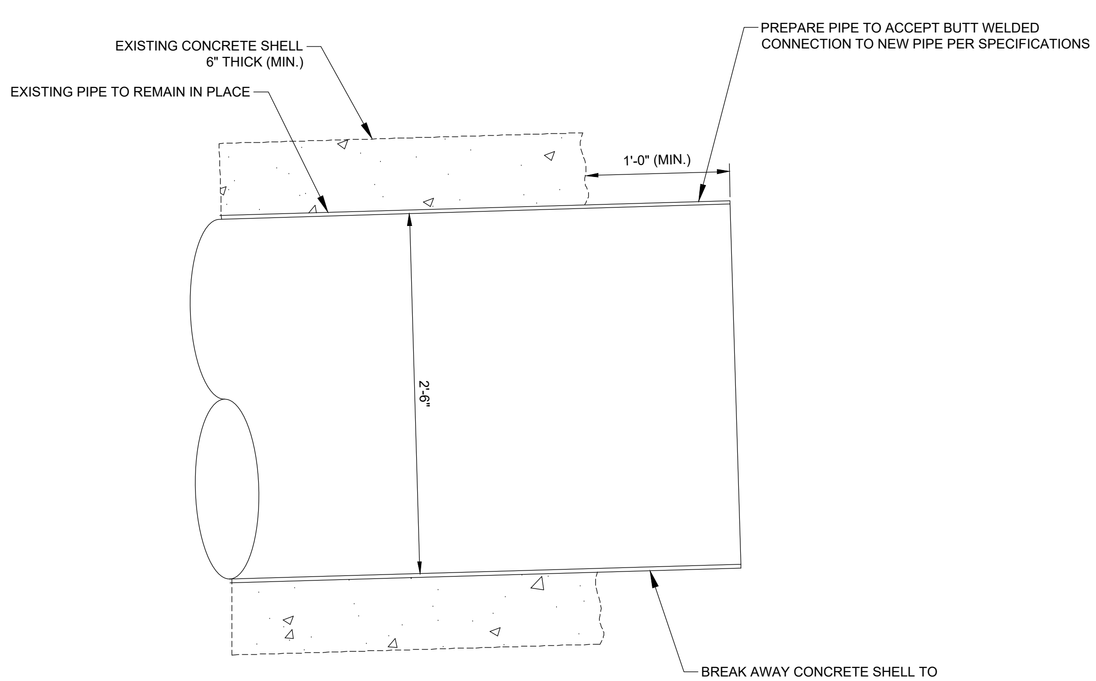
Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 IMPACT BASIN DETAILS.DWG Thursday, June 03, 2021 9:08 AM By: RIEDER, AUSTIN



1 STEEL ELBOW DETAIL
C16
SCALE: 1"=1'-0"



3 STEEL PIPE ENCASEMENT DETAIL
C33
SCALE: 1"=1'-0"



2 STEEL PIPE CONNECTION DETAIL
C33
SCALE: 1"=1'-0"

COLORADO LICENSED
TODD M. RUDOLPH
58436
PROFESSIONAL ENGINEER
2/20/2021

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STEEL PIPE DETAILS

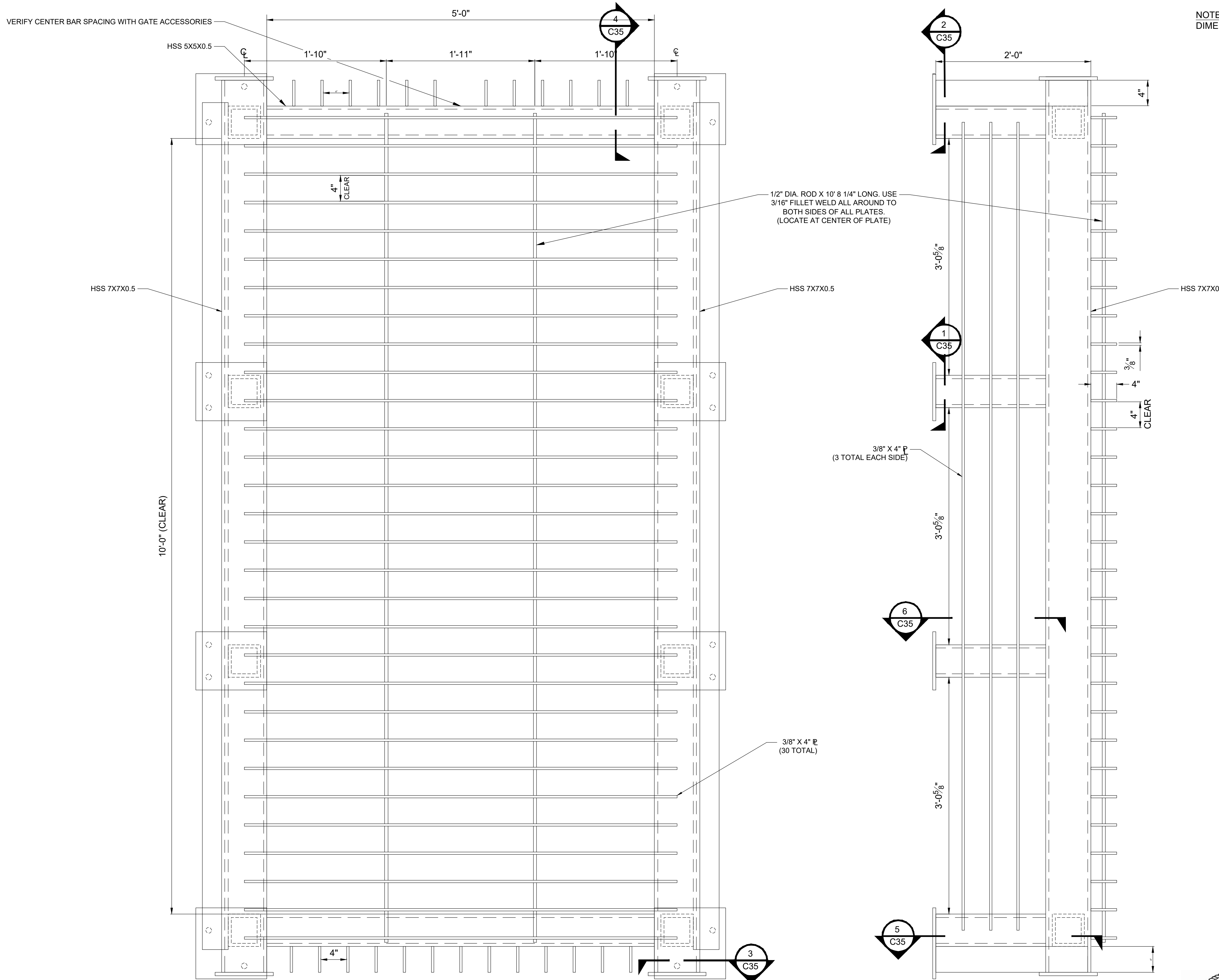
HOGCHUTE (AKA CARSON)
RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Date	Revisions

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C33

NOTE: VERIFY ALL FRAME DIMENSIONS WITH GATE DIMENSIONS DURING SHOP DRAWING PREPARATION.



1 / C16 SLIDE GATE TRASH RACK

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

COLORADO LICENSED TODD M. RUDOLPH 58436 PROFESSIONAL ENGINEER

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
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(970) 223-5556

TRASH RACK DETAILS

HOGCHUTE (AKA CARSON)
RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

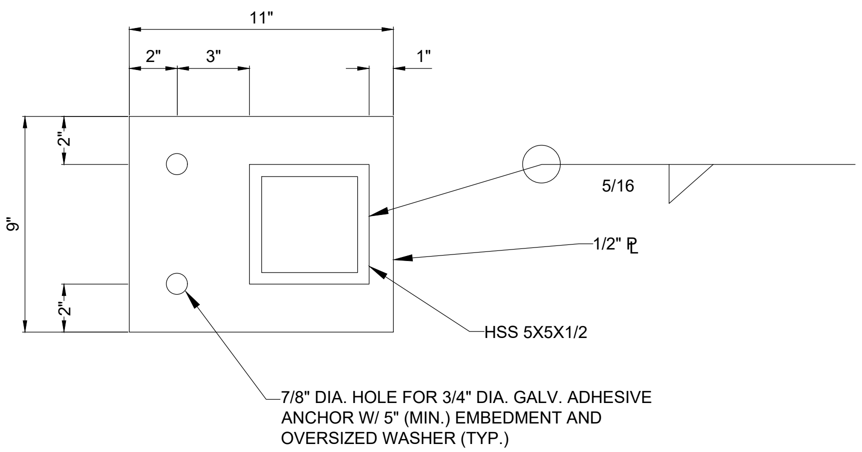
PROJECT NO. 26-1144.00

DRAWING NO. C34

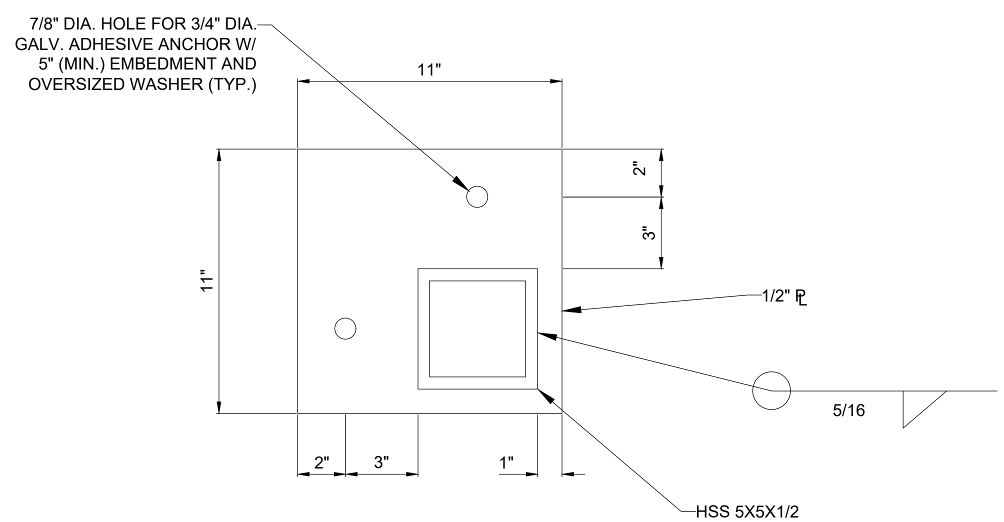
SHEET 41 OF 44

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 IMPACT BASIN DETAILS.DWG Thursday, June 03, 2021 9:08 AM By: RIEDER, AUSTIN

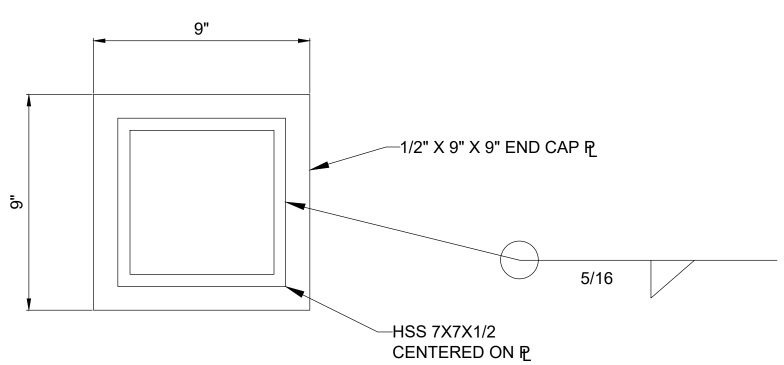
NOTE: VERIFY ALL FRAME DIMENSIONS WITH GATE DIMENSIONS DURING SHOP DRAWING PREPARATION.



1 C34 SECTION N.T.S.



2 C34 SECTION N.T.S.



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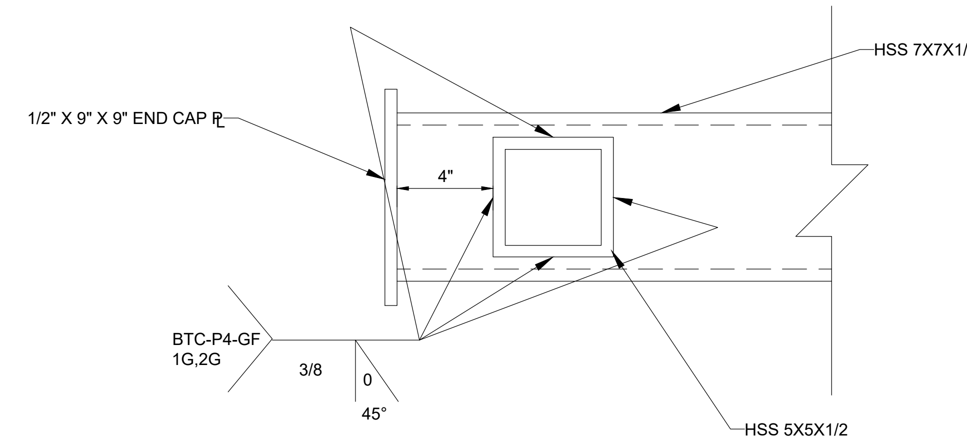
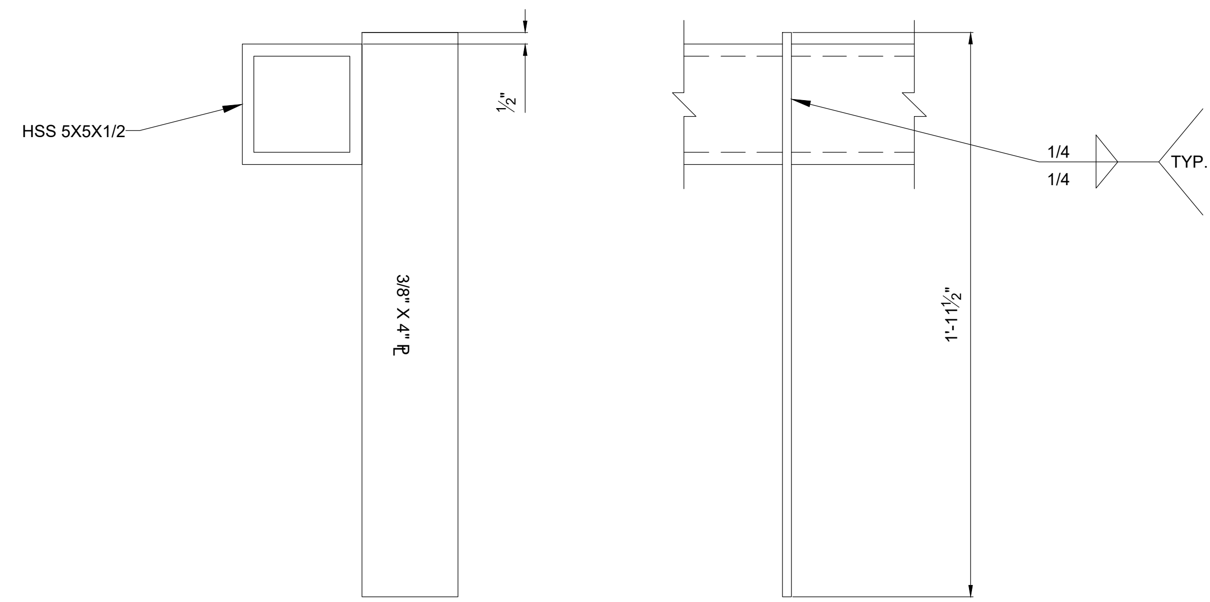
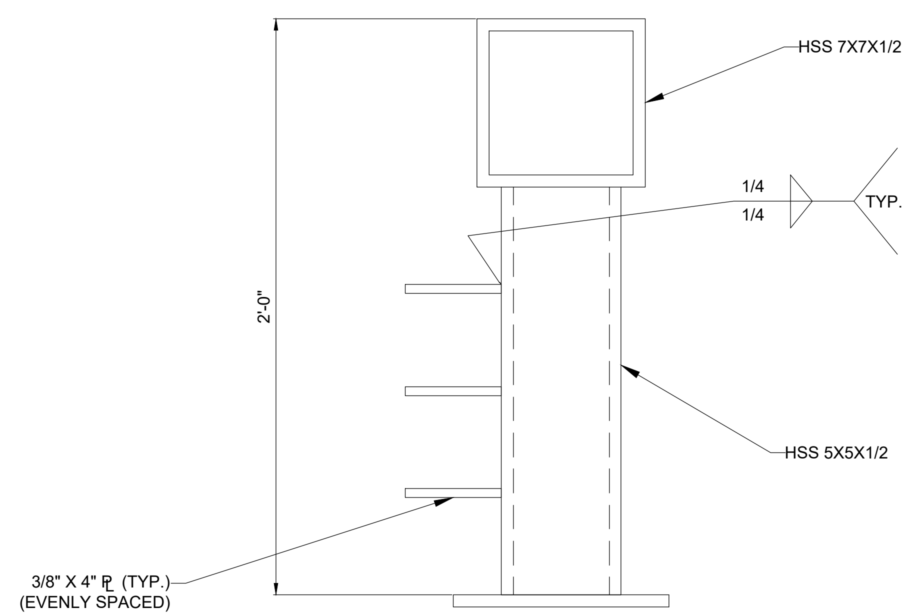


4 C34 SECTION N.T.S.



5 C34 SECTION N.T.S.



6 C34 SECTION N.T.S.

ONE INCH - IF NOT, SCALE ACCORDINGLY

AYRES
3665 JFK Parkway
Building 2, Suite 100
Fort Collins, CO 80525
(970) 223-5556

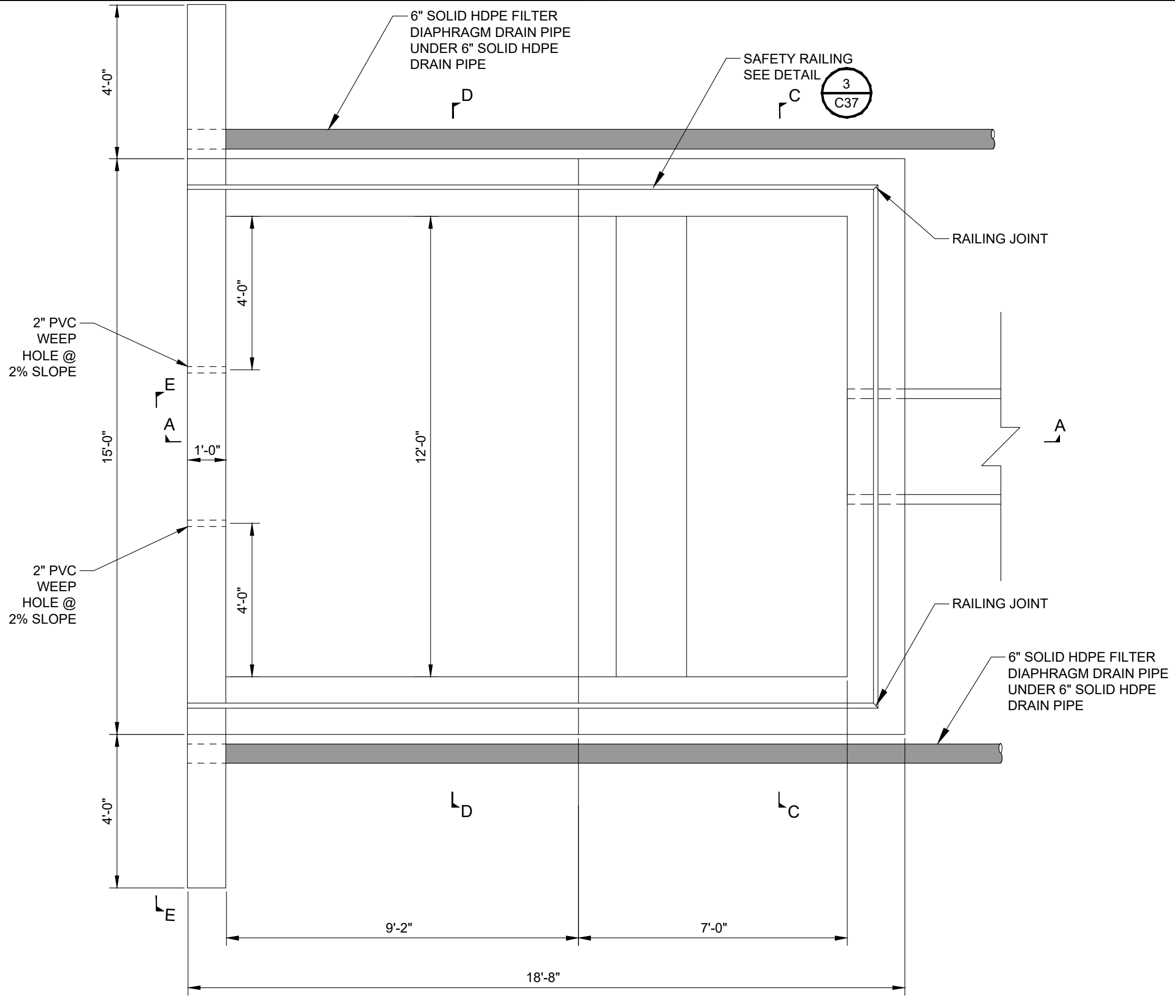
TRASH RACK DETAILS

HOGCHUTE (AKA CARSON)
RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

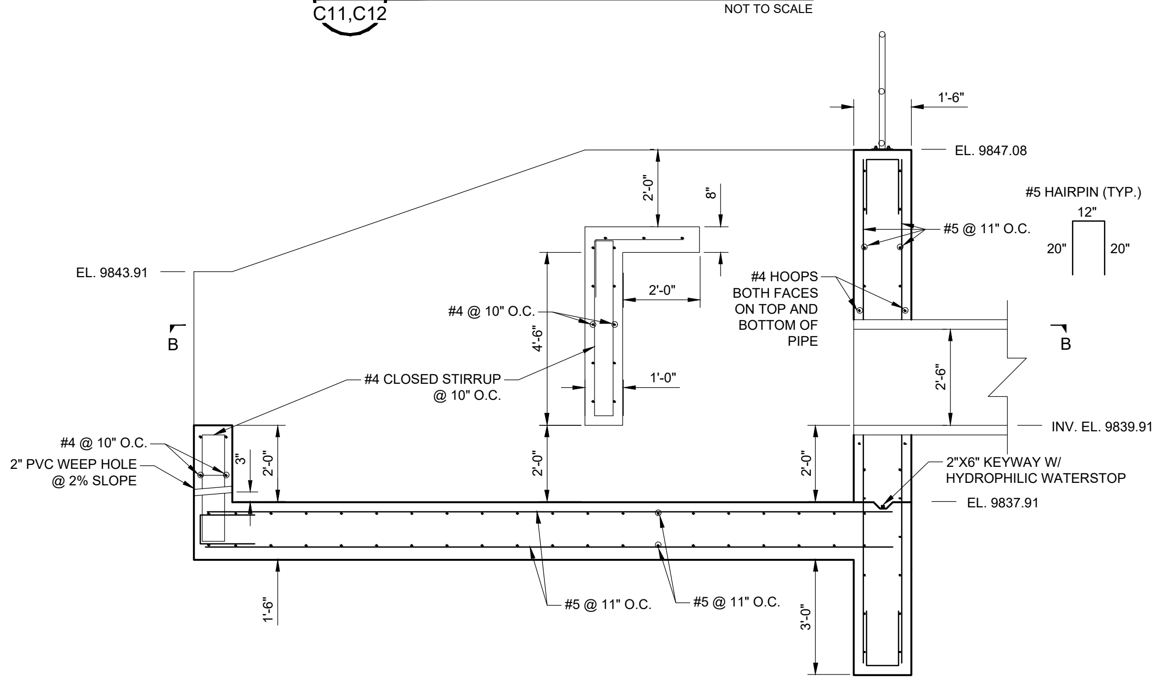
Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C35

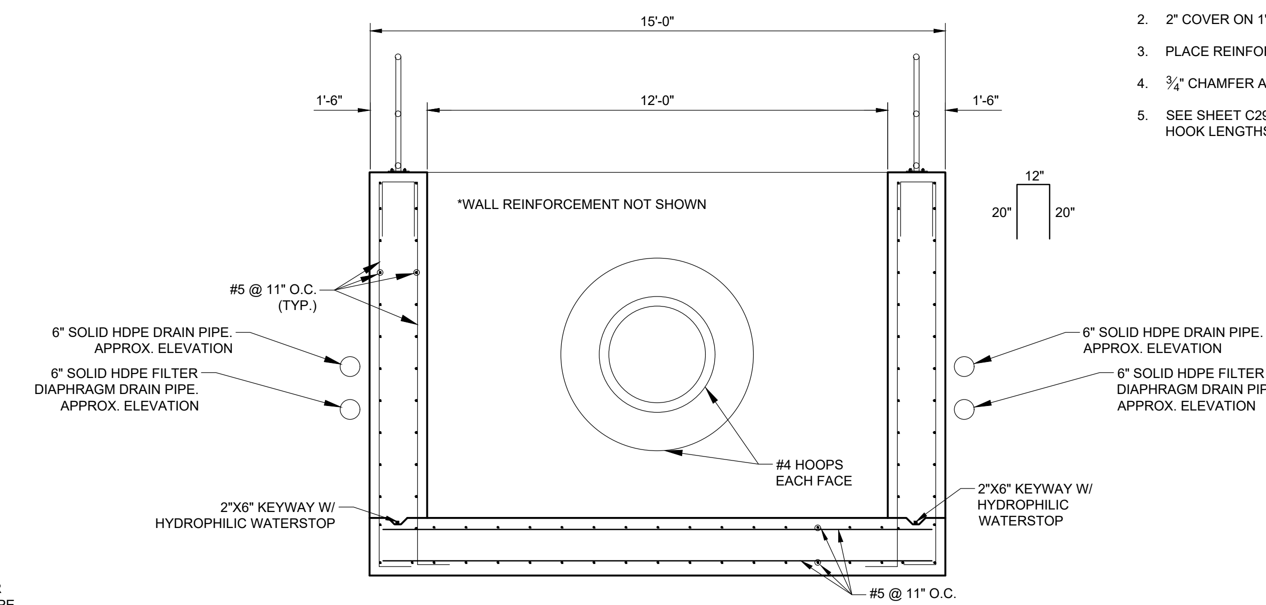


PLAN

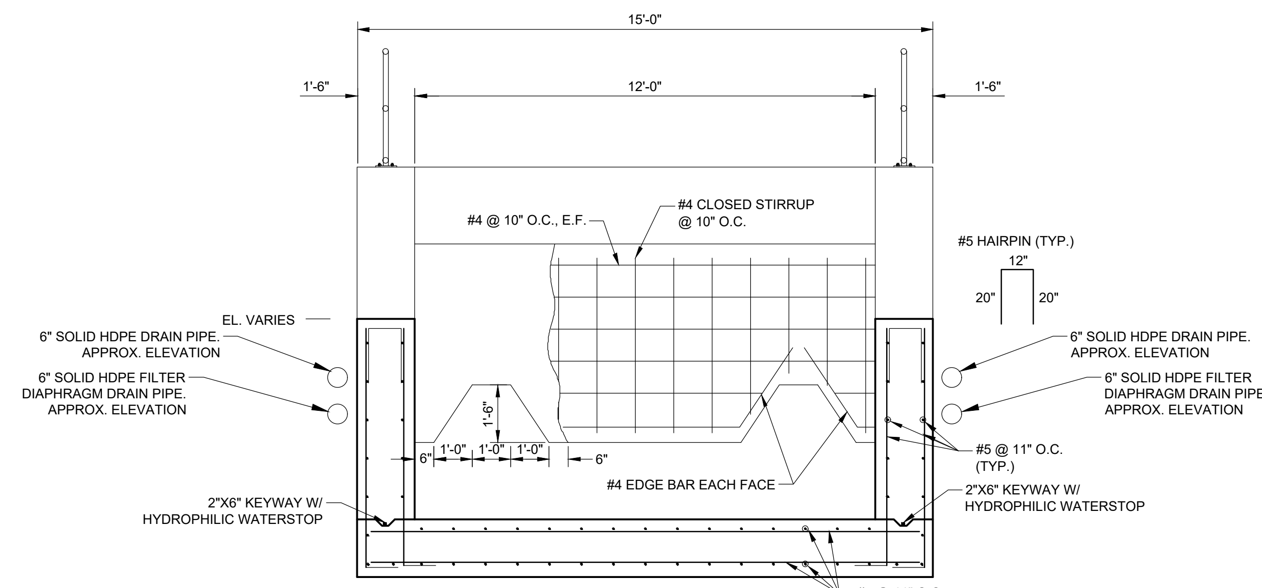
1 C11,C12 IMPACT BASIN DETAIL
NOT TO SCALE



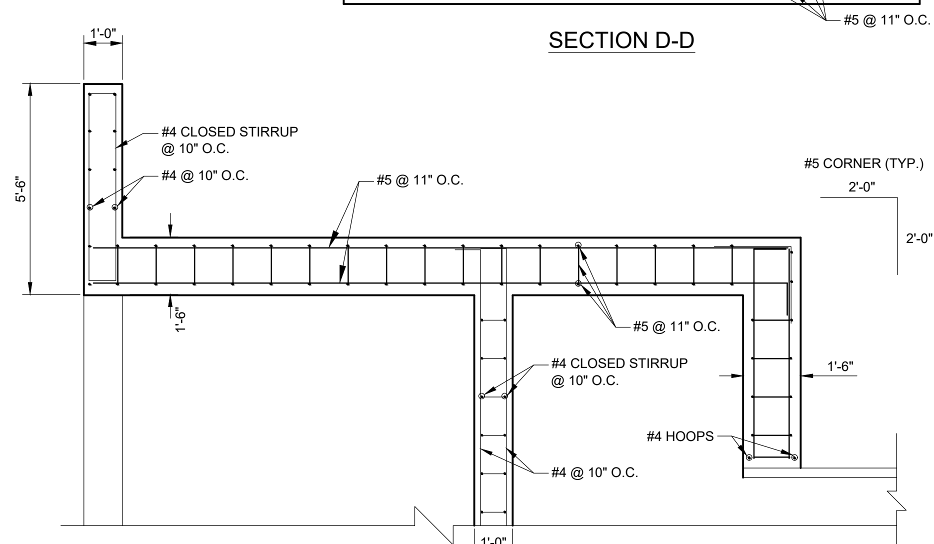
SECTION A-A



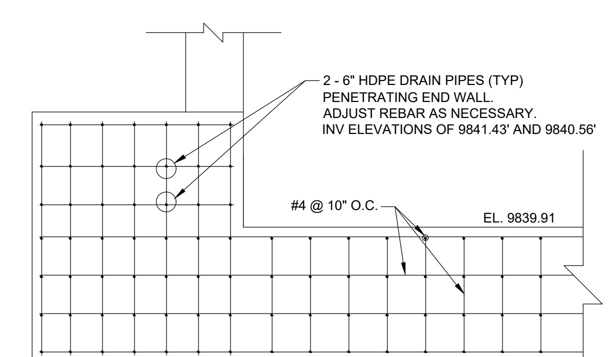
SECTION C-C



SECTION D-D



SECTION B-B



SECTION E-E

NOTES:

1. 3" COVER ON 1'-6" THICK SECTIONS.
2. 2" COVER ON 1'-0" THICK SECTIONS.
3. PLACE REINFORCEMENT IN CENTER FOR SECTIONS LESS THAN 1'-0".
4. ¾" CHAMFER ALL EXPOSED CONCRETE EDGES (TYP).
5. SEE SHEET C29 FOR REINFORCEMENT DEVELOPMENT, SPLICE, AND HOOK LENGTHS.

COLORADO LICENSED TODD M. RUDOLPH 58436 PROFESSIONAL ENGINEER
5/27/2021

ONE INCH - IF NOT, SCALE ACCORDINGLY

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IMPACT BASIN DETAILS

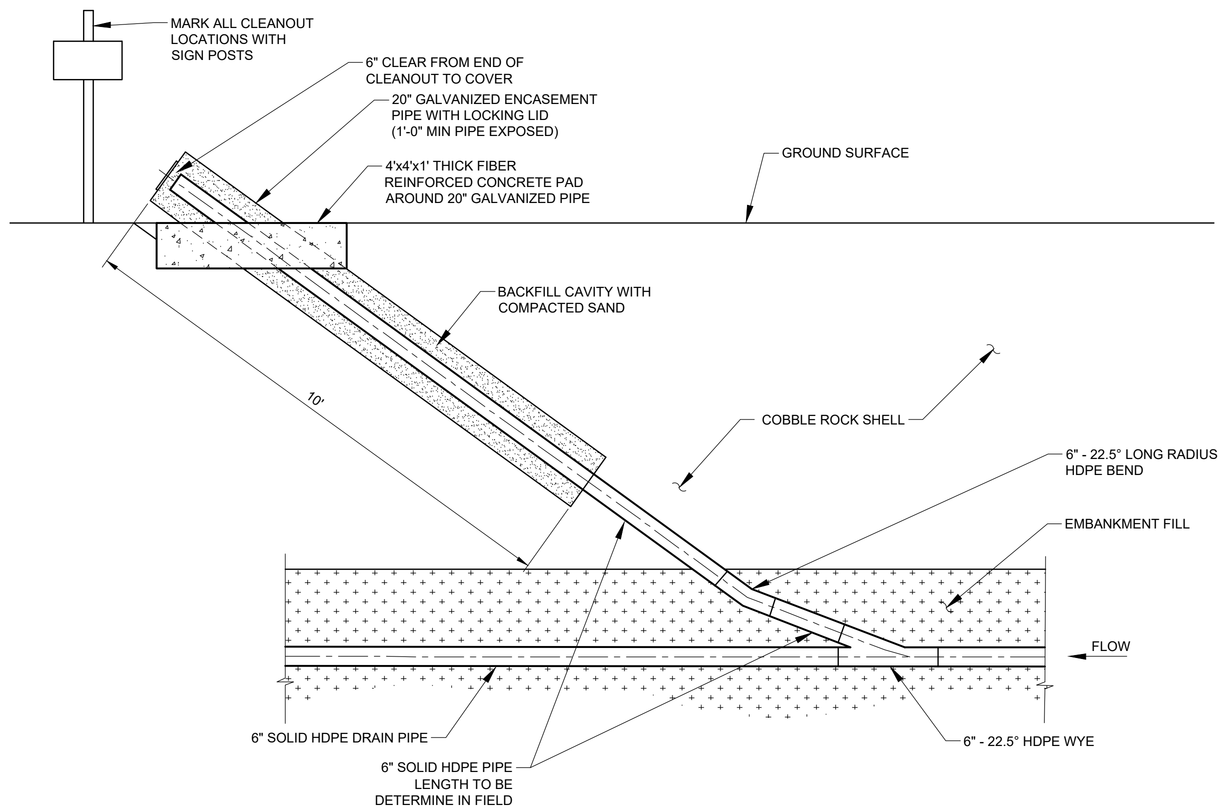
HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr.: CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

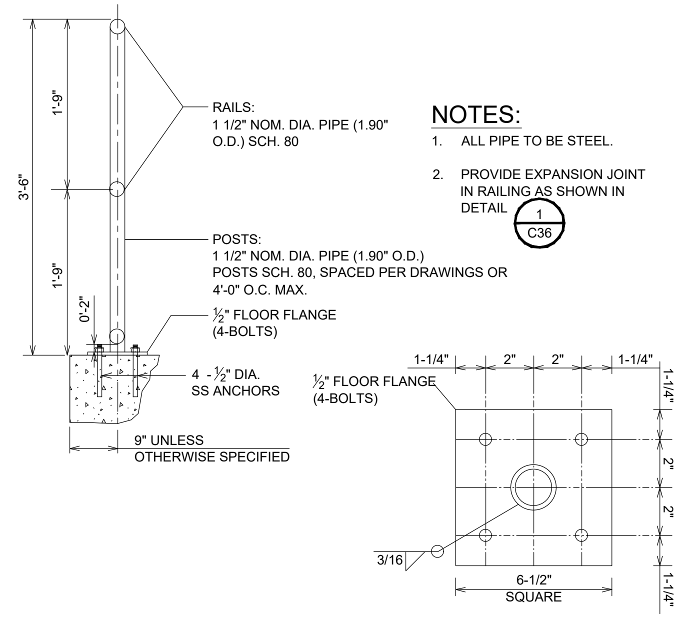
PROJECT NO. 26-1144.00
DRAWING NO. C36
SHEET 43 OF 44

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\26-1144.00 IMPACT BASIN DETAILS.DWG Thursday, June 03, 2021 9:08 AM By: RIEDER, AUSTIN



HDPE DRAIN PIPE LATERAL CLEANOUT DETAIL

1 / C12,C14 — NOT TO SCALE

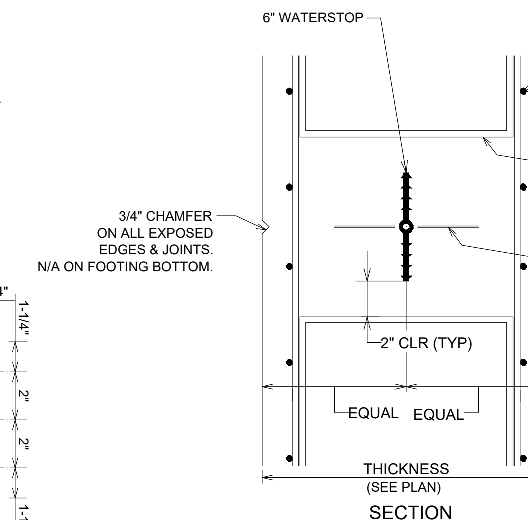


NOTES:

1. ALL PIPE TO BE STEEL.
2. PROVIDE EXPANSION JOINT IN RAILING AS SHOWN IN DETAIL 1/C36

SAFETY RAILING DETAIL

3 / C36 — NOT TO SCALE

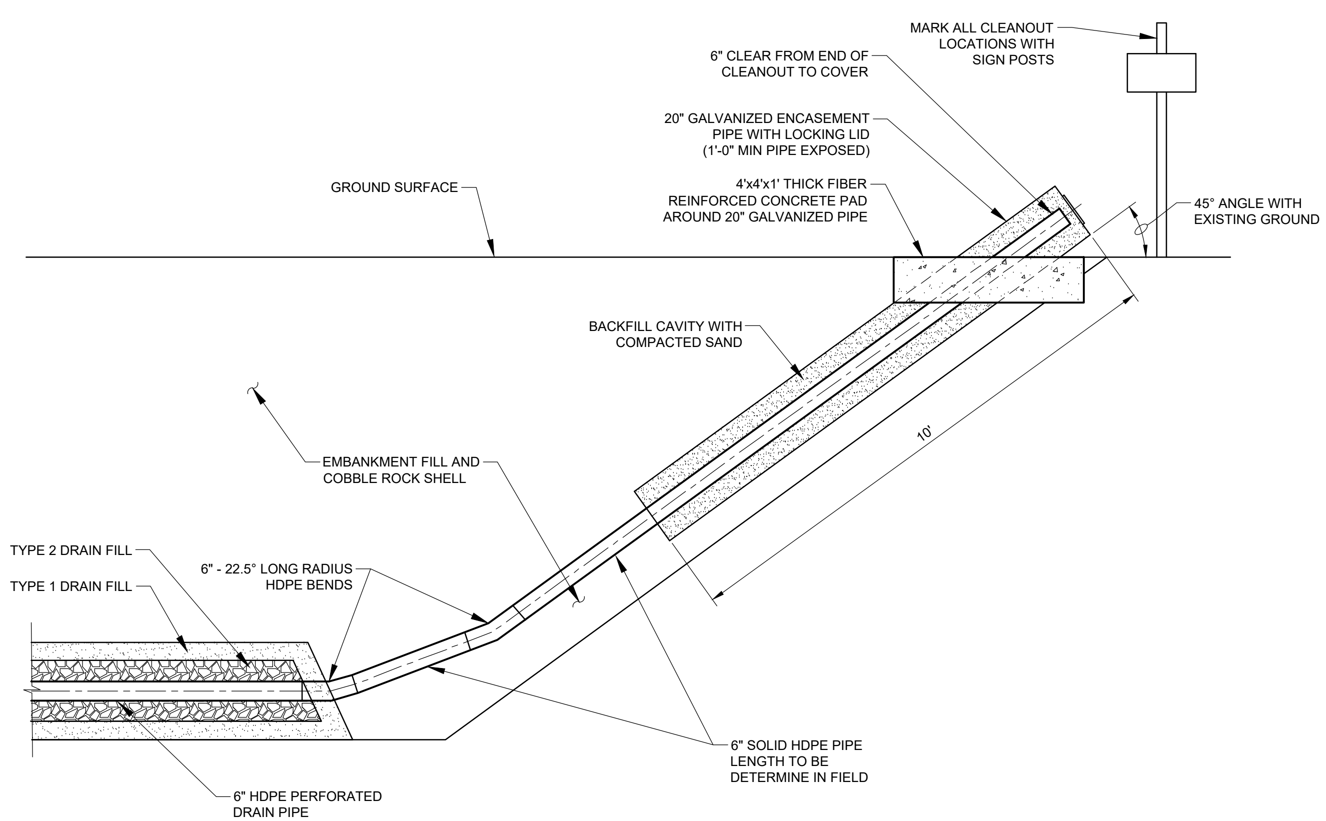


NOTES:

1. TERMINATE WATERSTOP 6" FROM TOP OF SHORTEST WALL. EXTEND INTO FOOTING AND SEAL TO FOOTING WATERSTOP.
2. TERMINATE WATERSTOP 6" FROM END OF SLAB EDGE, NOT AT JOINT.

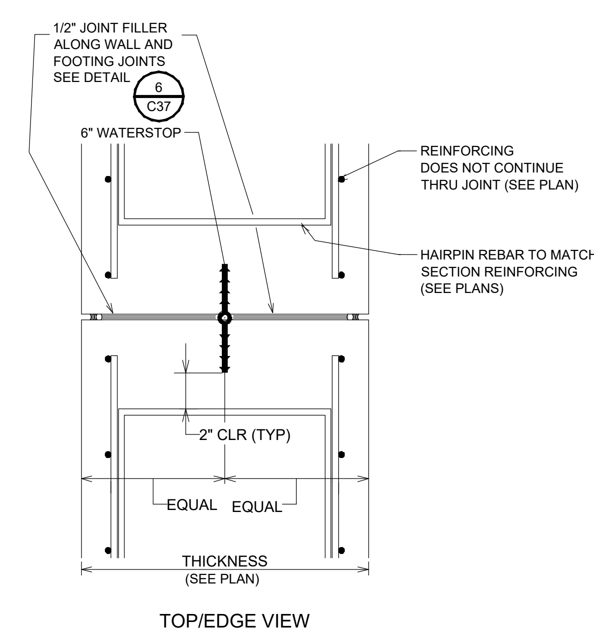
WALL/FOOTING CONTRACTION JOINT DETAIL

4 / C26 — (REINFORCEMENT PENETRATES JOINT) — N.T.S.



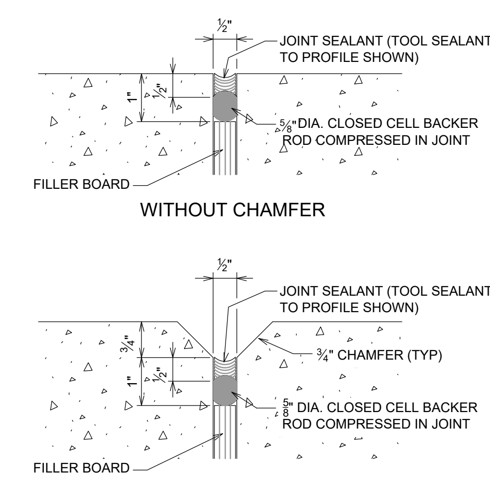
HDPE DRAIN PIPE END ACCESS DETAIL

2 / C11,C14 — NOT TO SCALE



WALL/FOOTING EXPANSION JOINT DETAIL

5 / C26 — (REINFORCEMENT DOES NOT PENETRATE JOINT) — N.T.S.



EXPANSION JOINT SEALANT DETAIL

6 / C36 — N.T.S.

COLORADO LICENSED
TODD M. RUDOLPH
58436
PROFESSIONAL ENGINEER
5/20/2021

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MISCELLANEOUS DETAILS

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
CITY OF GRAND JUNCTION
MESA COUNTY, COLORADO

Revisions	Date

Project Mgr. CTG
Designed By: AJS
Drawn By: RBR
Approved By: TMR
Date: 05/10/21

PROJECT NO. 26-1144.00
DRAWING NO. C37

Drawing Name: I:\36\26-114400 GRAND JUNCTION HOGCHUTE DAM\MAINDWGS 2020\SHEETS\C35 TOE DRAIN DETAILS.DWG Thursday, May 20, 2021 1:06 PM By: RIEDER, AUSTIN

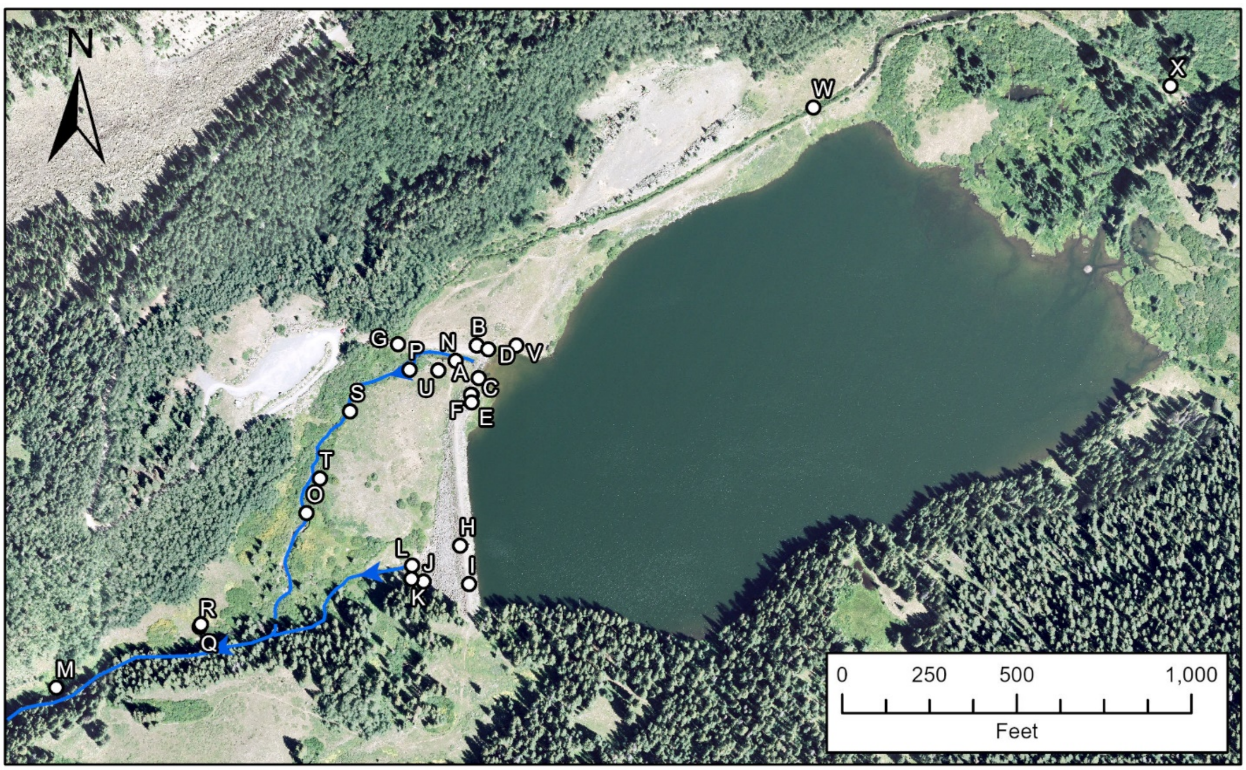
Attachment 2

Appendix H

Site Photos

Appendix

Site Visit Photographs



Spillway Weir

Spillway Weir

Spillway Weir

Spillway Weir

Hogchute Dam Embankment

Carson Lake looking Northeast

Bypass Channel and Foot Bridge

Hogchute Dam Outlet

Hogchute Dam Embankment

Hogchute Dam Outlet

Hogchute Dam Outlet

Hogchute Dam Outlet

Kannah Creek

Carson Lake Spillway Channel

Carson Lake Spillway Channel

Carson Lake Spillway Channel

Carson Lake Spillway Floodplain

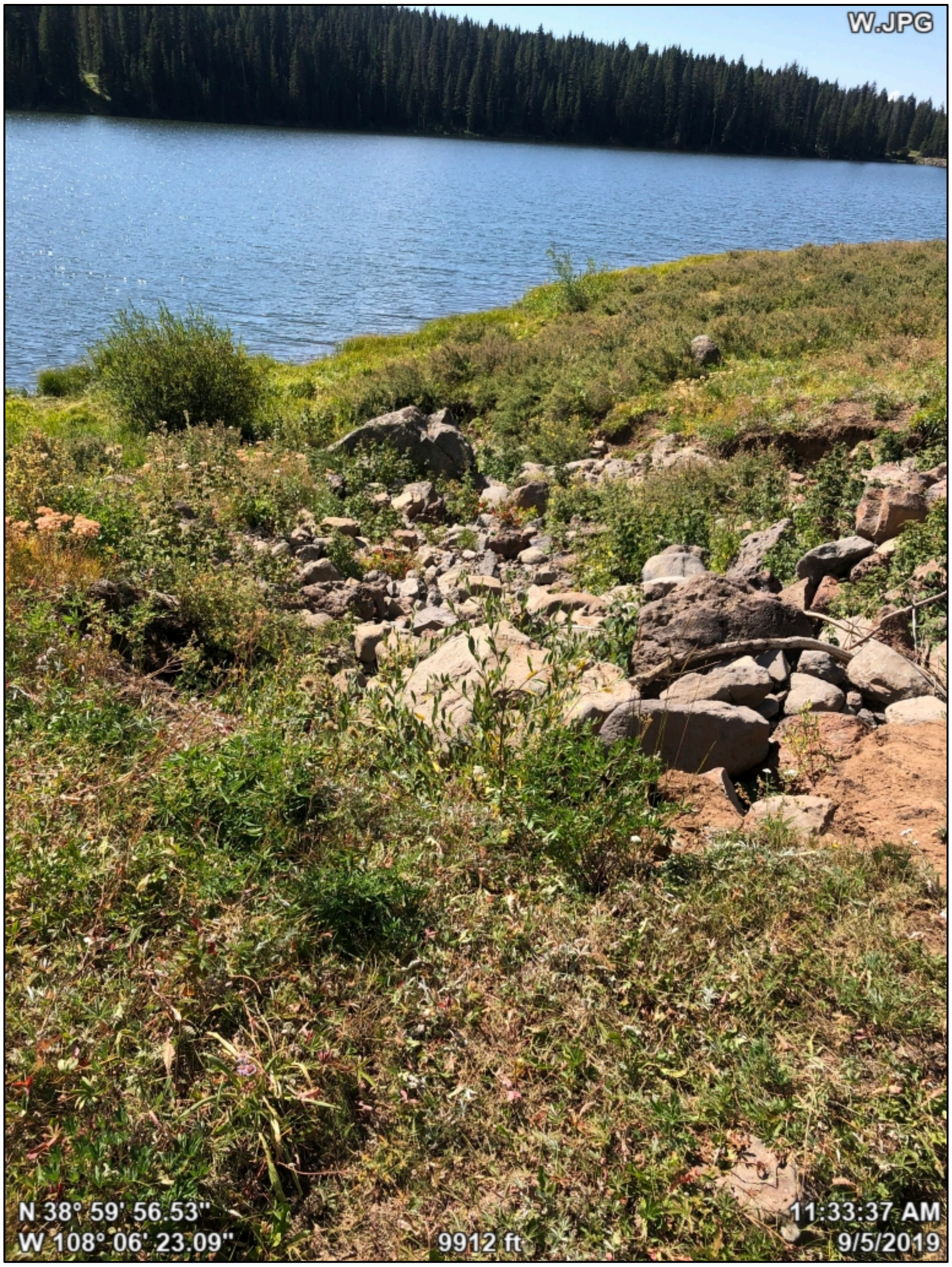
Carson Lake Spillway Floodplain

Carson Lake Spillway Channel

Carson Lake Spillway Floodplain

Carson Lake Spillway Channel

Carson Lake looking Southwest



Bypass Channel Overtopping Location

Diversion Structure for Bypass Channel

Attachment 3

Appendix C

Geotechnical Reports

Huddleston-Berry
Engineering & Testing, LLC

2789 Riverside Parkway
Grand Junction, Colorado 81501
Phone: 970-255-8005
Info@huddlestonberry.com

November 4, 2019
Project#01806-0002

Ayres Associates
3433 Oakwood Hills Parkway
Eau Claire, Wisconsin 54701

Attention: Mr. Chris Goodwin

Subject: Geotechnical Investigation
Carson Lake
Mesa County, Colorado

Dear Mr. Goodwin,

This letter presents the results of a geotechnical investigation conducted by Huddleston-Berry Engineering & Testing, LLC (HBET) at Carson Lake on the Grand Mesa in Mesa County, Colorado. The purpose of the investigation was to evaluate the subsurface conditions along the spillway chute to assist in designing spillway improvements for the reservoir.

Site Conditions

At the time of the investigation, the site was generally open. The existing spillway channel was fairly heavily vegetated; however, the area beyond the channel to the south and east was vegetated with weeds, grasses, and scattered low brush. The spillway channel was dry and the bottom of the channel was heavily armored with cobbles and boulders. Boulders were also observed to scattered on the ground surface across the site.

Subsurface Investigation

The subsurface investigation included three test pits as shown on Figure 2 – Site Plan. The test pits were excavated to depths of between 5.5 and 9.0 feet below the existing ground surface. Typed test pit logs are included in Appendix A.

As indicated on the logs, the subsurface conditions were slightly variable. However, the test pits generally encountered 1.5 to 2.0 feet of organic rich topsoil materials above brown, moist, dense to very dense clayey sand with gravel to clayey gravel with sand soils to the bottoms of the excavations. The sand and gravel soils contained varying quantities of cobbles and boulders. However, both TP-2 and TP-3 contained a higher percentage of cobbles and boulders than TP-1. This can be seen in test pit photographs included in Appendix B. Groundwater was not encountered in the test pits at the time of the investigation.

Laboratory Testing

Due to the presence of significant quantities of larger particles, representative samples of the overall soil mass were unable to be collected. However, HBET conducted laboratory testing on samples of the matrix soils. Laboratory testing included grain size analysis, natural moisture content determination, and Atterberg limits determination. The laboratory testing results are included in Appendix C.

The laboratory testing results indicate that native matrix soils are slightly to moderately plastic. The natural moisture content of the soils was very low at 9%.

Spillway Structure Recommendations

In general, the native cobble and boulder materials are in a dense to very dense condition and will provide excellent support for any new spillway structure. As a result, HBET recommends that any new structure bear directly on the native soils. However, where numerous boulders are present in the subgrade, it may be preferable to pour a concrete leveling pad to interlock with the boulders and provide a uniform bearing surface for the base of the structure.

Although the native soils will provide excellent structural support, as observed along the existing channel bottom, the fine grained portion of the soils will tend to wash out. The clays in the matrix have some plasticity; however, the quantity of clay is insufficient to limit hydraulic conductivity and prevent migration of the fines. As a result, any new spillway structure should include measures to limit/prevent seepage below the structure.

Prior to placement of concrete for any new structure, it is recommended that the bottom of the foundation excavation be moisture conditioned and proofrolled to the Engineer's satisfaction. Large particles may need to be removed at the direction of the Geotechnical and/or Structural Engineer.

For construction above properly prepared dense native soils, a maximum allowable bearing capacity of 3,000 psf may be used. In addition, a modulus of subgrade reaction of 250 pci may be used for the dense native soils. In general, for construction in accordance with the above recommendations, HBET anticipates that post-construction differential settlements will be less than 0.5-inch and total settlements will be less than 1.0-inch.

Engineering Properties

As discussed previously, due to the presence of large particles, representative samples of the overall native soil mass were unable to be collected. However, the samples collected still contained a significant quantity of gravels. Considering the grain-size limitations for the test, direct-shear testing on samples from the site would be even less representative of the natural soil mass. As a result, HBET developed engineering parameters for the overall soil mass based upon our observations of the in-situ material and upon our geotechnical engineering experience. The following conservative parameters are recommended for the native soils:

- γ = 125 pcf
- ϕ' = 32º
- c' = 0 psf

General Notes

The recommendations included above are based upon the results of the subsurface investigation and upon our experience. These conclusions and recommendations are valid only for the subject project.

As discussed previously, the subsurface conditions at the site were slightly variable. However, the precise nature and extent of subsurface variability may not become evident until construction. Therefore, HBET should be retained to provide engineering oversight during ***ALL*** phases of the construction to verify the subsurface conditions and/or provide alternative recommendations in the event that significant subsurface variability is encountered during construction.

We are pleased to be of service to your project. Please contact us if you have any questions or comments regarding the contents of this report.

Respectfully Submitted:
Huddleston-Berry Engineering and Testing, LLC

Michael A. Berry, P.E.
Vice President of Engineering

FIGURES

FIGURE 1
Site Plan

APPENDIX A
Typed Boring Logs

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

TEST PIT NUMBER TP-1

CLIENT Ayres Associates
PROJECT NAME Carson Lake
PROJECT NUMBER 01806-0002
PROJECT LOCATION Grand Mesa, CO
DATE STARTED 9/30/19 **COMPLETED** 9/30/19
GROUND ELEVATION **TEST PIT SIZE**
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
AT TIME OF EXCAVATION dry
LOGGED BY MAB **CHECKED BY** MAB
AT END OF EXCAVATION dry
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Clayey SAND with Gravel and Organics (TOPSOIL)										
		Clayey SAND with Gravel (sc) to Clayey GRAVEL with Sand (gc), some cobbles, trace boulders, brown, moist, dense to very dense										
2.5												
			GB 1					9	30	19	11	19
5.0												
7.5												
		Bottom of test pit at 9.0 feet.										

GEOTECH BH COLUMNS 01806-0002 CARSON LAKE.GPJ GINT US LAB.GDT 10/16/19

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

TEST PIT NUMBER TP-2

CLIENT Ayres Associates
PROJECT NAME Carson Lake
PROJECT NUMBER 01806-0002
PROJECT LOCATION Grand Mesa, CO
DATE STARTED 9/30/19 **COMPLETED** 9/30/19
GROUND ELEVATION **TEST PIT SIZE**
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
AT TIME OF EXCAVATION dry
LOGGED BY MAB **CHECKED BY** MAB
AT END OF EXCAVATION dry
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Clayey SAND with Gravel and Organics (TOPSOIL)										
2.5		Clayey SAND with Gravel (sc) to Clayey GRAVEL with Sand (gc), abundant cobbles, trace boulders, brown, dry to moist, dense to very dense										
		Higher percentage of cobbles and boulders than TP-1	GB 1					9	29	21	8	29
5.0												
		Bottom of test pit at 7.0 feet.										

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

TEST PIT NUMBER TP-3

CLIENT Ayres Associates
PROJECT NAME Carson Lake
PROJECT NUMBER 01806-0002
PROJECT LOCATION Grand Mesa, CO
DATE STARTED 9/30/19 **COMPLETED** 9/30/19
GROUND ELEVATION **TEST PIT SIZE**
EXCAVATION CONTRACTOR Client
GROUND WATER LEVELS:
EXCAVATION METHOD Backhoe
AT TIME OF EXCAVATION dry
LOGGED BY MAB **CHECKED BY** MAB
AT END OF EXCAVATION dry
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		Clayey SAND with Gravel and Organics (TOPSOIL)										
		Clayey SAND with Gravel (sc) to Clayey GRAVEL with Sand (gc), abundant cobbles, trace boulders, brown, dry to moist, dense to very dense										
2.5												
		Higher percentage of cobbles and boulders than TP-1										
5.0												
		Bottom of test pit at 5.5 feet.										

APPENDIX B
Test Pit Photographs

Profile of TP-1

Spoils pile from TP-1

Profile of TP-2

Spoils from TP-2

Profile of TP-3

Spoils from TP-3

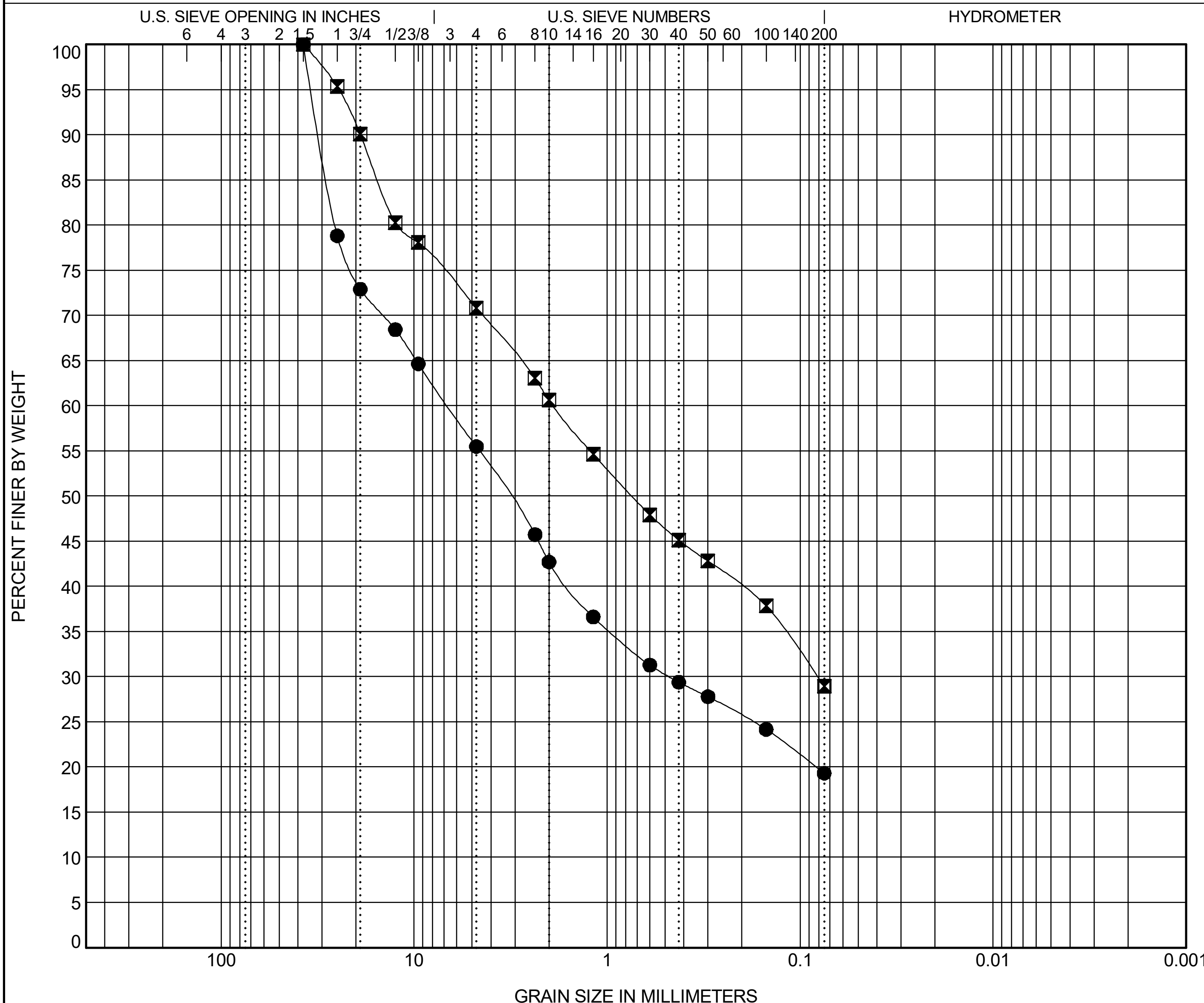
APPENDIX C
Laboratory Testing Results

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

GRAIN SIZE DISTRIBUTION

CLIENT Ayres Associates **PROJECT NAME** Carson Lake

PROJECT NUMBER 01806-0002 **PROJECT LOCATION** Grand Mesa, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**TP-1, GB1**	**9/19**	**CLAYEY GRAVEL with SAND(GC)**	**30**	**19**	**11**		
⊠	**TP-2, GB1**	**9/19**	**CLAYEY SAND with GRAVEL(SC)**	**29**	**21**	**8**		

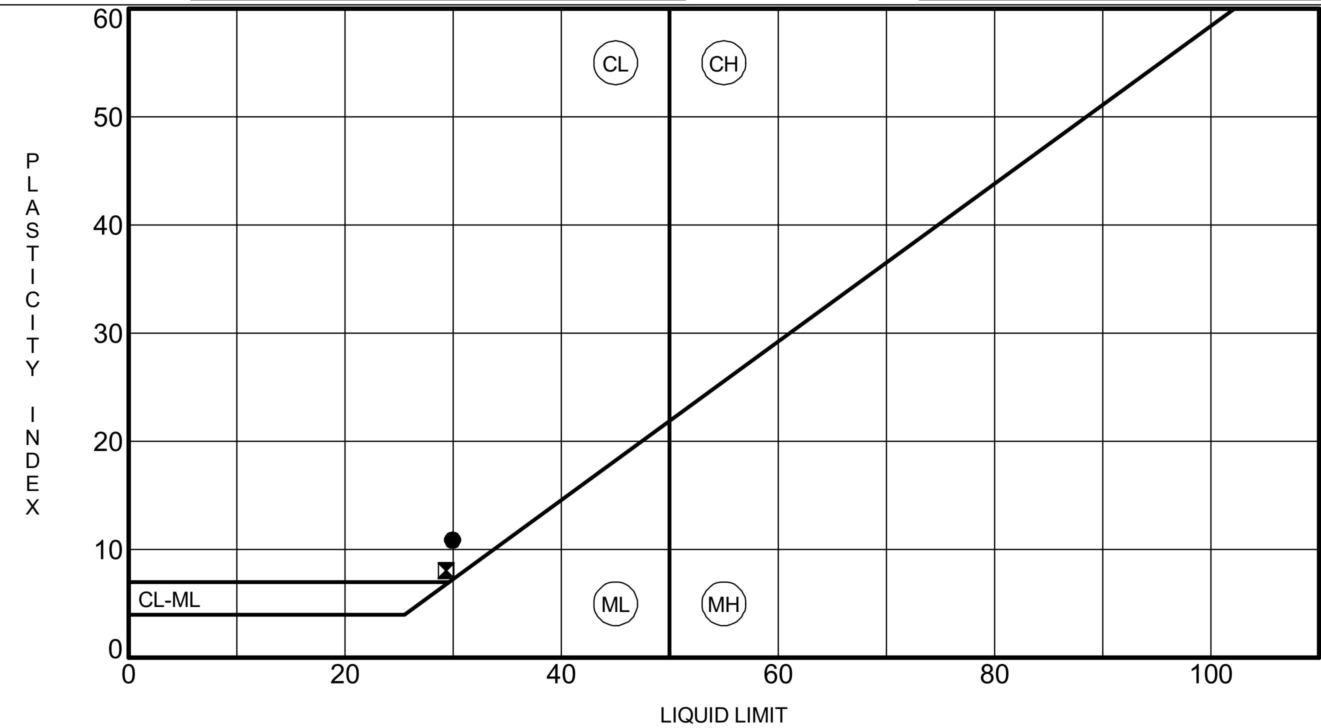
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP-1, GB1**	**9/19**	**37.5**	**6.687**	**0.475**		**44.5**	**36.2**	**19.3**	
⊠	**TP-2, GB1**	**9/19**	**37.5**	**1.895**	**0.082**		**29.2**	**41.9**	**28.9**	

Huddleston-Berry Engineering & Testing, LLC
640 White Avenue, Unit B
Grand Junction, CO 81501
970-255-8005
970-255-6818

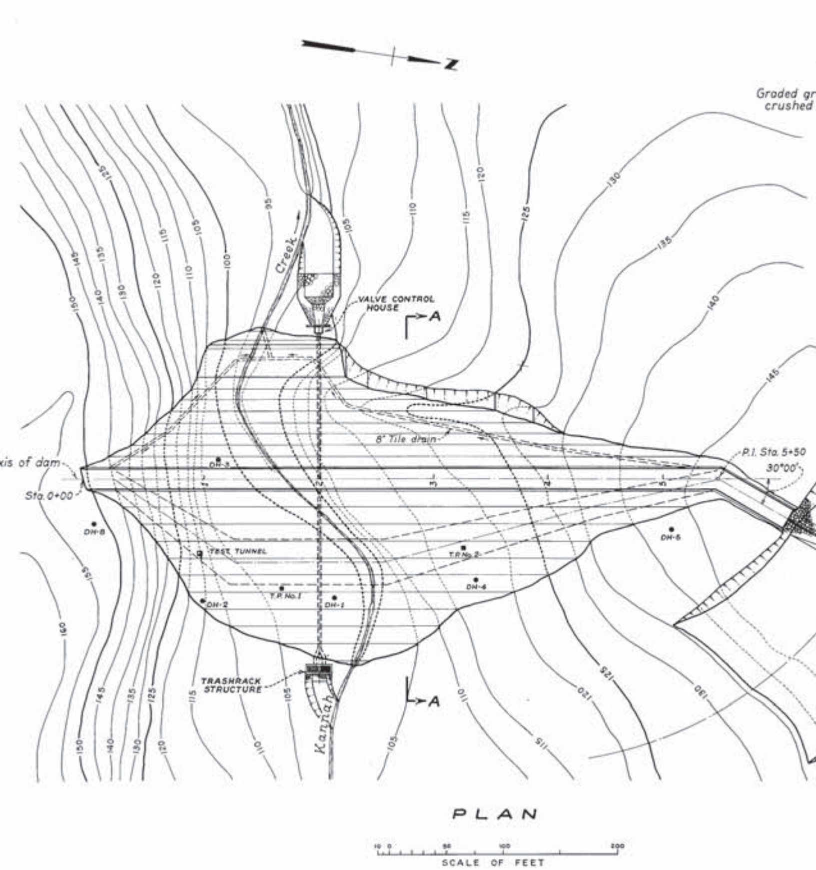
ATTERBERG LIMITS' RESULTS

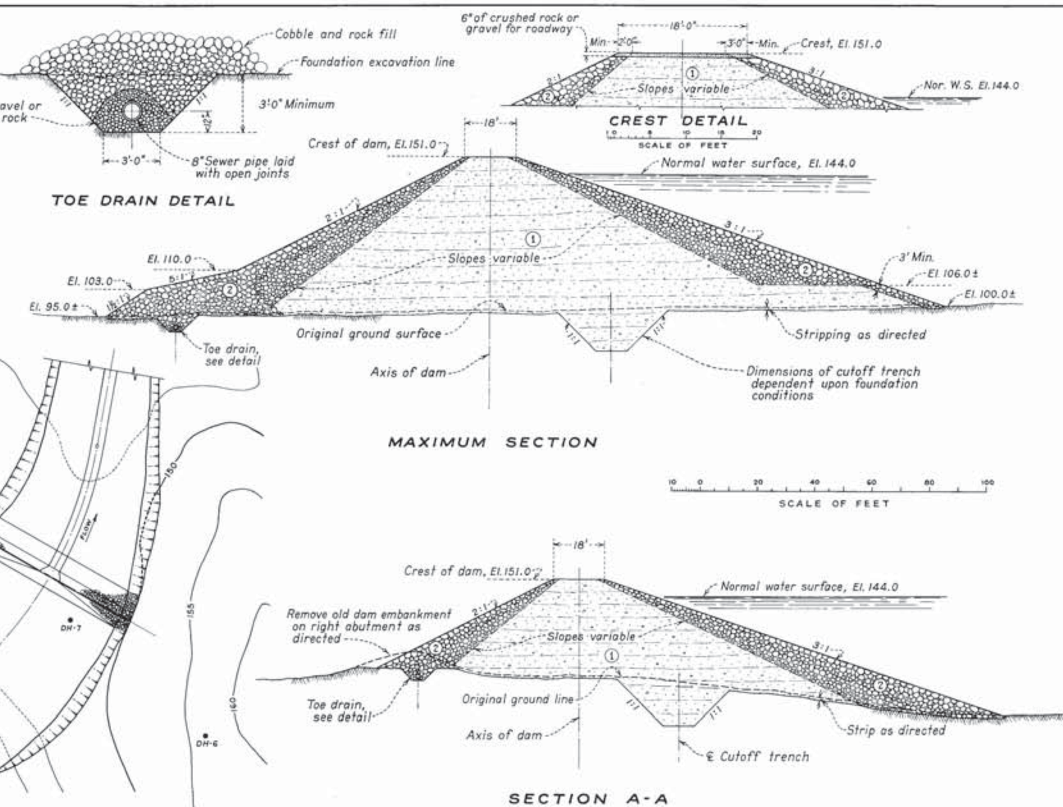
CLIENT Ayres Associates **PROJECT NAME** Carson Lake

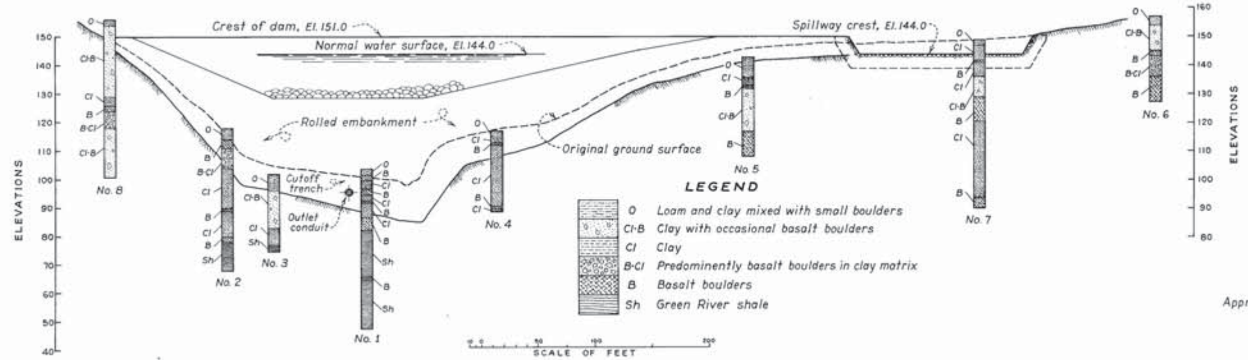
PROJECT NUMBER 01806-0002 **PROJECT LOCATION** Grand Mesa, CO



	Specimen Identification		LL	PL	PI	#200	Classification
●	**TP-1, GB1**	**9/30/2019**	**30**	**19**	**11**	**19**	**CLAYEY GRAVEL with SAND(GC)**
⊠	**TP-2, GB1**	**9/30/2019**	**29**	**21**	**8**	**29**	**CLAYEY SAND with GRAVEL(SC)**







PROFILE ON ℄ OF CUTOFF TRENCH AND SPILLWAY - LOG OF DRILL HOLES

EMBANKMENT NOTES

① Impervious fill of clay or clay, sand and gravel graded with coarser material on outer slopes and compacted in 6" layers.
② Cobble and rock fill graded with coarser material on outer slopes.

NOTES

All elevations refer to an assumed datum
Final location of outlet works and appurtenant structures are dependent on foundation conditions encountered.

Approved on the 24 day of May 1947.
By M. C. Hinderlider, STATE ENGINEER
By .... DEPUTY

CITY OF GRAND JUNCTION
R.J. TIPTON AND ASSOCIATES INC., ENGINEERS
DENVER, COLORADO

IMPROVEMENTS TO WATER SUPPLY SYSTEM
HOGCHUTE RESERVOIR
PLAN, PROFILE AND SECTIONS

DRAWN N.L.L. APPROVED
TRACED L.W.M. APPROVED
CHECKED N.L.L. APPROVED
DENVER, COLORADO MAY 1947
705-31
C-454

CONSULTANTS, INC.

GEOTECHNICAL AND
WATER RESOURCES ENGINEERING

GEOTECHNICAL DATA REPORT

HOGCHUTE DAM (AKA CARSON LAKE)
DAM ID 420127

MESA COUNTY, COLORADO

Submitted to
City of Grand Junction
250 North 5th Street
Grand Junction, CO 81501

Submitted by
RJH Consultants, Inc.
9800 Mt. Pyramid Court, Suite 330
Englewood, Colorado 80112
303-225-4611
www.rjh-consultants.com

COLORADO REGISTERED PROFESSIONAL ENGINEER
GARRETT O. JACKSON
1/4/19
29302

January 2019
Project 181155

Garrett O. Jackson, P.E.
Project Manager

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APPENDICES

SECTION 1 - INTRODUCTION

1.1 Objective and Purpose

The City of Grand Junction (City) retained RJH Consultants, Inc. (RJH) to provide engineering services for the Hogchute Dam Safety Evaluation Project (Project). The purpose of this Geotechnical Data Report (Report) is to present data collected by RJH to support engineering evaluations of potential dam safety issues that have been identified by the Colorado Office of the State Engineer (SEO) as part of a Comprehensive Dam Safety Evaluation (CDSE). The engineering evaluations are presented in a separate dam safety evaluation report.

1.2 Background

Hogchute Dam (DAMID 420127) is located in Mesa County, Colorado, approximately 22 miles east-southeast of Grand Junction (Site). The dam is a 56-foot-high earth structure that impounds Carson Lake on Kannah Creek at an elevation (El.) of about 9,900 feet in the Grand Mesa National Forest. The reservoir provides water storage for domestic use, irrigation, and fishing recreation. A Site vicinity map is shown on Figure 1.1.

Based on design records, the dam was constructed in 1947, with a low-permeability earthen core protected by upstream and downstream rock shells of gravels, cobbles, and boulders. The embankment was designed to have an 18-foot-wide crest, 3 horizontal to 1 vertical (H:V) upstream slope, and 2H:1V downstream slope. A plan of the dam is shown on Figure 1.2. The outlet works consists of two 20-inch welded steel pipes with hydraulic slide gates at the upstream toe of the dam. The 20-inch pipes converge within the dam into a single 30-inch conduit that discharges into a rock-lined basin at the downstream toe of the dam. There appears to also be a 12-inch outlet gate installed on a 12-inch pipe between the two 20-inch conduits, but the configuration and use of this gate are not clear. The unlined emergency spillway is located at the north (right) end of the dam.

In 1988, the City relocated the outlet control structure from the downstream toe to the crest of the dam. At about the same time, the City extended the 8-inch toe drain discharge pipe into the outlet discharge basin. The work to move the outlet controls and extend the toe drain discharge is described in a 1988 letter, which also includes some photographs of the toe drain work. There are no other construction records for the dam. The City has a four-sheet plan set, dated 1947, that appears to show the original design.

In 2015, the SEO changed the dam's hazard classification to high hazard, based on inundation mapping performed by the City to assess the impacts of a potential dam failure on downstream development that had occurred since construction of the dam. Several SEO dam safety inspection reports over the years have mentioned concerns for undocumented seepage (not collected and not monitored), the absence of any filtering of the embankment core material, apparently broken outlet gate air vents, and the deteriorated condition of the spillway.

In 2017, the SEO performed a CDSE to assess the overall safety of the dam and provide the City with guidance in planning needed dam improvements.

1.3 RJH Scope of Work

RJH performed the following for the data collection phase of the Project:

- Reviewed documents provided by City and SEO.
- Prepared a base topographic map of the Site based on survey data provided by the City.
- Prepared for fieldwork, which included preparing a Project-specific Health and Safety Plan (HASP), coordinating utility clearances, and developing a Drilling and Site Investigation Plan for SEO review and approval.
- Drilled, sampled, and logged seven borings. Six borings were completed as open-standpipe monitoring wells and one boring was backfilled with cement-bentonite grout.
- Surveyed the locations of RJH's borings and monitoring wells using a handheld Global Positioning System (GPS).
- Prepared Daily Site Reports to document field activities.
- Performed quality assurance review of collected samples and field logs by a senior engineer.
- Performed laboratory tests on representative samples from the borings.
- Prepared final boring logs based on the field logs, quality assurance review, and laboratory test results.
- Prepared this Report.

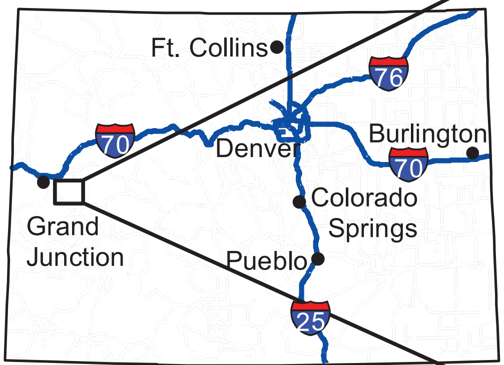
1.4 Authorization

This work was performed in general accordance with the terms and conditions of the Professional Services Contract RFP-4519-18-DH between the City and RJH, dated June 26, 2018 and a Contract Modification Request, dated September 12, 2018. Drilling was performed in general conformance with the Drilling and Site Investigation Plan approved by the SEO on July 16, 2018 and Addendum approved with contingencies by the SEO on August 28, 2018.

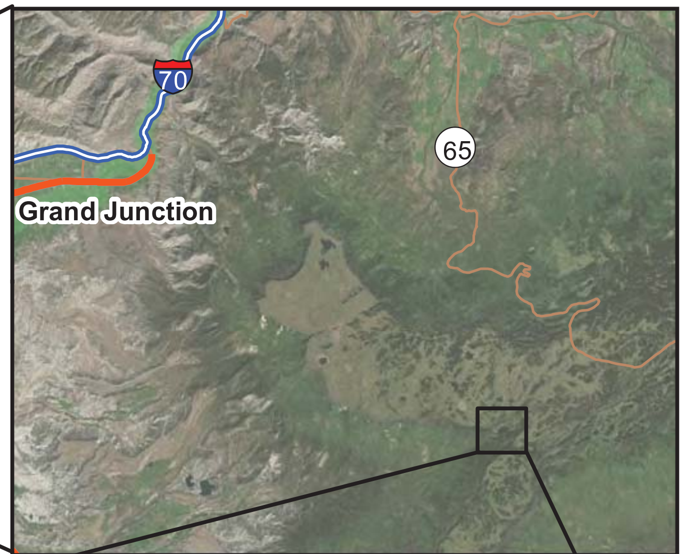
1.5 Project Personnel

The following personnel from RJH are responsible for the work contained in this Report:

Project Manager:	Garrett Jackson, P.E.
Staff Geological Engineer:	Jacquelyn Hagbery, E.I.
Technical Review:	Robert Huzjak, P.E.



PROJECT VICINITY MAP
(NOT TO SCALE)



PROJECT LOCATION MAP
(NOT TO SCALE)

N

SITE LOCATION MAP
(NOT TO SCALE)

P:\18115 - Hogchute Dam Safety Evaluation\Engineering\GIS\Geotech\Geotech_Data_Report\Site Vicinity Map.mxd

CITY OF Grand Junction COLORADO	RJH CONSULTANTS, INC.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	SITE VICINITY MAP
		PROJECT NO. 18115	January 2019 **Figure 1.1**

LEGEND

◉ MONITORING WELL

BORING BACKFILLED WITH CEMENT–BENTONITE GROUT

NOTES:

1. AERIAL IMAGERY WAS OBTAINED FROM MICROSOFT BING, IMAGERY DATE UNKNOWN.
2. GROUND SURFACE TOPOGRAPHY DATA PROVIDED BY CITY OF GRAND JUNCTION, CO. HORIZONTAL DATUM IS NAD83 AND VERTICAL DATUM IS NAVD88.
3. LOCATIONS OF MONITORING WELLS AND BORINGS WERE OBTAINED FROM HANDHELD GPS UNIT AND HAVE NOT BEEN SURVEYED.

REPRODUCE IN COLOR

0 50 100 200 300
SCALE IN FEET

CITY OF Grand Junction COLORADO	RJH CONSULTANTS, INC.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	DAM PLAN
		PROJECT NO. 18115	January 2019 — **Figure 1.2**

P:\18115 – HOGCHUTE DAM SAFETY EVALUATION\CAD\FIGURES\MONITORING WELLS\MONITORING WELLS.DWG 12/21/2018 11:28 AM

SECTION 2 - SITE INVESTIGATION

2.1 General

The Site investigation was performed in two phases, from July 23 to July 28, 2018 and from September 17 to September 22, 2018. The Site investigation generally consisted of the following activities:

- Surveying with handheld GPS.
- Drilling, sampling, and logging borings.
- Preparing Daily Site Reports.
- Performing permeability tests in embankment fill and colluvium.
- Installing monitoring wells.
- Measuring groundwater levels.

2.2 Surveying

The City performed Project-specific topographic surveying in winter 2017. Topographic surveying of the dam and spillway was performed using conventional (i.e., field) survey equipment. RJH prepared a base topographic map for the Project based on the collected survey data. Based on the topographic data, the dam crest is at approximately El. 9902. The crest width of the embankment is between 14 and 18 feet, the upstream slope of the embankment is inclined at approximately 2.5H:1V to 3H:1V, and the downstream slope is inclined at approximately 2H:1V. Based on survey data and design documents, the maximum normal water level (NWL) is at approximately El. 9895. The horizontal coordinate system used for the Project is Mesa County Local Coordinate System Grand Mesa Area (GMA) with an offset because the surveyed area is beyond the limits of GMA. Therefore, the horizontal coordinates are spatially correct with respect to other points in the survey, but are not related to other global coordinate systems. The horizontal datum is NAD83 and vertical datum is NAVD88.

The borings were surveyed by RJH using a handheld GPS. The horizontal coordinates are in WGS84 and the datum is NAD83. The boring elevations were estimated based on the topographic data provided by the City. The City plans to survey the borings in spring 2019 when the Site can be accessed as weather and ground conditions allow.

2.3 Borings

Seven borings were drilled for the Project. The horizontal coordinates and ground surface elevations at the boring locations are provided in Table 2.1. The boring locations are shown on Figure 1.2. Boring logs are provided in Appendix B.

TABLE 2.1
SUMMARY OF BORINGS

Boring ID	Latitude[1] (deg)	Longitude[1] (deg)	Ground Surface Elevation[2] (ft)	Total Depth[3] of Boring (ft)	Boring Completion
Dam Crest					
B-101(P)	38.995296	-108.109759	9902.2	77.5	1.5-inch Monitoring Well
B-102A(P)	38.995677	-108.109800	9902.1	48.0	2-inch Monitoring Well
B-102B	38.995667	-108.109796	9902.1	5.0	Cement-Bentonite Grout
B-103(P)	38.996095	-108.109881	9901.8	30.0	2-inch Monitoring Well
Dam Downstream Toe					
B-104(P)	38.995285	-108.110292	9846.1	33.0	2-inch Monitoring Well
B-105A(P)	38.995632	-108.110160	9865.7	73.5	2-inch Monitoring Well
B-105B(P)	38.995681	-108.110127	9866.9	12.6	2-inch Monitoring Well

Notes:
1. Boring locations were surveyed by RJH with a handheld GPS. Horizontal coordinate system is WGS84 and datum is NAD83.
2. Elevation was estimated from the topographic survey data. Vertical datum is NAVD88.
3. Depth measured along boring axis. All borings were vertical.

RJH retained HRL Compliance Solutions, Inc. (HRL) of Grand Junction, Colorado to provide drilling equipment and services. Borings were drilled using a track-mounted CME 55LC drill rig with an automatic hammer.

Vertical borings in the dam crest were advanced from the ground surface using 7.75-inch outside-diameter (O.D.) (4.25-inch inside-diameter (I.D.)) hollow-stem augers. During auger advancement, sampling was generally performed at 2.5-foot intervals but sampling ranged from continuously to 8-foot intervals, depending on the presence of cobbles and boulders. Auger refusal was encountered in all dam crest borings and in our opinion was caused by cobbles and boulders in the subsurface. Based on the presence of cobbles and boulders in the crest borings, the drillers switched to a Symmetrix drive casing advancer, an air-hammer drilling method, for the dam downstream toe borings. The Symmetrix drive casing advancer was 5.375-inch O.D. (5.0-inch I.D.) and had continuous casing advancement. During casing advancement, sampling was generally performed at 2.5-foot intervals but ranged from continuously to 5-foot intervals based on casing limitations at greater depths. The air compressor used for the Symmetrix drive casing advancer was set at the "low" pressure setting and air pressure measured at the air compressor ranged from 110 to 120 pounds per square inch (psi) during drilling.

The following sampler types were used during auger and Symmetrix drive casing advancer drilling:

- 1.375-inch I.D. (2.0-inch O.D.) standard split-spoon sampler (ASTM D1586). These sample locations are denoted with the prefix "S- "on the boring logs.
- 2.4-inch I.D. (2.5-inch O.D.) thin walled (Shelby) tube sampler (ASTM D1587). These sample locations are denoted with the prefix "U- "on the boring logs.
- 2.0-inch I.D. (2.5-inch O.D.) thick-walled, ring-lined (California) sampler (ASTM D3550). These sample locations are denoted with the prefix "CA- "on the boring logs.
- Bulk samples of cuttings were collected during auger advancement.

The ability to sample coarse particles was limited by the sampler sizes and sampling techniques; the collected samples likely underestimate the percentages of gravels, cobbles, or boulders within the embankment and colluvium.

A standard penetration test (SPT) was performed in general accordance with ASTM D1586 at the location of each split-spoon sample. At each SPT location, RJH obtained a "standard penetration resistance" or SPT N-value. The SPT N-value equals the number of blows that are required from a 140-pound hammer dropped 30 inches to drive a standard split-spoon sampler from 6 to 18 inches. At some locations, the SPT sampler encountered refusal (50 blows for less than 6 inches of penetration) prior to advancing 18 inches; therefore, SPT N-values and the associated samples could not be obtained at these locations. At some locations, more material was recovered than the penetration depth, likely because of either sampler seating blows or slough from the boring sides. Blow counts were also recorded at the location of California samples; these blow counts do not correlate directly to N-values, but provide a general indication of the consistency of the sampled material. The SPT N-values and blow counts presented in this Report were not adjusted to account for overburden pressures, hammer energy, etc. SPT and California sampler blow counts were likely influenced by the prevalence of larger gravel or cobbles.

Bedrock was not encountered in any of the borings.

At B-103(P), the initial boring location was terminated about 3 feet deep because of a boulder obstruction. This initial boring was backfilled with cuttings and the boring was re-drilled about 3 feet to the south. The surveyed coordinates presented in Table 2.1 correspond to the location of the re-drilled boring and the completed monitoring well.

Boring B-102B was terminated about 5 feet deep because of a boulder obstruction and was backfilled with cement-bentonite grout. Water from Carson Lake was used as the drilling fluid for mixing grout. The remaining borings were completed as open-standpipe monitoring wells as described in Section 2.7.

2.4 Daily Site Reports

RJH documented Site field activities in Daily Site Reports. Daily Site Reports are presented in Appendix D.

2.5 Logging and Sampling Procedures

RJH observed drilling procedures, recorded relevant drilling information, photographed and visually classified soil samples, and prepared a field log of each boring. In the field, soil samples were classified in general accordance with ASTM D2488 (visual-manual method), except for cuttings, where constituent percentages were estimated for the entire recovered sample, not just the fraction finer than 3 inches.

Recovered split-spoon samples were placed in sealed plastic bags to help preserve the natural moisture content of the material. Samples recovered from California samplers were generally capped and sealed with vinyl tape unless insufficient material was recovered and these samples were placed in sealed plastic bags to help preserve the natural moisture content. One successful Shelby tube sample was capped and sealed with vinyl tape. Bulk samples collected from auger cuttings were placed in either sealed plastic bags or canvas sample bags.

RJH prepared final boring logs based on field and laboratory classifications, quality assurance office review of samples, and indirect observations (i.e., drill chatter, drill resistance, etc.) as appropriate. Between recovered samples, the lithology presented on the boring logs is interpreted. Explanations of the soil descriptors used on the boring logs are presented in Appendix A. Boring logs are presented in Appendix B. Photographs of soil samples are presented in Appendix C.

2.6 Permeability Testing in Soil

RJH performed 13 tests to evaluate the hydraulic conductivity characteristics in the embankment fill and colluvium. In-situ permeability testing consisted of rising head and falling head tests over test intervals ranging between 0 and 21.0 feet in length. Testing was generally performed as follows:

Rising Head Test: Eleven rising head tests were performed in borings during drilling and in completed wells. Four tests were performed in borings during Symmetrix drilling; the casing was either raised from the bottom of the hole to expose the test interval or remained at the bottom of the hole. The test was conducted by measuring natural recovery of groundwater, because groundwater was removed from the hole during drilling by the use of an air compressor. No rising head tests were performed during auger drilling. The remaining seven tests were performed in wells; either a hand bailer or submersible pump was used to remove water from the well casing. The water level in the well was then measured over time as it recovered to near its original level. Hydraulic conductivity of the test interval was estimated from the field data using techniques published by Lambe and Whitman (1969) and equations by Hvorslev (1951) for all test configurations.

Falling Head Test: Two falling head tests were performed during auger drilling. Augers remained at the bottom of the hole and the vertical hydraulic conductivity was measured during testing. The augers were filled with water and then the water level within the augers was measured over time as it declined. Hole depths were measured again following the tests to confirm that hole collapse did not occur during testing. Hydraulic conductivity of the test interval was estimated from the field data using techniques published by Lambe and Whitman (1969) and equations by Hvorslev (1951) for both test configurations.

In-situ hydraulic conductivity test results are summarized in Table 2.2 and calculations are presented in Appendix E.

TABLE 2.2
SOIL HYDRAULIC CONDUCTIVITY TEST RESULTS

Boring ID	Test	Test Performed	Depth Interval (ft)$^{(1)}$	Test Type	Hydraulic Conductivity (cm/s)$^{(2)}$	USCS Soil Classification
Dam Embankment Fill						
B-102A(P)	K-1	During drilling	46.5 to 46.5	Falling Head$^{(3)}$	$1.2x10^{-4}$	GP-GC
B-102A(P)	K-2	In well	36.5 to 48.0	Rising Head$^{(4)}$	$2.7x10^{-6}$	GC, GP-GC, SC
B-102A(P)	K-3	In well	36.5 to 48.0	Rising Head$^{(4)}$	$8.0x10^{-6}$	GC, GP-GC, SC
Colluvium						
B-101(P)	K-1	In well	53.0 to 74.0	Rising Head$^{(4)}$	$4.0x10^{-6}$	Mostly CL, SP-SC
B-101(P)	K-2	In well	53.0 to 74.0	Rising Head$^{(4)}$	$5.3x10^{-6}$	Mostly CL, SP-SC
B-103(P)	K-1	During drilling	30.0 to 30.0	Falling Head$^{(3)}$	$1.6x10^{-3}$	SC
B-104(P)	K-1	During drilling	26.0 to 27.0	Rising Head$^{(4)}$	$2.0x10^{-4}$	SC
B-104(P)	K-2	In well	8.9 to 14.5	Rising Head$^{(4)}$	$7.9x10^{-5}$	CL
B-105A(P)	K-1	During drilling	21.0 to 22.0	Rising Head$^{(4)}$	$1.4x10^{-4}$	CL
B-105A(P)	K-2	During drilling	52.0 to 52.0	Rising Head$^{(3)}$	$1.1x10^{-3}$	SC
B-105A(P)	K-3	In well	53.0 to 73.5	Rising Head$^{(4)}$	$1.0x10^{-4}$	CL, SC
B-105B(P)	K-1	During drilling	12.6 to 12.6	Rising Head$^{(3)}$	$7.1x10^{-3}$	CL
B-105B(P)	K-2	In well	8.6 to 12.6	Rising Head$^{(4)}$	$3.4x10^{-4}$	CL, SC

Notes:
1. Depth below the ground surface, measured along the orientation of the boring.
2. Geometric mean of hydraulic conductivity was calculated.
3. Tested vertical hydraulic conductivity.
4. Tested horizontal hydraulic conductivity

While drilling B-105A(P), water pressure generated by the Symmetrix drilling method caused water and air to be expelled at the ground surface between the casing and the boring wall. Rising head test B-105A(P), K-2 was performed to measure recovery of the groundwater and resolution of expelled water. The water and air expulsion ceased after approximately 33 minutes into the test, and the test was stopped after about 67 minutes once the groundwater level approached static conditions similar to rising head test B-105A(P), K-1. The results for test B-105A(P) K-2 presented in Table 2.2 are for the first 15 minutes of the test.

2.7 Monitoring Wells

2.7.1 Monitoring Well Installation

Open-standpipe monitoring wells were installed in all borings, except B-102B. The locations of the monitoring wells are shown on Figure 1.2. B-101(P) measures groundwater levels in colluvium beneath the dam, B-102A(P) and B-103(P) measure groundwater levels in the embankment fill, and B-104(P), B-105A(P), and B-105B(P) measure groundwater levels in colluvium at the downstream toe of the dam. Information about construction of the monitoring wells is discussed below and shown on Figures 2.1 through 2.6.

All monitoring wells were installed following completion of the boring using conventional techniques, which generally consist of slowly introducing sand or gravel pack and boring sealing materials (bentonite chips or pellets and cement-bentonite grout) into the annular space between the boring wall and PVC pipe while simultaneously withdrawing either hollow-stem augers or casing from the ground.

Monitoring wells B-101(P), B-102A(P), and B-103(P) were constructed using solid and slotted PVC pipe and 10/20 silica sand pack. Well casings consisted of 2-inch Schedule 40 PVC pipe, except for B-101(P) which consisted of 1.5-inch Schedule 40 PVC pipe.

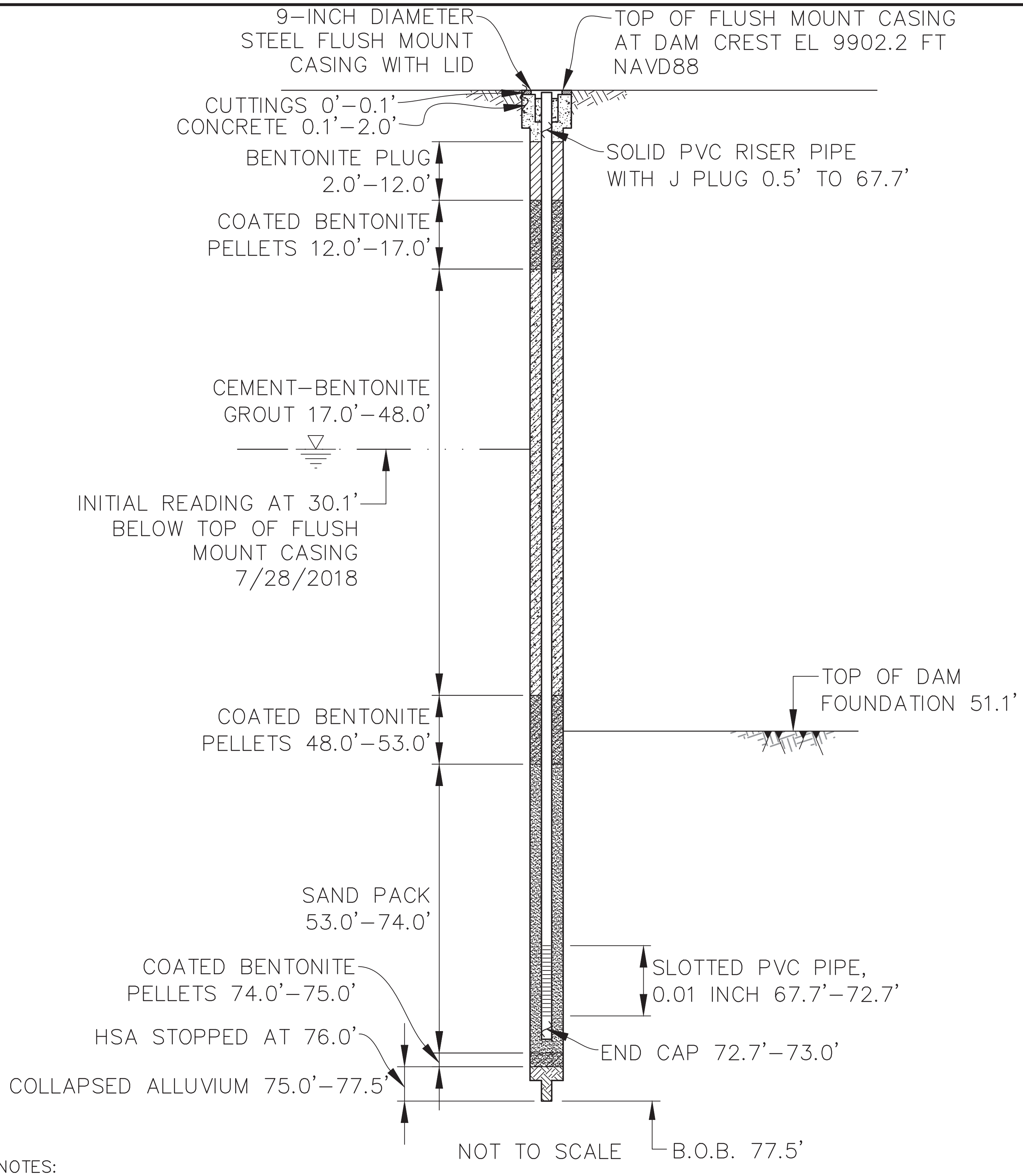
Monitoring wells B-104(P), B-105A(P), and B-105B(P) were constructed using solid PVC pipe, a pre-packed well screen, and minus ¼-inch gravel pack. The pre-packed well screen consisted of slotted PVC well screen surrounded by stainless steel mesh, which encapsulates 20/40 sized well sand between the PVC pipe exterior and the mesh interior. The pre-packed well screen was 2.0-inches I.D. and 2.8-inches O.D. Schedule 40 PVC pipe.

After installation, all monitoring wells were developed to remove groundwater and drilling water from the well and sand or gravel pack. The monitoring wells were developed by surging, bailing, and pumping water from the wells with a submersible pump until either no additional water could be removed or the water was clear.

2.7.2 Monitoring Well Readings

Monitoring wells were measured during the fieldwork. Groundwater level measurements were obtained by RJH while onsite. The City and the SEO also obtained groundwater level measurements. Measured groundwater levels obtained by RJH, the City, and the SEO are presented on Figure 2.7. Data are provided in Appendix F.

The groundwater level measured in B-101(P) on August 23, 2018 and September 6, 2018, do not appear to follow the trend of B-102A(P) or the general trend of decreasing reservoir level. These well measurements may have been improperly recorded.



NOTES:

1. MONITORING WELL INSTALLED 7/28/2018 WITH 7.75-INCH O.D. HOLLOW STEM AUGERS.
2. LOCATION: LAT 38.995296, LONG -108.109759 DEGREES WGS84. BASED ON HANDHELD GPS.
3. TWO 9/16-INCH BOLTS SECURE SURFACE MOUNT CASING.
4. PVC RISER PIPE 1.5 INCHES I.D. 1.9 INCHES O.D. SCH 40. SAND PACK SIZE 10/20.
5. ANNULAR BACKFILL FROM 76.0 FEET TO BOTTOM OF BORING IS ALLUVIUM THAT COLLAPSED INTO BORING AS HOLLOW STEM AUGERS WERE WITHDRAWN.
6. WELL DEVELOPED WITH HAND BAILER 7/28/2018 AND SUBMERSIBLE PUMP 9/18/2018.

City of Grand Junction Colorado	RJH Consultants, Inc.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	MONITORING WELL INSTALLATION B-101(P)
		PROJECT NO. 18115	January 2019 **Figure 2.1**

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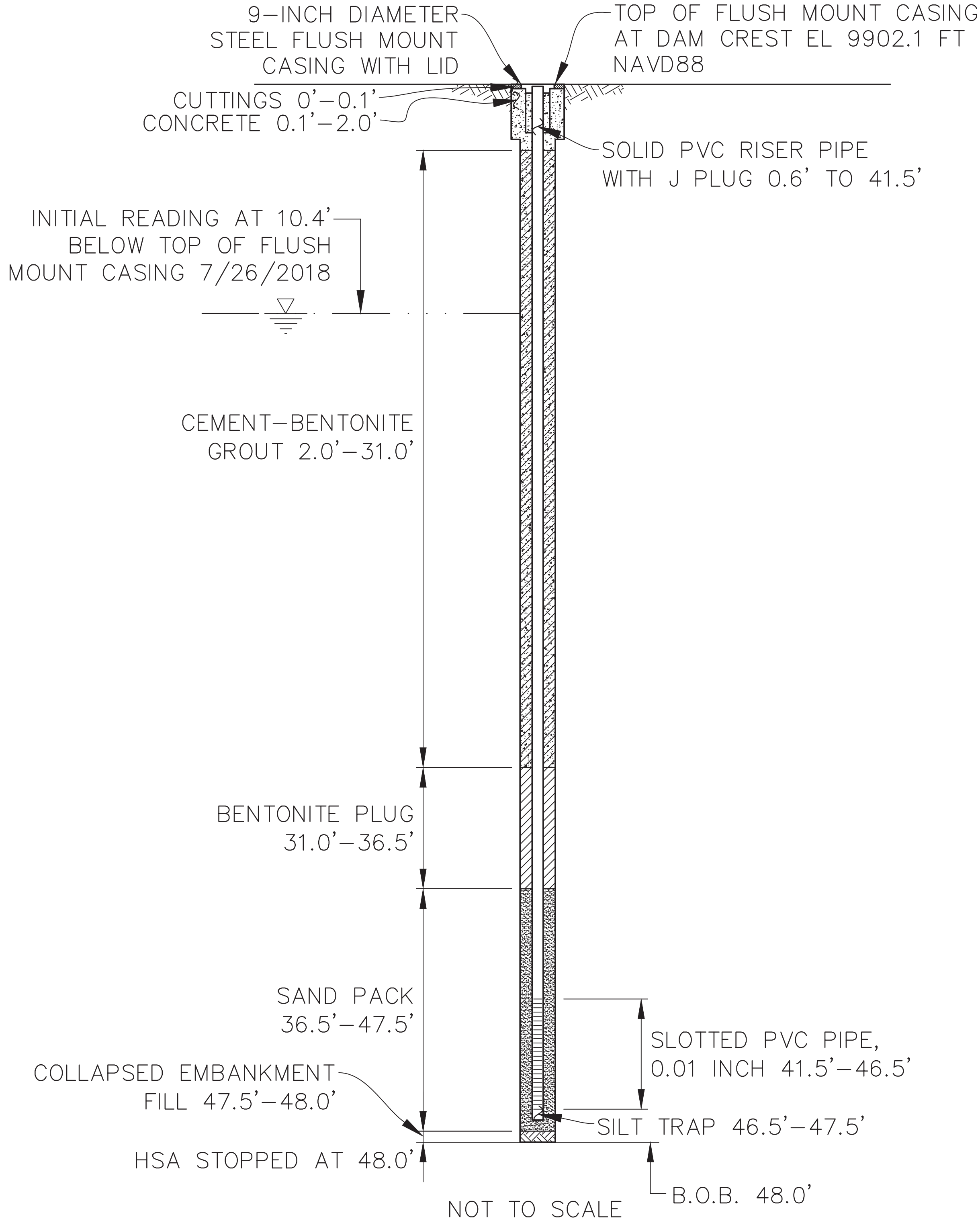

NOTES:

1. MONITORING WELL INSTALLED 7/26/2018 WITH 7.75–INCH O.D. HOLLOW STEM AUGERS.
2. LOCATION: LAT 38.995677, LONG –108.109800 DEGREES WGS84. BASED ON HANDHELD GPS.
3. TWO 9/16–INCH BOLTS SECURE SURFACE MOUNT CASING.
4. PVC RISER PIPE 2.0 INCHES I.D. 2–3/8 INCHES O.D. SCH 40. SAND PACK SIZE 10/20.
5. ANNULAR BACKFILL FROM 47.5 FEET TO BOTTOM OF BORING IS EMBANKMENT FILL THAT COLLAPSED INTO BORING AS HOLLOW STEM AUGERS WERE WITHDRAWN.
6. WELL DEVELOPED WITH SURGE BLOCK AND SUBMERSIBLE PUMP 7/26/2018.

CITY OF Grand Junction COLORADO	RJH CONSULTANTS, INC.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	MONITORING WELL INSTALLATION B-102A(P)
		PROJECT NO. 18115	January 2019 **Figure 2.2**

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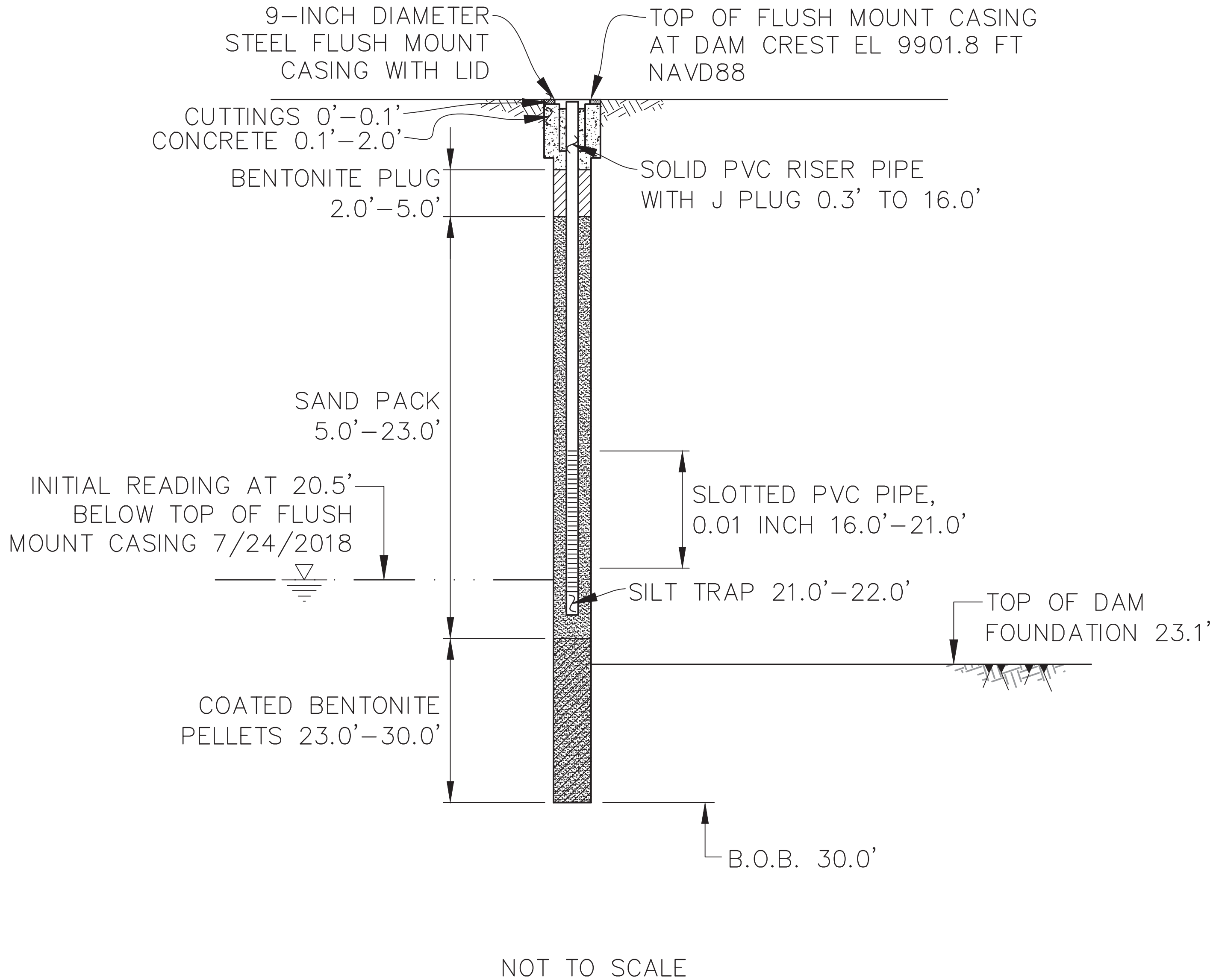

NOTES:

1. MONITORING WELL INSTALLED 7/24/2018 WITH 7.75-INCH O.D. HOLLOW STEM AUGERS.
2. LOCATION: LAT 38.996095, LONG -108.109881 DEGREES WGS84. BASED ON HANDHELD GPS.
3. TWO 9/16-INCH BOLTS SECURE SURFACE MOUNT CASING.
4. PVC RISER PIPE 2.0 INCHES I.D. 2-3/8 INCHES O.D. SCH 40. SAND PACK SIZE 10/20.
5. WELL DEVELOPED WITH SURGE BLOCK AND SUBMERSIBLE PUMP 7/24/2018.

HOGCHUTE DAM
SAFETY EVALUATION
GEOTECHNICAL DATA REPORT

MONITORING WELL
INSTALLATION B-103(P)

PROJECT NO. 18115

January 2019

Figure 2.3

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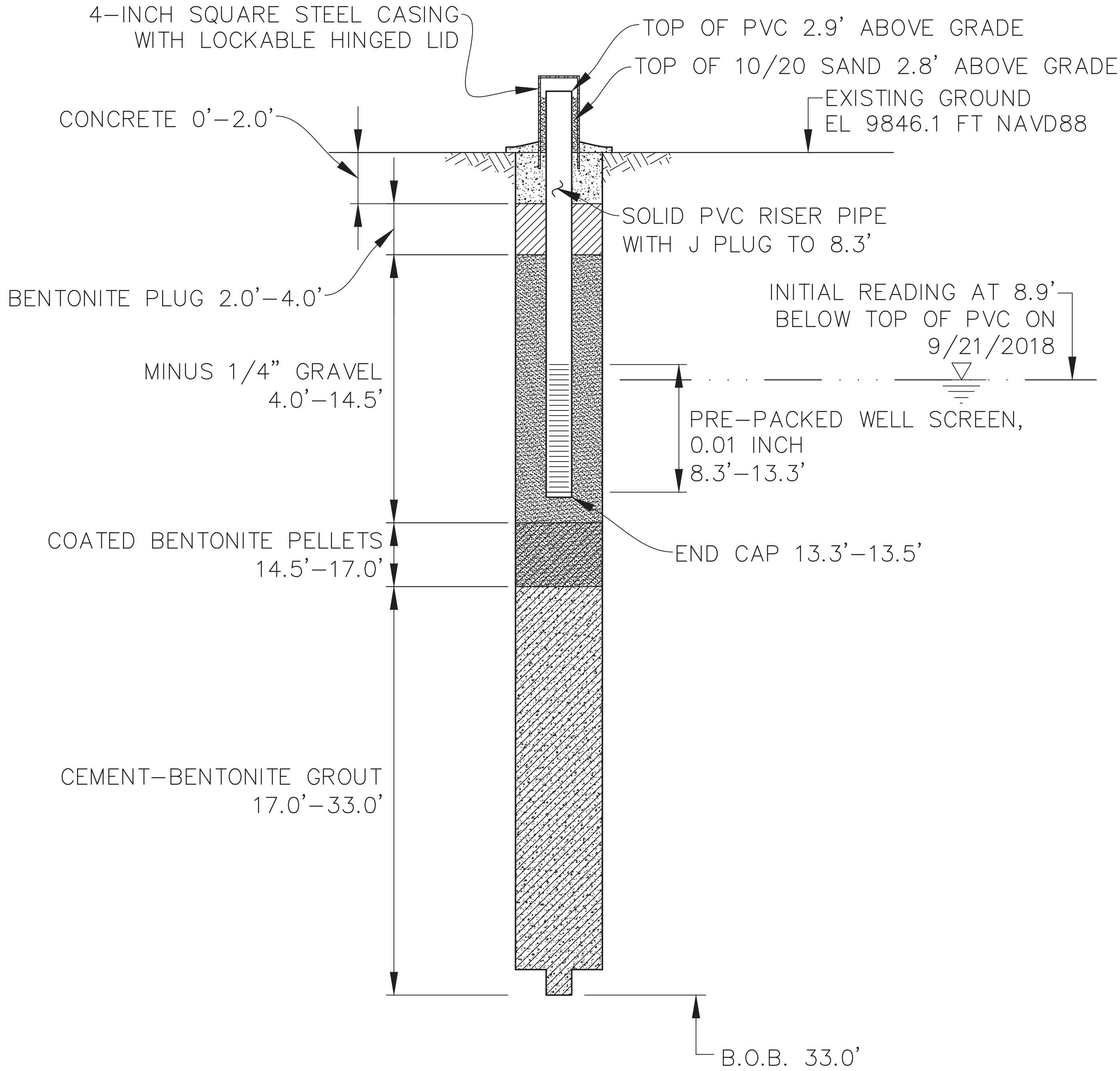

NOT TO SCALE

NOTES:

1. MONITORING WELL INSTALLED 9/21/2018 WITH 5–3/8 INCHES O.D. SYMMETRIX DRIVE CASING ADVANCER.
2. LOCATION: LAT 38.995285, LONG –108.110292 DEGREES WGS84. BASED ON HANDHELD GPS.
3. PVC RISER PIPE 2.0 INCHES I.D. 2–3/8 INCHES O.D. SCHEDULE 40.
4. PRE–PACKED WELL SCREEN 2.0 INCHES I.D. 2.8 INCHES O.D. PVC SCHEDULE 40. SAND PACK SIZE 20/40.
5. WELL DEVELOPED WITH SURGE BLOCK AND SUBMERSIBLE PUMP 9/21/2018.

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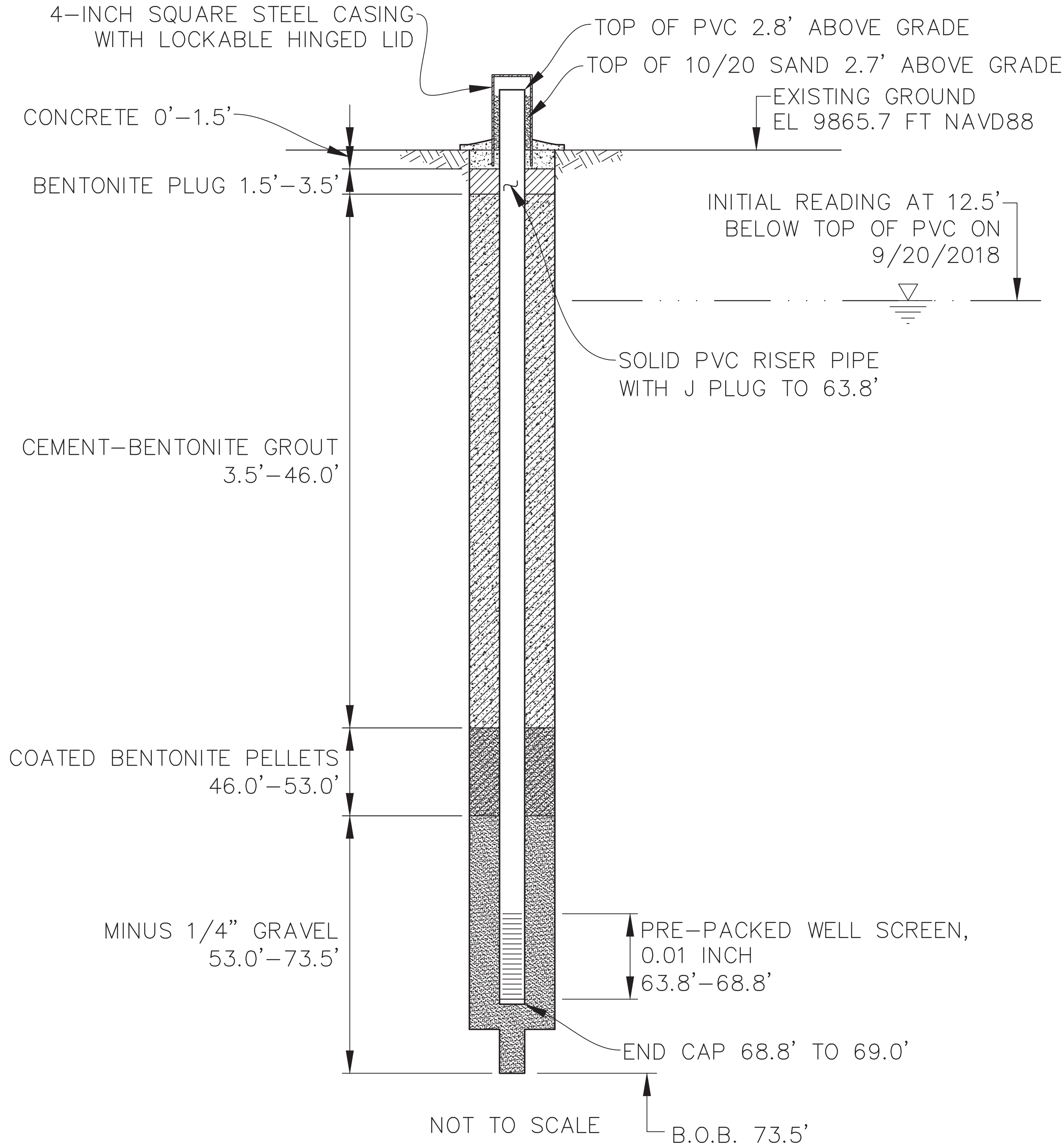
CITY OF Grand Junction COLORADO	RJH CONSULTANTS, INC.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	MONITORING WELL INSTALLATION B-104(P)
		PROJECT NO. 18115	January 2019 **Figure 2.4**



NOTES:

1. MONITORING WELL INSTALLED 9/20/2018 WITH 5-3/8 INCHES O.D. SYMMETRIX DRIVE CASING ADVANCER.
2. LOCATION: LAT 38.995632, LONG -108.110160 DEGREES WGS84. BASED ON HANDHELD GPS.
3. PVC RISER PIPE 2.0 INCHES I.D. 2-3/8 INCHES O.D. SCHEDULE 40.
4. PRE-PACKED WELL SCREEN 2.0 INCHES I.D. 2.8 INCHES O.D. PVC SCHEDULE 40. SAND PACK SIZE 20/40.
5. WELL DEVELOPED WITH SURGE BLOCK AND SUBMERSIBLE PUMP 9/20/2018.

CITY OF Grand Junction COLORADO	RJH CONSULTANTS, INC.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	MONITORING WELL INSTALLATION B-105A(P)
		PROJECT NO. 18115	January 2019 **Figure 2.5**

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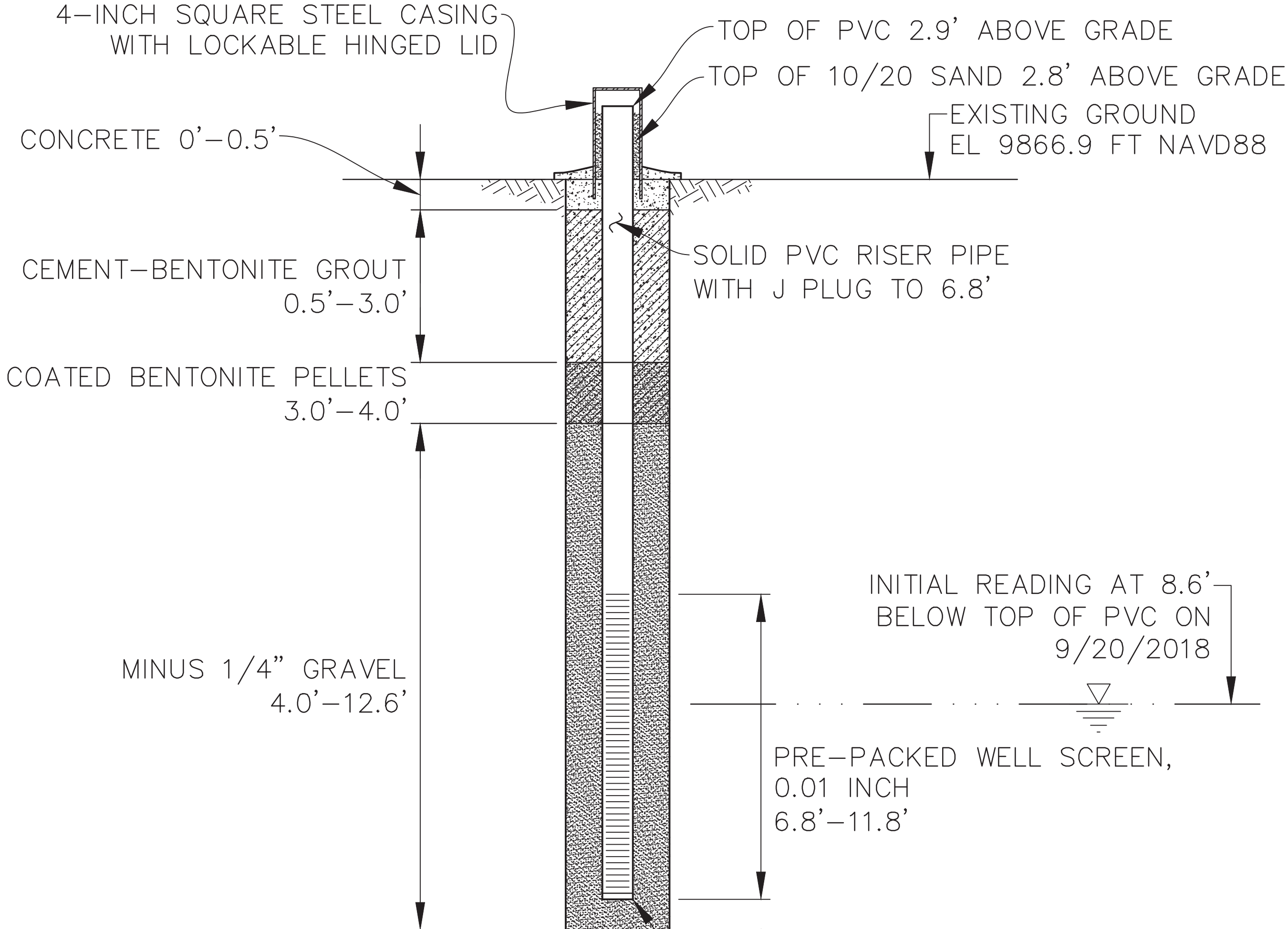

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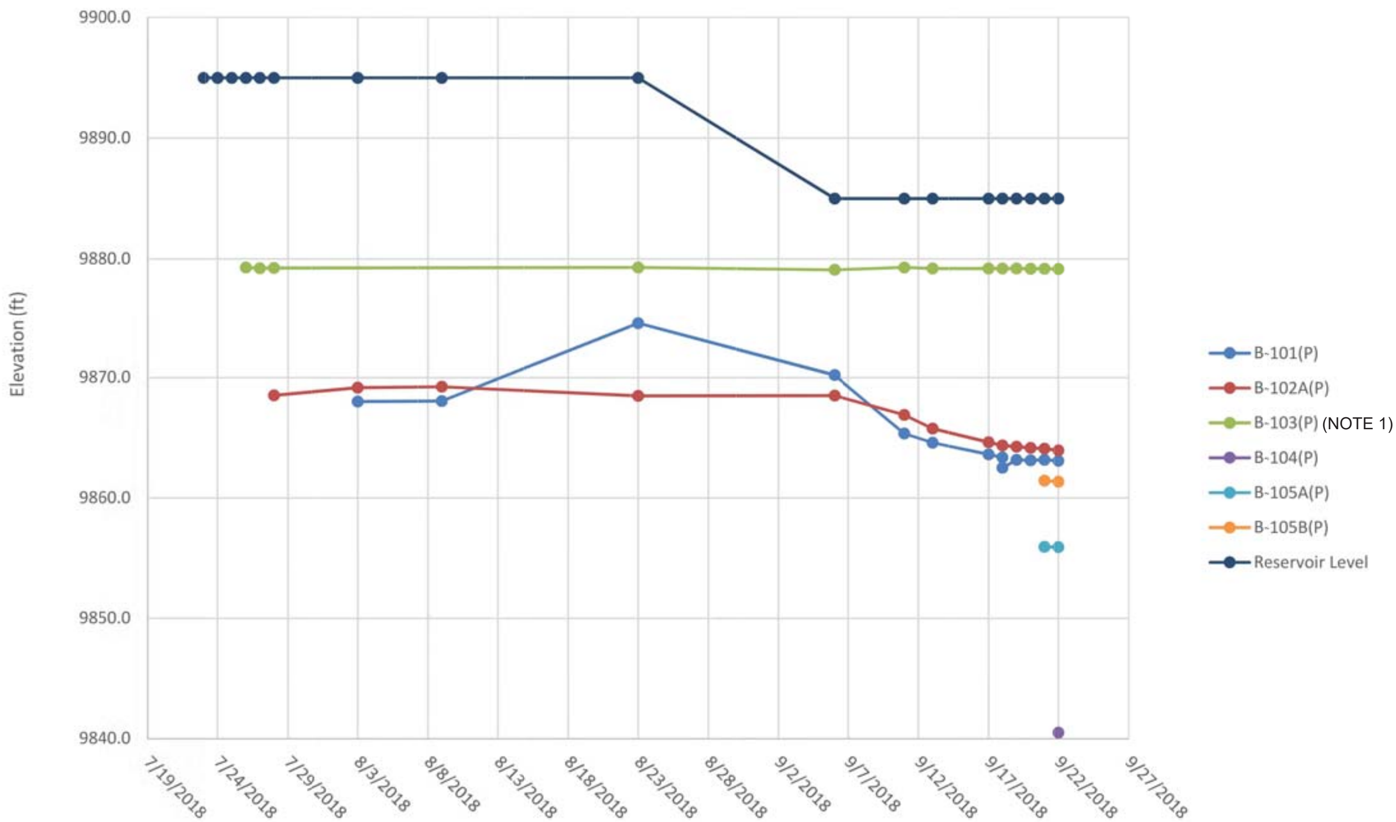
NOTES:

1. MONITORING WELL INSTALLED 9/20/2018 WITH 5-3/8 INCHES O.D. SYMMETRIX DRIVE CASING ADVANCER.
2. LOCATION: LAT 38.995681, LONG -108.110127 DEGREES WGS84. BASED ON HANDHELD GPS.
3. PVC RISER PIPE 2.0 INCHES I.D. 2-3/8 INCHES O.D. SCHEDULE 40.
4. PRE-PACKED WELL SCREEN 2.0 INCHES I.D. 2.8 INCHES O.D. PVC SCHEDULE 40. SAND PACK SIZE 20/40.
5. WELL DEVELOPED WITH SURGE BLOCK AND SUBMERSIBLE PUMP 9/20/2018.

CITY OF Grand Junction COLORADO	RJH CONSULTANTS, INC.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	MONITORING WELL INSTALLATION B-105B(P)
		PROJECT NO. 18115	January 2019 — **Figure 2.6**



NOTE:

1. MEASUREMENTS FOR B–103(P) ARE THE BOTTOM OF THE DRY WELL AND DO NOT REPRESENT THE GROUNDWATER LEVEL

REPRODUCE IN COLOR

CITY OF Grand Junction COLORADO	RJH CONSULTANTS, INC.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	FIELD INVESTIGATION MONITORING WELL DATA	
		PROJECT NO. 18115	January 2019	**Figure 2.7**

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SECTION 3 - LABORATORY TESTING

Laboratory tests were performed on representative samples of soil collected from the borings. RJH retained Advanced Terra Testing of Lakewood, Colorado to perform the laboratory testing. The tests consisted of:

Index Tests:

- Three moisture content and density tests (ASTM D2216 and D7263).
- Five Atterberg limit tests (ASTM D4318).
- Four grain-size analyses (ASTM D6913).
- Two grain-size analyses with hydrometer (ASTM D6913 and D7928).
- Three percent minus #200 analyses (ASTM D1140).
- Three standard Proctor compaction tests (ASTM D698).
- One one-dimensional consolidation test (ASTM D2435).
- Three corrosion suite tests (ASTM C1580, D4972, D1411, and G187).
- Two pinhole dispersion tests (ASTM D4647 Method A).

Permeability Tests:

- Three back pressure permeability tests, flow pump method (ASTM D5084 Method D).

Strength Tests:

- One series of three consolidated undrained triaxial compression tests (ASTM D4767).
- One unconfined compressive strength test (ASTM D2166).

The unconfined compressive strength tests could not be performed on two samples because gravel prevented the samples from remaining intact during extrusion. Similar material recovery issues may have influenced other laboratory results.

Laboratory index test results are summarized in Table 3.1. Laboratory permeability and strength test results are summarized in Table 3.2. Strength test results are shown on Figures 3.1 and 3.2. Laboratory test sheets are provided in Appendix G.

TABLE 3.1
SUMMARY OF INDEX LABORATORY TEST RESULTS

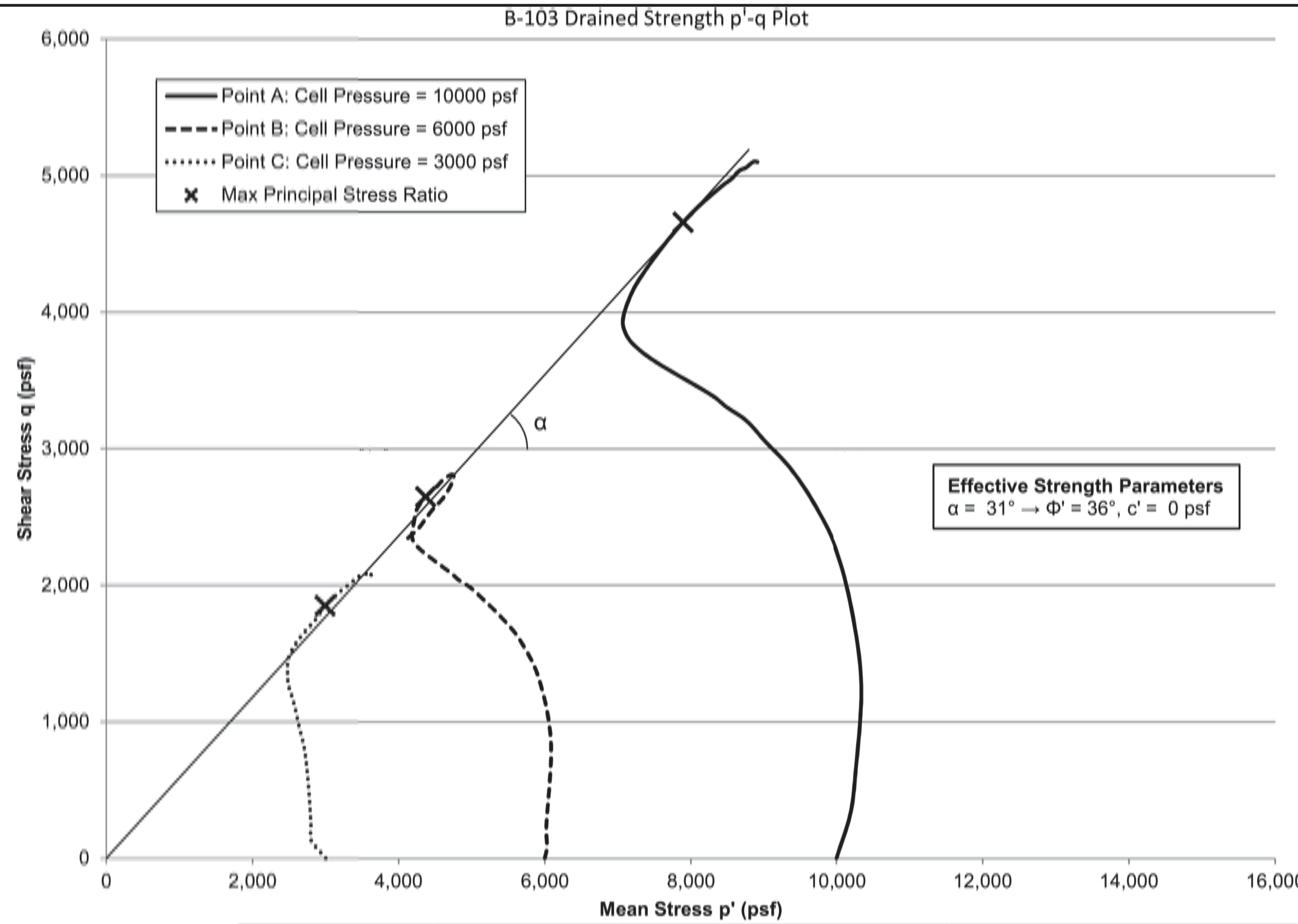
Boring	Sample ID	Depth (ft)	Moisture Content (%)	Dry Density (pcf)	Liquid Limit, LL	Plasticity Index, PI	Percent Gravel (3" to #4)	Percent Sand (#4 to #200)	Percent Fines (< #200)	Optimum Moisture Content (%)	Maximum Dry Unit Weight (pcf)	Coefficient of Compression, Cc	Coefficient of Re-Compression, Cr	Preconsolidation Stress (psf)	Sulfate Concentration (ppm)	Chloride Concentration (ppm)	pH	Minimum Resistivity (Ω*cm)	Sulfide Concentration (ppm)	Pinhole Dispersion Test Results
Dam Embankment Fill																				
B-101(P)	Bu-6	15.0 to 25.0								10.4[1]	131.1[1]									
B-101(P)	Bu-13	25.0 to 40.0			28	11	25.5	28.6	45.9											
B-101(P)	CA-11	30.0 to 31.0	14.3	109.6																ND1[2][3]
B-101(P)	CA-16	42.5 to 43.5					30.1	30.6	39.3											
B-101(P)	Bu-15	45.0 to 50.0													23	38.5	6.8	2,400	0.104	
B-101(P)	S-19	50.6 to 51.5													107	144	7.3	2,600	0.184	
B-102A(P)	Bu-10	18.0 to 41.5			28	11	24.3	29.1	46.6											
B-102A(P)	CA-14	29.0 to 30.0					57.0	21.1	21.9											
B-102A(P)	CA-20	44.0 to 45.0	25.4	95.6											5	108	7.4	1,540	0.01	
B-103(P)	Bu-11	10.0 to 17.5			27	11	23.9	33.1	43.0	10.3[1]	131.3[1]									
B-103(P)	CA-8	15.0 to 16.0	10.8	105.1			46.0	21.4	32.6											ND1[2][4]
Colluvium																				
B-101(P)	Bu-20	51.0 to 65.0			27	12	19.8	26.2	54.0	12.1[1]	126.9[1]									
B-103(P)	U-14	27.5 to 29.9	25.1[5]	101.6[5]			24.8	43.9	31.3			0.224	0.011	6,780						
B-104(P)	CA-9	32.0 to 33.0	19.7	111.8	32	13	33.4	8.5	58.1											

Notes:
1. Results in this table are presented with oversized particle corrections. Tests were performed using standard energy (ASTM D698) and the maximum particle size included in the test was ¾ inch. The percentage of oversized material exceeded the recommendations of ASTM D698.
2. ND1 corresponds to nondispersive clays with very slight to no colloidal erosion under 15 inches to 40 inches of head.
3. Specimen remolded to a dry unit weight of 110 pounds per cubic foot (pcf) and a water content of 17 percent.
4. Specimen remolded to a dry unit weight of 106 pcf and a water content of 14 percent.
5. Average of tests from three triaxial shear test specimens.

TABLE 3.2
SUMMARY OF PERMEABILITY AND STRENGH LABORATORY TEST RESULTS

Boring	Sample ID	Depth (ft)	Permeability (cm/s)	Effective Strength		Total Strength		Unconfined Compressive Strength (psf)
				ϕ' (deg.)	c' (psf)	ϕ_T (deg.)	c_T (psf)	
Colluvium								
B-103(P)	U-14	27.5 to 29.9	1.7×10^{-5}(1) 3.1×10^{-3}(2) 3.4×10^{-5}(3)	36(4,5)	0(4,5)	22(4,5)	640(4,5)	
B-104(P)	CA-9	32.0 to 33.0						958

Notes:
1. Permeability test performed at the consolidated undrained triaxial compression test pressure of 10,000 pounds per square foot (psf).
2. Permeability test performed at the consolidated undrained triaxial compression test pressure of 6,000 psf.
3. Permeability test performed at the consolidated undrained triaxial compression test pressure of 3,000 psf.
4. Consolidated undrained triaxial compression test performed in general accordance with ASTM D4767 with confining pressures of 3,000; 6,000; and 10,000 psf.
5. Based on maximum principal stress ratio.



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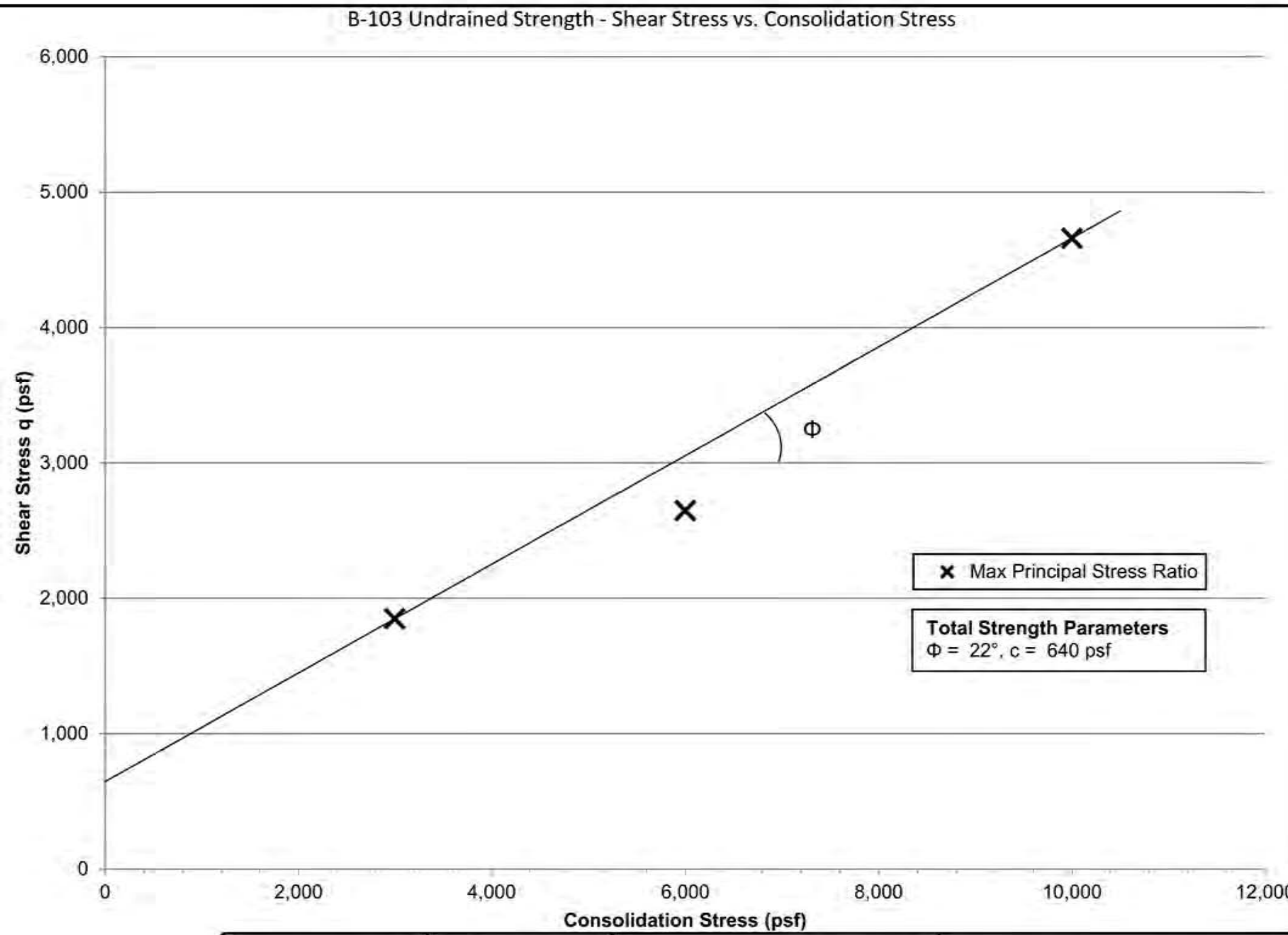
City of Grand Junction Colorado	RJH Consultants, Inc.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	COLLUVIUM DRAINED STRENGTH
		PROJECT NO. 18115	January 2019 **Figure 3.1**



HOGCHUTE DAM
SAFETY EVALUATION
GEOTECHNICAL DATA REPORT

PROJECT NO. 18115

COLLUVIUM
UNDRAINED STRENGTH

January 2019

Figure 3.2

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SECTION 4 - SITE AND SUBSURFACE CONDITIONS

4.1 General Geology

According to published maps (Ellis and Gabaldo, 1989), the Site is located in the southwest portion of the Piceance Basin on the Grand Mesa. The Piceance Basin is a Late Cretaceous to early Tertiary-age (56 to 100 million years old) feature with a series of Laramide uplifts defining the boundaries of the structural basin. The Grand Mesa is capped by resistant basalt flows. Geologic units at the Site consist of Quaternary-age (less than 2.6 million years old) colluvium overlying Tertiary-age (Eocene, 33.9 to 56 million years old) Green River Formation bedrock. Other geologic units in the nearby area surrounding the Site consist of Quaternary-age terrace gravel and till, and Tertiary-age basalt and Wasatch Formation. The published geology at the Site and nearby surrounding area is shown on Figure 4.1.

Published maps do not show faults in the Site vicinity; however, the southern edge of the Grand Mesa is defined by an escarpment above the flat-lying valley below. The Site is located near the top of the escarpment.

4.2 Site Geology

The Site is generally covered by native vegetation that would be typical of a wet, high-altitude environment. Evidence of possible reservoir seepage downstream of the dam included a small area of inactive seeps near shrubs on the hillside to the right of the outlet works and water flowing under the downstream rock shell toe and discharging from a drain to the right of the outlet works. No evidence of active seepage was observed near the shrubs during our work. Seepage from the drain appeared to be flowing clear at the time of our work and at a rate of approximately 4 to 5 gallons per minute (gpm).

The geologic Site conditions observed by RJH generally agreed with the published geologic mapping. The Site generally consists of colluvial deposits with basalt outcrops forming cliffs to the west, north, and east. Bedrock was not encountered in any of the borings.

4.3 Subsurface Conditions

4.3.1 General Subsurface Profile

The subsurface units encountered in the borings were embankment fill and colluvium. Bedrock was not encountered in any of the borings. Borings at the dam's downstream toe did not encounter embankment fill.

The following sections describe the properties of the encountered materials. Subsurface sections are shown on Figures 4.2 through 4.5.

4.3.2 Embankment Fill

Embankment fill was encountered at the ground surface in B-101(P), B-102A(P), B-102B, and B-103(P). Embankment fill extended to depths of 51.1 feet and 23.1 feet in B-101(P) and B-103(P), respectively, and was underlain by colluvial deposits in both borings. Borings B-102A(P) and B-102B encountered refusal at 48.0 feet and 5.0 feet, respectively, and did not extend into the colluvium beneath the dam.

Approximately the first foot of embankment fill was crushed gravel road base. In order of prevalence, the remaining embankment fill consisted of clayey sand with gravel (SC), clayey gravel with sand (GC), clayey sand (SC), and poorly graded gravel with clay and sand (GP-GC). Embankment fill contained 15 to 80 percent fine to coarse grained gravel, 15 to 65 percent fine to coarse grained sand, 5 to 47 percent low to medium plasticity fines, and less than 5 percent cobbles. The maximum recovered particle size was 4 inches. The composition and maximum particle size observed in the recovered samples were influenced by the size of the samplers; difficult drilling and sampling conditions were encountered that are likely indicative of larger cobbles or boulders within the embankment fill.

Embankment fill was generally moist above the water table and moist to wet below the water table. Drive sampler refusal (50 blows for less than 6 inches) was encountered at six locations after advancing the sampler 0.1 to 0.3 foot. At 28 other sample locations, uncorrected SPT N-values ranged from 16 to 54 and averaged 35. In our opinion, the SPT results were likely influenced by larger gravel or cobbles within the embankment fill and are not reliable to correlate with material density; however, apparent density based on SPT values is reported on the boring logs.

Three in-situ permeability tests were performed in the embankment fill in B-102A(P). The calculated vertical hydraulic conductivity was 1.2 x 10^{-4} centimeters per second (cm/s) and the calculated horizontal hydraulic conductivity values ranged from 8.0 x 10^{-6} to 2.7 x 10^{-6} cm/s.

As discussed above, observations during drilling and sampling indicate the presence of significant fractions of large materials, including gravels, cobbles, and boulders in the embankment fill. The results of the field tests were likely influenced by the presence of these larger materials.

Laboratory index property tests were performed on eleven samples of embankment fill material from B-101(P), B-102A(P), and B-103(P), ranging in depth from 10.0 to 51.5 feet. Some of the results are summarized as follows:

- The natural moisture content ranged from 10.8 to 25.4 percent and averaged 16.8 percent.
- The natural dry density ranged from 95.6 to 109.6 pcf and averaged 103.4 pcf.
- The liquid limit was either 27 or 28 and the plasticity index was 11 for all samples.
- Two standard Proctor tests were performed, and the results were very similar between the two samples. The maximum dry density for sample B-103(P), Bu-11 was 131.3 pcf at optimum moisture of 10.3 percent. The maximum dry density for sample B-101(P), Bu-6 was 131.3 pcf at optimum moisture of 10.4 percent.
- Three samples from B-101(P) and B-102A(P) had a suite of corrosion tests performed. The three samples were taken at depths near the approximated depth of the outlet works conduit, ranging from 44.0 to 51.5 feet. See Table 3.1 for corrosion test results.
- Embankment fill materials were classified as nondispersive.

4.3.3 Colluvium (Qc)

Colluvium was encountered at the ground surface in B-104(P), B-105A(P), and B-105B(P), and extended to the final boring depths of 33.0, 73.5, and 12.6 feet, respectively. Colluvium was encountered beneath embankment fill and within B-101(P) and B-103(P) at approximately 51.1 and 23.1 feet, respectively, and extended to the final boring depths of 77.5 and 30.0 feet, respectively.

In order of prevalence, colluvium consisted of sandy lean clay with gravel (CL), clayey sand with gravel (SC), gravelly lean clay with sand (CL), lean clay with sand (CL), lean clay (CL), sandy lean clay (CL), poorly graded gravel with silt and sand (GP-GM), lean clay with gravel (CL), and poorly graded sand with clay and gravel (SP-SC). Colluvium contained 5 to 100 percent nonplastic to highly plastic fines, fines were mostly low to medium plasticity, 0 to 80 percent fine to coarse grained sand, and 0 to 75 percent fine to coarse grained gravel. The maximum recovered particle size was 2.0 inches. Chlorite deposits were present in colluvium from depths of 25.3 to 30.3 feet in B-104(P). The composition and maximum particle size observed in the recovered samples were influenced by the size of the samplers; difficult sampling conditions were encountered that are likely indicative of larger gravels, cobbles, or boulders within the colluvium. The colluvium is anticipated to be a heterogeneous material based on its formation from talus deposit, landslide, earthflow, and soil creep processes (Ellis and Gabaldo, 1989).

Colluvium was generally dry to moist above the water table and moist to wet below the water table. Drive samplers encountered refusal (50 blows for less than 6 inches) at nine locations after advancing the sampler 0.2 to 0.4 foot. At 20 other sample locations, uncorrected SPT N-values ranged from 5 to 76 and averaged 33. In our opinion, the SPT results were likely influenced by larger gravel, cobbles, or boulders within the colluvium and are not reliable to correlate with material density; however, apparent density based on SPT values is reported on the boring logs.

Ten in-situ permeability tests were performed in the colluvium; the calculated vertical hydraulic conductivity values ranged from 7.1×10^{-3} to 1.1×10^{-3} cm/s and the calculated horizontal hydraulic conductivity values ranged from 3.4×10^{-4} to 4.0×10^{-6} cm/s.

As discussed above, observations during drilling and sampling indicate the presence of significant fractions of large materials, including gravels, cobbles, and boulders in the colluvium. The results of the field tests were likely influenced by the presence of these larger materials.

Laboratory index, permeability, and strength tests were performed on three samples of colluvium from B-101(P), B-103(P), and B-104(P). Some of the results are summarized as follows:

- The natural moisture content ranged from 19.7 percent to 25.1 percent.
- The natural dry density ranged from 101.6 pcf to 111.8 pcf.
- The liquid limit was either 27 or 32 and the plasticity index was 12 or 13.

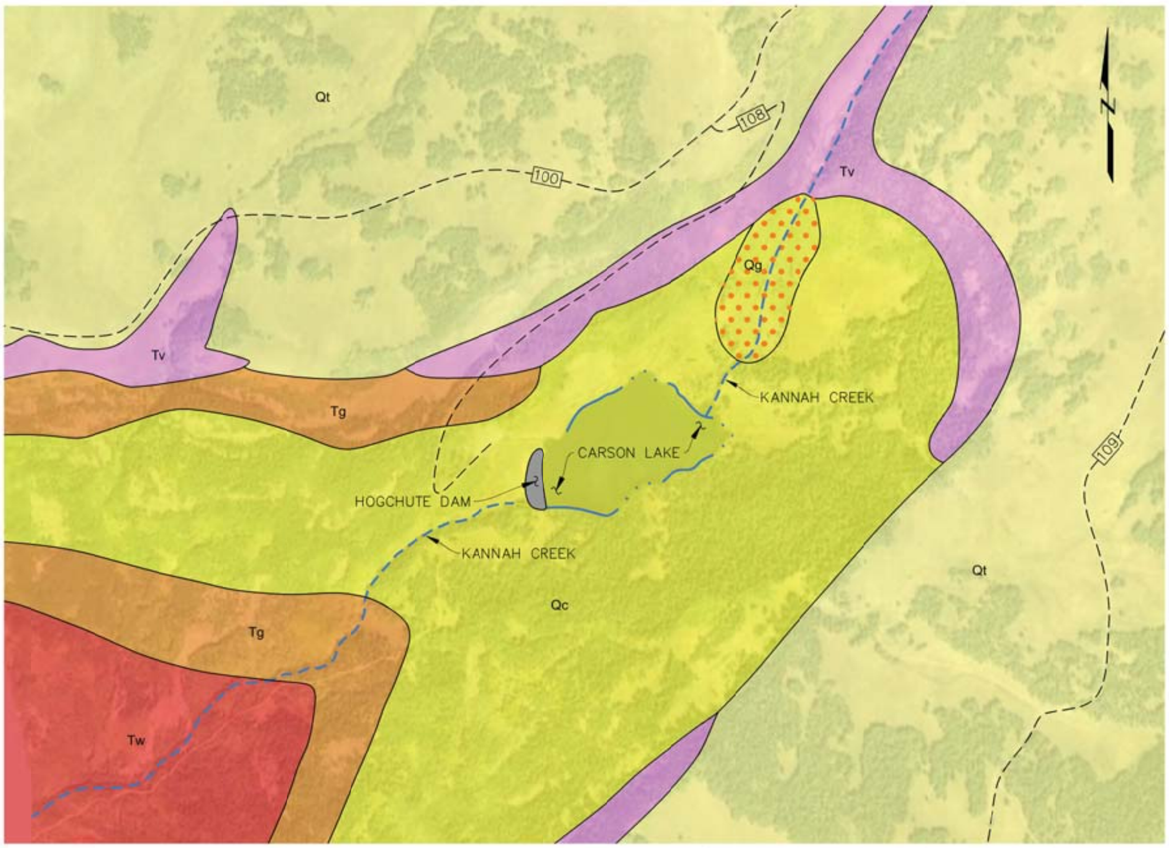
- One standard Proctor test was performed. The maximum dry density for sample B-101(P), Bu-20 was 126.9 pcf at optimum moisture of 12.1 percent.
- Consolidated-undrained triaxial tests and permeability tests were performed on one sample at compression test pressures of 3,000, 6,000, and 10,000 pounds per square foot (psf). The effective strength parameters were phi' of 36 degrees and c' of zero psf. The total strength parameters were phi of 22 degrees and cohesion of 640 psf. The triaxial data are based on the maximum principal stress ratio.
- The permeability results at 3,000, 6,000, and 10,000 psf compression test pressures were 3.4 x 10^{-5}, 3.1 x 10^{-3}, and 1.7 x 10^{-5} cm/s, respectively.
- See Table 3.1 for results of the one-dimensional compression test and see Table 3.2 for results on the unconfined compressive strength test.

4.3.4 Groundwater

Three monitoring wells are located along the crest of the dam (B-101(P), B-102A(P), and B-103(P)). The static water level was recorded in B-101(P) and B-102A(P) at about El. 9868.0 and El. 9869.2, respectively on August 9, 2018, when the reservoir was full at El. 9895. The water level in both wells dropped about 5 feet with a 10-foot decrease in reservoir elevation (to about El. 9885 on September 22, 2018). It is our opinion that the readings for B-101(P) taken on August 23, 2018 and September 6, 2018 were likely recorded in error because they do not appear to follow the trend of B-102A(P) or the general trend of decreasing reservoir level, and do not represent the water level during that period. No water was measured in B-103(P) when the reservoir was full or when the reservoir was lowered 10 feet. The measurements for B-103(P) on Figure 2.7 are the bottom of the dry well; it is likely that groundwater is lower than the B-103(P) screened interval.

Three monitoring wells are located in colluvium downstream of the dam (B-104(P), B-105A(P), and B-105B(P)). The water level at the downstream toe of the dam in B-105A(P) and B-105(B) was at El. 9855.9 and El. 9861.4, respectively, on September 22, 2018 when the reservoir was at El. 9885 feet (about 10 feet below the spillway level). The water level in B-104(P), which is about 45 feet downstream from the embankment toe on the left side of the outlet works, was at El. 9840.5 on September 22, 2018 when the reservoir was at El. 9885.

The drilling operations did not appear to affect the observed flow at the drain near the outlet works or the seeps near shrubs on the hillside. The seepage at the outlet works remained clear prior to, during, and following drilling activities and the seepage rate remained between approximately 4 and 5 gpm.



LEGEND:

		EMBANKMENT FILL
	Qg	TERRACE GRAVEL
	Qc	COLLUVIUM
	Qt	UNDIFFERENTIATED TILL
	Tv	BASALT
	Tg	GREEN RIVER FORMATION
	Tw	WASATCH FORMATION
		CREEK
		U.S. FOREST SERVICE ROAD
		BODY OF WATER

NOTES:

1. AERIAL IMAGERY WAS OBTAINED FROM MICROSOFT BING, IMAGERY DATE UNKNOWN.
2. MAPPED UNITS ARE APPROXIMATE AND BASED ON INFORMATION FROM A PUBLISHED U.S. GEOLOGICAL SURVEY MAP (ELLIS AND GABALDO, 1989). MAPPED UNITS ARE SHOWN ON THIS FIGURE FOR COMPLETENESS AND MAY NOT HAVE BEEN ENCOUNTERED DURING FIELD WORK PERFORMED BY RJH. NOT ALL UNITS SHOWN IMPACT THIS PROJECT AND THEREFORE ARE NOT DESCRIBED IN THE REPORT TEXT.
3. APPROXIMATE LOCATIONS OF U.S. FOREST SERVICE ROADS, HOGCHUTE DAM, AND CARSON LAKE DEVELOPED USING MICROSOFT BING AERIAL IMAGERY.

REPRODUCE IN COLOR

0 500 1000 2000 3000
SCALE IN FEET

CITY OF Grand Junction COLORADO	RJH CONSULTANTS, INC.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	PUBLISHED SITE GEOLOGY
		PROJECT NO. 18115	January 2019 Figure 4.1

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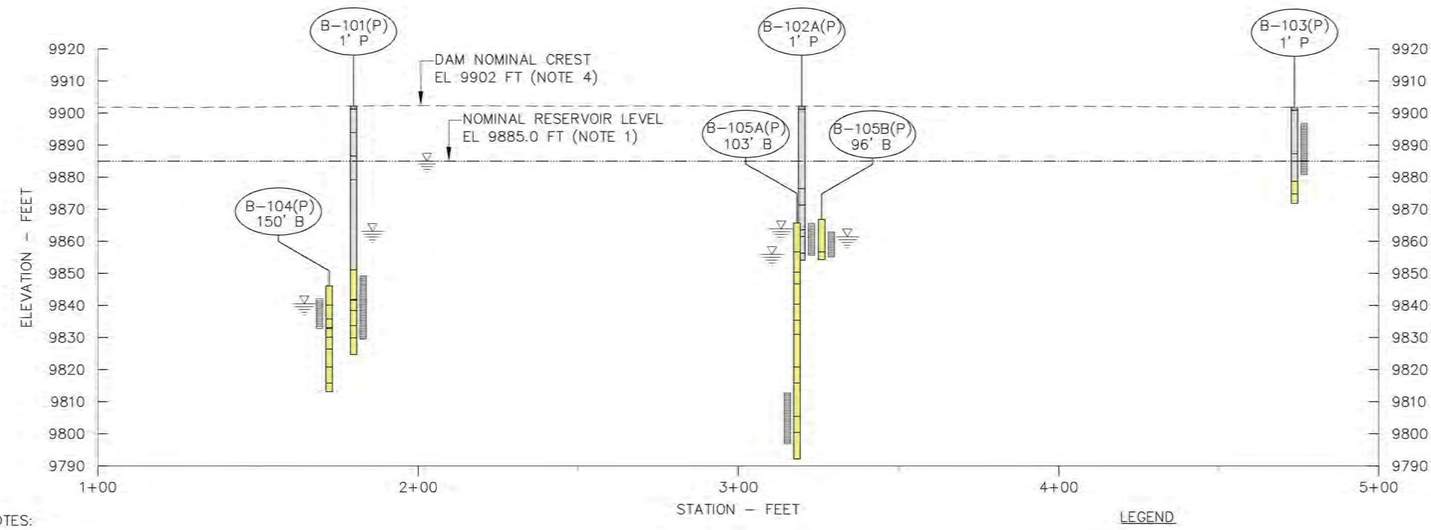

PROFILE

0 15 30 60 90
SCALE IN FEET

NOTES:

1. NOMINAL RESERVOIR LEVEL DURING FINAL GROUNDWATER LEVEL MEASUREMENT ON 9/22/2018.
2. B-103(P) WELL WAS DRY AT FINAL GROUNDWATER LEVEL MEASUREMENT.
3. ALL GEOLOGICAL CONTACTS ARE APPROXIMATE AND NOT ALL INFORMATION IS SHOWN. BORING LOGS SHOWN GENERALIZE SUBSURFACE CONDITIONS AND ARE NOT INTENDED TO BE A COMPLETE OR ACCURATE DEPICTION OF THE SUBSURFACE CONDITIONS. COMPLETE BORING LOGS ARE PROVIDED IN APPENDIX B.
4. GROUND SURFACE TOPOGRAPHY DATA PROVIDED BY CITY OF GRAND JUNCTION, CO. HORIZONTAL DATUM IS NAD83 AND VERTICAL DATUM IS NAVD88.
5. GEOMETRY OF EMBANKMENT ZONES, OUTLET WORKS, TOE DRAIN, AND CUTOFF TRENCH NOT SHOWN.
6. BORING B-102B NOT SHOWN BECAUSE DRILLED STRATIGRAPHIC UNITS ARE THE SAME AS B-102A(P).

LEGEND

- ROAD BASE
- EMBANKMENT FILL
- Qc COLLUVIUM
- MONITORING WELL SENSING ZONE
- GROUNDWATER LEVEL MEASURED FROM MONITORING WELL ON 9/22/2018
- B-101(P) 1' P — MONITORING WELL NAME; DISTANCE PROJECTED (P) OR BEYOND (B) SECTION LOCATION

City of Grand Junction Colorado	RJH CONSULTANTS, INC.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	DAM PROFILE
		PROJECT NO. 18115	January 2019 — Figure 4.2

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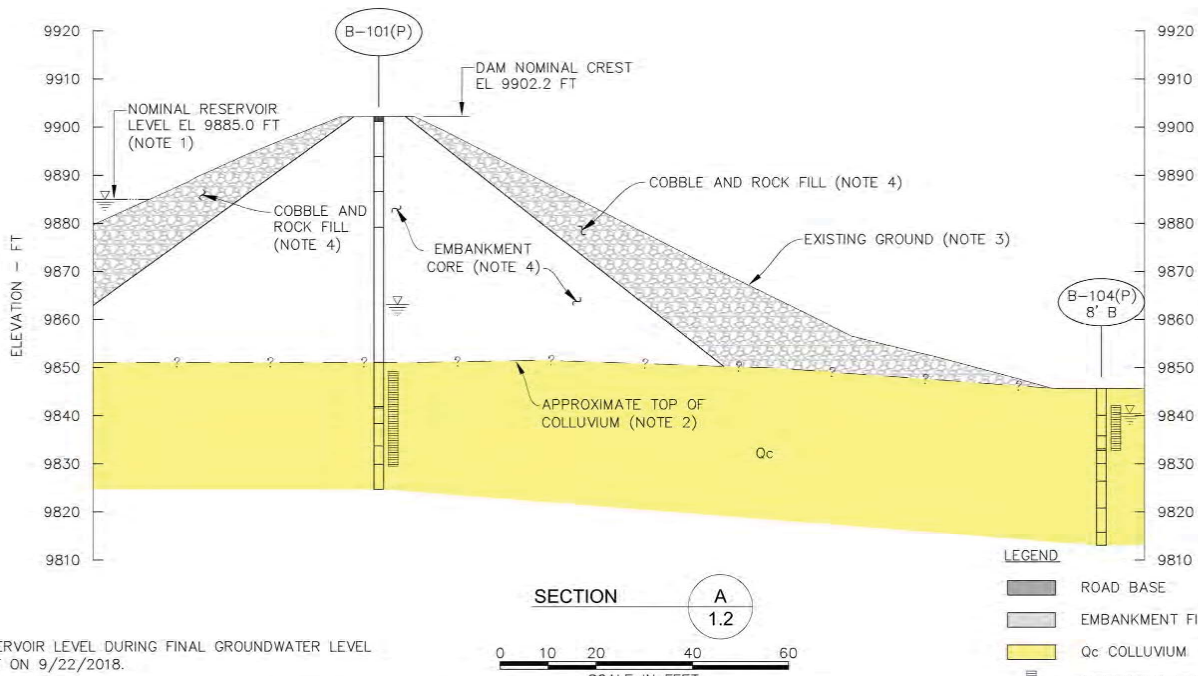


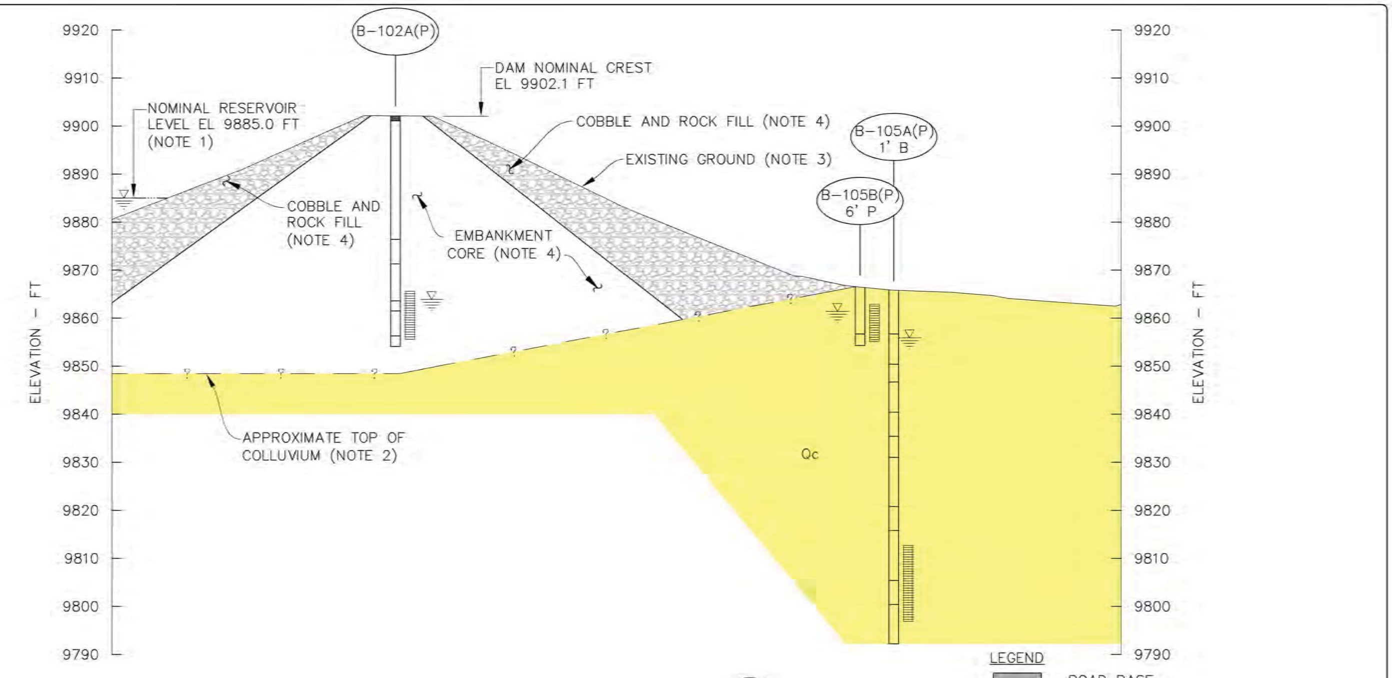
LEGEND

- ROAD BASE
- EMBANKMENT FILL
- Qc COLLUVIUM
- MONITORING WELL SENSING ZONE
- GROUNDWATER LEVEL MEASURED FROM MONITORING WELL ON 9/22/2018
- B-101(P) 1' P — MONITORING WELL NAME; DISTANCE PROJECTED (P) OR BEYOND (B) SECTION LOCATION

NOTES:

1. NOMINAL RESERVOIR LEVEL DURING FINAL GROUNDWATER LEVEL MEASUREMENT ON 9/22/2018.
2. ALL GEOLOGICAL CONTACTS ARE APPROXIMATE AND NOT ALL INFORMATION IS SHOWN. BORING LOGS SHOWN GENERALIZE SUBSURFACE CONDITIONS AND ARE NOT INTENDED TO BE A COMPLETE OR ACCURATE DEPICTION OF THE SUBSURFACE CONDITIONS. COMPLETE BORING LOGS ARE PROVIDED IN APPENDIX B.
3. GROUND SURFACE TOPOGRAPHY DATA PROVIDED BY CITY OF GRAND JUNCTION, CO. HORIZONTAL DATUM IS NAD83 AND VERTICAL DATUM IS NAVD88.
4. GEOMETRY OF EMBANKMENT ZONES WAS APPROXIMATED USING DATA FROM DESIGN DRAWINGS. OUTLET WORKS, TOE DRAIN, AND CUTOFF TRENCH NOT SHOWN.

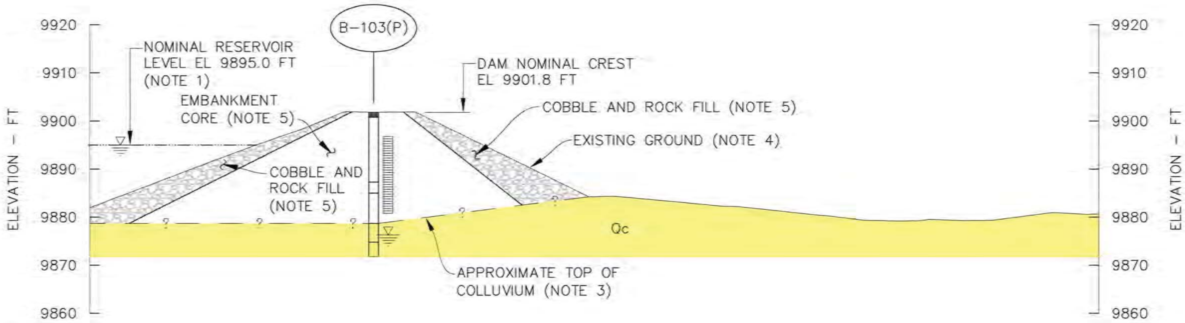
City of Grand Junction Colorado	RJH Consultants, Inc.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	DAM SECTION A SOUTH
		PROJECT NO. 18115	January 2019 **Figure 4.3**



NOTES:

1. NOMINAL RESERVOIR LEVEL DURING FINAL GROUNDWATER LEVEL MEASUREMENT ON 9/22/2018.
2. ALL GEOLOGICAL CONTACTS ARE APPROXIMATE AND NOT ALL INFORMATION IS SHOWN. BORING LOGS SHOWN GENERALIZE SUBSURFACE CONDITIONS AND ARE NOT INTENDED TO BE A COMPLETE OR ACCURATE DEPICTION OF THE SUBSURFACE CONDITIONS. COMPLETE BORING LOGS ARE PROVIDED IN APPENDIX B.
3. GROUND SURFACE TOPOGRAPHY DATA PROVIDED BY CITY OF GRAND JUNCTION, CO. HORIZONTAL DATUM IS NAD83 AND VERTICAL DATUM IS NAVD88.
4. GEOMETRY OF EMBANKMENT ZONES WAS APPROXIMATED USING DATA FROM DESIGN DRAWINGS. OUTLET WORKS, TOE DRAIN, AND CUTOFF TRENCH NOT SHOWN.
5. BORING B-102B NOT SHOWN BECAUSE DRILLED STRATIGRAPHIC UNITS ARE THE SAME AS B-102A(P). BORING B-102B TERMINATED SHALLOW ON A ROCK.

City of Grand Junction Colorado	RJH Consultants, Inc.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	DAM SECTION B MIDDLE
		PROJECT NO. 18115	January 2019 — Figure 4.4



SECTION C 1.2

0 10 20 40 60
SCALE IN FEET

NOTES:

1. NOMINAL RESERVOIR LEVEL DURING DRILLING ON 7/23/2018.
2. B-103(P) WELL WAS DRY DURING FINAL GROUNDWATER LEVEL MEASUREMENT FROM WELL ON 9/22/2018. GROUNDWATER LEVEL SHOWN WAS MEASURED DURING DRILLING ON 7/23/2018.
3. ALL GEOLOGICAL CONTACTS ARE APPROXIMATE AND NOT ALL INFORMATION IS SHOWN. BORING LOGS SHOWN GENERALIZE SUBSURFACE CONDITIONS AND ARE NOT INTENDED TO BE A COMPLETE OR ACCURATE DEPICTION OF THE SUBSURFACE CONDITIONS. COMPLETE BORING LOGS ARE PROVIDED IN APPENDIX B.
4. GROUND SURFACE TOPOGRAPHY DATA PROVIDED BY CITY OF GRAND JUNCTION, CO. HORIZONTAL DATUM IS NAD83 AND VERTICAL DATUM IS NAVD88.
5. GEOMETRY OF EMBANKMENT ZONES WAS APPROXIMATED USING DATA FROM DESIGN DRAWINGS. OUTLET WORKS, TOE DRAIN, AND CUTOFF TRENCH NOT SHOWN.

LEGEND

- ROAD BASE
- EMBANKMENT FILL
- Qc COLLUVIUM
- MONITORING WELL SENSING ZONE
- GROUNDWATER LEVEL MEASURED FROM MONITORING WELL ON 7/23/2018
- B-101(P) MONITORING WELL NAME

City of Grand Junction Colorado	RJH CONSULTANTS, INC.	HOGCHUTE DAM SAFETY EVALUATION GEOTECHNICAL DATA REPORT	DAM SECTION C NORTH
		PROJECT NO. 18115	January 2019 Figure 4.5

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SECTION 5 - LIMITATIONS

This Report has been prepared for the exclusive use of RJH, the City of Grand Junction, and the SEO to support evaluation of potential dam safety issues at Hogchute Dam. RJH is not responsible for technical interpretations of this data by others. RJH has endeavored to conduct our professional services for this Project in a manner consistent with a level of care and skill ordinarily exercised by members of the engineering profession currently practicing in Colorado under similar conditions as this Project. RJH makes no other warranty, expressed or implied.

The methods used in this study indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect variations in subsurface conditions that may exist between sampling locations.

SECTION 6 - REFERENCES

Ellis, M.S. and Gabaldo, V. (1989). *Geologic Map and Cross Sections of Parts of the Grand Junction and Delta 30' x 60' Quadrangles, West-Central Colorado.* U.S. Geological Survey Coal Investigations Map C-124.

Hvorslev, M.J. (1951). *Time Lag and Soil Permeabilities in Groundwater Observations.* U.S. Army Corps of Engineers Waterways Experiment Station Bulletin 36.

Lambe, T.W. and Whitman, R.V. (1969). *Soil Mechanics.* John Wiley & Sons, New York.

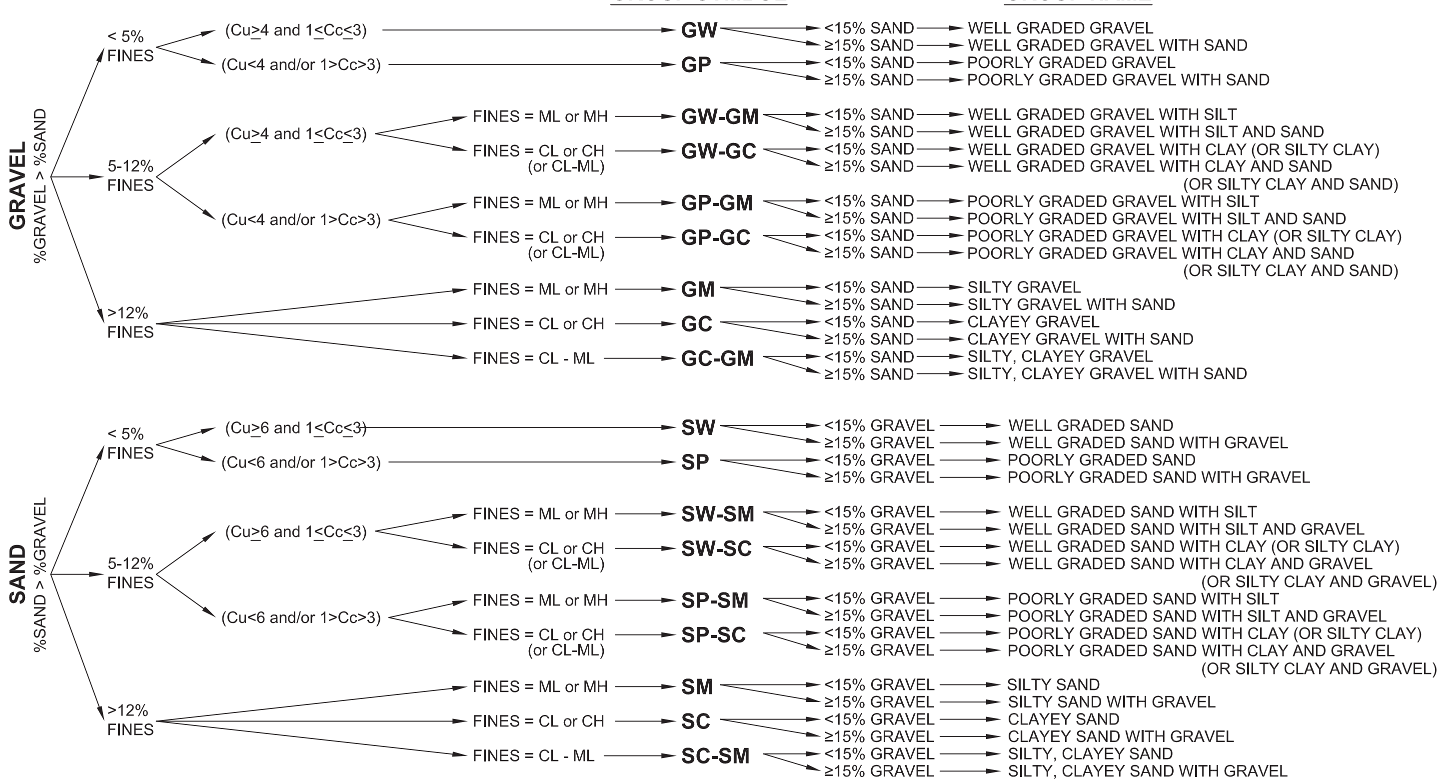
APPENDIX A

SOIL DESCRIPTORS

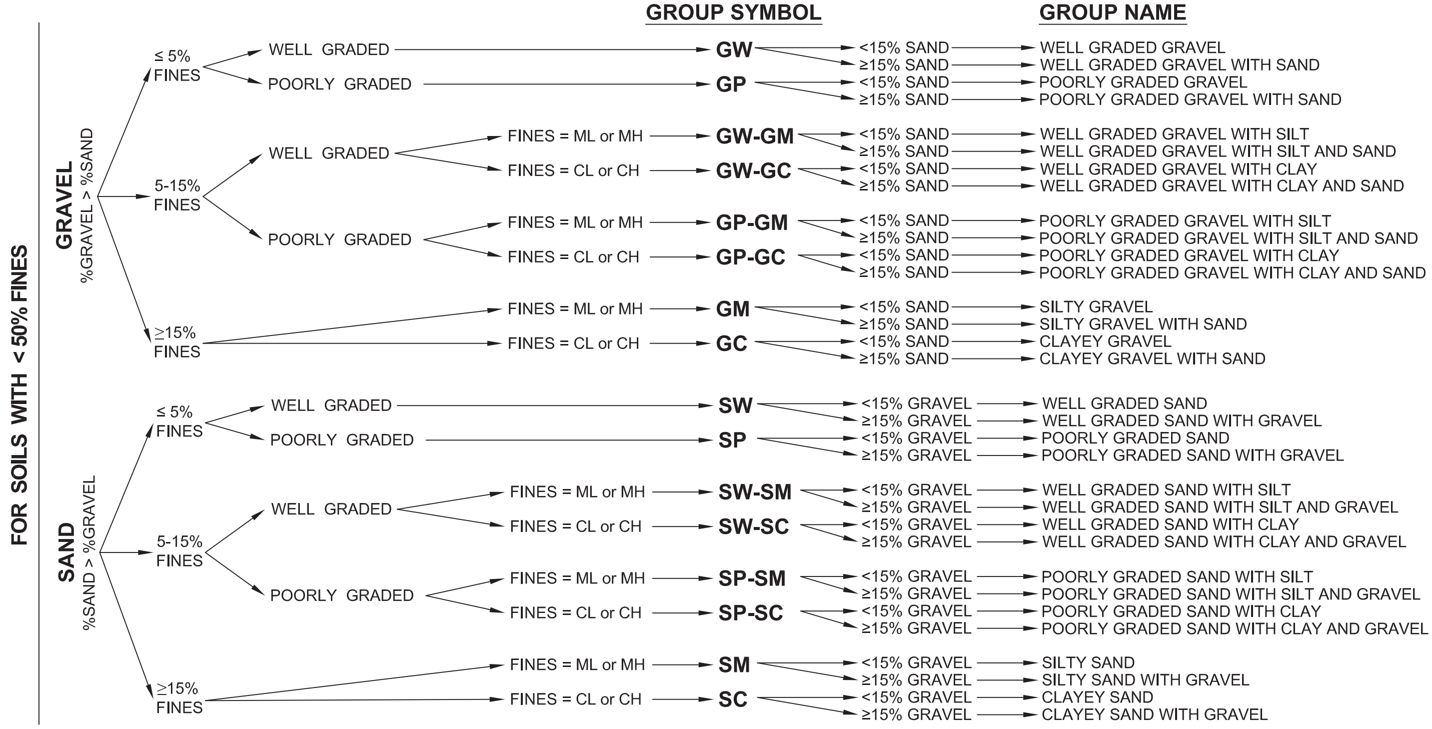
Bu	Bulk sample
CA	2.0-inch I.D. ring-lined split barrel California sample
DM	2.5-inch I.D. ring-lined split barrel Dames and Moore (modified California) sample
RQD	Rock Quality Designation
S	1.375-inch I.D. standard split-spoon sample (unlined)
U	Shelby Tube sample

COARSE GRAINED SOILS
(< 50% FINES)

A) FLOWCHART APPLIED TO LABORATORY TESTED SOIL SAMPLES.
ADAPTED FROM ASTM D 2487 *CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (USCS)* .



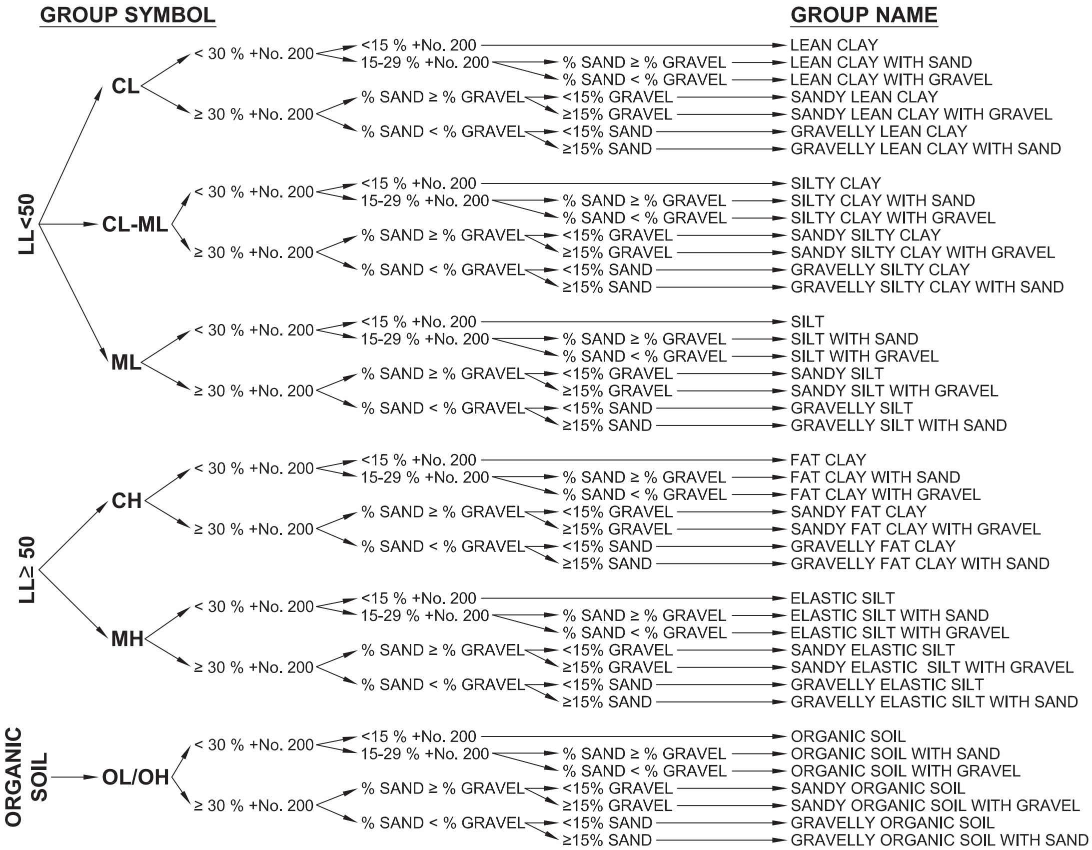
B) FLOWCHART APPLIED TO FIELD CLASSIFIED SOIL SAMPLES.
ADAPTED FROM ASTM D 2488 *DESCRIPTION AND IDENTIFICATION OF SOILS (VISUAL-MANUAL PROCEDURE)* .



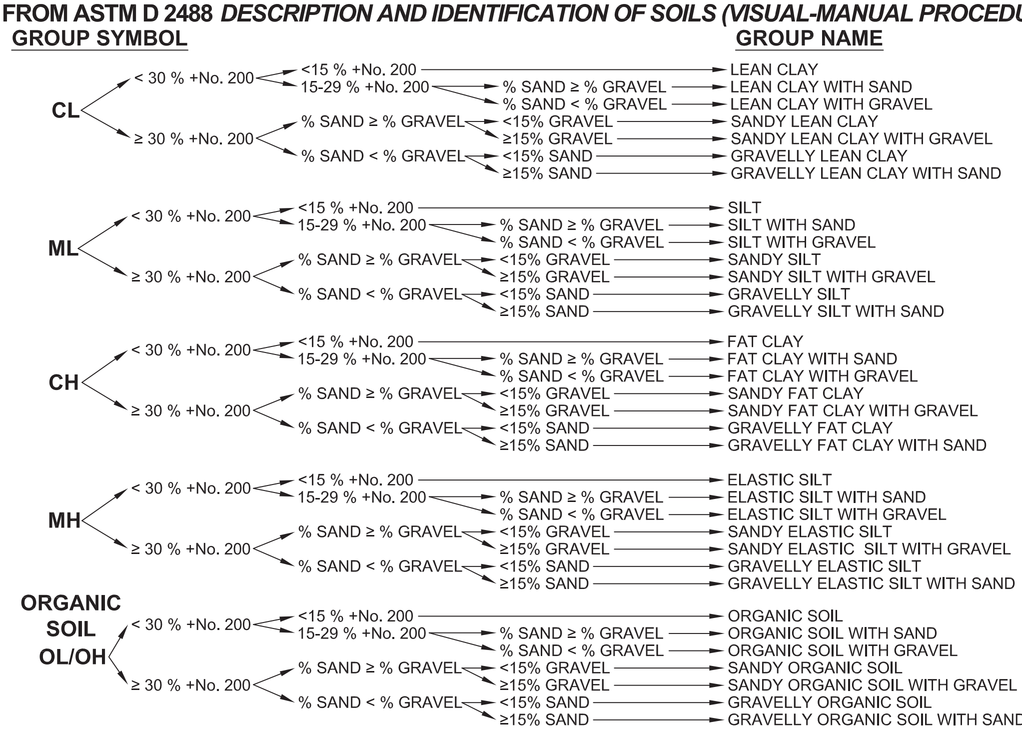
UPDATED 03-2014

FINE GRAINED SOILS
(≥ 50% FINES)

A) FLOWCHART APPLIED TO LABORATORY TESTED SOIL SAMPLES.
ADAPTED FROM ASTM D 2487 *CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (USCS)*.



B) FLOWCHART APPLIED TO FIELD CLASSIFIED SOIL SAMPLES.
ADAPTED FROM ASTM D 2488 *DESCRIPTION AND IDENTIFICATION OF SOILS (VISUAL-MANUAL PROCEDURE)*.

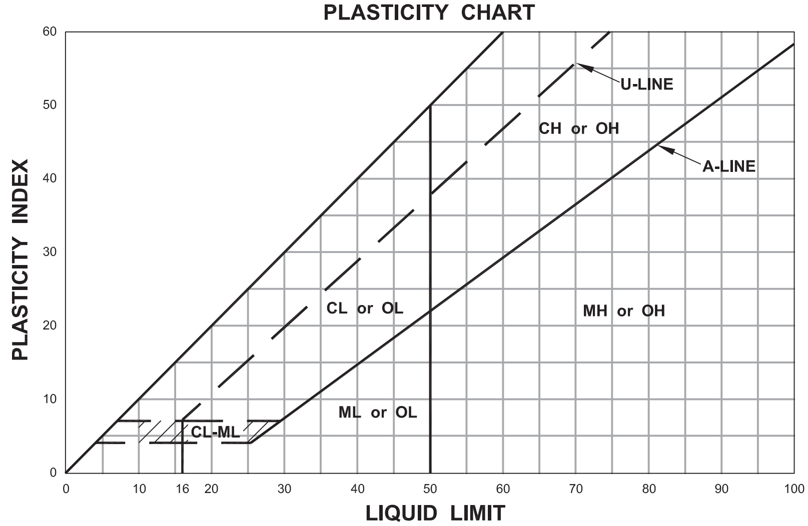


NOTE:

1. THE PLASTICITY CHART ON THE FOLLOWING PAGE WAS USED TO IDENTIFY THE GROUP SYMBOL FOR FLOWCHART A.
   A COMBINATION OF THE VISUAL MANUAL CRITERIA ON THE FOLLOWING PAGE WERE USED TO IDENTIFY THE GROUP SYMBOL FOR FLOWCHART B.

UPDATED 03-2014

SOIL PLASTICITY CHARACTERISTICS



A) IDENTIFICATION OF FINES GROUP SYMBOL FROM LABORATORY TESTS.
REPRODUCED FROM ASTM D 2487 *CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES (USCS)*.

B) IDENTIFICATION OF FINES GROUP SYMBOL FROM VISUAL-MANUAL CRITERIA.
REPRODUCED FROM ASTM D 2488 *DESCRIPTION AND IDENTIFICATION OF SOILS (VISUAL-MANUAL PROCEDURE).*

DRY STRENGTH	
DESCRIPTION	CRITERIA
NONE	CRUMBLES TO POWDER WHILE HANDLING.
LOW	CRUMBLES TO POWDER WITH SOME FINGER PRESSURE.
MEDIUM	BREAKS INTO PIECES OR CRUMBLES WITH CONSIDERABLE FINGER PRESSURE.
HIGH	CANNOT BE BROKEN WITH FINGER PRESSURE. BREAKS INTO PIECES BETWEEN THUMB AND HARD SURFACE.
VERY HIGH	CANNOT BE BROKEN BETWEEN THUMB AND HARD SURFACE.

DILATANCY (RESISTANCE TO SHAKING)	
DESCRIPTION	CRITERIA
NONE	NO VISIBLE CHANGE IN SPECIMEN.
SLOW	WATER APPEARS SLOWLY ON THE SURFACE OF THE SPECIMEN DURING SHAKING AND DOES NOT DISAPPEAR OR DISAPPEARS SLOWLY UPON SQUEEZING.
RAPID	WATER APPEARS QUICKLY ON THE SURFACE OF THE SPECIMEN DURING SHAKING AND DISAPPEARS QUICKLY UPON SQUEEZING.

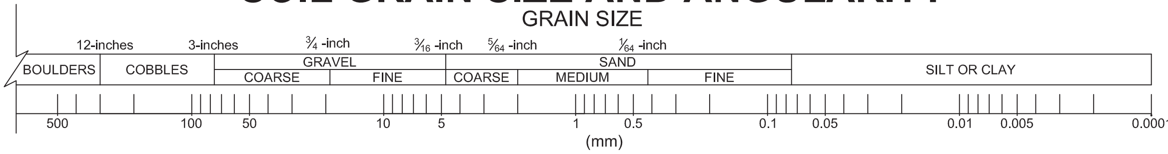
TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)	
DESCRIPTION	CRITERIA
LOW	ONLY SLIGHT PRESSURE IS REQUIRED TO ROLL THE THREAD. THREAD AND LUMP ARE WEAK AND SOFT.
MEDIUM	MEDIUM PRESSURE IS REQUIRED TO ROLL THE THREAD. THREAD AND LUMP HAVE MEDIUM STIFFNESS.
HIGH	CONSIDERABLE EFFORT IS REQUIRED TO ROLL THE THREAD. THREAD AND LUMP HAVE HIGH STIFFNESS.

PLASTICITY	
DESCRIPTION	CRITERIA FOR A 1/8-INCH (3 mm) THREAD.
NON-PLASTIC	THREAD CANNOT BE ROLLED.
LOW	THREAD CAN BARELY BE ROLLED AND THE LUMP CANNOT BE FORMED WHEN DRIER THAN THE PLASTIC LIMIT.
MEDIUM	THREAD IS EASY TO ROLL AND NOT MUCH TIME IS REQUIRED TO REACH THE PLASTIC LIMIT. THE THREAD CANNOT BE RE-ROLLED SEVERAL TIMES AFTER REACHING THE PLASTIC LIMIT. THE LUMP CRUMBLES WHEN DRIER THAN THE PLASTIC LIMIT.
HIGH	IT TAKES CONSIDERABLE TIME ROLLING AND KNEADING TO REACH THE PLASTIC LIMIT. THE THREAD CAN BE RE-ROLLED SEVERAL TIMES AFTER REACHING THE PLASTIC LIMIT. THE LUMP CAN BE FORMED WITHOUT CRUMBLING WHEN DRIER THAN THE PLASTIC LIMIT.

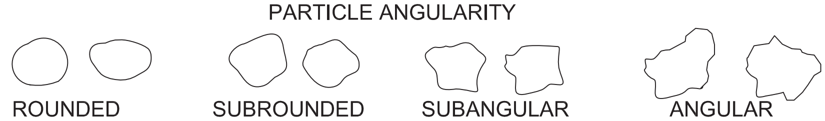
SYMBOL	DRY STRENGTH	DILATANCY	TOUGHNESS AND PLASTICITY	PLASTICITY
ML	NONE - LOW	SLOW - RAPID	LOW	LOW TO NON-PLASTIC
CL	MEDIUM - HIGH	NONE - SLOW	MEDIUM	LOW TO MEDIUM
MH	LOW - MEDIUM	NONE - SLOW	LOW TO MEDIUM	LOW TO MEDIUM
CH	HIGH - VERY HIGH	NONE	HIGH	HIGH

SOIL GRAIN SIZE AND ANGULARITY

GRAIN SIZE



PARTICLE ANGULARITY



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UPDATED 03-2014

TABLE 1.1
CRITERIA FOR DESCRIBING SOIL STRUCTURE[1]

Description	Criteria
Stratified	Alternating layers of varying material or color with layers greater than or equal to 1/4 inch thick (6 mm)
Laminated	Alternating layers of varying material or color with layers less than 1/4 inch thick (6 mm)
Fissured	Breaks along definite plates of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay
Homogeneous	Same color and appearance throughout

Note:
1. Modified from ASTM D 2488 *Description and Identification of Soils (Visual-Manual Procedure)* and differ from the U.S. Bureau of Reclamation *Engineering Geology Field Manual* (2001).

TABLE 1.2
RELATIVE DENSITY OF SANDS ACCORDING TO RESULTS OF STANDARD PENETRATION TEST[1]

Number of Blows N	Relative Density
0-4	Very Loose
5-10	Loose
11-30	Medium
31-50	Dense
Over 50	Very Dense

Note:
1. Modified from Terzaghi, Peck, and Mesri (1996).

TABLE 1.3
GUIDE FOR STIFFNESS OF FINE-GRAINED SOILS[1]

Description	Criteria	Estimated Unconfined Compressive Strength (TSF)
Very Soft	Extrudes between fingers when squeezed	<0.25
Soft	Molded by light finger pressure	0.25-0.50
Medium	Molded by strong finger pressure	0.50-1.00
Stiff	Readily indented by thumb or penetrated with great effort	1.00-2.00
Very Stiff	Readily indented by thumbnail	2.00-4.00
Hard	Indented with difficulty by thumbnail	>4.00

Note:
1. Reproduced from NAVFAC (1986).

TABLE 1.4
CRITERIA FOR DESCRIBING SOIL MOISTURE CONDITION[1]

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below the water table

Note:
1. Reproduced from ASTM 2488 *Description and Identification of Soils (Visual-Manual Procedure)*.

TABLE 1.5
CRITERIA FOR DESCRIBING SOIL CEMENTATION[1][2]

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

Notes:
1. Reproduced from ASTM 2488 *Description and Identification of Soils (Visual-Manual Procedure)*.
2. The absence of cementation was not recorded on boring logs.

TABLE 1.6
CRITERIA FOR DESCRIBING SOIL REACTION WITH HCL[1]

Description	Criteria
None[2]	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

Notes:
1. Reproduced from ASTM 2488 Description and Identification of Soils (Visual-Manual Procedure).
2. The absence of a reaction was not recorded on boring logs.

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Appendix B

Boring Logs

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995296, Long: -108.109759 deg
Ground El: 9902.2 ft Total Depth: 77.5 ft
Groundwater El: 9878.0 ft On Date: 07-26-2018

Start Date: 07-25-2018 End Date: 07-28-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS

Borehole ID: **B-101(P)**

Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 4-1/4" ID, 7-3/4" OD Hollow Stem Auger (HSA)

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	0.0–1.0							0.0 to 1.0 ft: Road Base; [--]
9901.2	1.0					Grinding and minor rig rocking from 1.0 to 14.0 feet. Sample Bu-1 collected from 2.0 to 10.0 feet.		Bu-1, S-2: Clayey Gravel with Sand. Mostly gravel, fine to coarse grained, subangular to subrounded; 20-35% fines, medium plasticity; 15-30% sand, fine to coarse grained, subangular to subrounded; less than 5% cobbles; maximum particle size = 4 inches; dense; moist; dark brown; (GC); [Fill]
	5.0–6.5	S - 2	7/13/21	1.5	1.6			5.0 to 6.5 ft: 20-35% sand; 15-30% fines;
9893.9	8.3							S-3, S-4, U-5: Clayey Sand with Gravel. Mostly sand, fine to coarse grained, subangular to subrounded; 20-35% fines, medium plasticity; 15-25% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1.75 inches; medium dense; moist; dark brown; (SC); [Fill]
	10.0–11.5	S - 3	5/10/12	1.5	1.6			
	12.5–14.0	S - 4	7/11/10	1.5	1.9			
	14.0					Smooth augering from 14.0 to 16.0 feet.		
	15.0–15.6	U - 5		0.6		U-5 disturbed, gravel/cobble damaged sampler.		
9886.6	15.6					Sample Bu-6 collected from 15.0 to 25.0 feet. Grinding and minor rig rocking from 16.0 to 36.5 feet.		Bu-6, S-7, CA-8: Clayey Gravel with Sand. Mostly gravel, fine to coarse grained, subangular to subrounded; 20-30% sand, fine to coarse grained, subangular to subrounded; 15-30% fines, medium plasticity; maximum particle size = 2.25 inches; dense; moist; dark brown; (GC); [Fill]
	17.5–19.0	S - 7	11/15/20	1.5	0.6			
	20							

Continued on next sheet

Notes: Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well in the dam foundation.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995296, Long: -108.109759 deg
Ground El: 9902.2 ft Total Depth: 77.5 ft
Groundwater El: 9878.0 ft On Date: 07-26-2018

Start Date: 07-25-2018 End Date: 07-28-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS
Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 4-1/4" ID, 7-3/4" OD Hollow Stem Auger (HSA)

Borehole ID:
B-101(P)

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	20–21	CA - 8	35/40	1.0	1.0	CA-8 disturbed by gravel/ cobble.		
9879.2	23							S-9, S-10, CA-11, S-12, Bu-13, S-14, Bu-15, CA-16, U-17, S-18, S-19: Clayey Sand with Gravel Mostly sand, fine to coarse grained, subangular to subrounded; 20-45% fines, medium plasticity; 20-35% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1.5 inches; medium dense to dense; moist to wet; dark brown; (SC); [Fill]
	24					Groundwater encountered at 24.2 feet during drilling on 7/26/2018.		
	25–26.5	S - 9	8/13/18	1.5	1.6	Sample Bu-13 collected from 25.0 to 40.0 feet.		
	27.5–29	S - 10	9/10/23	1.5	1.5			
	30–31	CA - 11	10/15	1.0	1.0			*30.0 to 31.0 ft: PP = 4 tsf;*
	34					Cuttings and samples are moist, no longer wet, from 34.0 to 55.3 feet. Potential perched water table at 24.2 feet.		
	35–36.5	S - 12	30/21/17	1.5	1.5			*35.0 to 36.5 ft: 15-30% fines;*
	36.5					Grinding with occasional periods of smooth augering from 36.5 to 64.5 feet.		
	38.3					Groundwater encountered at 38.3 feet on 7/27/2018 a.m. after drilling to 75.0 feet the previous day.		
	40							

Continued on next sheet

Notes Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well in the dam foundation.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995296, Long: -108.109759 deg
Ground El: 9902.2 ft Total Depth: 77.5 ft
Groundwater El: 9878.0 ft On Date: 07-26-2018

Start Date: 07-25-2018 End Date: 07-28-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS
Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 4-1/4" ID, 7-3/4" OD Hollow Stem Auger (HSA)

Borehole ID:
B-101(P)

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	41	S - 14	6/10/25	1.5	1.6			
	42							
	43	CA - 16	13/28	1.0	1.0			42.5 to 43.5 ft: PP = 4.5 tsf;
	44							
	45	U - 17		0.3	0.3	U-17 disturbed, gravel/cobble damaged sampler.		
	46	S - 18	9/17/20	1.5	1.7	Sample Bu-15 collected from 45.0 to 50.0 feet.		
	47							
	48							
	49							
	50							
9851.1	51	S - 19	11/23/20	1.5	1.6	Bottom of embankment fill at approximately 51.1 feet.		S-19, Bu-20, U-21, S-22: Sandy Lean Clay with Gravel Mostly fines, low to medium plasticity; 20-35% sand, fine to coarse grained, subangular to subrounded; 15-25% gravel, fine to coarse grained; maximum particle size = 2 inches; soft to medium stiff; moist; brown-gray; gravel composed of mostly basalt; (CL); [Colluvium]
	52					Sample Bu-20 collected from 51.0 to 65.0 feet.		
	53							
	54							
	55	U - 21		0.3	0.3	U-21 disturbed, gravel/cobble damaged sampler.		
	56					Groundwater encountered at 55.3 feet during drilling on 7/26/2018.		
	57							
	58							
	59							
	60							

Continued on next sheet

Notes: Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well in the dam foundation.

RJH CONSULTANTS, INC.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995296, Long: -108.109759 deg
Ground El: 9902.2 ft Total Depth: 77.5 ft
Groundwater El: 9878.0 ft On Date: 07-26-2018

Start Date: 07-25-2018 End Date: 07-28-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS

Borehole ID: **B-101(P)**

Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 4-1/4" ID, 7-3/4" OD Hollow Stem Auger (HSA)

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
9841.9								
9841.6	61	S - 22	8/23/31	1.5	1.5			S-22: Poorly Graded Sand with Clay and Gravel Mostly sand, fine to coarse grained, subangular to subrounded; 15-30% gravel, fine grained, subangular to subrounded; 5-15% fines, low to medium plasticity; maximum particle size = 0.5 inches; very dense; wet; dark brown-black; (SP-SC); [Colluvium]
	62							S-22: Sandy Lean Clay with Gravel Mostly fines, medium plasticity; 20-35% gravel, fine to coarse grained, subangular to subrounded; 15-25% sand, fine to coarse grained, subangular to subrounded; maximum particle size = 1.75 inches; soft to medium stiff; moist; brown-gray; (CL); [Colluvium]
	63							
9838.4	64					Grinding and minor rig rocking from 64.5 to 76.5 feet.		Bu-23: Lean Clay with Sand Mostly fines, medium plasticity; 5-15% sand, fine to coarse grained, subangular to subrounded; less than 5% gravel, fine grained; maximum particle size = 0.2 inches; very soft; wet; brown-gray; (CL); [Colluvium]
	65							
	66					Sample Bu-23 collected from 66.0 to 67.0 feet.		
	67							
	68							
9833.7	69							S-24: Lean Clay Mostly fines, medium plasticity; 5-15% sand, fine to coarse grained, subangular to subrounded; soft to medium stiff; moist to wet; dark brown-gray; (CL); [Colluvium]
	70							
	71	S - 24	4/14/18	1.5	1.5			
9829.9	72							S-25, S-26: Sandy Lean Clay Mostly fines, medium plasticity; 10-25% sand, fine to coarse grained, subangular to subrounded; 5-15% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1.5 inches; medium stiff; moist; dark brown-gray; (CL); [Colluvium]
	73							
	74	S - 25	10/41/35	1.5	1.6			
	75							
	76							
	77	S - 26	11/32/50 for 5 inches	1.4	1.5	Auger encountered refusal at 76.5 feet.		
9824.7						Bottom of boring at 77.5 feet.		End of boring log at 77.50 ft
	78							
	79							
	80							

Notes Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well in the dam foundation.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995677, Long: -108.109800 deg
Ground El: 9902.1 ft Total Depth: 48.0 ft
Groundwater El: 9860.6 ft On Date: 07-24-2018

Start Date: 07-24-2018 End Date: 07-26-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS
Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 4-1/4" ID, 7-3/4" OD Hollow Stem Auger (HSA)

Borehole ID:
B-102A(P)

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks
	0–1.0					Continuous grinding and occasional rig rocking from 0.5 to 6.0 feet.
9901.1	1					
	2	S - 2	4/7/9	1.5	1.1	Sample Bu-1 collected from 2.0 to 18.0 feet.
	4	S - 3	16/7/30	1.5	1.5	
	6					Smooth augering from 6.0 to 7.5 feet.
	7	S - 4	11/15/14	1.5	1.1	Continuous grinding from 7.5 to 11.0 feet.
	9	S - 5	7/9/11	1.5	1.5	
	11					Smooth augering from 11.0 to 14.0 feet.
	12	S - 6	9/8/10	1.5	1.7	
	14	S - 7	7/10/15	1.5	1.5	Grinding from 14.0 to 16.0 feet.
	16					Smooth augering from 16.0 to 17.5 feet.
	17	S - 8	8/21/33	1.5	0.8	Continuous grinding and occasional rig rocking from 17.5 to 21.0 feet.
	18					Sample Bu-10 collected from 18.0 to 41.5 feet.
	19	CA - 9	34/50 for 2 inches	0.7	0.5	CA-9 disturbed by gravel/ cobble.
	20					

Description and Classification of Materials

0.0 to 1.0 ft:
Road Base;
[--]

Bu-1, S-2, S-3, S-4, S-5, S-6, S-7, S-8, CA-9, Bu-10, S-11, S-12: Clayey Gravel with Sand
Mostly gravel, fine to coarse grained, subangular to subrounded; 20-35% sand, fine to coarse grained, subangular to subrounded; 20-30% fines, medium plasticity; maximum particle size = 3 inches; medium dense; moist; dark brown; (GC);
[Fill]

4.0 to 5.5 ft: dense;

16.5 to 18.0 ft: very dense;

18.0 to 23.0 ft: 20-49% fines, low to medium plasticity;

Continued on next sheet

Notes Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well in the embankment.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995677, Long: -108.109800 deg
Ground El: 9902.1 ft Total Depth: 48.0 ft
Groundwater El: 9860.6 ft On Date: 07-24-2018

Start Date: 07-24-2018 End Date: 07-26-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS
Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 4-1/4" ID, 7-3/4" OD Hollow Stem Auger (HSA)

Borehole ID: **B-102A(P)**

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Description and Classification of Materials
	21					Smooth augering from 21.0 to 22.0 feet.	
	22	S - 11	12/19/30	1.5	1.5	Continuous grinding and minor rig rocking from 22.0 to 26.0 feet.	*21.5 to 23.0 ft: dense;*
	24	S - 12	26/50 for 3 inches	0.8	0.8		*24.0 to 24.8 ft: very dense; brown-gray;*
9876.4	26					Smooth augering from 26.0 to 27.0 feet.	S-13, CA-14: Clayey Sand Mostly sand, fine to coarse grained, subangular to subrounded; 20-30% fines, medium plasticity; 15-25% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1 inch; dense; moist; dark brown; (SC); [Fill]
	27	S - 13	10/19/21	1.5	1.1	Minor grinding from 27.0 to 30.0 feet.	
	29	CA - 14	59/60	1.0	1.0		*29.0 to 30.0 ft: PP = 2.75 tsf;*
	30					Smooth augering from 30.0 to 33.0 feet.	
9871.3	31						S-15, S-16, S-17: Clayey Gravel with Sand Mostly gravel, fine to coarse grained, subangular to subrounded; 20-35% sand, fine to coarse grained, subangular to subrounded; 20-30% fines, medium plasticity; maximum particle size = 1.25 inches; dense; moist; dark brown; (GC); [Fill]
	32	S - 15	13/16/15	1.5	1.7		
	33					Continuous grinding and minor rig rocking from 33.0 to 48.0 feet.	
	34	S - 16	13/21/28	1.5	1.0		
	37	S - 17	7/14/21	1.5	1.6		
9863.6	38						S-18: Poorly Graded Gravel with Clay and Sand Mostly gravel, fine to coarse grained, subangular to subrounded; 15-25% sand, fine to coarse grained, subangular to subrounded; 5-15% fines, medium plasticity; maximum particle size = 1.5 inches; very dense; moist;
	39	S - 18	52/50 for 4 inches	0.8	0.6	Shelby tube attempt had no recovery, gravel/cobble damaged sampler. Drove split spoon at same depth.	
	40						

Continued on next sheet

Notes: Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well in the embankment.

RJH CONSULTANTS, INC.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995677, Long: -108.109800 deg
Ground El: 9902.1 ft Total Depth: 48.0 ft
Groundwater El: 9860.6 ft On Date: 07-24-2018

Start Date: 07-24-2018 End Date: 07-26-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS
Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 4-1/4" ID, 7-3/4" OD Hollow Stem Auger (HSA)

Borehole ID: **B-102A(P)**

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
								brown-gray; (GP-GC); [Fill]
9861.5	41							S-19, CA-20: Clayey Sand Mostly sand, fine to coarse grained, subangular to subrounded; 25-40% fines, medium plasticity; 20-35% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 3 inches; medium dense; wet; dark brown; (SC); [Fill]
	42	S - 19	12/10/11	1.5	0.3	Groundwater encountered at 41.5 feet during drilling on 7/24/2018.		
	43							
	44	CA - 20	15/22	1.0	1.2			*44.0 to 45.0 ft: PP = 3.5 tsf;*
	45							
9856.3	46							S-21: Poorly Graded Gravel with Clay and Sand Mostly gravel, fine to coarse grained, subangular to subrounded; 15-30% sand, fine to coarse grained, angular to subrounded; 5-15% fines, medium plasticity; maximum particle size = 1 inch; very dense; wet; black; gravels composed of mostly basalt; (GP-GC); [Fill]
		S - 21	50 for 3 inches	0.3	0.3			
	47							
9854.1	48					Augers encountered refusal at 48.0 feet. Bottom of boring at 48.0 feet.		End of boring log at 48.00 ft
	49							
	50							
	51							
	52							
	53							
	54							
	55							
	56							
	57							
	58							
	59							
	60							

Notes Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well in the embankment.

RJH CONSULTANTS, INC.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation	Start Date: 07-25-2018
Project No: 18115	End Date: 07-26-2018
Boring Location: Lat: 38.995667, Long: -108.109796 deg	Driller: HRL Compliance - Jose
Ground El: 9902.1 ft	Logged By: JNH
Total Depth: 5.0 ft	Bedrock Depth: Not encountered
Groundwater El: Not Encountered	Checked By: ERS
On Date: 07-26-2018	Borehole ID: **B-102B**
Drilling Rig: CME 55LC Track Mounted Rig	Sheet 1 of 1
Equipment: 4-1/4" ID, 7-3/4" OD Hollow Stem Auger (HSA)	

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	0							0.0 to 1.0 ft: Road Base; [--]
9901.1	1					Continuous grinding and rig rocking.		Bu-1: Clayey Gravel with Sand Mostly gravel, fine to coarse grained, subangular to subrounded; 20-35% fines, medium plasticity; 15-30% sand, fine to coarse grained, subangular to subrounded; less than 5% cobbles; maximum particle size = 4 inches; moist; dark brown; (GC); [Fill]
	2					Sample Bu-1 collected from 2.0 to 5.0 feet.		
	3							
	4					Auger encountered refusal at 5.0 feet.		
9897.1	5					Bottom of boring at 5.0 feet.		End of boring log at 5.00 ft
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							
	17							
	18							
	19							
	20							

Notes: Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was backfilled with cement-bentonite grout.

RJH CONSULTANTS, INC.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.996095, Long: -108.109881 deg
Ground El: 9901.8 ft Total Depth: 30.0 ft
Groundwater El: 9876.3 ft On Date: 07-23-2018

Start Date: 07-23-2018 End Date: 07-24-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS
Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 4-1/4" ID, 7-3/4" OD Hollow Stem Auger (HSA)

Borehole ID: **B-103(P)**

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks
9900.8	1					Sample Bu-1 collected from 1.0 to 7.5 feet. Grinding, minor rig rocking.
	2	S - 2	8/19/34	1.5	1.0	
	3					Augers encountered refusal at 3.0 feet. Backfilled hole with cuttings, moved 3 feet south and continued augering.
	4	S - 3	29/24/50 for 1 inch	1.1	0.5	At 3.5 feet, changed to conical auger bit to help reduce grinding.
	5					Minor grinding from 5.0 to 23.1 feet.
	6	S - 4	5/15/31	1.5	1.4	
	8	S - 5	22/10/22	1.5	1.5	
	10					Sample Bu-11 collected from 10.0 to 17.5 feet.
	11	S - 6	19/14/30	1.5	1.5	
	13	S - 7	11/13/29	1.5	1.5	
9887.3	14.5					
	15.5	CA - 8	15/17	1.0	1.0	
9885.0	16.8					
	18	CA - 9	22/22	1.0	1.0	
	20					

Description and Classification of Materials

0.0 to 1.0 ft:
Road Base;
[--]

Bu-1, S-2, S-3, S-4, S-5, S-6, S-7: Clayey Sand with Gravel
Mostly sand, fine to coarse grained, subangular to subrounded; 30-45% fines, medium plasticity; 20-35% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1.5 inches; dense to very dense; moist; dark brown; (SC);
[Fill]

7.5 to 9.0 ft: occasional strong reaction with HCl;

CA-8: Clayey Gravel with Sand
Mostly gravel, fine to coarse grained, subangular to subrounded; 30-40% fines, medium plasticity; 15-25% sand, fine to coarse grained, subangular to subrounded; maximum particle size = 1.5 inches; moist; dark brown; PP = 1.5 tsf; (GC);
[Fill]

CA-9, S-10, Bu-11, S-12: Clayey Sand with Gravel
Mostly sand, fine to coarse grained, subangular to subrounded; 30-45% fines, medium plasticity; 20-35% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1.75 inches; dense to very dense; moist; dark brown; (SC);
[Fill]

17.5 to 18.5 ft: 15-35% fines; PP = 1 tsf;

Continued on next sheet

Notes Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well in the embankment.

RJH CONSULTANTS, INC.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.996095, Long: -108.109881 deg
Ground El: 9901.8 ft Total Depth: 30.0 ft
Groundwater El: 9876.3 ft On Date: 07-23-2018

Start Date: 07-23-2018 End Date: 07-24-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS
Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 4-1/4" ID, 7-3/4" OD Hollow Stem Auger (HSA)

Borehole ID: **B-103(P)**

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	21	S - 10	12/18/50 for 3 inches	1.3	1.3			
	22							
9878.7	23	S - 12	8/4/9	1.5	1.5	Bottom of embankment fill at approximately 23.1 feet. Smooth augering from 23.1 to 30.0 feet.		S-12, S-13: Gravelly Lean Clay with Sand Mostly fines, medium plasticity; 15-30% gravel, fine to coarse grained, subangular to subrounded; 15-25% sand, fine to coarse grained, subangular to subrounded; maximum particle size = 1 inch; soft; moist to wet; brown; (CL); [Colluvium]
	24							
	25	S - 13	2/4/4	1.5	1.3	Groundwater encountered at 25.5 feet during drilling on 7/23/2018.		
	26							
9874.8	27							U-14: Clayey Sand with Gravel Mostly sand, fine to coarse grained, subangular to subrounded; 25-35% fines, medium plasticity; 20-30% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1 inch; moist; brown; (SC); [Colluvium]
	28	U - 14		2.1	2.1			
	29							
9871.8	30					Bottom of boring at 30.0 feet.		End of boring log at 30.00 ft
	31							
	32							
	33							
	34							
	35							
	36							
	37							
	38							
	39							
	40							

Notes Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well in the embankment.

RJH CONSULTANTS, INC.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995285, Long: -108.110292 deg
Ground El: 9846.1 ft Total Depth: 33.0 ft
Groundwater El: 9835.7 ft On Date: 09-20-2018

Start Date: 09-19-2018 End Date: 09-21-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS

Borehole ID: **B-104(P)**

Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 5" ID, 5-3/8" OD Symmetrix Drive Casing Advancer

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Description and Classification of Materials
	0					Continuous slow, smooth drilling; dust from cobbles/boulders from 0 to 6.0 feet.	S-1: Poorly Graded Gravel with Silt and Sand Mostly gravel, fine to coarse grained, subangular to subrounded; 20-35% sand, fine to coarse grained, subangular to subrounded; 5-15% fines, nonplastic; maximum particle size = 1.25 inches; dense; dry; black; gravel composed of mostly basalt; (GP-GM); [Colluvium]
	4	S - 1	7/15/18	1.5	0.3		
9840.1	6					At 6.0 feet, driller said material feels like clay. Continuous slow, smooth drilling from 6.0 to 33.0 feet.	S-2: Sandy Lean Clay with Gravel Mostly fines, low plasticity; 20-35% sand, fine to coarse grained, subangular to subrounded; 15-30% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1.5 inches; medium stiff; moist; brown; (CL); [Colluvium]
	7	S - 2	4/7/9	1.5	1.5		
9835.8	10.3					Groundwater encountered at 10.4 feet during drilling on 9/20/2018.	U-3: Lean Clay with Sand Mostly fines, medium to high plasticity; 5-15% sand, fine to coarse grained, subangular to subrounded; 5-10% gravel, fine grained, subangular to subrounded; maximum particle size = 0.75 inches; stiff; moist; dark gray; (CL); [Colluvium]
	12	U - 3		1.0	1.0	U-3 disturbed, cobble/boulder damaged sampler.	
9833.1	13	S - 4	50 for 3 inches	0.3	0.3		S-4: Gravelly Lean Clay with Sand Mostly fines, medium plasticity; 20-35% gravel, fine to coarse grained, subangular to subrounded; 15-25% sand, fine to coarse grained, subangular to subrounded; maximum particle size = 1.5 inches; medium stiff; moist; dark gray; (CL); [Colluvium]
9832.8	13.3	S - 5	17/28/24	1.5	1.9	Driller said material feels like gravel from 13.3 to 16.0 feet.	S-5: Sandy Lean Clay with Gravel Mostly fines, low plasticity; 20-35% sand, fine to coarse grained, subangular to subrounded; 15-30% gravel, fine to coarse grained, subangular to rounded; maximum particle size = 1.25 inches; stiff; moist; brown; (CL); [Colluvium]
9830.1	16						S-6: Gravelly Lean Clay with Sand Mostly fines, medium plasticity; 20-35% gravel, fine to coarse grained, subangular to subrounded; 15-25% sand, fine to coarse grained, subangular to subrounded; maximum particle size = 1.5 inches; soft; wet; brown to gray; (CL); [Colluvium]
	17	S - 6	50 for 4 inches	0.3	0.3		
9826.4	19.7						S-7: Lean Clay with Gravel

Continued on next sheet

Notes: Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well at the dam toe.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995285, Long: -108.110292 deg
Ground El: 9846.1 ft Total Depth: 33.0 ft
Groundwater El: 9835.7 ft On Date: 09-20-2018

Start Date: 09-19-2018 End Date: 09-21-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS
Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 5" ID, 5-3/8" OD Symmetrix Drive Casing Advancer

Borehole ID: **B-104(P)**

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	21							Mostly fines, low plasticity; 10-15% gravel, fine to coarse grained, subangular to subrounded; 5-10% sand, fine to coarse grained, subangular to subrounded; maximum particle size = 1 inch; very stiff; moist; brown; occasional weak reaction to HCl; (CL); [Colluvium]
	22–23	S - 7	12/14/17	1.5	1.5			
9820.8	25							S-8: Sandy Lean Clay with Gravel Mostly fines, low plasticity; 20-35% sand, fine to coarse grained, subangular to subrounded; 15-30% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1 inch; very stiff; moist; brown; chlorite deposits throughout; (SC); [Colluvium]
	27–28	S - 8	20/17/15	1.5	1.5	Unable to perform Shelby tube because of gravel/cobbles.		
9815.8	30							CA-9: Gravelly Lean Clay Mostly fines, low to medium plasticity; 30-40% gravel, fine to coarse grained, subangular to subrounded; 5-10% sand, fine to coarse grained, subangular to subrounded; maximum particle size = 1.25 inches; stiff to very stiff; moist; brown; PP = 1.75 tsf; (CL); [Colluvium]
	32–33	CA - 9	9/13	1.0	1.3	Unable to perform Shelby tube because of gravel/cobbles.		
9813.1	33					Bottom of boring at 33.0 feet.		End of boring log at 33.00 ft

Depth scale: 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Notes Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well at the dam toe.

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LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995632, Long: -108.110160 deg
Ground El: 9865.7 ft Total Depth: 73.5 ft
Groundwater El: 9860.9 ft On Date: 09-17-2018

Start Date: 09-17-2018 End Date: 09-20-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS
Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 5" ID, 5-3/8" OD Symmetrix Drive Casing Advancer

Borehole ID: **B-105A(P)**

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	0–2					Sample Bu-1 collected from 0 to 12.0 feet. Continuous slow, smooth drilling. Dust from large boulder while drilling, approximately 1 foot in diameter per driller.		Bu-1, S-2, S-3, S-4,: Clayey Sand with Gravel Mostly sand, fine to coarse grained, subangular to subrounded; 20-35% gravel, fine to coarse grained, subangular to subrounded; 15-30% fines, medium plasticity; maximum particle size = 1.5 inches; medium dense; moist; brown; occasional strong reaction with HCl; (SC); [Colluvium]
	2–3.5	S - 2	11/8/7	1.5	0.5			
	4.5–6	S - 3	3/2/4	1.5	1.5	Groundwater encountered at 4.8 feet during drilling on 9/17/2018.		*4.5 to 6.0 ft: 15-25% gravel; 25-40% fines; loose; wet;*
	7–7.9	S - 4	50 for 5 inches	0.9	0.7			*7.0 to 7.9 ft: 20-35% fines; very dense; moist to wet;*
	8–10					Dust from large boulder while drilling, approximately 1 foot in diameter per driller.		
9856.7	9					Groundwater encountered at 9.2 feet on 9/18/2018 a.m. after drilling to 27.0 feet the previous day.		S-5, S-6: Sandy Lean Clay with Gravel Mostly fines, low plasticity; 15-30% sand, fine to coarse grained, subangular to subrounded; 15-25% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 0.75 inches; very soft to soft; moist to wet; brown; (CL); [Colluvium]
	10–11.5	S - 5	2/3/3	1.5	1.8			
	12–13.5	S - 6	2/3/2	1.5	1.3	Sampling interval changed to about every 5 feet.		
9850.4	15.3							S-7: Lean Clay with Sand Mostly fines, low to medium plasticity; 5-15% sand, fine to medium grained, subangular to subrounded; less than 10% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1.25 inches; soft; moist to wet; brown; (CL); [Colluvium]
	17–18.5	S - 7	4/4/6	1.5	1.7			
9846.7	19					Driller said material changed to clay with more gravel or a stiffer clay.		S-8: Lean Clay Mostly fines, low to medium plasticity; less than 10% sand, fine to medium grained, subangular to subrounded; medium

Continued on next sheet

Notes: Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well at the dam toe.

RJH CONSULTANTS, INC.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation	Start Date: 09-17-2018
Project No: 18115	End Date: 09-20-2018
Boring Location: Lat: 38.995632, Long: -108.110160 deg	Driller: HRL Compliance - Jose
Ground El: 9865.7 ft	Logged By: JNH
Total Depth: 73.5 ft	Bedrock Depth: Not encountered
Groundwater El: 9860.9 ft	Checked By: ERS
On Date: 09-17-2018	Borehole ID: **B-105A(P)**
Drilling Rig: CME 55LC Track Mounted Rig	Sheet 2 of 4
Equipment: 5" ID, 5-3/8" OD Symmetrix Drive Casing Advancer	

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	20–25.5							stiff; moist to wet; brown; (CL); [Colluvium]
	22–23.5	S - 8	8/13/15	1.5	1.8			
9840.4	25.5					Very slow drilling and increased basalt gravel in cuttings from 25.5 to 34.0 feet.		S-9: Sandy Lean Clay with Gravel Mostly fines, low plasticity; 15-30% sand, fine to coarse grained, subangular to subrounded; 15-25% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1.25 inches; medium stiff to stiff; moist; (CL); [Colluvium]
	27–28.5	S - 9	12/15/42	1.5	1.5			
9835.4	30.5							S-10: Sandy Lean Clay Mostly fines, low plasticity; 15-30% sand, fine to coarse grained, subangular to subrounded; 5-15% gravel, fine grained, subangular to subrounded; maximum particle size = 0.75 inches; medium stiff to stiff; moist; brown; (CL); [Colluvium]
	32–32.3	S - 10	50 for 4 inches	0.3	0.4			
9831.0	34.9							S-11, CA-12: Sandy Lean Clay with Gravel Mostly fines, low plasticity; 15-30% sand, fine to coarse grained, subangular to subrounded; 15-25% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1.5 inches; medium stiff; moist; brown; (CL); [Colluvium]
	37–38.5	S - 11	25/34/31	1.5	1.8			
	40							

Continued on next sheet

Notes: Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well at the dam toe.

RJH CONSULTANTS, INC.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995632, Long: -108.110160 deg
Ground El: 9865.7 ft Total Depth: 73.5 ft
Groundwater El: 9860.9 ft On Date: 09-17-2018

Start Date: 09-17-2018 End Date: 09-20-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS
Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 5" ID, 5-3/8" OD Symmetrix Drive Casing Advancer

Borehole ID: **B-105A(P)**

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	41							
	42	CA - 12	50/50 for 3 inches	0.8	0.8			*42.0 to 42.8 ft: PP = 2.75 tsf;*
	43							
	44							
9820.8	45							CA-13: Gravelly Lean Clay with Sand Mostly fines, low to medium plasticity; 20-35% gravel, fine to coarse grained, subangular to rounded; 15-25% sand, fine to coarse grained, subangular to subrounded; maximum particle size = 2 inches; medium stiff to stiff; moist; brown; (CL); [Colluvium]
	46							
	47	CA - 13	28/50 for 2 inches	0.7	0.7	CA-13 disturbed, sampler bouncing on cobble/boulder.		
	48							
	49					Driller said encountered pea gravel at 49.0 feet.		
9815.8	50							S-14, S-15: Clayey Sand with Gravel Mostly sand, fine to coarse grained, subangular to subrounded; 25-40% fines, low to medium plasticity; 20-35% gravel, fine to coarse grained, subangular to rounded; maximum particle size = 1.5 inches; very dense; moist to wet; brown; (SC); [Colluvium]
	51							
	52	S - 14	10/50 for 5 inches	0.9	0.4	Pressurized water coming out between casing and boring annulus at surface on 9/18/2018 after drilling to 52.0 feet. Resolved and continued drilling approximately 1 hour later.		
	53							
	54							
	55							
	56							
	57	S - 15	31/27/39	1.5	0.5			*57.0 to 58.5 ft: 20-35% fines; 15-25% gravel, subangular to subrounded;*
	58							
	59							
	60							

Continued on next sheet

Notes Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well at the dam toe.

RJH CONSULTANTS, INC.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995632, Long: -108.110160 deg
Ground El: 9865.7 ft Total Depth: 73.5 ft
Groundwater El: 9860.9 ft On Date: 09-17-2018

Start Date: 09-17-2018 End Date: 09-20-2018
Driller: HRL Compliance - Jose Logged By: JNH
Bedrock Depth: Not encountered Checked By: ERS

Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 5" ID, 5-3/8" OD Symmetrix Drive Casing Advancer

Borehole ID: **B-105A(P)**
Sheet 4 of 4

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Description and Classification of Materials
9805.4	60.3						CA-16: Sandy Lean Clay with Gravel Mostly fines, low plasticity; 15-30% sand, fine to coarse grained, subangular to subrounded; 15-25% gravel, fine to coarse grained, subangular to subrounded; maximum particle size = 1.25 inches; medium stiff; moist to wet; brown; (CL); [Colluvium]
	62.0–63.5	CA - 16	20/13/19	1.5	1.5	CA-16 sample rings collected from 62.5 to 63.5 feet.	*62.0 to 63.5 ft: PP = 4.5 tsf;*
9800.4	65.3						S-17, S-18: Clayey Sand with Gravel Mostly sand, fine to coarse grained, subangular to subrounded; 20-35% gravel, fine to coarse grained, subangular to subrounded; 15-25% fines, low to medium plasticity; maximum particle size = 1.5 inches; very dense; moist to wet; brown; (SC); [Colluvium]
	67.0	S - 17	50 for 2 inches	0.2	0.2		
	72.0–73.5	S - 18	12/22/33	1.5	1.5		*72.0 to 73.5 ft: 25-35% fines;*
9792.2	73.5					Bottom of boring at 73.5 feet.	End of boring log at 73.50 ft

Notes: Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well at the dam toe.

RJH CONSULTANTS, INC.

LOG OF SOIL BORING

Project name: Hogchute Dam Safety Evaluation
Project No: 18115
Boring Location: Lat: 38.995681, Long: -108.110127 deg
Ground El: 9866.9 ft   Total Depth: 12.6 ft
Groundwater El: 9858.7 ft   On Date: 09-19-2018

Start Date: 09-19-2018   End Date: 09-20-2018
Driller: HRL Compliance - Jose   Logged By: JNH
Bedrock Depth: Not encountered   Checked By: ERS
Drilling Rig: CME 55LC Track Mounted Rig
Equipment: 5" ID, 5-3/8" OD Symmetrix Drive Casing Advancer

Borehole ID: **B-105B(P)**
Sheet 1 of 1

Elevation	Depth (ft)	Type - No	Blows per 6 inch	Penetration (ft)	Recovery (ft)	Remarks	Graphic Lithology	Description and Classification of Materials
	0					Continuous slow, smooth drilling from 0 to 12.6 feet.		0.0 to 12.6 ft: No Sampling. Refer to B-105A(P) for lithology.; [Colluvium]
	8.2					Groundwater encountered at 8.2 feet during drilling on 9/19/2018.		
9854.3	12.6					Bottom of boring at 12.6 feet.		End of boring log at 12.60 ft

Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Notes: Contacts are approximate and lithology between recovered samples is interpreted. Material descriptions are based on recovered samples, cuttings, and surface observations. Density descriptions are based on blow counts. Large particles may have influenced blow counts and sample recovery. Boring was completed as a monitoring well at the dam toe.

RJH CONSULTANTS, INC.

Appendix C

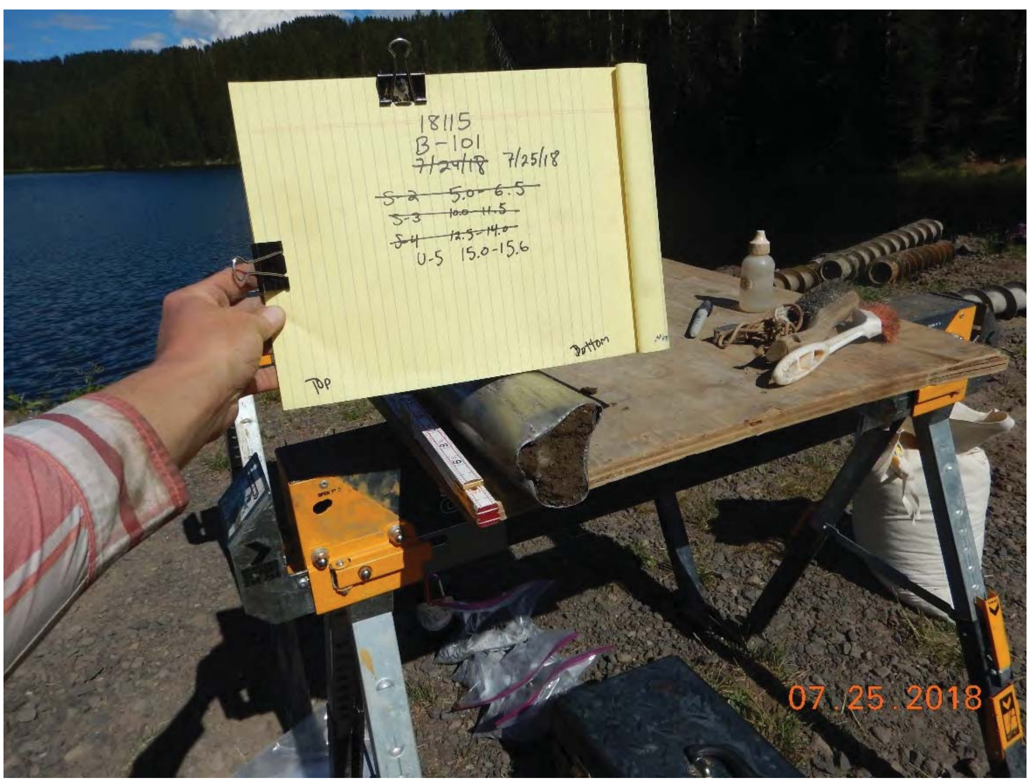
Sample Photographs

B-101(P)

Photograph 1: B-101(P); S-2 from 5.0 to 6.5 feet. Clayey Gravel with Sand [Fill].

Photograph 2: B-101(P); S-3 from 10.0 to 11.5 feet. Clayey Sand with Gravel [Fill].

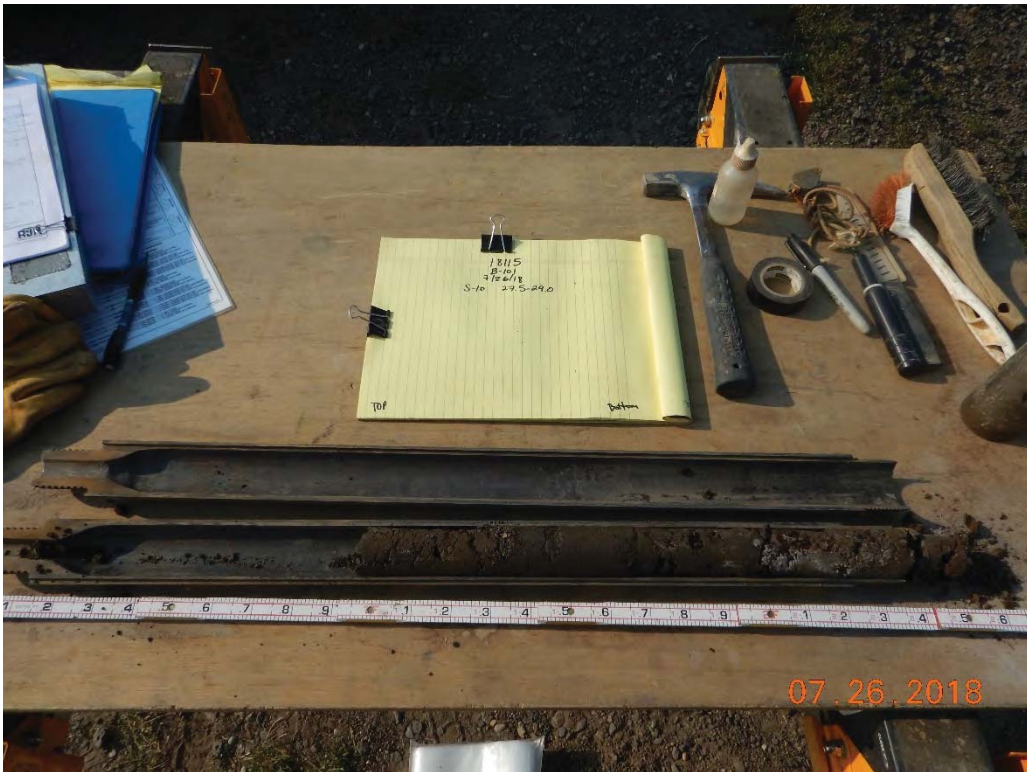
Photograph 3: B-101(P); S-3 from 12.5 to 14.0 feet. Clayey Sand with Gravel [Fill].



Photograph 4: B-101(P); U-5 from 15.0 to 15.6 feet. Disturbed. Clayey Sand with Gravel [Fill].

Photograph 5: B-101(P); S-7 from 17.5 to 19.0 feet. Clayey Sand with Gravel [Fill].

Photograph 6: B-101(P); S-9 from 25.0 to 26.5 feet. Clayey Sand with Gravel [Fill].



Photograph 7: B-101(P); S-10 from 27.5 to 29.0 feet. Clayey Sand with Gravel [Fill].

Photograph 8: B-101(P); S-12 from 35.0 to 36.5 feet. Clayey Sand with Gravel [Fill].

Photograph 9: B-101(P); S-14 from 40.0 to 41.5 feet. Clayey Sand with Gravel [Fill].

Photograph 10: B-101(P); S-18 from 45.0 to 46.5 feet. Clayey Sand with Gravel [Fill].

Photograph 11: B-101(P); S-19 from 50.0 to 51.5 feet. Clayey Sand with Gravel [Fill]. Sandy Lean Clay with Gravel [Alluvium/Colluvium].

Photograph 12: B-101(P); S-22 from 60.0 to 61.5 feet. Sandy Lean Clay with Gravel and Poorly Graded Sand with Clay and Gravel [Alluvium/Colluvium].

Photograph 13: B-101(P); S-24 from 70.0 to 71.5 feet. Lean Clay [Alluvium/Colluvium].

Photograph 14: B-101(P); S-25 from 73.0 to 74.5 feet. Sandy Lean Clay [Alluvium/Colluvium].

Photograph 15: B-101(P); S-26 from 76.0 to 77.5 feet. Sandy Lean Clay [Alluvium/Colluvium].

B-102A(P)

Photograph 16: B-102A(P); S-2 from 1.5 to 3.0 feet. Clayey Gravel with Sand [Fill].

Photograph 17: B-102A(P); S-3 from 4.0 to 5.5 feet. Clayey Gravel with Sand [Fill].

Photograph 18: B-102A(P); S-4 from 6.5 to 8.0 feet. Clayey Gravel with Sand [Fill].

Photograph 19: B-102A(P); S-5 from 9.0 to 10.5 feet. Clayey Gravel with Sand [Fill].

Photograph 20: B-102A(P); S-6 from 11.5 to 13.0 feet. Clayey Gravel with Sand [Fill].

Photograph 21: B-102A(P); S-7 from 14.0 to 15.5 feet. Clayey Gravel with Sand [Fill].

Photograph 22: B-102A(P); S-8 from 16.5 to 18.0 feet. Clayey Gravel with Sand [Fill].

Photograph 23: B-102A(P); S-11 from 21.5 to 23.0 feet. Clayey Gravel with Sand [Fill].

Photograph 24: B-102A(P); S-12 from 24.0 to 24.8 feet. Clayey Gravel with Sand [Fill].

Photograph 25: B-102A(P); S-13 from 26.5 to 28.0 feet. Clayey Sand with Gravel [Fill].

Photograph 26: B-102A(P); S-15 from 31.5 to 33.0 feet. Clayey Gravel with Sand [Fill].

Photograph 27: B-102A(P); S-16 from 34.0 to 35.5 feet. Clayey Gravel with Sand [Fill].

Photograph 28: B-102A(P); S-17 from 36.5 to 38.0 feet. Clayey Gravel with Sand [Fill].

Photograph 29: B-102A(P); S-18 from 39.0 to 39.8 feet. Poorly Graded Gravel with Clay and Sand [Fill].

Photograph 30: B-102A(P); S-19 from 41.5 to 43.0 feet. Clayey Sand with Gravel [Fill].

Photograph 31: B-102A(P); S-21 from 46.5 to 46.8 feet. Poorly Graded Gravel with Clay and Sand [Fill].

B-103(P)

Photograph 32: B-103(P); S-2 from 1.0 to 2.5 feet. Clayey Sand with Gravel [Fill].

Photograph 33: B-103(P); S-3 from 3.5 to 4.6 feet. Clayey Gravel with Sand [Fill].

Photograph 34: B-103(P); S-4 from 5.0 to 6.5 feet. Clayey Sand with Gravel [Fill].

Photograph 35: B-103(P); S-5 from 7.5 to 9.0 feet. Clayey Sand with Gravel [Fill].

Photograph 36: B-103(P); S-6 from 10.0 to 11.5 feet. Clayey Sand with Gravel [Fill].

Photograph 37: B-103(P); S-7 from 12.5 to 14.0 feet. Clayey Sand with Gravel [Fill].

Photograph 38: B-103(P); S-10 from 21.0 to 22.3 feet. Clayey Sand with Gravel [Fill].

Photograph 39: B-103(P); S-12 from 22.5 to 24.0 feet. Clayey Sand with Gravel [Fill]. Gravelly Lean Clay with Sand [Alluvium/Colluvium].

Photograph 40: B-103(P); S-13 from 25.0 to 26.5 feet. Gravelly Lean Clay with Sand [Alluvium/Colluvium].

B-104(P)

Photograph 41: B-104(P); S-1 from 4.0 to 5.5 feet. Basalt [Alluvium/Colluvium].

Photograph 42: B-104(P); S-2 from 4.0 to 5.5 feet. Sandy Lean Clay with Gravel [Alluvium/Colluvium].

Photograph 43: B-104(P); S-4 from 13.0 to 13.3 feet. Gravelly Lean Clay with Sand [Alluvium/Colluvium].

Photograph 44: B-104(P); S-5 from 13.4 to 14.9 feet. Sandy Lean Clay with Gravel [Alluvium/Colluvium].

Photograph 45: B-104(P); S-6 from 17.0 to 17.3 feet. Gravelly Lean Clay with Sand [Alluvium/Colluvium].

Photograph 46: B-104(P); S-7 from 22.0 to 23.5 feet. Lean Clay with Gravel [Alluvium/Colluvium].

Photograph 47: B-104(P); S-8 from 27.0 to 28.5 feet. Sandy Silt with Gravel [Alluvium/Colluvium].

B-105A(P)

Photograph 48: B-105A(P); S-2 from 2.0 to 3.5 feet. Clayey Sand with Gravel [Alluvium/Colluvium].

Photograph 49: B-105A(P); S-3 from 4.5 to 6.0 feet. Clayey Sand with Gravel [Alluvium/Colluvium].

Photograph 50: B-105A(P); S-4 from 7.0 to 7.9 feet. Clayey Sand with Gravel [Alluvium/Colluvium].

Photograph 51: B-105A(P); S-5 from 10.0 to 11.5 feet. Sandy Lean Clay with Gravel [Alluvium/Colluvium].

Photograph 52: B-105A(P); S-6 from 12.0 to 13.5 feet. Sandy Lean Clay with Gravel [Alluvium/Colluvium].

Photograph 53: B-105A(P); S-7 from 17.0 to 18.5 feet. Lean Clay with Sand [Alluvium/Colluvium].

Photograph 54: B-105A(P); S-8 from 22.0 to 23.5 feet. Lean Clay [Alluvium/Colluvium].

Photograph 55: B-105A(P); S-9 from 27.0 to 28.5 feet. Sandy Lean Clay with Gravel [Alluvium/Colluvium].

Photograph 56: B-105A(P); S-10 from 32.0 to 32.3 feet. Sandy Lean Clay [Alluvium/Colluvium].

Photograph 57: B-105A(P); S-11 from 37.0 to 38.5 feet. Sandy Lean Clay with Gravel [Alluvium/Colluvium].

Photograph 58: B-105A(P); S-14 from 52.0 to 52.9 feet. Clayey Sand with Gravel [Alluvium/Colluvium].

Photograph 59: B-105A(P); S-15 from 57.0 to 58.5 feet. Clayey Sand with Gravel [Alluvium/Colluvium].

Photograph 60: B-105A(P); S-17 from 67.0 to 67.2 feet. Clayey Sand with Gravel [Alluvium/Colluvium].

Photograph 61: B-105A(P); S-18 from 72.0 to 73.5 feet. Clayey Sand with Gravel [Alluvium/Colluvium].

APPENDIX D

DAILY SITE REPORTS

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project
Task 1002 Geotechnical Investigation

Report No.: 001-JNH
Date: Monday, July 23, 2018

Prepared By: JNH
Weather: low 80's, mostly sunny, light-moderate breeze
Boring(s): B-103(P)

People on Site (arrival/departure time)

- RJH:
  - JNH (09:45/19:00)
  - GOJ (09:45/17:10)
- HRL:
  - Jose Suarez & Devin Lucero (10:00/18:55)
  - Mark Mumby (10:00/12:05)
- Colorado SEO: Jackie Blumberg (on-site upon RJH arrival/15:50)
- U.S. Forest Service: name unknown, 1 person (11:45)

Equipment on Site

Mobile
- RJH T3
- GJ Chevy Silverado
- HRL Chevy 2500HD
- HRL Dodge 3500
- SEO Ford F-150
- USFS full-size pick-up truck

At Site Parking Lot Overnight
- HRL semi-truck and trailer
- HRL support trailer & materials

At Drill Site Overnight
- CME 55LC track mounted drill rig

Material Used

- 2 buckets coated pellets (5 gallon)
- 2 bags of medium bentonite chips (50# bag)
- 15 bags of 10/20 sand (50# bag)
- 1 J plug
- 10 ft slotted 2" PVC (40) pipe
- (2) 10 ft riser 2" PVC (40) pipe
- 1 slip cap

Drilling Progress Summary

- HRL mobilized the drill rig and drilling support equipment to the Site.
- Boring B-103 was drilled via HSA to a depth of 30.0 feet. Drillers changed the drill bit to a conical drill bit at 3.5 feet to aid with progressing through gravel and cobbles in the embankment fill.
- A falling head permeability test was completed in the foundation material, below groundwater, at the bottom of the boring.
- The drillers began the monitoring well installation and completed the backfill materials to about 2.0 feet. Tomorrow, concrete will be used to complete the backfill material and a surface mount casing placed in concrete.
- The drillers positioned the drill rig over the boring so as to cover the partially completed monitoring well. A J plug is set in the PVC to prevent debris from entering the monitoring well.

Seepage Observations

- Seepage near outlet works at toe appeared to have little to no flow prior to and post drilling activities.
- No water was observed in either of the two seepage channels in the willows right (north) of the outlet works prior to and post drilling activities.

Plan for Next Work Day

- JNH and drillers to meet at Site at 07:00.
- Mark to deliver concrete and packer. Complete monitoring well installation at B-103.
- Begin the next boring, B-102, and drill via HSA until advanced 2-3 feet into bedrock. Once in bedrock, switch to HQ wireline coring.
- If time and site conditions allow, install two nested piezometers at B-102; one into bedrock (denoted as B-102A(P)) and one into the embankment fill (denoted as B-102B(P)).

Site Coordination Activities

- A USFS personnel (Cliff) opened the locked gate so the field crew could transport equipment onto the crest. The gate lock is “dummy locked” for overnight so the field crew can access equipment tomorrow. Either the USFS or the City of Grand Junction will provide the field crew a key to the gate; until this occurs, the field crew will continue to “dummy lock” the gate for overnight.
- Several hikers and fishermen walked past the drill rig on the dam crest during the day with no incidents. Cliff will contact Jon Hare (USFS) about placing signage to close the

dam crest to the public during drilling operations. GJ also left a phone message for Jon about closing the dam crest.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project
Task 1002 Geotechnical Investigation

Photographs
Boring B-103:

Figure 1. Dam crest and B-103 prior to drilling activities, looking south.

Figure 2. B-103 equipment set-up, looking southeast.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 001-JNH**
Task 1002 Geotechnical Investigation **Date: Monday, July 23, 2018**

Figure 3. B-103 at the end of day, looking southeast. Drill rig parked over monitoring well.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 002-JNH**
Task 1002 Geotechnical Investigation **Date: Tuesday, July 24, 2018**

Prepared By: JNH
Weather: upper 70's, mostly sunny, clouds and breeze increase throughout day
Boring(s): B-102A(P) & B-103(P)

People on Site (arrival/departure time)

- RJH: JNH (06:50/19:45)
- HRL:
    - Jose Suarez & Devin Lucero (07:00/19:40)
    - Mark Mumby (12:20/13:25)
- City of Grand Junction: Lee Cooper (09:50/10:20)
- Colorado SEO: Jason Ward (12:40/13:10)

Equipment on Site

Mobile

- RJH T3
- HRL Chevy 2500HD
- HRL Dodge 3500
- City of Grand Junction full-size pick-up truck
- SEO Chevy Trailblazer

At Site Parking Lot Overnight

- HRL semi-truck and trailer
- HRL support trailer & materials

At Drill Site Overnight

- CME 55LC track mounted drill rig

Material Used

B-102A(P)

- 2 bags of 10/20 sand (50# bag)
- 1 J plug
- 10 ft slotted 2" PVC (40) pipe
- (4) 10 ft riser 2" PVC (40) pipe
- 1 slip cap

B-103(P)

- 1 bag concrete
- (1) 9-inch flush mount casing

Drilling Progress Summary

- Boring B-102 was drilled via HSA until augers hit refusal at 48.0 feet in the embankment fill. At 46.5 feet, drilling progressed 1.5 feet in 45 to 60 minutes to reach auger refusal depth of 48.0 feet. Numerous gravel and cobbles were encountered throughout drilling and prevented further advancement of the boring.
- A falling head permeability test was completed in the embankment fill, below groundwater and prior to auger refusal.
- Monitoring well, denoted as B-102A(P), was installed at about 48 feet within the embankment fill.
- The drillers began the monitoring well installation at B-102A(P) and completed the backfill materials to about 44.0 feet.
- The drillers attached the auger casing rod to the augers in boring B-102A(P) to cover and protect the integrity of the monitoring well for overnight.
- The drillers completed monitoring well B-103(P) by backfilling the remaining 2.0 feet with concrete and installing the surface mount casing.
- JNH developed B-103(P) using the surge block and submersible pump.

Seepage Observations

- Seepage behind the outlet works at toe appeared to have little to no flow prior to, during, and post drilling activities.
- Seepage from drain right of outlet works was flowing at a few gallons per minute with little to no turbidity. This amount of seepage was also observed yesterday with no changes throughout the day today.
- No water was observed in either of the two seepage channels in the willows right (north) of the outlet works prior to, during, and post drilling activities.
- No other signs of seepage or abnormalities were observed.

Plan for Next Work Day

- JNH and drillers to meet at Site at 07:30.
- Mark to deliver additional cement and sand.
- Complete the monitoring well installation at B-102A(P).
- Attempt to drill B-102B via HSA about 5-8 feet south of B-102A location.
    - If difficulties advancing boring, JNH will contact GJ. GJ may advise field crew to backfill the boring with cement bentonite grout and proceed to drilling the toe borings.
    - If drilling advancement successful, drill via HSA until advanced 2-3 feet into bedrock. Once in bedrock, switch to HQ wireline coring. If time and site conditions allow, install monitoring well within bedrock.

Site Coordination Activities

- Representatives from the City of Grand Junction and Colorado SEO were temporarily on-site to meet the field crew, observe and discuss drilling progress, and make other on-site observations.
- GJ provided a lock to secure the USFS gate for the remainder of the week. JNH will remove the lock upon completion of site activities.
- For public safety, JNH will place flags on the crest between the parking lot and the drilling equipment and project vehicles.

Non-RJH Activities

- About 8-10 hikers and fishermen on-site throughout the day, but not near the crest or drilling equipment.

<u>Photographs</u>

Boring B-102A:

Figure 1. Dam crest and B-102A prior to drilling activities, looking south. Green “X” in photo indicates boring location.

Figure 2. B-102A equipment set-up, looking southeast.

Figure 3. B-102A at the end of day, looking southeast. Auger casing rod is attached to in-place augers.

Boring B-103:

Figure 1. Monitoring well at B-103 covered with bucket while awaiting concrete backfill and well completion. Looking north.

Figure 2. Completed monitoring well installation at B-103, looking north.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 003-JNH**
Task 1002 Geotechnical Investigation **Date: Wednesday, July 25, 2018**

Prepared By: JNH
Weather: mid 70's, partly sunny and moderate breeze
Boring(s): B-102A(P), B-102B, B-101

People on Site (arrival/departure time)

- RJH: JNH (07:20/18:30)
- HRL:
  - Jose Suarez & Devin Lucero (07:20/18:30)
  - Mark Mumby (08:50/11:55)
- City of Grand Junction: Slade & Jerry(?) (10:30/10:50)

Equipment on Site

Mobile
- RJH T3
- HRL Chevy 2500HD
- HRL Dodge 3500
- City of Grand Junction full-size pick-up truck

At Site Parking Lot Overnight
- HRL semi-truck and trailer
- HRL support trailer & materials

At Drill Site Overnight (at B-101)
- CME 55LC track mounted drill rig

Material Used

B-102A(P)
- 4 bags of 10/20 sand (50# bag)
- 4 buckets of coated bentonite pellets
- 5 bags of Portland cement (47# bag)
- ½ bag high yield bentonite powder (50# bag)

B-102B(P)
- 2 bags of Portland cement (47# bag)
- ¼ bag high yield bentonite powder (50# bag)

B-101
- None

Drilling Progress Summary

- The drillers continued to work on the B-102A(P) monitoring well installation. The sand pack was having difficulty settling on the bottom of the boring due to the presence of turbid water inside the boring. Mark was able to help the drillers troubleshoot the problem by pumping the fluid out of the boring and adding clean water to the boring; this allowed for the sand to settle and pack properly at the bottom of the boring.
- Cement bentonite grout was placed in B-102A(P) via tremie pipe and hose. The grout needs to set overnight and the monitoring well was covered with a bucket at the end of the day.
- Boring B-102B was attempted about 8 feet south of B-102A(P) and drilled via HSA until auger refusal at about 5 feet. It took 45 minutes to advance the boring 5 feet and continuous auger grinding and rig rocking were observed. Numerous gravel and cobbles were encountered during drilling and prevented further advancement of the boring.
- B-102B was backfilled with cement bentonite grout. The grout needs to set overnight and the boring was covered with a basalt boulder at the end of the day.
- Boring B-101 was drilled via HSA. Gravel and cobbles are present in the embankment fill; however, the augers are advancing at a rate of about 5 feet in 30 minutes, including taking samples. Today, attempts to sample with the California sampler and the Shelby tube have failed due to the presence of gravel and cobbles. The depth of the boring was at 25.0 feet at the end of the day.
- The drillers attached the auger casing rod to the augers in B-101 to cover and protect the integrity of the boring for overnight.

Seepage Observations

- Seepage behind the outlet works right headwall at toe appeared to have little flow prior to, during, and post drilling activities.
- Seepage from drain right of outlet works was flowing at a few gallons per minute with little to no turbidity. JNH approximated the seepage rate using a 5-gallon bucket at about 4.3 gpm. No changes in the seepage rate or clarity of water were observed prior to, during, and post drilling activities.
- No water was observed in either of the two seepage channels in the willows right (north) of the outlet works prior to, during, and post drilling activities.
- No other signs of seepage or abnormalities were observed.

Plan for Next Work Day

- JNH and drillers to meet at Site at 07:30.
- Mark to deliver additional cement.

- Complete the monitoring well installation at B-102A(P) by placing concrete and the surface mount casing.
- Complete the backfilling of B-102B and cover with cuttings.
- Continue to drill B-101 via HSA.
    - If drilling advancement successful, drill via HSA until advanced 2-3 feet into bedrock. Once in bedrock, switch to HQ wireline coring. If time and site conditions allow, install nested piezometers (one in bedrock and one in embankment).
    - If difficulties advancing boring, either install a monitoring well below the phreatic surface or, if groundwater not encountered prior to auger refusal, backfill boring with cement bentonite grout.

Site Coordination Activities

- Representatives from the City of Grand Junction were temporarily on-site to deliver materials to place flagging on the crest between the parking lot and the drilling equipment and project vehicles. JNH placed two orange cones and strung caution tape between the cones, across the crest. The representatives said to leave the material near the gate building on the crest at the end of drilling activities.

Non-RJH Activities

- About 20 hikers and fishermen on-site throughout the day. In the morning, a group of about 8 hikers walked around the drilling equipment along the crest but remained a safe distance from equipment.
- City of Grand Junction on-site with full-size pick-up truck and backhoe. Slade said the City is removing a beaver dam on the right side of the reservoir; a backhoe is being used to remove the debris. The beaver dam has diverted water flow into the reservoir, thus resulting in the spillway overtopping. Once the beaver dam is removed, the reservoir level should return to below or at the spillway crest.

DAILY SITE REPORT

Photographs

Borings B-102A and B-102B:

Figure 1. B-102A at start of day, looking southeast.

Figure 2. B-102A equipment set-up during grouting, looking southeast.

Figure 3. B-102B prior to drilling activity, boring area circled in red and indicated with green "X." Augers in foreground are in B-102A during coated pellet curing time. Looking south.

Figure 4. B-102A and B-102B at the end of day, looking north. B-102A is in background covered with a white bucket, circled in red. B-102B is in foreground covered with a basalt boulder, indicated by red arrow.

Boring B-101:

Figure 5. B-101 prior to drilling activities, indicated by green "X." Looking south.

Figure 6. B-101 equipment set-up during drilling, looking south.

Figure 7. B-101 at the end of day, looking south.

Other Photos:

Figure 8. Cones and caution tape across crest at north end (nearest parking lot), looking south.

Figure 9. Crest at the end of day, looking south. Cones and caution tape across crest are indicated with red arrows.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 004-JNH**
Task 1002 Geotechnical Investigation **Date: Thursday, July 26, 2018**

Prepared By: JNH
Weather: mid 70's, mostly sunny with moderate breeze in afternoon
Boring(s): B-102A(P), B-102B, B-101

People on Site (arrival/departure time)

- RJH:
  - JNH (07:30/18:55)
  - GOJ (11:20/12:05)
- HRL:
  - Jose Suarez & Devin Lucero (07:30/18:55)
  - Chris (07:30/08:00)

Equipment on Site

Mobile
- RJH T3
- GJ Chevy Silverado
- HRL Chevy 2500HD
- HRL Dodge 3500

At Site Parking Lot Overnight
- HRL semi-truck and trailer
- HRL support trailer & materials

At Drill Site Overnight (at B-101)
- CME 55LC track mounted drill rig

Material Used

B-102A(P)
- 2 bags of concrete (50# bag)
- 9-inch surface mount casing

B-102B(P)
- None

B-101
- None

Drilling Progress Summary

- Chris (HRL) dropped off additional bags of Portland cement and buckets of coated pellets.
- The drillers completed the monitoring well installation at B-102A(P) by placing concrete and installing the surface mount casing.
- JNH developed B-102A(P) using the surge block and submersible pump. A rising head permeability test was also completed.
- The backfill of B-102B was completed by covering the cement bentonite grout with 0.3 feet of cuttings to create a level surface with the crest.
- Drilling B-101 was continued via HSA. Prior to start of drilling for the day, groundwater was measured in the boring to about 24.2 feet below ground surface (bgs). The cuttings appeared wet to about 34 feet bgs; however, the samples within the interval from 25 to 31 feet were moist. Deeper than 34 feet the cuttings and samples were moist.
- The contact between the embankment and natural ground occurred at about 50.6 feet bgs. The contact appeared as a distinct change in color and increasing clay content (from a generally clayey sand with gravel in the embankment to a sandy lean clay with gravel in the foundation).
- Groundwater was encountered at about 55.3 feet bgs.
- Today, attempts to sample with the California sampler were successful but attempts with the Shelby tube have failed due to the presence of gravel and cobbles.
- Numerous cobbles were encountered throughout drilling resulting in slow boring advancement. At the beginning of the day, the augers were advancing at a rate of about 5 feet in 25 to 30 minutes. Near the middle to end of the day, the augers were advancing about 5 feet in 45 minutes with intermittent auger grinding.
- The depth of the boring was at 75.0 feet at the end of the day and bedrock was not encountered.
- The drillers attached the auger casing rod to the augers in B-101 to cover and protect the integrity of the boring for overnight.

Seepage Observations

- Seepage behind the outlet works right headwall at toe appeared to have little flow prior to, during, and post drilling activities.
- Seepage from drain right of outlet works was flowing at a few gallons per minute with little to no turbidity. JNH approximated the seepage rate using a 5-gallon bucket at about 4.3 gpm. No changes in the seepage rate or clarity of water were observed prior to, during, and post drilling activities.
- No water was observed in either of the two seepage channels in the willows right (north) of the outlet works prior to, during, and post drilling activities.

- No other signs of seepage or abnormalities were observed.

Plan for Next Work Day

- JNH and drillers to meet at Site at 07:30.
- Mark to deliver additional 5-10 feet of augers and core boxes.
- Continue to drill B-101 via HSA until auger refusal, socketed into bedrock, or if augers reach maximum depth as identified by HRL.
    - If bedrock is encountered, drill via HSA until augers advanced 2-3 feet into bedrock only if the end auger depth is less than the maximum identified by HRL. Once in bedrock, switch to HQ wireline coring. If time and site conditions allow, install piezometer into bedrock only, since groundwater was encountered in the embankment foundation.
    - If difficulties advancing boring, install a monitoring well within the foundation material.

Site Coordination Activities

- None

Non-RJH Activities

- About 25-30 hikers and fishermen on-site throughout the day. A group of 3 hikers walked around the drilling equipment along the crest but remained a safe distance from equipment.

Photographs

Borings B-102A and B-102B:

Figure 1. B-102A and B-102B at start of day, looking south. B-102A in the foreground is covered by a white bucket, circled in red. B-102B in the background is covered by a basalt boulder, indicated by red arrow.

Figure 2. B-102A and B-102B at completion, looking south. B-102A in the foreground is circled in red. B-102B in the background is indicated by red arrow.

Figure 3. B-102B at completion, circled in red. Looking south.

Boring B-101:

Figure 4. B-101 at start of day, looking south.

Figure 5. B-101 equipment set-up during drilling, looking southeast.

Figure 6. B-101 at the end of day, looking southeast.

Other Photos:

Figure 7. Crest at the end of day, looking south. Cones and caution tape across crest are indicated with red arrows.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 005-JNH**
Task 1002 Geotechnical Investigation **Date: Friday, July 27, 2018**

Prepared By: JNH
Weather: high mid 70's, mostly sunny with increasing clouds and thunderstorm in the evening. Drilling was stopped and Site evening clean-up was occurring when first signs of thunder began.
Boring(s): B-101

People on Site (arrival/departure time)

- RJH: JNH (07:20/19:20)
- HRL:
  - Jose Suarez & Devin Lucero (07:20/19:20)
  - Mark Mumby (08:30/19:15)

Equipment on Site

Mobile
- RJH T3
- HRL Chevy 2500HD
- HRL Dodge 3500

At Site Parking Lot Overnight
- HRL semi-truck and trailer
- HRL support trailer & materials

At Drill Site Overnight (at B-101)
- CME 55LC track mounted drill rig

Material Used

B-101
- 10 bags of 10/20 sand (50# bag)
- 4 buckets of coated bentonite pellets
- 3 bags of Portland cement (92.6# bag) (so about 6 bags of 47# cement)
- 1 bag high yield bentonite powder (50# bag)
- (1) 5 ft slotted 1.5" PVC (40) pipe
- (7) 10 ft riser 1.5" PVC (40) pipe
- (16) 5 ft tremie 1" PVC (40) pipe
- 1 PVC elbow
- 1 end cap

DAILY SITE REPORT

Drilling Progress Summary

- Drilling B-101 was continued via HSA. Prior to start of drilling for the day, groundwater was measured in the boring to about 38.3 feet below ground surface (bgs). The augers hit refusal at 76.0 feet. At 75.0 feet, drilling progressed 1.0 foot in 30 to 40 minutes with continuous auger grinding and rig rocking to reach auger refusal depth of 76.0 feet. A split spoon sample was taken from 76.0 to 77.5 feet and recovered a sandy lean clay with basalt gravel. Bedrock was not encountered in B-101.
- The drillers installed monitoring well B-101(P) at about 73.0 feet within the foundation. Backfill materials were completed to about 12.0 feet.
- During monitoring well installation, a nested piezometer was considered at B-101, with one piezometer within the foundation and one within the embankment; however, due to well installation challenges, time constraints, driller's Department of Transportation (DOT) hour restrictions, and other non-project constraints, only one piezometer was installed within the foundation.
- During the initial phase of the monitoring well installation, the sand pack was having difficulty settling on the bottom of the boring, similar to conditions encountered during the installation of B-102A(P). Mark was on-site to help the drillers troubleshoot the well installation. After discussions with RJH management, additional water was poured down the hole to counteract an upward gradient from a confined groundwater source. The additional water head allowed for the sand to settle and pack properly at the bottom of the boring.
- Cement bentonite grout was placed in B-101(P) via tremie pipe to about 12.0 feet. The grout needs to set overnight and the monitoring well was covered for overnight.

Seepage Observations

- Seepage behind the outlet works right headwall at toe appeared to have little flow prior to, during, and post drilling activities.
- Seepage from drain right of outlet works was flowing at a few gallons per minute with little to no turbidity. JNH approximated the seepage rate using a 5-gallon bucket at about 4.3 gpm. No changes in the seepage rate or clarity of water were observed prior to, during, and post drilling activities.
- No water was observed in either of the two seepage channels in the willows right (north) of the outlet works prior to, during, and post drilling activities.
- No other signs of seepage or abnormalities were observed.

Plan for Next Work Day

- JNH and drillers to meet at Site at 07:30.
- Complete the monitoring well installation at B-101(P) by placing bentonite chips, concrete, and the surface mount casing. Place cuttings around monitoring well to cover concrete.
- Demobilize equipment from site. Preferably, this will occur prior to persons from the Grand Mesa Ultra running race being on-site. However, if runners are present, equipment travel will attempt to be coordinated so as to move equipment while runners are not on the crest.
- JNH to store City of Grand Junction cones and caution tape at the gate structure building and to relock the gate with the USFS lock.

Site Coordination Activities

- None

Non-RJH Activities

- About 15-20 hikers and fishermen on-site throughout the day. Two hikers walked around the drilling equipment along the crest but remained a safe distance from equipment.
- A person from the Grand Mesa Ultra running race was on-site placing flags along the crest. The man said that there is a trail running race taking place tomorrow, Saturday 7/28/18, and the route travels across the crest of Hogchute Dam. The man indicated that the runners will be at the crest starting around 14:00.

Photographs

Boring B-101:

Figure 1. B-101 at start of day, looking southeast.

Figure 2. B-101 equipment set-up during grouting, looking southeast.

Figure 3. B-101 at end of day, looking southeast.

Other Photos:

Figure 4. Cones and caution tape across crest at north end (nearest parking lot) at end of day, looking south.

Figure 5. Flag placed on crest for trail running race that occurs Saturday 7/28/18, looking north. Flag circled in red. Monitoring well in photo is B-102A(P).

Figure 6. Flag placed on roadway between parking lot and crest for trail running race.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 006-JNH**
Task 1002 Geotechnical Investigation **Date: Saturday, July 28, 2018**

Prepared By: JNH
Weather: high low-mid 60's, clouds increasing to overcast with intermittent rain and few lightning and thunder. Drilling equipment was demobilized off the crest prior to lightning.
Boring(s): B-101

People on Site (arrival/departure time)

- RJH: JNH (07:20/10:30)
- HRL:
  - Jose Suarez & Devin Lucero (07:30/10:05)
  - Mark Mumby (08:25/10:05)

Equipment on Site

Mobile
- RJH T3
- HRL Chevy 2500HD
- HRL Dodge 3500

Demobilized
- HRL semi-truck and trailer
- HRL support trailer & materials
- CME 55LC track mounted drill rig

Material Used

B-101
- 2 buckets of coated bentonite pellets
- 5 bags of medium bentonite chips (50# bag)
- 2 bags of concrete (50# bag)
- 9-inch surface mount casing

Drilling Progress Summary

- No drilling occurred today.
- Prior to continuing the monitoring well installation at B-101 for the day, groundwater was measured in the well to about 30.55 feet below ground surface (bgs).
- The drillers completed the monitoring well installation at B-101(P).
- The drillers demobilized the drill rig and equipment off of the crest. Mark was on-site to assist the drillers with demobilization. The drillers completed site clean-up while JNH

developed well B-101(P) with the 1-inch hand bailer and performed a rising head permeability test.
- No 1.5-inch slip cap or J-plug was on-site. The well at B-101(P) was covered with duct tape to protect the well from debris. Mark said that he would return to the site next week (of 7/30/18) and install a cap for the well; JNH requested that Mark install a J-plug. Mark to notify JNH when he returns to the site to cover the well at B-101(P).
- JNH placed the City of Grand Junction cones and tape surrounding B-101(P) in an attempt to prevent the trail runners or other public on the crest from stepping into the concrete that was placed today. Plenty of space remains for public to safely access the crest on either side of the monitoring well.
- JNH secured the USFS gate with the USFS lock and removed RJH's lock.
- The drillers and all equipment and material were demobilized from the Site prior to any trail runners being present.

Seepage Observations

- Seepage behind the outlet works right headwall at toe appeared to have little flow prior to and post daily activities.
- Seepage from drain right of outlet works was flowing at a few gallons per minute with little to no turbidity. JNH approximated the seepage rate using a 5-gallon bucket at about 4.3 gpm. No changes in the seepage rate or clarity of water were observed prior to and post daily activities.
- No water was observed in either of the two seepage channels in the willows right (north) of the outlet works prior to and post daily activities.
- No other signs of seepage or abnormalities were observed.

Plan for Next Work Day

- Drilling for this phase of the geotechnical investigation is complete.
- Mark to notify JNH when he returns to the site next week to place the J-plug in B-101(P).

Site Coordination Activities

- None

Non-RJH Activities

- About 15-20 fishermen and trail running race spectators were on-site throughout the morning.

<u>Photographs</u>

Boring B-101:

Figure 1. B-101 at start of day, looking southeast.

Figure 2. Duct tape covering well opening at B-101.

18115 Hogchute Dam Safety Evaluation Project **Report No.: 006-JNH**
Task 1002 Geotechnical Investigation **Date: Saturday, July 28, 2018**

Figure 3. B-101 at end of day, looking north. Cones and caution tape placed either side of monitoring well surface mount casing.

Figure 4. Crest and B-101 at end of day, looking south. B-101 location circled in red.

Other Photos:

Figure 5. Crest at the beginning of day, looking south.

Figure 6. Crest at the end of day, looking south.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 007-JNH**
Task 1002 Geotechnical Investigation **Date: Monday, September 17, 2018**

Prepared By: JNH
Weather: high low 70's, mostly sunny, light to moderate breeze
Boring(s): B-105

People on Site (arrival/departure time)

- RJH:
  - JNH (08:45/17:45)
  - GOJ (12:50/17:10)
- HRL:
  - Jose Suarez & Devin Lucero (09:15/17:35)
  - Mark Mumby (09:15/11:45)
  - Chris (09:15/09:35 and 16:25/16:35)
- SEO: Jackie Blumberg (12:15/16:30)
- Girardis Towing (09:15/09:25)

Equipment on Site

Mobile
- RJH T3
- GOJ Chevy Silverado
- HRL Chevy 2500HD
- HRL Dodge 3500
- HRL Dodge diesel pickup truck and trailer
- SEO Ford F-150
- Girardis semi-truck and trailer

At Site Parking Lot Overnight
- HRL support trailer & materials

At Drill Site Overnight (B-105)
- CME 55LC track mounted drill rig
- Sullair 375HH trailer mounted air compressor
- New Holland C185 track mounted skid steer

Material

At Site Parking Lot
- About 4 cubic yards (CY) of C-33 fine aggregate sand
- About 4 CY of Chat/minus ¼ inch gravel

Used (B-105)

- About 2 CY each of fine aggregate sand and Chat/minus ¼ inch gravel staged near B-105

Carson Lake Water Level

- About 10 feet below the spillway crest

Drilling Progress Summary

- JNH recorded groundwater levels in B-101(P), B-102A(P), and B-103(P) prior to the start of drilling activities. B-102A(P) was pumped dry with the submersible pump and a rising head permeability test was performed.
- HRL mobilized the drill rig and drilling support equipment to the Site. HRL stated that Whitewater delivered the C-33 fine aggregate and Chat/minus ¼ inch gravel to the Site parking lot Friday 9/14/18.
- The keyed lock to the USFS gate was cut to allow equipment access. GOJ to coordinate lock replacement with the City and USFS.
- HRL mobilized about 2 CY each of the fine aggregate sand and ¼ inch gravel emergency supplies to near B-105.
- Boring B-105 was drilled via drive casing advancer methods, specifically Symmetrix, to a depth of 27.0 feet. A representative from the SEO was onsite during drilling. Smooth drilling advanced through clay, gravel, cobbles, and a few boulders. The air compressor was kept at the “low pressure” setting throughout drilling.
- Groundwater was encountered at about 4.8 feet and the depth of water in the boring varied throughout drilling. The groundwater was under positive pressure and as a result, a rising head permeability test was completed at 21.0 to 22.0 feet in lean clay material.
- A split spoon sample was taken from about 27.0 to 28.5 at the end of the day and bedrock was not encountered.
- The drillers attached the drive casing head in B-105 to cover and protect the integrity of the boring for overnight.
- RJH placed a keyed lock to secure the USFS gate for overnight.

Seepage Observations

- Seepage behind the outlet works right headwall at toe appeared to have typical low flow prior to and post daily activities.
- Seepage from drain right of outlet works was flowing at a few gallons per minute with little to no turbidity. JNH approximated the seepage rate using a 5-gallon bucket at about 5 gpm. No changes in the seepage rate or clarity of water were observed prior to and post daily activities.

- No water was observed in either of the two seepage channels in the willows right (north) of the outlet works prior to and post daily activities.
- No other signs of seepage or abnormalities were observed.

Plan for Next Work Day

- JNH to use the 1.5-inch submersible pump on B-101(P) and perform a rising head permeability test.
- JNH to meet drillers at Site at 07:30.
- Continue to drill B-105 via drive casing advancer until bedrock is encountered or a depth of about 75 feet is reached; HRL identified about 75 feet as the maximum allowable depth.
    - o If bedrock is encountered, drill via drive casing advancer until advanced 2-3 feet into bedrock, only if the end casing depth is less than the maximum identified by HRL. Once in bedrock, switch to HQ wireline coring and perform packer tests.
- If time and site conditions allow, install piezometer in colluvium/alluvium.

Site Coordination Activities

- None

Non-RJH Activities

- About 15-25 fishermen and campers were on-site throughout the day; no public were near equipment at dam toe.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project
Task 1002 Geotechnical Investigation

<u>Photographs</u>

Boring B-105:

Figure 1. B-105 (circled in red) prior to drilling, looking southeast.

Figure 2. B-105 equipment set-up prior to drilling, taken from crest looking west.

Figure 3. B-105 equipment set-up during drilling, looking south.

Figure 4. B-105 at the end of day, looking southeast.

Other Photos:

Figure 5. Carson lake water level prior to drilling activities, looking southwest. Water level is about 10 feet below normal maximum. Normal maximum marked with red arrow.

Figure 6. Emergency stockpiles of sand and gravel stationed at the Site parking lot, looking east.

Figure 7. Symmetrix drive casing advancer bit. Camera case is 6-inches long for scale.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 008-JNH**
Task 1002 Geotechnical Investigation **Date: Tuesday, September 18, 2018**

Prepared By: JNH
Weather: high low-mid 70's, mostly sunny, light to moderate breeze
Boring(s): B-105A

People on Site (arrival/departure time)

- RJH: JNH (06:40/17:40)
- HRL: Jose Suarez & Devin Lucero (07:25/17:25)
- SEO: Jason Ward (09:05/15:00)

Equipment on Site

Mobile
- RJH T3
- HRL Chevy 2500HD
- SEO – vehicle unknown

At Site Parking Lot Overnight
- HRL support trailer & materials

At Drill Site Overnight (B-105A)
- CME 55LC track mounted drill rig
- Sullair 375HH trailer mounted air compressor
- New Holland C185 track mounted skid steer

Material

At Site Parking Lot
- About 4 cubic yards (CY) of C-33 fine aggregate sand
- About 4 CY of Chat/minus ¼ inch gravel

Used (B-105A)
- About 2 CY each of fine aggregate sand and Chat/minus ¼ inch gravel staged near B-105
- RJH provided:
  - End Cap
  - 5 ft prepacked well screen 2" PVC (40) pipe
- HRL provided:
  - (7) 10 ft riser 2" PVC (40) pipe
  - 3 buckets of bentonite coated pellets

Carson Lake Water Level

- About 10 feet below the spillway crest

Drilling Progress Summary

- JNH pumped B-101(P) with the 1.5-inch submersible pump and performed a rising head permeability test prior to the start of drilling activities.
- Drilling B-105A was continued via drive casing advancer methods. Prior to start of drilling for the day, groundwater was measured in the boring to about 9.2 feet below ground surface (bgs). A representative from the SEO was onsite during almost the entire drilling process.
- Slow and smooth drilling advanced through clay, gravel, cobbles, and boulders. The air compressor was kept at the “low pressure” setting throughout drilling.
- The depth of groundwater in the boring varied throughout drilling. The groundwater was under positive pressure and water releasing (i.e. bubbling) at the surface was observed when the boring bottom was at about 52.0 feet. The water was releasing between the casing and the boring wall. Drilling was stopped to observed if conditions changed or recovered. A rising head permeability test (K-2) was performed and data was recorded for 67 minutes. The water release at the surface stopped after about 30 minutes of no drilling activity. At about 65 minutes, the water level and water rebound rate was similar to the water depth and rate of water rebound observed in the rising head permeability test (K-1) performed yesterday, 9/17/18.
- After discussions among the field crew, it appeared likely that no damage was caused from today’s drilling activities. RJH decided to continue drilling based on the following observations:
    - The water release stopped.
    - The ring bit provided about 3/8-inch total annulus around the casing and boring wall and is the source of space for air and water to travel to the surface.
    - The water rebound rate was observed to be approximately the same as observed during K-1 at a similar water depth.
- The depth of the boring was at a maximum allowable depth of 72.0 feet at the end of the day and bedrock was not encountered. No additional water releases at the surface were observed.
- A split spoon sample was taken from about 72.0 to 73.5 at the end of the day and bedrock was not encountered.
- The drillers began the monitoring well installation at B-105A(P) and completed the backfill materials to about 48.0 feet. Chat/minus ¼ inch gravel was used as the permeable backfill around the prepacked well screen and was placed downhole. Bentonite coated pellets were placed to 48.0 feet and allowed to set overnight.
- The drillers attached the drive casing head in B-105A(P) to cover and protect the integrity of the boring and monitoring well for overnight.

Seepage Observations

- Seepage behind the outlet works right headwall at toe appeared to have typical low flow prior to, during, and post daily activities.
- Seepage from drain right of outlet works was flowing at a few gallons per minute with little to no turbidity. No changes in the seepage rate or clarity of water were observed prior to, during, and post daily activities.
- No water was observed in either of the two seepage channels in the willows right (north) of the outlet works prior to, during, and post daily activities.
- No other signs of seepage or abnormalities were observed.

Plan for Next Work Day

- JNH to meet drillers at Site at 07:30.
- Continue to install monitoring well B-105A(P).
- Move drill rig about 10 feet in any feasible direction and begin drilling B-105B.
- Install monitoring well B-105B at about 10-12 feet to capture non-high-pressure phreatic surface. No sampling necessary at B-105B.
- If time and site conditions allow, begin to move equipment and material to B-104.

Site Coordination Activities

- JNH and Jason Ward discussed the SEO's verbal approval to continuing drilling the remaining monitoring wells along the dam toe. RJH to send summary email to Project partners and SEO regarding approval to continue drilling remaining borings; GOJ to perform this task after tomorrow's activities.

Non-RJH Activities

- About 15-25 fishermen, hunters, and campers were on-site throughout the day; no public were near equipment at dam toe.

City of Grand Junction (City)
- People on Site: 1 man
- Equipment on Site: City pickup truck
- One man from the City was observed onsite on the dam crest appearing to take monitoring well measurements of the crest wells. The water level he measured in B-101(P) will likely be still rebounding from RJH pumping that well and performing a rising head permeability test earlier today.

Photographs

Boring B-105A:

Figure 1. B-105A at start of day, looking west.

Figure 2. B-105A at start of day, looking south.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 008-JNH**
Task 1002 Geotechnical Investigation **Date: Tuesday, September 18, 2018**

Figure 3. B-105A equipment set-up during drilling, looking south.

Figure 4. B-105A at the end of day, looking southeast.

Figure 5. B-105A at the end of day, looking west.

Other Photos:

Figure 6. Area where water release was occurring at the surface, circled in red. Drilling stopped.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 009-JNH**
Task 1002 Geotechnical Investigation **Date: Wednesday, September 19, 2018**

Prepared By: JNH
Weather: high mid 60's but mostly mid 50's, partly cloudy to overcast, occasional light rain, light to moderate breeze
Boring(s): B-105A, B-105B, B-104

People on Site (arrival/departure time)

- RJH:
  - JNH (06:55/17:30)
  - GOJ (13:15/14:40)
- HRL:
  - Jose Suarez & Devin Lucero (07:20/17:30)
  - Mark Mumby (10:50/11:15)

Equipment on Site

Mobile
- RJH T3
- GOJ Chevy Silverado
- HRL Chevy 2500HD
- HRL Dodge 3500

At Site Parking Lot Overnight
- HRL support trailer & materials

At Drill Site Overnight
- *At B-104*
  - CME 55LC track mounted drill rig

- *Right of Outlet Works*
  - Sullair 375HH trailer mounted air compressor
  - New Holland C185 track mounted skid steer

Material

At Site Parking Lot
- About 4 cubic yards (CY) of C-33 fine aggregate sand
- About 3 CY of Chat/minus ¼ inch gravel

Used
B-105A(P)
- 7 bags of Portland cement (47# bag)

- ½ bag high yield bentonite powder (50# bag)
- J plug

B-105B(P)

- RJH provided:
  - End cap
  - 5 ft prepacked well screen 2" PVC (40) pipe
- HRL provided:
  - (1) 10 ft riser 2" PVC (40) pipe
  - 1 bucket of bentonite coated pellets
  - 1 bag of Portland cement (47# bag)
  - ¼ bag high yield bentonite powder (50# bag)
  - J plug

B-104

- About 2 CY of fine aggregate sand and Chat/minus ¼ inch gravel moved from near B-105 to near B-104
- Additional about 1 CY Chat/minus ¼ inch gravel moved from Site parking lot to near B-104

Carson Lake Water Level

- About 10 feet below the spillway crest

Drilling Progress Summary

- JNH measured water levels in B-101(P), B-102A(P), and B-103(P) prior to the start of daily activities.
- Groundwater was measured in boring B-105A at about 9.1 feet bgs prior to daily activities.
- The drillers continued to work on the B-105A(P) monitoring well installation. Cement bentonite grout was placed via tremie pipe; the grout needs to set overnight.
- Boring B-105B was drilled about 9.5 feet north of B-105A via drive casing advancer methods to a total depth of about 12.6 feet. Smooth drilling advanced through clay, gravel, cobbles, and a few boulders at the surface. The air compressor was kept at the "low pressure" setting throughout drilling. No sampling was taken at B-105B due to the proximity to B-105A.
- No groundwater was observed in boring B-105B during drilling; however, water was heard entering the boring at a depth of about 12.6 feet and a rising head permeability test was performed. Groundwater raised to about 8.2 feet bgs.
- The drillers began the monitoring well installation at B-105B(P) and completed the backfill materials to about 2 feet. Chat/minus ¼ inch gravel was used as the

permeable backfill around the prepacked well screen and was placed downhole. Bentonite coated pellets were placed to 3 feet and allowed to set for about 1.5 hours. Cement bentonite grout was placed downhole; the grout needs to set overnight.

- The drillers mobilized equipment and material to B-104. Stockpiles of sand and gravel were moved from near B-105 to near B-104. Additional gravel was moved from the Site parking lot to near B-104. The remaining sand and gravel near B-105 was smoothed with rakes and shovels.
- Boring B-104 was drilled via drive casing advancer methods to a depth of about 12.0 feet. Slow and smooth drilling advanced through clay, gravel, cobbles, and boulders; numerous boulders were encountered from about 0 to 6 feet. The air compressor was kept at the "low pressure" setting throughout drilling.
- Groundwater was not encountered during drilling but samples were moist after about 7 feet.
- A Shelby tube was attempted at 12.0 feet but encountered a cobble at 13.0 feet which disturbed the sample. A split spoon sample was taken at about 13.0 feet but only advanced 0.3 feet due to a cobble. Bedrock was not encountered.
- The drillers attached the drive casing head in B-104 to cover and protect the integrity of the boring for overnight.

Seepage Observations

- Seepage behind the outlet works right headwall at toe appeared to have typical low flow prior to and post daily activities.
- Seepage from drain right of outlet works was flowing at a few gallons per minute with little to no turbidity. No changes in the seepage rate or clarity of water were observed prior to and post daily activities.
- No water was observed in either of the two seepage channels in the willows right (north) of the outlet works prior to and post daily activities.
- No other signs of seepage or abnormalities were observed.

Plan for Next Work Day

- JNH to meet drillers at Site at 07:30.
- Continue installation of monitoring wells B-105A(P) and B-105B(P).
- Continue to drill B-104 via drive casing advancer until bedrock is encountered or a depth of about 35 feet is reached.
  - If bedrock is encountered, drill via drive casing advancer until advanced 2-3 feet into bedrock. Once in bedrock, switch to HQ wireline coring, core about 10 feet into bedrock, and perform packer tests.
- Begin monitoring well B-104(P) installation. Install monitoring well in colluvium/alluvium.

Site Coordination Activities

- None

Non-RJH Activities

- About 10-15 fishermen, hunters, and campers were on-site throughout the day; no public were near equipment at dam toe.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 009-JNH**
Task 1002 Geotechnical Investigation **Date: Wednesday, September 19, 2018**

Photographs

Boring B-105A:

Figure 1. B-105A at start of day, looking southeast.

Figure 2. B-105A during monitoring well installation, looking south.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 009-JNH**
Task 1002 Geotechnical Investigation **Date: Wednesday, September 19, 2018**

Boring B-105B:

Figure 3. B-105B prior to drilling, looking south.

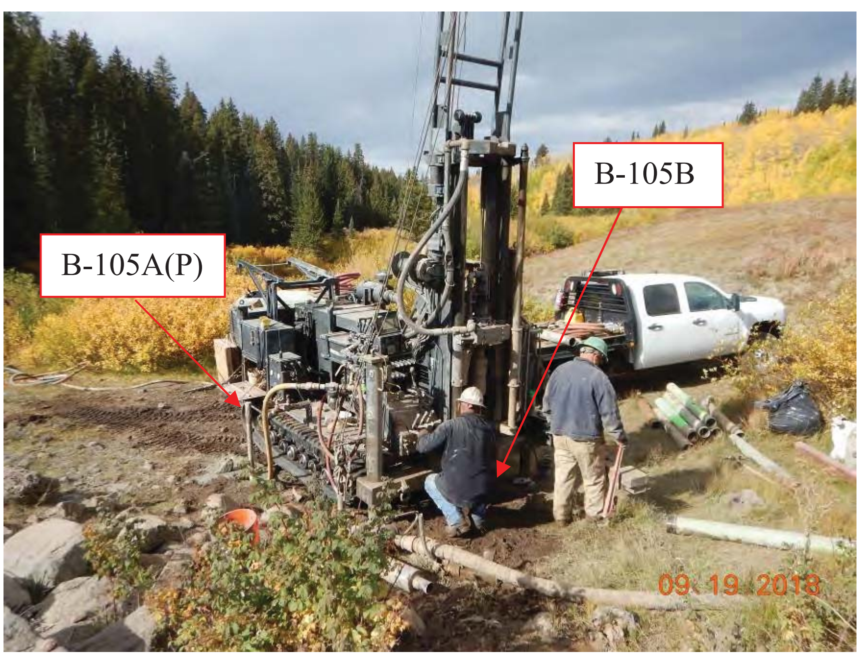


Figure 4. B-105B equipment set-up during drilling, looking west. B-105A(P) riser pipe on left in photo.

Figure 5. B-105B equipment set-up during drilling, looking south.

B-105A(P) and B-105B(P):

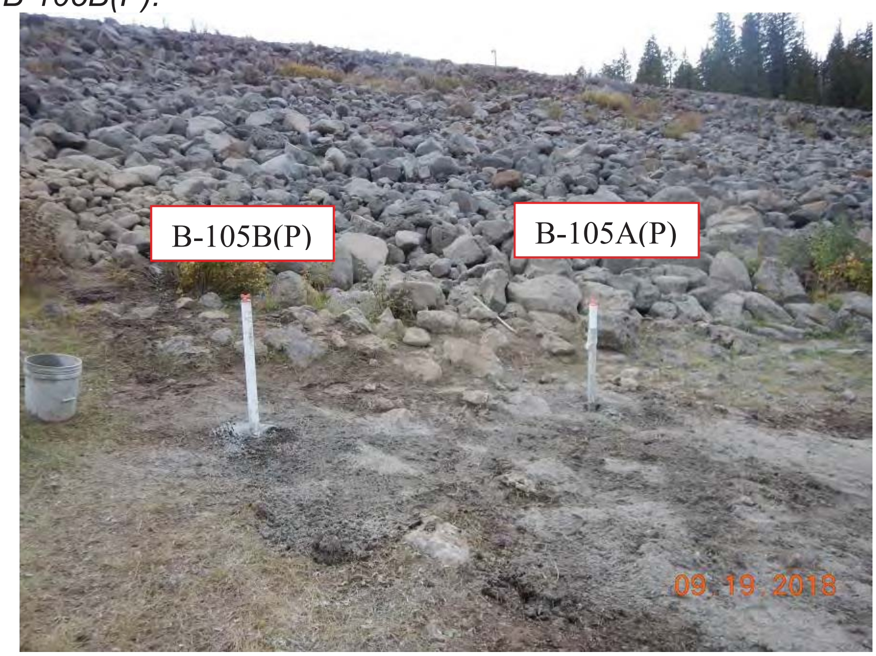


Figure 6. Riser pipes to B-105A(P) on right and B-105B(P) on left in photo at the end of day, looking southeast.

Boring B-104:

Figure 7. B-104 prior to drilling, looking south.

Figure 8. B-104 equipment set-up prior to drilling, looking southeast. Air compressor is right of outlet works and drill rig and skid steer are left of outlet works.

Figure 9. B-104 equipment set-up during drilling, looking east.

Figure 10. Sand and gravel stockpiles near B-104, looking west.

Figure 11. B-104 at the end of day, looking south.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project
Task 1002 Geotechnical Investigation

Report No.: 010-JNH
Date: Thursday, September 20, 2018

Prepared By: JNH
Weather: high about 60°, sunny, light to moderate breeze
Boring(s): B-105A, B-105B, B-104

<u>People on Site (arrival/departure time)</u>

- RJH: JNH (07:00/16:50)
- HRL:
  - Jose Suarez & Devin Lucero (07:25/15:15)
  - Chris (Prior to RJH arrival on Site/07:10)
- SEO: Jackie Blumberg (08:25/13:20)

<u>Equipment on Site</u>

Mobile
- RJH T3
- HRL Chevy 2500HD
- HRL Toyota Tacoma
- SEO Ford F150

At Site Parking Lot Overnight
- HRL support trailer & materials
- Sullair 375HH trailer mounted air compressor

At Drill Site Overnight
- *At B-104*
  - CME 55LC track mounted drill rig

- *Right of Outlet Works*
  - New Holland C185 track mounted skid steer

<u>Material</u>

At Site Parking Lot
- About 4 cubic yards (CY) of C-33 fine aggregate sand
- About 3 CY of Chat/minus ¼ inch gravel

Used
B-105A(P)
- 1 bag medium bentonite chips (50# bag)
- ½ bag of concrete (50# bag)

- ½ bag 10/20 sand (50# bag)
- 5 ft steel riser casing, 4 in x 4 in square

B-105B(P)

- ½ bag of concrete (50# bag)
- ½ bag 10/20 sand (50# bag)
- 5 ft steel riser casing, 4 in x 4 in square

B-104

- About 2 CY of fine aggregate sand and about 3 CY Chat/minus ¼ inch gravel staged near B-104
- 2 bags of Portland cement (47# bag)
- ¼ bag high yield bentonite powder (50# bag)

<u>Carson Lake Water Level</u>

- About 10 feet below the spillway crest

<u>Drilling Progress Summary</u>

- JNH measured water levels in B-101(P), B-102A(P), and B-103(P) prior to the start of daily activities.
- The installation of monitoring wells B-105A(P) and B-105B(P) were completed by adding concrete and setting steel riser casings in each well. The steel riser casings are hinged and lockable; however, RJH did not place a lock on either casing.
- Groundwater was measured in boring B-104 at about 10.4 feet bgs prior to drilling activities.
- Drilling B-104 was continued via drive casing advancer methods to a total depth of about 32 feet. A representative from the SEO was onsite during the drilling process. Slow and smooth drilling advanced through clay, gravel, cobbles, and a few boulders. The air compressor was kept at the "low pressure" setting throughout drilling. Intervals with consistent clay materials took up to about 30 minutes to progress about 1.0 foot; however, typical progression rates were about 30 to 40 minutes to progress 5 feet.
- Two Shelby tubes were attempted but were unable to be pushed due to the presence of gravels and cobbles.
- The depth of groundwater in the boring varied throughout drilling. The groundwater was under positive pressure and water was heard entering the boring at a depth of about 26 to 27 feet and a rising head permeability test was performed.
- The drillers began to prepare for the monitoring well installation at B-104 and completed the backfill of cement bentonite grout to about 12 feet. The grout needs to set overnight and is anticipated to settle to about 15 to 16 feet.

- The drillers attached the drive casing head in B-104 to cover and protect the integrity of the boring for overnight.
- At the end of the day, JNH developed wells B-105A(P) and B-105B(P) with a surge block and submersible pump and performed a rising head permeability test on each well.

Seepage Observations

- Seepage behind the outlet works right headwall at toe appeared to have typical low flow prior to, during, and post daily activities.
- Seepage from drain right of outlet works was flowing at a few gallons per minute with little to no turbidity. No changes in the seepage rate or clarity of water were observed prior to, during, and post daily activities.
- No water was observed in either of the two seepage channels in the willows right (north) of the outlet works prior to, during, and post daily activities.
- No other signs of seepage or abnormalities were observed.

Plan for Next Work Day

- JNH to meet drillers at Site at 08:30.
- HRL to complete installation of monitoring well B-104(P).
- JNH to develop monitoring well B-104(P) with a surge block and submersible pump if conditions allow. JNH to also perform rising head permeability test if conditions allow.
- HRL to demobilize all equipment from Site in the afternoon.

Site Coordination Activities

- None

Non-RJH Activities

- About 10-20 fishermen, hunters, and campers were on-site throughout the day; no public were near equipment at dam toe.

City of Grand Junction (City)

- People on Site: Slade and Craig from about 09:30 to 09:50 and two men from about 11:45 to 11:55.
- Equipment on Site: City Dodge and Ford pickup trucks
- Slade and Craig were onsite measuring groundwater levels in the crest borings. JNH discussed the Project progress and pumping of B-101(P) on Tuesday 9/18/18 morning, prior to Craig's well measurement, which likely influenced Craig's measurement.

- Two other men from the City were onsite on the dam crest; RJH did not meet with these two City representatives.

- **Photographs**

Boring B-104:

Figure 1. B-104 prior to drilling, looking southwest.

Figure 2. B-104 equipment set-up prior to drilling, looking east.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project | **Report No.: 010-JNH**
Task 1002 Geotechnical Investigation | **Date: Thursday, September 20, 2018**

Figure 3. B-104 equipment set-up during drilling, looking east.

Figure 4. B-104 at the end of day, looking east.

B-105A(P) and B-105B(P):

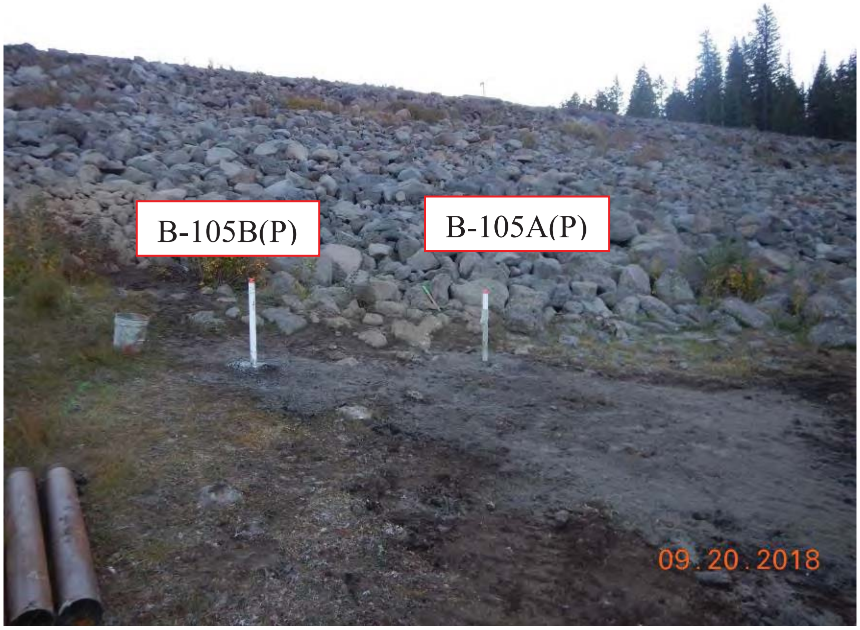


Figure 5. Riser pipes to B-105A(P) on right and B-105B(P) on left in photo at the start of day, looking southeast.

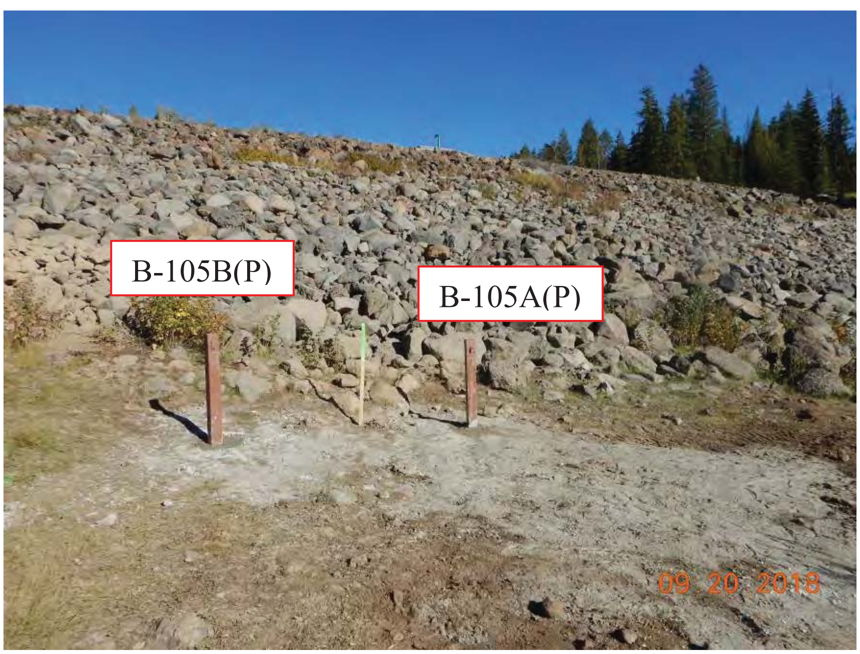


Figure 6. Riser casings to B-105A(P) on right and B-105B(P) on left in photo at the end of day, looking southeast.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 011-JNH**
Task 1002 Geotechnical Investigation **Date: Friday, September 21, 2018**

Prepared By: JNH
Weather: high about 60°, sunny
Boring(s): B-104

People on Site (arrival/departure time)

- RJH: JNH (08:45/14:10)
- HRL:
  - Jose Suarez & Devin Lucero (08:45/12:55)
  - Mark Mumby (11:15/12:55)
  - Chris (11:40/12:55)

Equipment on Site

Mobile
- RJH T3
- HRL Chevy 2500HD
- HRL Dodge diesel pickup truck and trailer
- HRL semi-truck and trailer

Demobilized
- HRL support trailer & materials
- Sullair 375HH trailer mounted air compressor
- CME 55LC track mounted drill rig
- New Holland C185 track mounted skid steer

Material

At Site Parking Lot
- About 4 cubic yards (CY) of C-33 fine aggregate sand
- About 3 CY of Chat/minus ¼ inch gravel

Near B-104
- About 2 CY of C-33 fine aggregate sand
- About 2 CY Chat/minus ¼ inch gravel

Used
B-104
- RJH provided:
  - End cap
  - 5 ft prepacked well screen 2” PVC (40) pipe

- HRL provided:
  - (2) 10 ft riser 2" PVC (40) pipe
  - 1 bucket of coated bentonite pellets
  - 1 bag of medium bentonite chips (50# bag)
  - J plug
  - 1 bag of concrete (50# bag)
  - 2 bags 10/20 sand (50# bag)
  - 5 ft steel riser casing, 4 in x 4 in square

Carson Lake Water Level

- About 10 feet below the spillway crest

Drilling Progress Summary

- JNH measured water levels in B-101(P), B-102A(P), B-103(P), B-105A(P), and B-105B(P) prior to the start of daily activities.
- The cement bentonite grout backfill in B-104 settled to about 17 feet bgs. Coated pellets were placed downhole and allowed to hydrate for 1 hour, bringing the bottom of B-104 up to about 14.5 feet bgs.
- The installation of monitoring well B-104(P) was completed by placing the monitoring well casing, adding backfill and concrete, and setting the steel riser casing. The steel riser casing is hinged and lockable; however, RJH did not place a lock on the casing.
- HRL demobilized all equipment from the Site.
- At the end of the day, JNH developed well B-104(P) with a surge block and submersible pump and performed a rising head permeability test.
- Drilling for this phase of the geotechnical investigation is complete.

Seepage Observations

- Seepage behind the outlet works right headwall at toe appeared to have typical low flow prior to, during, and post daily activities.
- Seepage from drain right of outlet works was flowing at a few gallons per minute with little to no turbidity. No changes in the seepage rate or clarity of water were observed prior to, during, and post daily activities.
- No water was observed in either of the two seepage channels in the willows right (north) of the outlet works prior to, during, and post daily activities.
- No other signs of seepage or abnormalities were observed.

Plan for Next Work Day

- JNH to measure groundwater levels in monitoring wells B-101(P), B-102A(P), B-103(P), B-104(P), B-105A(P), and B-105B(P).

Site Coordination Activities

- None

Non-RJH Activities

- About 10-20 fishermen, hunters, and campers were on-site throughout the day; no public were near equipment at dam toe.

DAILY SITE REPORT

<u>Photographs</u>

Boring B-104:

Figure 1. B-104 prior to drilling, looking east.

Figure 2. B-104(P) completed well installation at the end of day, looking east.

DAILY SITE REPORT

B-105A(P) and B-105B(P):

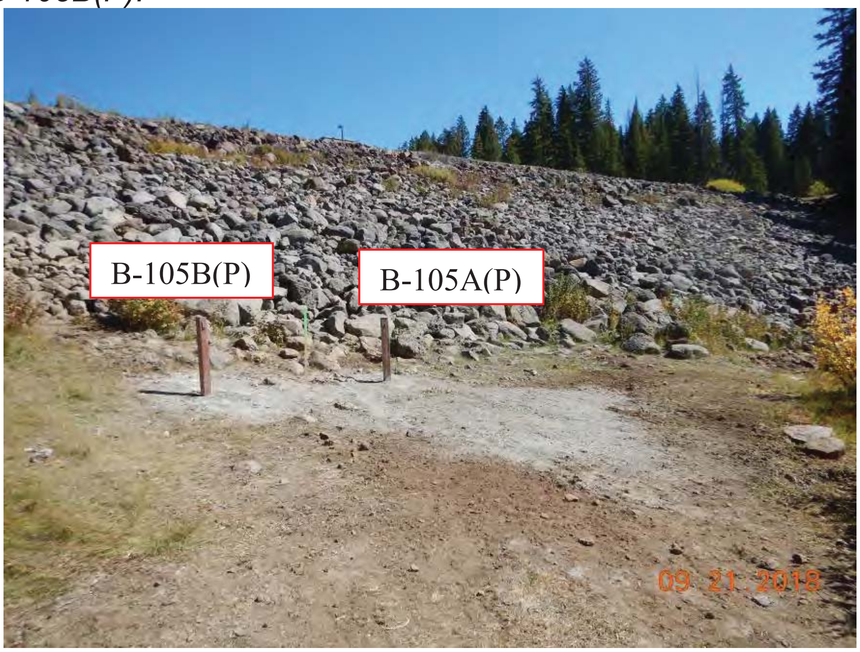


Figure 3. Riser casings to B-105A(P) on right and B-105B(P) on left in photo at the end of day, looking southeast.

Other Photos:

Figure 4. Demobilization of the drill rig and air compressor, looking west.

Figure 5. Site parking lot after equipment demobilization, looking east.

Figure 6. Sand and gravel stockpiles remain near B-104, looking west.

Figure 7. Sand and gravel stockpiles remain at Site parking lot, looking east. Camera case in photo is 6 inches long.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 012-JNH**
Task 1002 Geotechnical Investigation **Date: Saturday, September 22, 2018**

Prepared By: JNH
Weather: high about 45°, clear
Monitoring Wells: B-101, B-102A, B-103, B-104, B-105A, B-105B

People on Site (arrival/departure time)

- RJH: JNH (06:40/07:35)

Equipment on Site

Mobile
- RJH T3

Material

At Site Parking Lot
- About 4 cubic yards (CY) of C-33 fine aggregate sand
- About 3 CY of Chat/minus ¼ inch gravel

Near B-104
- About 2 CY of C-33 fine aggregate sand
- About 2 CY Chat/minus ¼ inch gravel

Used
- None

Carson Lake Water Level

- About 10 feet below the spillway crest

Site Progress Summary

- No drilling occurred today.
- JNH measured water levels in all six monitoring wells:
    - B-101(P)
    - B-102A(P)
    - B-103(P)
    - B-104(P)
    - B-105A(P)
    - B-105B(P)

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 012-JNH**
Task 1002 Geotechnical Investigation **Date: Saturday, September 22, 2018**

Seepage Observations

- Seepage behind the outlet works right headwall at toe appeared to have typical low flow.
- Seepage from drain right of outlet works was flowing at a few gallons per minute with little to no turbidity. No changes in the seepage rate or clarity of water were observed.
- No water was observed in either of the two seepage channels in the willows right (north) of the outlet works.
- No other signs of seepage or abnormalities were observed.

Plan for Next Work Day

- No further field work is anticipated to be completed by RJH.

Site Coordination Activities

- RJH removed their temporary keyed lock and closed the gate with the chain link. The gate is not locked. The City is to coordinate with the USFS if needed to replace the lock and secure the access gate.

Non-RJH Activities

- About 5 fishermen and hunters were on-site in the morning; no public were near equipment at dam toe.

<u>Photographs</u>

Access Gate:

Figure 1. Access gate closed with chain link, but is not secured with lock. Looking east.

APPENDIX E

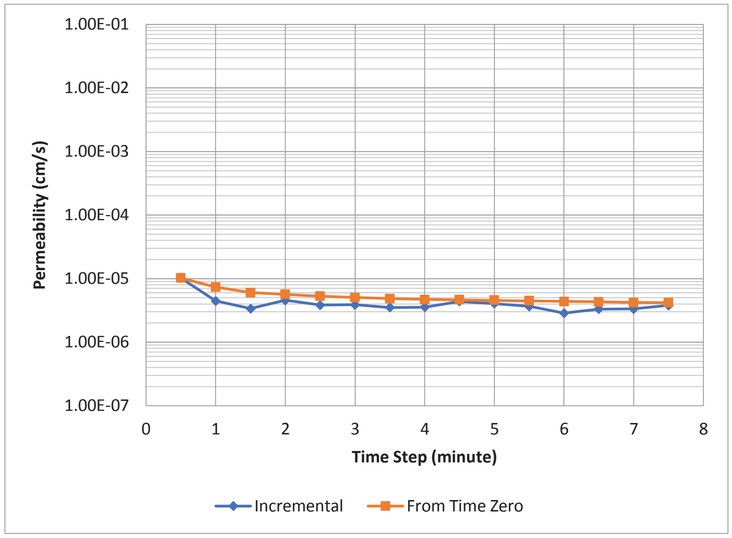
PERMEABILITY RESULTS

Rising Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	7/28/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-101(P)**
Test Number:	**K-1**

Depth to top of Ground Water	30.55	ft
Casing Stickup	0.0	ft
Top Depth of Test Interval	53.0	ft
Bottom Depth of Test Interval	74.0	ft
Inside Diameter Pipe	1.50	in
D = Diameter, intake, sample	7.75	in
L = Length, intake, sample	21.0	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
41.50	0.0	0	11.0	--	--	--	--
41.22	0.5	30	10.7	3.35E-07	1.02E-05	3.35E-07	1.02E-05
41.10	1.0	60	10.6	1.46E-07	4.46E-06	2.41E-07	7.34E-06
41.01	1.5	90	10.5	1.11E-07	3.38E-06	1.98E-07	6.02E-06
40.89	2.0	120	10.3	1.49E-07	4.55E-06	1.85E-07	5.65E-06
40.79	2.5	150	10.2	1.26E-07	3.83E-06	1.74E-07	5.29E-06
40.69	3.0	180	10.1	1.27E-07	3.87E-06	1.66E-07	5.05E-06
40.60	3.5	210	10.1	1.15E-07	3.52E-06	1.59E-07	4.83E-06
40.51	4.0	240	10.0	1.16E-07	3.55E-06	1.53E-07	4.67E-06
40.40	4.5	270	9.9	1.44E-07	4.38E-06	1.52E-07	4.64E-06
40.30	5.0	300	9.8	1.32E-07	4.03E-06	1.50E-07	4.58E-06
40.21	5.5	330	9.7	1.20E-07	3.66E-06	1.47E-07	4.50E-06
40.14	6.0	360	9.6	9.41E-08	2.87E-06	1.43E-07	4.36E-06
40.06	6.5	390	9.5	1.08E-07	3.30E-06	1.40E-07	4.28E-06
39.98	7.0	420	9.4	1.09E-07	3.33E-06	1.38E-07	4.21E-06
39.89	7.5	450	9.3	1.24E-07	3.78E-06	1.37E-07	4.18E-06
Estimated Permeability				**2.9E-06**	**to**	**1.0E-05**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**4.0.E-06**	**(cm/sec)**	

(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case G.

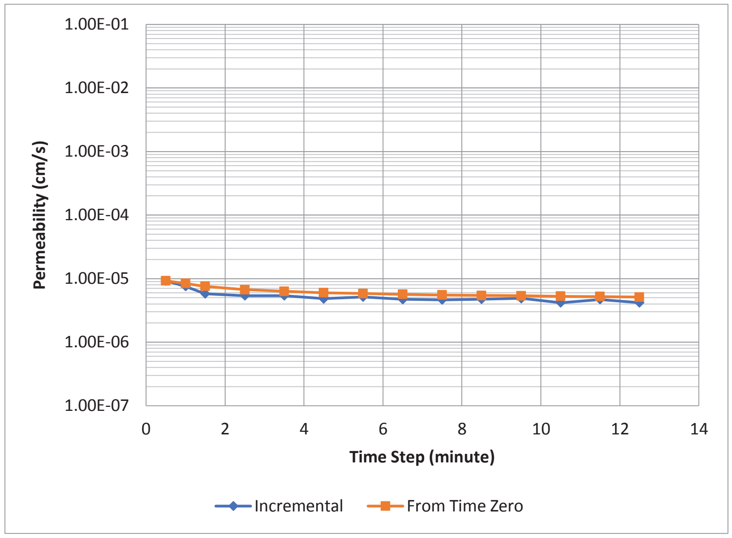
E-1

Rising Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	9/18/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-101(P)**
Test Number:	**K-2**

Depth to top of Ground Water	38.84	ft
Casing Stickup	0.0	ft
Top Depth of Test Interval	53.0	ft
Bottom Depth of Test Interval	74.0	ft
Inside Diameter Pipe	1.50	in
D = Diameter, intake, sample	7.75	in
L = Length, intake, sample	21.0	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
51.77	0.0	0	12.9	--	--	--	--
51.47	0.5	30	12.6	3.04E-07	9.26E-06	3.04E-07	9.26E-06
51.23	1.0	60	12.4	2.48E-07	7.57E-06	2.76E-07	8.42E-06
51.05	1.5	90	12.2	1.89E-07	5.77E-06	2.47E-07	7.53E-06
50.72	2.5	150	11.9	1.77E-07	5.40E-06	2.19E-07	6.68E-06
50.40	3.5	210	11.6	1.77E-07	5.39E-06	2.07E-07	6.31E-06
50.12	4.5	270	11.3	1.59E-07	4.84E-06	1.96E-07	5.98E-06
49.83	5.5	330	11.0	1.69E-07	5.14E-06	1.91E-07	5.83E-06
49.57	6.5	390	10.7	1.55E-07	4.72E-06	1.86E-07	5.66E-06
49.32	7.5	450	10.5	1.53E-07	4.65E-06	1.81E-07	5.53E-06
49.07	8.5	510	10.2	1.56E-07	4.76E-06	1.78E-07	5.44E-06
48.82	9.5	570	10.0	1.60E-07	4.88E-06	1.76E-07	5.38E-06
48.61	10.5	630	9.8	1.38E-07	4.20E-06	1.73E-07	5.26E-06
48.38	11.5	690	9.5	1.54E-07	4.70E-06	1.71E-07	5.22E-06
48.18	12.5	750	9.3	1.37E-07	4.18E-06	1.68E-07	5.13E-06
Estimated Permeability				**4.2E-06**	**to**	**9.3E-06**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**5.3.E-06**	**(cm/sec)**	

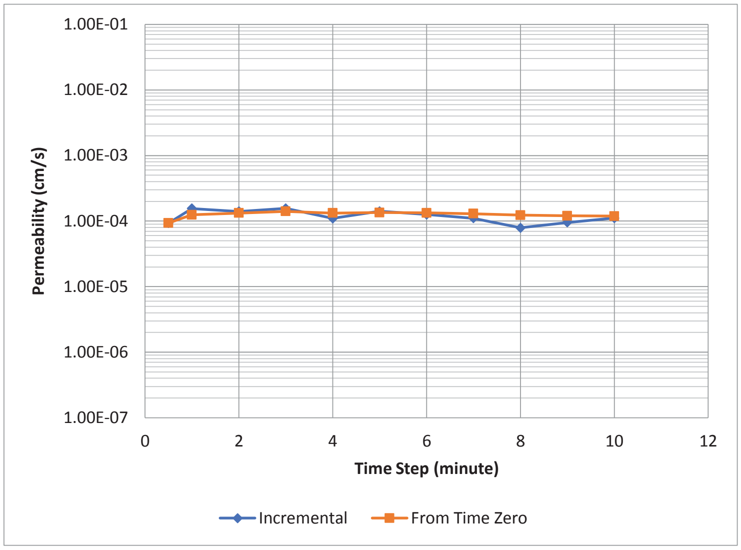
(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case G.

Falling Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	7/24/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-102A(P)**
Test Number:	**K-1**

Depth to top of Ground Water	35.25	ft
Casing Stickup	3.9	ft
Top Depth of Test Interval	46.5	ft
Bottom Depth of Test Interval	46.5	ft
Inside Diameter Pipe	4.25	in
D = Diameter, intake, sample	4.25	in
L = Length, intake, sample	0.0	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
6.09	0.0	0	33.1	--	--	--	--
6.12	0.5	30	33.0	3.06E-06	9.33E-05	3.06E-06	9.33E-05
6.17	1.0	60	33.0	5.11E-06	1.56E-04	4.08E-06	1.24E-04
6.26	2.0	120	32.9	4.61E-06	1.40E-04	4.35E-06	1.32E-04
6.36	3.0	180	32.8	5.13E-06	1.56E-04	4.61E-06	1.40E-04
6.43	4.0	240	32.7	3.60E-06	1.10E-04	4.36E-06	1.33E-04
6.52	5.0	300	32.6	4.64E-06	1.42E-04	4.41E-06	1.35E-04
6.60	6.0	360	32.6	4.14E-06	1.26E-04	4.37E-06	1.33E-04
6.67	7.0	420	32.5	3.63E-06	1.11E-04	4.26E-06	1.30E-04
6.72	8.0	480	32.4	2.60E-06	7.92E-05	4.05E-06	1.24E-04
6.78	9.0	540	32.4	3.12E-06	9.52E-05	3.95E-06	1.20E-04
6.85	10.0	600	32.3	3.65E-06	1.11E-04	3.92E-06	1.20E-04
Estimated Permeability				**7.9E-05**	**to**	**1.6E-04**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**1.2.E-04**	**(cm/sec)**	

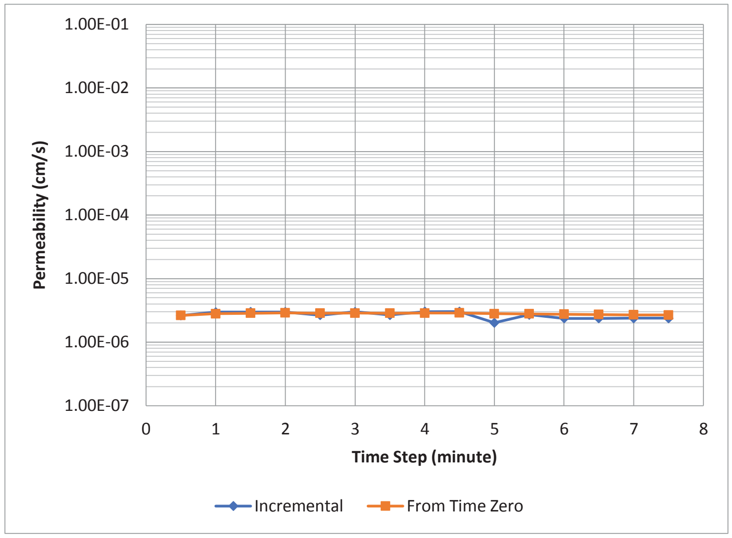
(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case C.

Rising Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	7/26/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-102A(P)**
Test Number:	**K-2**

Depth to top of Ground Water	10.36	ft
Casing Stickup	0.0	ft
Top Depth of Test Interval	36.5	ft
Bottom Depth of Test Interval	48.0	ft
Inside Diameter Pipe	2.00	in
D = Diameter, intake, sample	7.75	in
L = Length, intake, sample	11.5	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
43.70	0.0	0	33.3	--	--	--	--
43.62	0.5	30	33.3	8.64E-08	2.63E-06	8.64E-08	2.63E-06
43.53	1.0	60	33.2	9.75E-08	2.97E-06	9.19E-08	2.80E-06
43.44	1.5	90	33.1	9.77E-08	2.98E-06	9.39E-08	2.86E-06
43.35	2.0	120	33.0	9.80E-08	2.99E-06	9.49E-08	2.89E-06
43.27	2.5	150	32.9	8.73E-08	2.66E-06	9.34E-08	2.85E-06
43.18	3.0	180	32.8	9.85E-08	3.00E-06	9.42E-08	2.87E-06
43.10	3.5	210	32.7	8.78E-08	2.68E-06	9.33E-08	2.84E-06
43.01	4.0	240	32.7	9.90E-08	3.02E-06	9.40E-08	2.87E-06
42.92	4.5	270	32.6	9.93E-08	3.03E-06	9.46E-08	2.88E-06
42.86	5.0	300	32.5	6.63E-08	2.02E-06	9.18E-08	2.80E-06
42.78	5.5	330	32.4	8.86E-08	2.70E-06	9.15E-08	2.79E-06
42.71	6.0	360	32.4	7.77E-08	2.37E-06	9.03E-08	2.75E-06
42.64	6.5	390	32.3	7.79E-08	2.37E-06	8.94E-08	2.72E-06
42.57	7.0	420	32.2	7.81E-08	2.38E-06	8.86E-08	2.70E-06
42.50	7.5	450	32.1	7.82E-08	2.38E-06	8.79E-08	2.68E-06
Estimated Permeability				**2.0E-06**	**to**	**3.0E-06**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**2.7.E-06**	**(cm/sec)**	

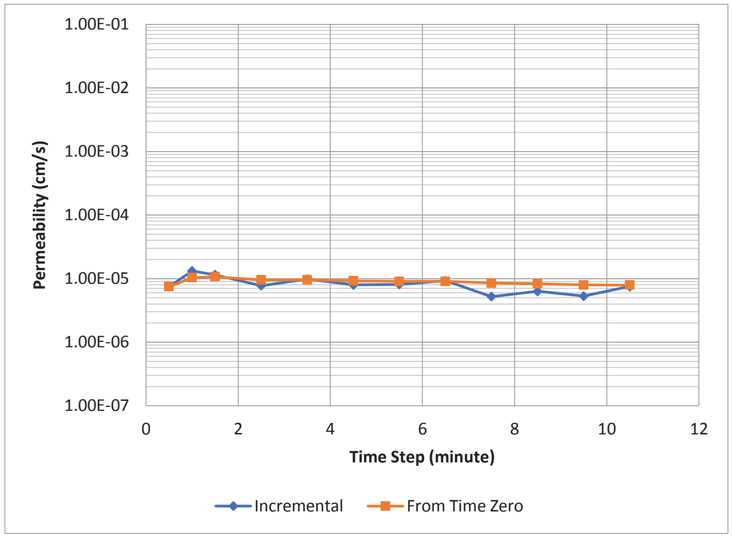
(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case G.

Rising Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	9/17/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-102A(P)**
Test Number:	**K-3**

Depth to top of Ground Water	37.48	ft
Casing Stickup	0.0	ft
Top Depth of Test Interval	36.5	ft
Bottom Depth of Test Interval	48.0	ft
Inside Diameter Pipe	2.00	in
D = Diameter, intake, sample	7.75	in
L = Length, intake, sample	11.5	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
43.37	0.0	0	5.9	--	--	--	--
43.33	0.5	30	5.9	2.45E-07	7.47E-06	2.45E-07	7.47E-06
43.26	1.0	60	5.8	4.33E-07	1.32E-05	3.39E-07	1.03E-05
43.20	1.5	90	5.7	3.75E-07	1.14E-05	3.51E-07	1.07E-05
43.12	2.5	150	5.6	2.53E-07	7.72E-06	3.12E-07	9.51E-06
43.02	3.5	210	5.5	3.22E-07	9.81E-06	3.15E-07	9.59E-06
42.94	4.5	270	5.5	2.62E-07	7.97E-06	3.03E-07	9.23E-06
42.86	5.5	330	5.4	2.65E-07	8.09E-06	2.96E-07	9.03E-06
42.77	6.5	390	5.3	3.03E-07	9.25E-06	2.97E-07	9.06E-06
42.72	7.5	450	5.2	1.71E-07	5.21E-06	2.80E-07	8.55E-06
42.66	8.5	510	5.2	2.07E-07	6.31E-06	2.72E-07	8.28E-06
42.61	9.5	570	5.1	1.74E-07	5.32E-06	2.62E-07	7.97E-06
42.54	10.5	630	5.1	2.47E-07	7.53E-06	2.60E-07	7.93E-06
Estimated Permeability				**5.2E-06**	**to**	**1.3E-05**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**8.0.E-06**	**(cm/sec)**	

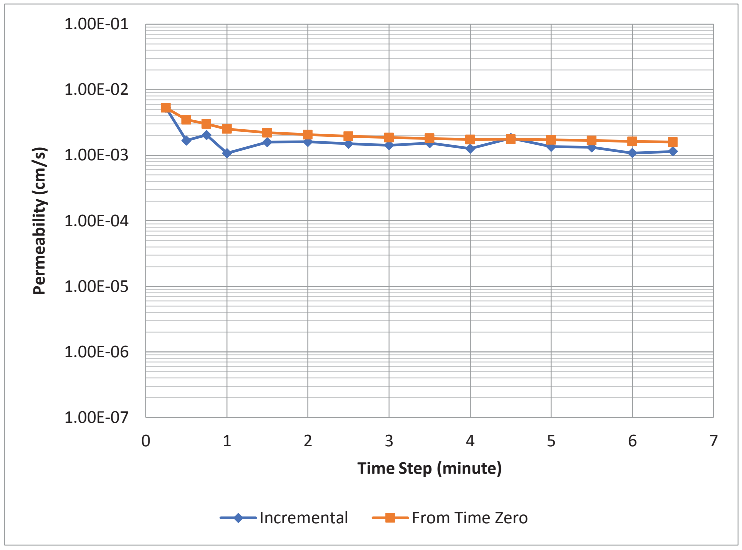
(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case G.

Falling Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	7/23/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-103(P)**
Test Number:	**K-1**

Depth to top of Ground Water	25.5	ft
Casing Stickup	0.4	ft
Top Depth of Test Interval	30.0	ft
Bottom Depth of Test Interval	30.0	ft
Inside Diameter Pipe	4.25	in
D = Diameter, intake, sample	4.25	in
L = Length, intake, sample	0.0	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
1.87	0.0	0	24.0	--	--	--	--
2.48	0.3	15	23.4	1.73E-04	5.28E-03	1.73E-04	5.28E-03
2.67	0.5	30	23.2	5.49E-05	1.67E-03	1.14E-04	3.48E-03
2.90	0.8	45	23.0	6.71E-05	2.05E-03	9.85E-05	3.00E-03
3.02	1.0	60	22.9	3.53E-05	1.08E-03	8.27E-05	2.52E-03
3.37	1.5	90	22.5	5.20E-05	1.58E-03	7.24E-05	2.21E-03
3.72	2.0	120	22.2	5.28E-05	1.61E-03	6.75E-05	2.06E-03
4.04	2.5	150	21.9	4.90E-05	1.49E-03	6.38E-05	1.95E-03
4.34	3.0	180	21.6	4.66E-05	1.42E-03	6.10E-05	1.86E-03
4.66	3.5	210	21.2	5.04E-05	1.54E-03	5.94E-05	1.81E-03
4.92	4.0	240	21.0	4.15E-05	1.27E-03	5.72E-05	1.74E-03
5.29	4.5	270	20.6	6.00E-05	1.83E-03	5.75E-05	1.75E-03
5.56	5.0	300	20.3	4.45E-05	1.36E-03	5.62E-05	1.71E-03
5.82	5.5	330	20.1	4.34E-05	1.32E-03	5.50E-05	1.68E-03
6.03	6.0	360	19.9	3.54E-05	1.08E-03	5.34E-05	1.63E-03
6.25	6.5	390	19.7	3.75E-05	1.14E-03	5.22E-05	1.59E-03
Estimated Permeability				**1.1E-03**	**to**	**5.3E-03**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**1.6.E-03**	**(cm/sec)**	

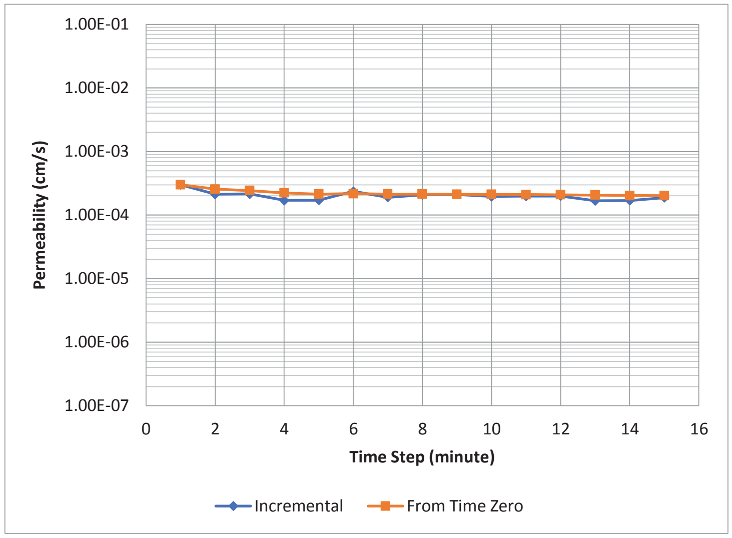
(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case C.

Rising Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	9/20/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-104(P)**
Test Number:	**K-1**

Depth to top of Ground Water	10.4	ft
Casing Stickup	2.1	ft
Top Depth of Test Interval	26.0	ft
Bottom Depth of Test Interval	27.0	ft
Inside Diameter Pipe	5.75	in
D = Diameter, intake, sample	5.75	in
L = Length, intake, sample	1.0	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
27.00	0.0	0	14.5	--	--	--	--
26.80	1.0	60	14.3	9.84E-06	3.00E-04	9.84E-06	3.00E-04
26.66	2.0	120	14.16	6.97E-06	2.13E-04	8.41E-06	2.56E-04
26.52	3.0	180	14.0	7.04E-06	2.15E-04	7.95E-06	2.42E-04
26.41	4.0	240	13.9	5.58E-06	1.70E-04	7.36E-06	2.24E-04
26.30	5.0	300	13.8	5.63E-06	1.72E-04	7.01E-06	2.14E-04
26.15	6.0	360	13.65	7.75E-06	2.36E-04	7.14E-06	2.18E-04
26.03	7.0	420	13.53	6.26E-06	1.91E-04	7.01E-06	2.14E-04
25.90	8.0	480	13.4	6.84E-06	2.09E-04	6.99E-06	2.13E-04
25.77	9.0	540	13.3	6.91E-06	2.11E-04	6.98E-06	2.13E-04
25.65	10.0	600	13.2	6.44E-06	1.96E-04	6.93E-06	2.11E-04
25.53	11.0	660	13.03	6.50E-06	1.98E-04	6.89E-06	2.10E-04
25.41	12.0	720	12.91	6.56E-06	2.00E-04	6.86E-06	2.09E-04
25.31	13.0	780	12.81	5.51E-06	1.68E-04	6.76E-06	2.06E-04
25.21	14.0	840	12.7	5.56E-06	1.69E-04	6.67E-06	2.03E-04
25.10	15.0	900	12.6	6.16E-06	1.88E-04	6.64E-06	2.02E-04
Estimated Permeability				**1.7E-04**	**to**	**3.0E-04**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**2.0.E-04**	**(cm/sec)**	

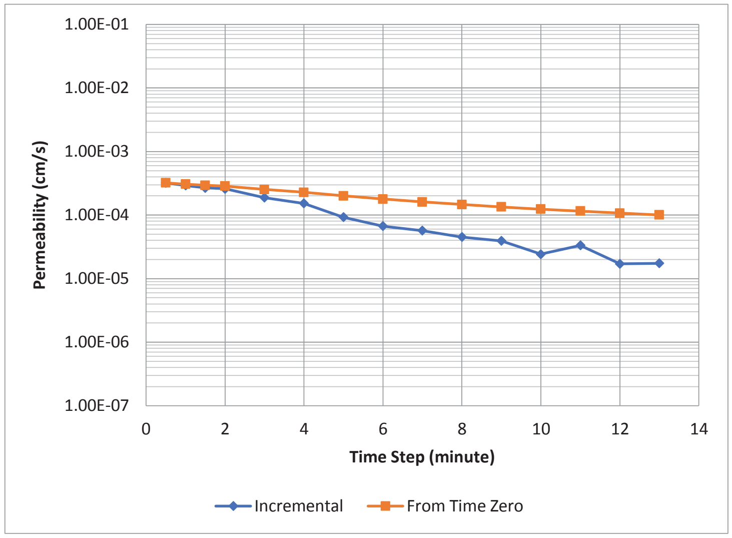
(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case G.

Rising Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	9/21/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-104(P)**
Test Number:	**K-2**

Depth to top of Ground Water	5.99	ft
Casing Stickup	2.9	ft
Top Depth of Test Interval	8.9	ft
Bottom Depth of Test Interval	14.5	ft
Inside Diameter Pipe	2.00	in
D = Diameter, intake, sample	5.75	in
L = Length, intake, sample	5.6	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
13.10	0.0	0	4.21	--	--	--	--
12.47	0.5	30	3.58	1.06E-05	3.22E-04	1.06E-05	3.22E-04
11.98	1.0	60	3.09	9.58E-06	2.92E-04	1.01E-05	3.07E-04
11.59	1.5	90	2.70	8.78E-06	2.68E-04	9.64E-06	2.94E-04
11.26	2.0	120	2.37	8.49E-06	2.59E-04	9.35E-06	2.85E-04
10.85	3.0	180	1.96	6.18E-06	1.88E-04	8.29E-06	2.53E-04
10.57	4.0	240	1.68	5.02E-06	1.53E-04	7.48E-06	2.28E-04
10.42	5.0	300	1.53	3.04E-06	9.28E-05	6.59E-06	2.01E-04
10.32	6.0	360	1.43	2.20E-06	6.71E-05	5.86E-06	1.79E-04
10.24	7.0	420	1.35	1.87E-06	5.71E-05	5.29E-06	1.61E-04
10.18	8.0	480	1.29	1.48E-06	4.51E-05	4.81E-06	1.47E-04
10.13	9.0	540	1.24	1.29E-06	3.92E-05	4.42E-06	1.35E-04
10.10	10.0	600	1.21	7.97E-07	2.43E-05	4.06E-06	1.24E-04
10.06	11.0	660	1.17	1.09E-06	3.33E-05	3.79E-06	1.15E-04
10.04	12.0	720	1.15	5.61E-07	1.71E-05	3.52E-06	1.07E-04
10.02	13.0	780	1.13	5.71E-07	1.74E-05	3.29E-06	1.00E-04
Estimated Permeability				**1.7E-05**	**to**	**3.2E-04**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**7.9.E-05**	**(cm/sec)**	

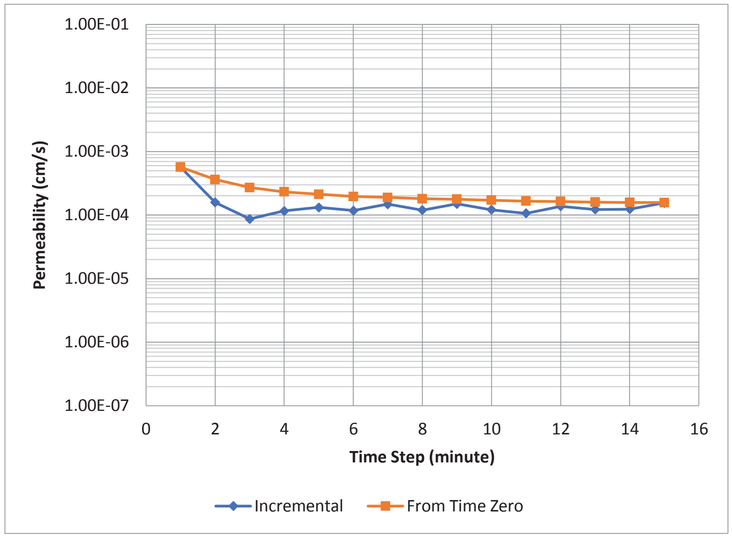
(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case G.

Rising Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	9/17/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-105A(P)**
Test Number:	**K-1**

Depth to top of Ground Water	4.8	ft
Casing Stickup	2.9	ft
Top Depth of Test Interval	21.0	ft
Bottom Depth of Test Interval	22.0	ft
Inside Diameter Pipe	5.75	in
D = Diameter, intake, sample	5.75	in
L = Length, intake, sample	1.0	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
23.15	0.0	0	15.45	--	--	--	--
22.75	1.0	60	15.05	1.86E-05	5.67E-04	1.86E-05	5.67E-04
22.64	2.0	120	14.94	5.20E-06	1.58E-04	1.19E-05	3.63E-04
22.58	3.0	180	14.88	2.85E-06	8.69E-05	8.88E-06	2.71E-04
22.50	4.0	240	14.80	3.82E-06	1.16E-04	7.62E-06	2.32E-04
22.41	5.0	300	14.71	4.32E-06	1.32E-04	6.96E-06	2.12E-04
22.33	6.0	360	14.63	3.87E-06	1.18E-04	6.44E-06	1.96E-04
22.23	7.0	420	14.53	4.86E-06	1.48E-04	6.22E-06	1.89E-04
22.15	8.0	480	14.45	3.91E-06	1.19E-04	5.93E-06	1.81E-04
22.05	9.0	540	14.35	4.92E-06	1.50E-04	5.82E-06	1.77E-04
21.97	10.0	600	14.27	3.96E-06	1.21E-04	5.63E-06	1.72E-04
21.90	11.0	660	14.20	3.49E-06	1.06E-04	5.44E-06	1.66E-04
21.81	12.0	720	14.11	4.51E-06	1.37E-04	5.36E-06	1.63E-04
21.73	13.0	780	14.03	4.03E-06	1.23E-04	5.26E-06	1.60E-04
21.65	14.0	840	13.95	4.05E-06	1.24E-04	5.17E-06	1.58E-04
21.55	15.0	900	13.85	5.10E-06	1.55E-04	5.17E-06	1.57E-04
Estimated Permeability				**8.7E-05**	**to**	**5.7E-04**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**1.4.E-04**	**(cm/sec)**	

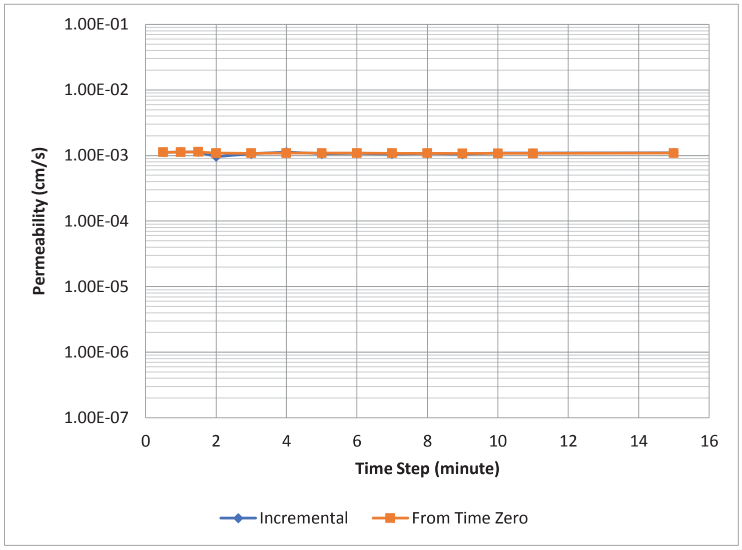
(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case G.

Rising Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	9/18/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-105A(P)**
Test Number:	**K-2**

Depth to top of Ground Water	9.18	ft
Casing Stickup	1.3	ft
Top Depth of Test Interval	52.0	ft
Bottom Depth of Test Interval	52.0	ft
Inside Diameter Pipe	5.38	in
D = Diameter, intake, sample	5.38	in
L = Length, intake, sample	0.0	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
45.40	0.0	0	34.92	--	--	--	--
45.10	0.5	30	34.62	3.68E-05	1.12E-03	3.68E-05	1.12E-03
44.80	1.0	60	34.32	3.71E-05	1.13E-03	3.70E-05	1.13E-03
44.50	1.5	90	34.02	3.74E-05	1.14E-03	3.71E-05	1.13E-03
44.25	2.0	120	33.77	3.15E-05	9.59E-04	3.57E-05	1.09E-03
43.70	3.0	180	33.22	3.50E-05	1.07E-03	3.55E-05	1.08E-03
43.13	4.0	240	32.65	3.69E-05	1.12E-03	3.58E-05	1.09E-03
42.60	5.0	300	32.12	3.49E-05	1.06E-03	3.56E-05	1.09E-03
42.07	6.0	360	31.59	3.55E-05	1.08E-03	3.56E-05	1.09E-03
41.56	7.0	420	31.08	3.47E-05	1.06E-03	3.55E-05	1.08E-03
41.05	8.0	480	30.57	3.53E-05	1.08E-03	3.55E-05	1.08E-03
40.56	9.0	540	30.08	3.45E-05	1.05E-03	3.53E-05	1.08E-03
40.06	10.0	600	29.58	3.57E-05	1.09E-03	3.54E-05	1.08E-03
39.57	11.0	660	29.09	3.56E-05	1.09E-03	3.54E-05	1.08E-03
37.66	15.0	900	27.18	3.62E-05	1.10E-03	3.56E-05	1.09E-03
Estimated Permeability				**9.6E-04**	**to**	**1.1E-03**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**1.1.E-03**	**(cm/sec)**	

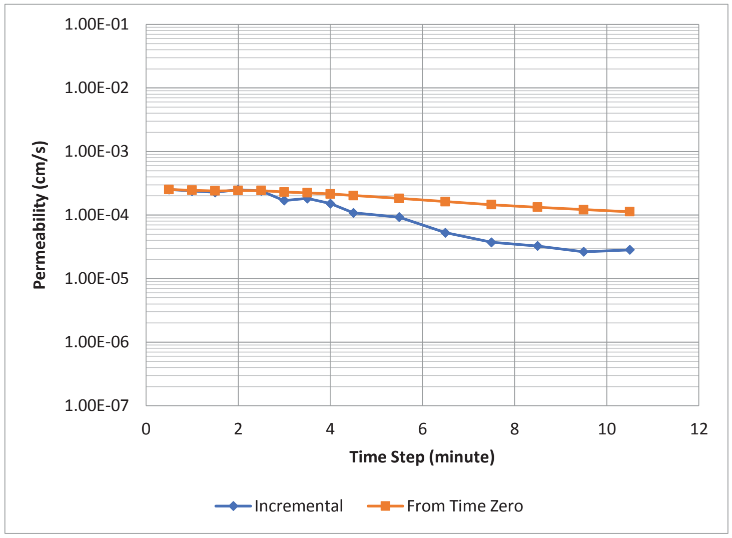
(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case C.

Rising Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	9/20/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-105A(P)**
Test Number:	**K-3**

Depth to top of Ground Water	9.74	ft
Casing Stickup	2.8	ft
Top Depth of Test Interval	53.0	ft
Bottom Depth of Test Interval	73.5	ft
Inside Diameter Pipe	2.00	in
D = Diameter, intake, sample	5.75	in
L = Length, intake, sample	20.5	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
21.11	0.0	0	8.57	--	--	--	--
18.70	0.5	30	6.16	8.29E-06	2.53E-04	8.29E-06	2.53E-04
17.05	1.0	60	4.51	7.83E-06	2.39E-04	8.06E-06	2.46E-04
15.89	1.5	90	3.35	7.47E-06	2.28E-04	7.87E-06	2.40E-04
14.95	2.0	120	2.41	8.27E-06	2.52E-04	7.97E-06	2.43E-04
14.30	2.5	150	1.76	7.90E-06	2.41E-04	7.95E-06	2.42E-04
13.95	3.0	180	1.41	5.57E-06	1.70E-04	7.56E-06	2.30E-04
13.65	3.5	210	1.11	6.01E-06	1.83E-04	7.33E-06	2.24E-04
13.45	4.0	240	0.91	4.99E-06	1.52E-04	7.04E-06	2.15E-04
13.33	4.5	270	0.79	3.55E-06	1.08E-04	6.65E-06	2.03E-04
13.16	5.5	330	0.62	3.04E-06	9.28E-05	6.00E-06	1.83E-04
13.08	6.5	390	0.54	1.74E-06	5.29E-05	5.34E-06	1.63E-04
13.03	7.5	450	0.49	1.22E-06	3.72E-05	4.79E-06	1.46E-04
12.99	8.5	510	0.45	1.07E-06	3.26E-05	4.35E-06	1.33E-04
12.96	9.5	570	0.42	8.67E-07	2.64E-05	3.99E-06	1.22E-04
12.93	10.5	630	0.39	9.31E-07	2.84E-05	3.70E-06	1.13E-04
Estimated Permeability				**2.6E-05**	**to**	**2.5E-04**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**1.0.E-04**	**(cm/sec)**	

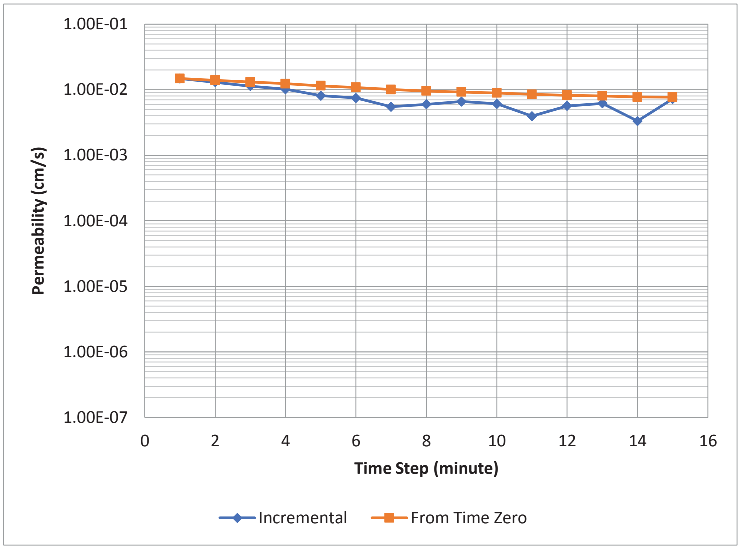
(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case G.

Rising Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	9/19/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-105B(P)**
Test Number:	**K-1**

Depth to top of Ground Water	8.24	ft
Casing Stickup	1.4	ft
Top Depth of Test Interval	12.6	ft
Bottom Depth of Test Interval	12.6	ft
Inside Diameter Pipe	5.38	in
D = Diameter, intake, sample	5.38	in
L = Length, intake, sample	0.0	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
11.65	0.0	0	2.01	--	--	--	--
11.24	1.0	60	1.60	4.86E-04	1.48E-02	4.86E-04	1.48E-02
10.95	2.0	120	1.31	4.26E-04	1.30E-02	4.56E-04	1.39E-02
10.74	3.0	180	1.10	3.73E-04	1.14E-02	4.28E-04	1.31E-02
10.58	4.0	240	0.94	3.35E-04	1.02E-02	4.05E-04	1.23E-02
10.47	5.0	300	0.83	2.65E-04	8.09E-03	3.77E-04	1.15E-02
10.38	6.0	360	0.74	2.45E-04	7.46E-03	3.55E-04	1.08E-02
10.32	7.0	420	0.68	1.80E-04	5.50E-03	3.30E-04	1.01E-02
10.26	8.0	480	0.62	1.97E-04	6.00E-03	3.13E-04	9.55E-03
10.20	9.0	540	0.56	2.17E-04	6.61E-03	3.03E-04	9.23E-03
10.15	10.0	600	0.51	1.99E-04	6.08E-03	2.92E-04	8.91E-03
10.12	11.0	660	0.48	1.29E-04	3.94E-03	2.78E-04	8.46E-03
10.08	12.0	720	0.44	1.86E-04	5.65E-03	2.70E-04	8.23E-03
10.04	13.0	780	0.40	2.03E-04	6.19E-03	2.65E-04	8.07E-03
10.02	14.0	840	0.38	1.09E-04	3.33E-03	2.54E-04	7.73E-03
9.98	15.0	900	0.34	2.37E-04	7.23E-03	2.53E-04	7.70E-03
Estimated Permeability				**3.3E-03**	**to**	**1.5E-02**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**7.1.E-03**	**(cm/sec)**	

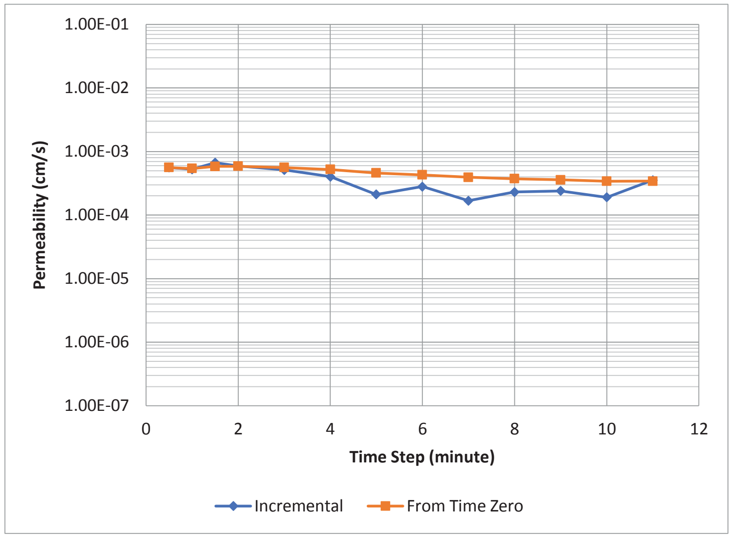
(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case C.

Rising Head Test - Data Reduction Calculation Sheet

Field Engineer/Geologist:	JNH	9/20/2018
Calculated By:	JNH	11/20/2018
Checked By:	ALC	11/20/2018
Approved By:	GOJ	11/26/2018

Project Number:	**18115**
Boring:	**B-105B(P)**
Test Number:	**K-2**

Depth to top of Ground Water	5.55	ft
Casing Stickup	2.9	ft
Top Depth of Test Interval	8.6	ft
Bottom Depth of Test Interval	12.6	ft
Inside Diameter Pipe	2.00	in
D = Diameter, intake, sample	5.75	in
L = Length, intake, sample	4.1	ft
M = Transformation Ratio	1.00	--



Depth to Water Surface In Pipe From Top of Riser Pipe	Time, t	Time, t	Length of Water Column at time, H	Incremental		From Time Zero	
				Permeability	Permeability	Permeability	Permeability
(ft)	(min)	(sec)	(ft)	(ft/s)	(cm/s)	(ft/s)	(cm/s)
12.25	0.0	0	3.8	--	--	--	--
11.48	0.5	30	3.0	1.83E-05	5.58E-04	1.83E-05	5.58E-04
10.90	1.0	60	2.5	1.72E-05	5.24E-04	1.78E-05	5.41E-04
10.32	1.5	90	1.9	2.19E-05	6.66E-04	1.91E-05	5.83E-04
9.92	2.0	120	1.5	1.95E-05	5.94E-04	1.92E-05	5.86E-04
9.42	3.0	180	1.0	1.68E-05	5.13E-04	1.84E-05	5.61E-04
9.15	4.0	240	0.7	1.32E-05	4.02E-04	1.71E-05	5.21E-04
9.04	5.0	300	0.6	6.92E-06	2.11E-04	1.51E-05	4.59E-04
8.92	6.0	360	0.5	9.20E-06	2.80E-04	1.41E-05	4.30E-04
8.86	7.0	420	0.4	5.52E-06	1.68E-04	1.29E-05	3.92E-04
8.79	8.0	480	0.3	7.57E-06	2.31E-04	1.22E-05	3.72E-04
8.73	9.0	540	0.3	7.85E-06	2.39E-04	1.17E-05	3.57E-04
8.69	10.0	600	0.2	6.24E-06	1.90E-04	1.12E-05	3.41E-04
8.63	11.0	660	0.2	1.16E-05	3.55E-04	1.12E-05	3.42E-04
Estimated Permeability				**1.7E-04**	**to**	**6.7E-04**	**(cm/sec)**
Geometric Mean of Incremental Permeability					**3.4.E-04**	**(cm/sec)**	

(1) Calculations above the water table are from USBR, Engineering Geology Field Manual, Volume 2, pp 162-165.
Calculations below the water table are from Hvorslev printed in Lambe & Whitman, Soil Mechanics, 1969, pp 285, case G.

APPENDIX F

FIELD INVEST WATER LEVEL DATA

18115 Hogchute Dam Safety Evaluation
Field Investigation Water Levels

Top of Casing or PVC Riser Elevation (ft) Same as ground | Same as ground | Same as ground | 9849.0 | 9868.5 | 9869.8
Ground Elevation (ft) 9902.2 CAD survey elev | 9902.1 CAD survey elev | 9901.8 CAD survey elev | 9846.1 CAD survey elev | 9865.7 CAD survey elev | 9866.9 CAD survey elev | 9902.0 CAD survey elev

Note:
1. B-101, B-102A, and B-103: depths are referenced from top of ground surface. B-104, B-105A, and B-105B: depths are referenced from top of pvc riser pipe.

	B-101(P)			B-102A(P)			B-103(P)			B-104(P)			B-105A(P)			B-105B(P)			Reservoir Level		
Date	Depth[1]	El	Notes	Depth[1]	El	Notes	Depth[1]	El	Notes	Depth[1]	El	Notes	Depth[1]	El	Notes	Depth[1]	El	Notes	Depth[1]	El	Notes
7/23/2018		#N/A			#N/A		25.5	9876.3	During drilling. Time: 1605, 80° mostly sunny.		#N/A			#N/A			#N/A		7.0	9895.0	Reservoir elevation assumed ~ 7' below crest.
7/24/2018		#N/A		41.5	9860.6	During drilling. Time: 1425, 75° mostly sunny.		#N/A			#N/A			#N/A			#N/A		7.0	9895.0	Reservoir elevation assumed ~ 7' below crest.
7/24/2018		#N/A		35.3	9866.9	During drilling, prior to K-1. Time: 1520, 75° mostly sunny.		#N/A			#N/A			#N/A			#N/A		7.0	9895.0	Reservoir elevation assumed ~ 7' below crest.
7/25/2018		#N/A			#N/A		21.7	9880.1	In well, well developed 7/24/18. Time: 0845, 70° sunny.		#N/A			#N/A			#N/A		7.0	9895.0	Reservoir elevation assumed ~ 7' below crest.
7/26/2018	24.2	9878.0	During drilling. Perched zone in embankment? Time: 0840, 65° mostly sunny.		#N/A		22.5	9879.3	Time: 0805, 65° mostly sunny.		#N/A			#N/A			#N/A		7.0	9895.0	Reservoir elevation assumed ~ 7' below crest.
7/26/2018	55.3	9846.9	During drilling. Level in foundation. Time: 1405, 73° mostly sunny.		#N/A			#N/A			#N/A			#N/A			#N/A		7.0	9895.0	Reservoir elevation assumed ~ 7' below crest.
7/27/2018	38.3	9863.9	During drilling. Time: 0803, 60° mostly sunny.	33.6	9868.5	In well, well developed 7/26/18. Time: 0813, 60° mostly sunny.	22.6	9879.2	Time: 0822, 60° mostly sunny.		#N/A			#N/A			#N/A		7.0	9895.0	Reservoir elevation assumed ~ 7' below crest.
7/28/2018	30.6	9871.7	In well. Prior to developing well. Time: 0745, 55° partly cloudy. Well developed after measurement.	33.6	9868.5	Time: 0845, 70° mostly cloudy.	22.6	9879.3	Time: 0840, 65° mostly cloudy.		#N/A			#N/A			#N/A		7.0	9895.0	Reservoir elevation assumed ~ 7' below crest.
8/3/2018	34.2	9868.0	~60°	32.9	9869.2	~60°	Dry	#N/A	~60°		#N/A			#N/A			#N/A		7.0	9895.0	Reservoir elevation assumed ~ 7' below crest.
8/9/2018	34.2	9868.0	Measured by SEO.	32.9	9869.2	Measured by SEO.	Dry	#N/A	Measured by SEO.		#N/A			#N/A			#N/A		7.0	9895.0	Reservoir elevation assumed ~ 7' below crest.
8/23/2018	27.7	9874.5	Measured by City.	33.6	9868.5	Measured by City.	22.5	9879.3	Measured by City.		#N/A			#N/A			#N/A		7.0	9895.0	Reservoir elevation assumed ~ 7' below crest.
9/6/2018	32.0	9870.2	Measured by City.	33.6	9868.5	Measured by City.	22.7	9879.1	Measured by City.		#N/A			#N/A			#N/A		17.0	9885.0	Reservoir elevation lowered 10' below normal, so ~ 17' below crest.

	B-101(P)			B-102A(P)			B-103(P)			B-104(P)			B-105A(P)			B-105B(P)			Reservoir Level		
Date	Depth(1)	El	Notes	Depth(1)	El	Notes	Depth(1)	El	Notes	Depth(1)	El	Notes	Depth(1)	El	Notes	Depth(1)	El	Notes	Depth(1)	El	Notes
9/11/2018	36.9	9865.4	Measured by City.	35.2	9866.9	Measured by City.	22.5	9879.3	Measured by City.		#N/A			#N/A			#N/A		17.0	9885.0	Reservoir elevation lowered 10' below normal, so ~ 17' below crest.
9/13/2018	37.6	9864.6	Measured by City.	36.4	9865.8	Measured by City.	22.6	9879.2	Measured by City.		#N/A			#N/A			#N/A		17.0	9885.0	Reservoir elevation lowered 10' below normal, so ~ 17' below crest.
9/17/2018	38.6	9863.6	Time: 1036, 65° mostly sunny.	37.5	9864.6	Time: 1042, 65° mostly sunny.	22.6	9879.2	Time: 1050, 65° mostly sunny.		#N/A		4.8	9863.7	During drilling. Time: 1345, 70° sunny.		#N/A		17.0	9885.0	Reservoir elevation lowered 10' below normal, so ~ 17' below crest.
9/18/2018	38.8	9863.4	Time: 0655, 50° clear. Well pumped with submersible pump after reading.	37.7	9864.4	Time: 1732, 70° sunny.	22.6	9879.2	Measured by City.		#N/A		9.2	9859.3	In boring, measured prior to daily drilling. Time: 0740, 55° clear.		#N/A		17.0	9885.0	Reservoir elevation lowered 10' below normal, so ~ 17' below crest.
9/18/2018	39.7	9862.5	Time: 1726, 70° sunny. Measured after well pumped this morning. Recharging.		#N/A			#N/A			#N/A			#N/A			#N/A		17.0	9885.0	Reservoir elevation lowered 10' below normal, so ~ 17' below crest.
9/19/2018	39.0	9863.2	Time: 0724, 50° partly cloudy.	37.8	9864.3	Time: 0728, 50° partly cloudy.	22.6	9879.2	Time: 0732, 50° partly cloudy.		#N/A		9.1	9859.5	In boring, measured prior to daily activity. Time: 0755, 50° partly cloudy.	8.2	9861.5	During drilling. Time: 1120, 55° overcast.	17.0	9885.0	Reservoir elevation lowered 10' below normal, so ~ 17' below crest.
9/20/2018	39.1	9863.1	Time: 0727, 50° clear.	37.9	9864.2	Time: 0731, 50° clear.	22.6	9879.2	Time: 0735, 50° clear.	10.4	9838.6	During drilling. Time: 0825, 50° clear.	12.5	9856.0	In well. Prior to develop well. Time: 1445, 60° sunny. Developed well after measurement.	8.6	9861.2	In well. Prior to develop well. Time: 1448, 60° sunny. Developed well after measurement.	17.0	9885.0	Reservoir elevation lowered 10' below normal, so ~ 17' below crest.
9/21/2018	39.0	9863.2	Time: 0907, 50° sunny.	38.0	9864.1	Time: 0913, 50° sunny.	22.6	9879.2	Time: 0917, 50° sunny.	8.9	9840.1	In well. Prior to develop well. Time: 1315, 60° sunny. Developed well after measurement.	12.6	9855.9	Time: 0923, 50° sunny.	8.3	9861.4	Time: 0925, 50° sunny.	17.0	9885.0	Reservoir elevation lowered 10' below normal, so ~ 17' below crest.
9/22/2018	39.1	9863.1	Time: 0704, 45° clear.	38.2	9863.9	Time: 0707, 45° clear.	22.6	9879.2	Time: 0711, 45° clear.	8.5	9840.5	Time: 0658, 45° clear.	12.6	9855.9	Time: 0652, 45° clear.	8.4	9861.4	Time: 0654, 45° clear.	17.0	9885.0	Reservoir elevation lowered 10' below normal, so ~ 17' below crest.

Jacquelyn Hagbery

From: Mark Mumby <mmumby@hrlcomp.com>
Sent: Monday, August 06, 2018 1:31 PM
To: Garrett Jackson
Cc: Jacquelyn Hagbery
Subject: Hogchute Dam Water Levels

Good afternoon Garrett,

Great news on the additional drilling. I did get the J-Plug installed on B 101.

I also collected a round of water levels which are as follows:

B-101 34.20 feet from TOC
B-102 32.94 feet From TOC
B-103 was dry.

I have us penciled in for the 17th of September

Regards

Mark

Mark Mumby, RPG | Drilling Program Manager
HRL Compliance Solutions, Inc.
2385 F 1/2 Road | Grand Junction, CO 81505
main 970.243.3271 Ex. 404 | mobile 970.260.1576
Web | vCard | Map | |

HRL COMPLIANCE SOLUTIONS

Hogchute Dam (DAMID 420127) Monitoring Record

Piezometers

		B-101(P)		B-102(P)		B-103(P)		
		TOC[1] Elev.	151.00	TOC[1] Elev.	151.00	TOC[1] Elev.	151.00	
Date	Res. Elev.	DTW[2]	Water Elev.	DTW[2]	Water Elev.	DTW[2]	Water Elev.	Comments
7/28/2018	144.00	--	--	--	--	22.55	128.45	Top of Casing not yet surveyed, used dam crest elev = 151. Reservoir elevation assumed ~ 7' below crest.
8/3/2018	144.00	34.20	116.80	32.94	118.06	dry (22)	--	Top of Casing not yet surveyed, used dam crest elev = 151. Reservoir elevation assumed ~ 7' below crest.
8/9/2018	144.00	34.16	116.84	32.87	118.13	dry (22)	--	Top of Casing not yet surveyed, used dam crest elev = 151. Reservoir elevation assumed ~ 7' below crest.
8/23/2018	144.00	27.68	123.32	33.62	117.38	22.50	128.50	Top of Casing not yet surveyed, used dam crest elev = 151. Reservoir elevation assumed ~ 7' below crest.

Notes:

1 - TOC = Top of Casing elevation (to be surveyed by City)

2 - DTW = Depth to Water below TOC

City of Grand Junction
Carson Reservoir
Piezometer Readings

Date	9/6/2018	9/11/2018	9/13/2018	9/18/2018	9/20/2018			
Recorder	SC/CP	SC/CP	SC/CP	CP	CP			
PZ-N	22.7	22.5	22.6	22.58	22.58			
PZ-M	33.6	35.2	36.35	37.71	38.01			
PZ-S	32	36.85	37.62	41.2--RJH pumped down	39.02			
Toe Drain	5 gpm	5 gpm	4.25 gpm					
Level	47.6	41.8	38.35	38.35	38.35			
AF	637	425	320	320	320			

APPENDIX G

LABORATORY TESTING RESULTS

Moisture Content and Density ASTM D2216 and D7263

ADVANCED TERRA TESTING

Moisture and Density
ASTM D 2216 and ASTM D 7263

CLIENT	RJH Consultants	JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation	LOCATION	--
PROJECT NO.	18115		

BORING NO.	B-101	
DEPTH	30-31'	
SAMPLE NO.	CA-11	
DATE SAMPLED		
DATE TESTED	10/26/18	
TECHNICIAN	BDF	
DESCRIPTION		
Mass of Wet Pan and Soil (g):	262.24	
Mass of Dry Pan and Soil (g):	230.30	
Mass of Pan (g):	6.71	
Moisture (%):	**14.3**	
Diameter (in):	1.94	
Height (in):	2.22	
Mass of Wet Soil and Ring (g):	956.35	
Mass of Ring (g):	740.98	
Wet Density (lbs/ft³):	**125.3**	
Dry Density (lbs/ft³):	**109.6**	
Wet Density (kg/m³):	**2007**	
Dry Density (kg/m³):	**1756**	
BORING NO.		
DEPTH		
SAMPLE NO.		
DATE SAMPLED		
DATE TESTED		
TECHNICIAN		
DESCRIPTION		
Mass of Wet Pan and Soil (g):		
Mass of Dry Pan and Soil (g):		
Mass of Pan (g):		
Moisture (%):		
Diameter (in):		
Height (in):		
Mass of Wet Soil and Ring (g):		
Mass of Ring (g):		
Wet Density (lbs/ft³):		
Dry Density (lbs/ft³):		
Wet Density (kg/m³):		
Dry Density (kg/m³):		
NOTES	Significant amount of filling required.	

Data entry by:	CAL	Date:	10/29/2018
Checked by:	KMS	Date:	10/29/18
File name:	2679130__Moisture and Density ASTM D7236_1.xls		

ADVANCED TERRA TESTING

Moisture and Density
ASTM D 2216 and ASTM D 7263

CLIENT	RJH Consultants	JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation	LOCATION	--
PROJECT NO.	18115		

BORING NO.	B-102A
DEPTH	44-45'
SAMPLE NO.	CA-20
DATE SAMPLED	07/24/18
DATE TESTED	10/19/18
TECHNICIAN	SKS
DESCRIPTION	
Mass of Wet Pan and Soil (g):	75.44
Mass of Dry Pan and Soil (g):	61.76
Mass of Pan (g):	7.92
Moisture (%):	**25.4**
Diameter (in):	2.03
Height (in):	4.20
Mass of Wet Soil and Ring (g):	535.00
Mass of Ring (g):	108.80
Wet Density (lbs/ft³):	**119.8**
Dry Density (lbs/ft³):	**95.6**
Wet Density (kg/m³):	**1920**
Dry Density (kg/m³):	**1531**
BORING NO.	
DEPTH	
SAMPLE NO.	
DATE SAMPLED	
DATE TESTED	
TECHNICIAN	
DESCRIPTION	
Mass of Wet Pan and Soil (g):	
Mass of Dry Pan and Soil (g):	
Mass of Pan (g):	
Moisture (%):	
Diameter (in):	
Height (in):	
Mass of Wet Soil and Ring (g):	
Mass of Ring (g):	
Wet Density (lbs/ft³):	
Dry Density (lbs/ft³):	
Wet Density (kg/m³):	
Dry Density (kg/m³):	
NOTES	

Data entry by:	SKS	Date:	10/23/2018
Checked by:	KMS	Date:	10/24/18
File name:	2679130__Moisture and Density ASTM D7236_0.xls		

ADVANCED TERRA TESTING

Moisture and Density
ASTM D 2216 and ASTM D 7263

CLIENT	RJH Consultants	JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation	LOCATION	--
PROJECT NO.	18115		

BORING NO.	B-103
DEPTH	15-16'
SAMPLE NO.	CA-8
DATE SAMPLED	
DATE TESTED	10/26/18
TECHNICIAN	BDF
DESCRIPTION	
Mass of Wet Pan and Soil (g):	598.84
Mass of Dry Pan and Soil (g):	566.35
Mass of Pan (g):	266.20
Moisture (%):	**10.8**
Diameter (in):	1.94
Height (in):	2.50
Mass of Wet Soil and Ring (g):	648.18
Mass of Ring (g):	422.73
Wet Density (lbs/ft^3):	**116.5**
Dry Density (lbs/ft^3):	**105.1**
Wet Density (kg/m^3):	**1866**
Dry Density (kg/m^3):	**1683**
BORING NO.	
DEPTH	
SAMPLE NO.	
DATE SAMPLED	
DATE TESTED	
TECHNICIAN	
DESCRIPTION	
Mass of Wet Pan and Soil (g):	
Mass of Dry Pan and Soil (g):	
Mass of Pan (g):	
Moisture (%):	
Diameter (in):	
Height (in):	
Mass of Wet Soil and Ring (g):	
Mass of Ring (g):	
Wet Density (lbs/ft^3):	
Dry Density (lbs/ft^3):	
Wet Density (kg/m^3):	
Dry Density (kg/m^3):	
NOTES	Filling required for density.

Data entry by:	SPH	Date:	10/30/2018
Checked by:	KMS	Date:	10/31/18
File name:	2679130__Moisture and Density ASTM D7236_2.xls		

Atterberg Limits
ASTM D4318

ADVANCED TERRA TESTING

Atterberg Limits
ASTM D 4318

CLIENT	RJH Consultants		BORING NO.	B-101
JOB NO.	2679-130		DEPTH	25-40'
PROJECT	Hogchute Dam Safety Evaluation		SAMPLE NO.	Bu-13
PROJECT NO.	18115		DATE SAMPLED	--
LOCATION	--		SAMPLED BY	--
DATE TESTED	11/06/18		DESCRIPTION	--
TECHNICIAN	SPH			

Plastic Limits

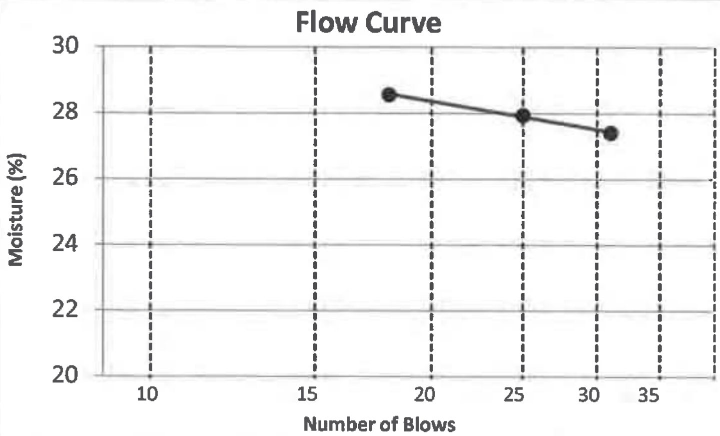
Mass of Wet Pan and Soil (g):	9.93	9.90
Mass of Dry Pan and Soil (g):	8.68	8.65
Mass of Pan (g):	1.16	1.15
Moisture (%)	**16.7**	**16.7**

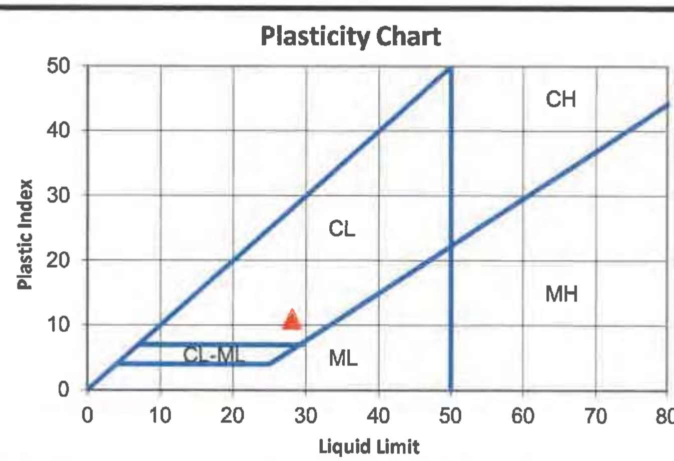
Liquid Limits

Number of Blows	18	25	31
Mass of Wet Pan and Soil (g):	8.94	9.50	9.99
Mass of Dry Pan and Soil (g):	7.21	7.68	8.10
Mass of Pan (g):	1.13	1.14	1.18
Moisture (%)	**28.6**	**27.9**	**27.4**

Plastic Index

Plastic Limit:	**17**	Atterberg Classification:	CL
Liquid Limit:	**28**	Method:	A
Plastic Index:	**11**		





NOTES

Data entry by:	SPH	Date:	11/7/2018
Checked by:	KMS	Date:	11/8/18
File name:	2679130__Atterberg ASTM D4318_1.xlsm		

ADVANCED TERRA TESTING

Atterberg Limits
ASTM D 4318

CLIENT	RJH Consultants	BORING NO.	B-101
JOB NO.	2679-130	DEPTH	51-65'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-20
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	11/07/18	DESCRIPTION	--
TECHNICIAN	AD		

Plastic Limits

Mass of Wet Pan and Soil (g):	7.61	7.53
Mass of Dry Pan and Soil (g):	6.77	6.71
Mass of Pan (g):	1.09	1.11
Moisture (%)	**14.9**	**14.8**

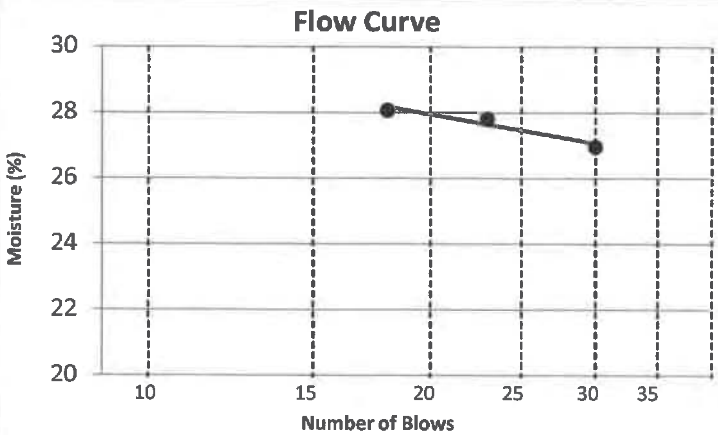
Liquid Limits

Number of Blows	18	23	30
Mass of Wet Pan and Soil (g):	11.55	10.96	11.78
Mass of Dry Pan and Soil (g):	9.27	8.83	9.52
Mass of Pan (g):	1.14	1.14	1.13
Moisture (%)	**28.1**	**27.8**	**27.0**

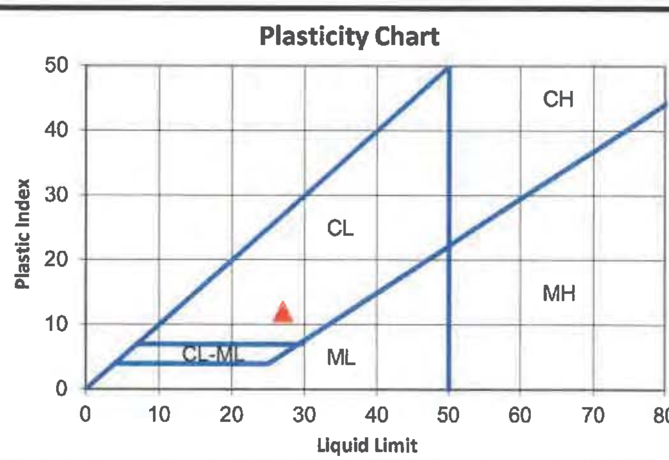
Plastic Index

Plastic Limit:	**15**	Atterberg Classification:	CL
Liquid Limit:	**27**	Method:	A
Plastic Index:	**12**		

Flow Curve



Plasticity Chart



NOTES

Data entry by:	KMS	Date:	11/8/2018
Checked by:	KR	Date:	11/8/18
File name:	2679130__Atterberg ASTM D4318_4.xlsm		

ADVANCED TERRA TESTING

Atterberg Limits
ASTM D 4318

CLIENT	RJH Consultants	BORING NO.	B-102A
JOB NO.	2679-130	DEPTH	18-41.5'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-10
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	11/05/18	DESCRIPTION	--
TECHNICIAN	SPH		

Plastic Limits

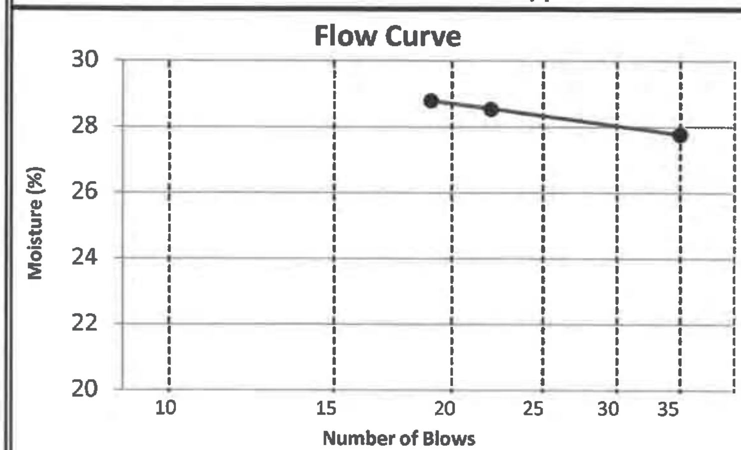
Mass of Wet Pan and Soil (g):	9.17	9.20
Mass of Dry Pan and Soil (g):	8.02	8.03
Mass of Pan (g):	1.17	1.07
Moisture (%)	**16.7**	**16.7**

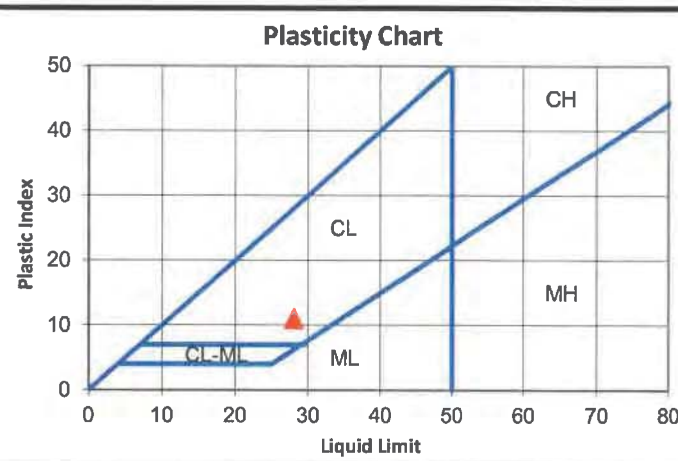
Liquid Limits

Number of Blows	19	22	35
Mass of Wet Pan and Soil (g):	13.22	14.23	13.44
Mass of Dry Pan and Soil (g):	10.51	11.32	10.76
Mass of Pan (g):	1.12	1.14	1.10
Moisture (%)	**28.8**	**28.5**	**27.8**

Plastic Index

Plastic Limit:	**17**	Atterberg Classification:	CL
Liquid Limit:	**28**	Method:	A
Plastic Index:	**11**		





NOTES

Data entry by:	SPH	Date:	11/7/2018
Checked by:	KMS	Date:	11/7/18
File name:	2679130__Atterberg ASTM D4318_2.xlsm		

ADVANCED TERRA TESTING

Atterberg Limits
ASTM D 4318

CLIENT	RJH Consultants	BORING NO.	B-103
JOB NO.	2679-130	DEPTH	10-17.5'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-11
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	11/07/18	DESCRIPTION	--
TECHNICIAN	CAL		

Plastic Limits

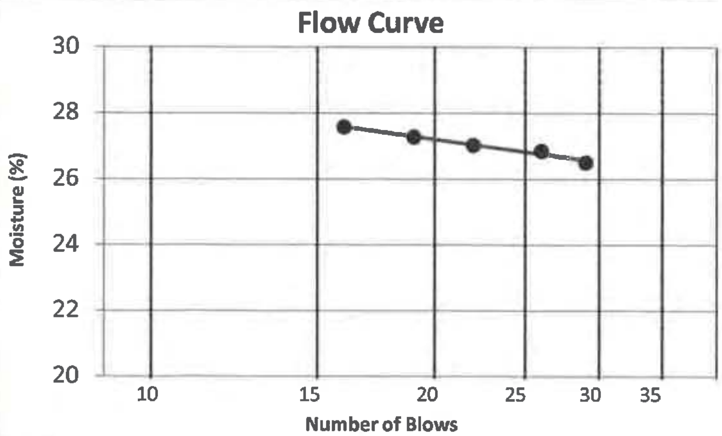
Mass of Wet Pan and Soil (g):	9.35	8.35
Mass of Dry Pan and Soil (g):	8.24	7.38
Mass of Pan (g):	1.15	1.13
Moisture (%)	**15.7**	**15.6**

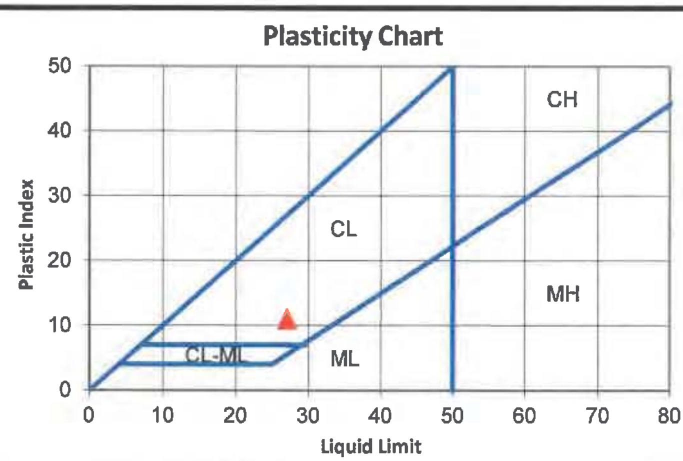
Liquid Limits

Number of Blows	16	19	22	26	29
Mass of Wet Pan and Soil (g):	10.62	10.48	9.39	11.05	10.09
Mass of Dry Pan and Soil (g):	8.57	8.48	7.63	8.96	8.22
Mass of Pan (g):	1.14	1.18	1.15	1.15	1.14
Moisture (%)	**27.6**	**27.3**	**27.0**	**26.9**	**26.5**

Plastic Index

Plastic Limit:	**16**	Atterberg Classification:	CL
Liquid Limit:	**27**	Method:	A
Plastic Index:	**11**		





NOTES

Data entry by:	CAL	Date:	11/8/2018
Checked by:	KMS	Date:	11/8/18
File name:	2679130__Atterberg ASTM D4318_3.xlsm		

Atterberg Limits
ASTM D 4318

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	BORING NO.	B-104
JOB NO.	2679-130	DEPTH	32-33'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-9
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	SAMPLED BY	--
DATE TESTED	10/25/18	DESCRIPTION	--
TECHNICIAN	KJT		

Plastic Limits

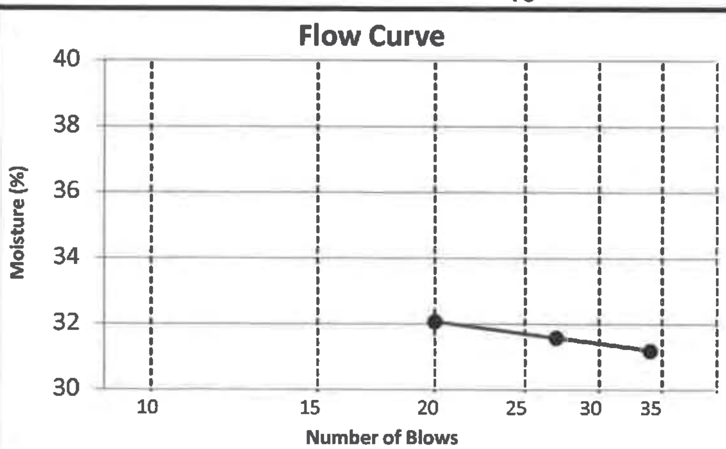
Mass of Wet Pan and Soil (g):	7.69	7.79
Mass of Dry Pan and Soil (g):	6.64	6.74
Mass of Pan (g):	1.13	1.15
Moisture (%)	**19.0**	**18.7**

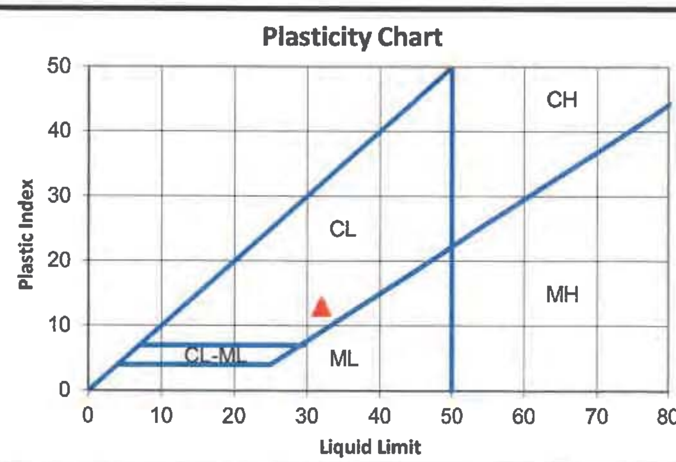
Liquid Limits

Number of Blows	20	27	34
Mass of Wet Pan and Soil (g):	10.64	11.64	10.28
Mass of Dry Pan and Soil (g):	8.32	9.12	8.09
Mass of Pan (g):	1.08	1.11	1.09
Moisture (%)	**32.1**	**31.6**	**31.2**

Plastic Index

Plastic Limit:	**19**	Atterberg Classification:	CL
Liquid Limit:	**32**	Method:	A
Plastic Index:	**13**		





NOTES

Data entry by:	SPH	Date:	10/26/2018
Checked by:	CAL	Date:	10/26/18
File name:	2679130__Atterberg ASTM D4318_0.xlsm		

Grain Size Analysis
ASTM D6913

ADVANCED TERRA TESTING

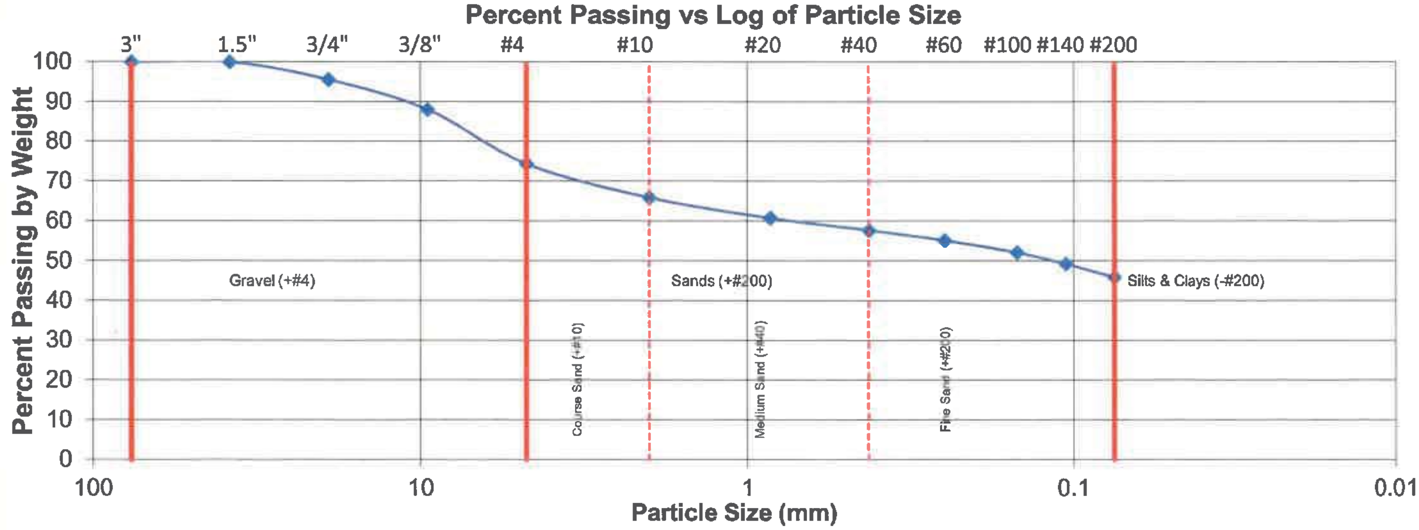
Grain Size Analysis
ASTM D 6913

CLIENT	RJH Consultants	BORING NO.	B-101
JOB NO.	2679-130	DEPTH	25-40'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-13
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	11/01/18		
TECHNICIAN	AD		

Hygroscopic Moisture of Fines		Sample Data	
Mass Wet Pan and Soil (g):	1409.38	Total Wet Mass of Sample (g):	23501.7
Mass Dry Pan and Soil (g):	1399.33	Total Dry Mass of Sample (g):	23169.2
Mass of Pan (g):	782.51	Split Fraction:	3/8"
Moisture (%):	**1.6**	Mass of Sub-Sample Fraction (g):	626.87

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	--	--	--	--	**--**
1.5"	38.1	0.0	--	--	--	**100%**
3/4"	19.05	1014.6	--	1014.6	1.00	**95.6**
3/8"	9.53	1748.4	--	1748.4	1.00	**88.1**
#4	4.75	95.3	--	95.3	0.88	**74.5**
#10	2.00	59.5	--	59.5	0.88	**66.0**
#20	0.850	36.0	--	36.0	0.88	**60.8**
#40	0.425	21.7	--	21.7	0.88	**57.7**
#60	0.250	17.9	--	17.9	0.88	**55.2**
#100	0.150	21.1	--	21.1	0.88	**52.2**
#140	0.106	20.1	--	20.1	0.88	**49.3**
#200	0.075	23.6	--	23.6	0.88	**45.9**

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification:	CL	Coefficient of Curvature - C_c:	--
Group Symbol:	SC	Coefficient of Uniformity - C_u:	--
USCS Classification:	Clayey Sand With Gravel		

Data entry by:	SPH	Date:	11/7/2018
Checked by:	KMS	Date:	11/7/18
File name:	2679130__Grain Size Analysis ASTM D6913_2.xlsm		

Grain Size Analysis
ASTM D 6913

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	BORING NO.	B-102A
JOB NO.	2679-130	DEPTH	18-41.5'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-10
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	11/05/18		
TECHNICIAN	AD		

Hygroscopic Moisture of Fines

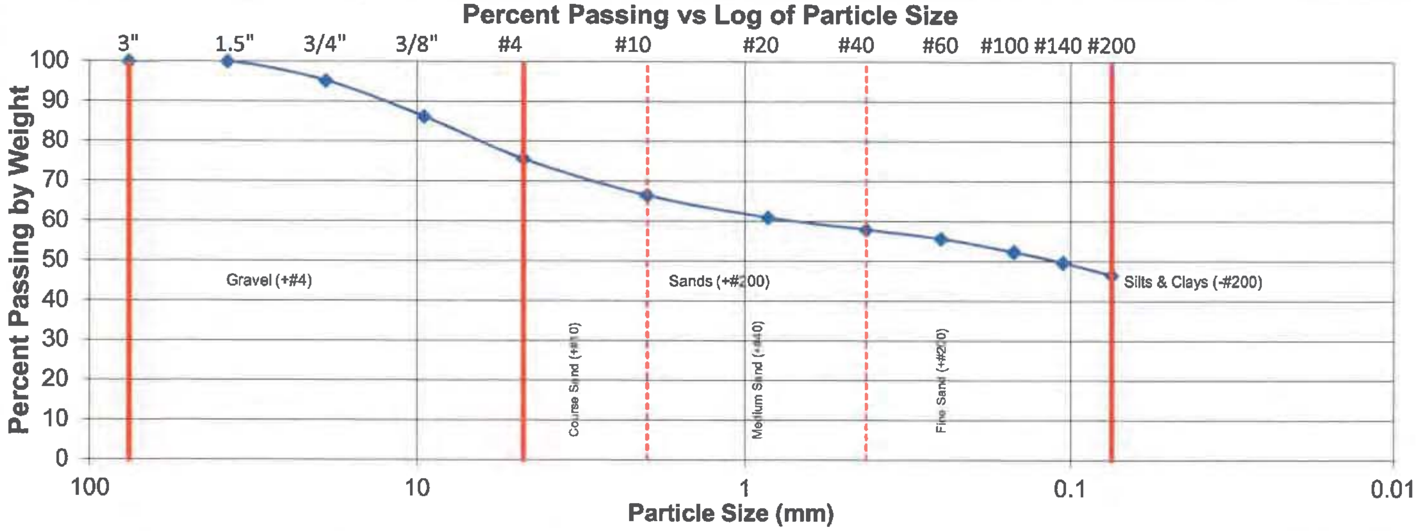
Mass Wet Pan and Soil (g): 1809.96
Mass Dry Pan and Soil (g): 1794.70
Mass of Pan (g): 843.18
Moisture (%): **1.6**

Sample Data

Total Wet Mass of Sample (g): 24771.5
Total Dry Mass of Sample (g): 24433.6
Split Fraction: 3/8"
Mass of Sub-Sample Fraction (g): 966.78

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	--	--	--	--	**--**
1.5"	38.1	0.0	--	--	--	**100%**
3/4"	19.05	1165.8	--	1165.8	1.00	**95.2**
3/8"	9.53	2201.0	--	2201.0	1.00	**86.2**
#4	4.75	116.4	--	116.4	0.86	**75.7**
#10	2.00	100.5	--	100.5	0.86	**66.6**
#20	0.850	61.0	--	61.0	0.86	**61.0**
#40	0.425	33.7	--	33.7	0.86	**58.0**
#60	0.250	24.9	--	24.9	0.86	**55.7**
#100	0.150	36.7	--	36.7	0.86	**52.4**
#140	0.106	29.3	--	29.3	0.86	**49.7**
#200	0.075	35.2	--	35.2	0.86	**46.6**

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: CL
Group Symbol: SC
USCS Classification: Clayey Sand With Gravel

Coefficient of Curvature - C_c: --
Coefficient of Uniformity - C_u: --

Data entry by:	SPH	Date:	11/7/2018
Checked by:	KMS	Date:	11/7/18
File name:	2679130__Grain Size Analysis ASTM D6913_3.xlsm		

Grain Size Analysis
ASTM D 6913

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	BORING NO.	B-103
JOB NO.	2679-130	DEPTH	27.5-29.9
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	u-14
PROJECT NO.	18115	DATE SAMPLED	07/23/18
LOCATION	--	DESCRIPTION	--
DATE TESTED	10/30/18		
TECHNICIAN	KJT		

Hygroscopic Moisture of Fines

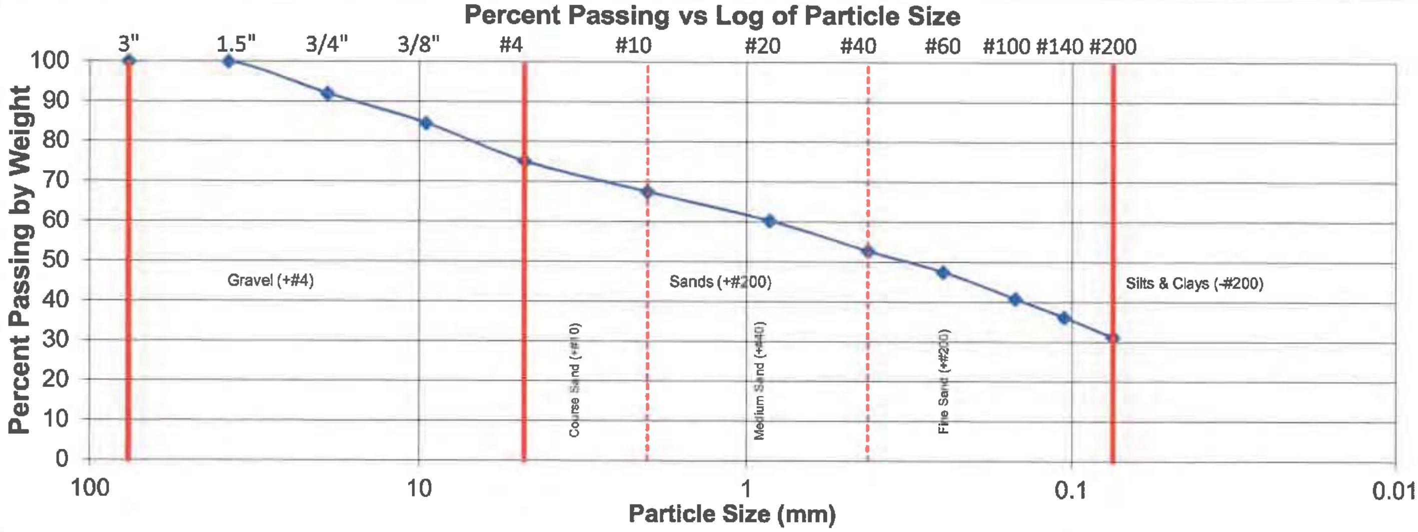
Mass Wet Pan and Soil (g): 1325.03
Mass Dry Pan and Soil (g): 1317.04
Mass of Pan (g): 811.12
Moisture (%): **1.6**

Sample Data

Total Wet Mass of Sample (g): 687.1
Total Dry Mass of Sample (g): 679.0
Split Fraction: #4
Mass of Sub-Sample Fraction (g): 513.86

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	--	--	--	--	**--**
1.5"	38.1	0.0	--	--	--	**100%**
3/4"	19.05	53.9	--	53.9	1.00	**92.1**
3/8"	9.53	50.2	--	50.2	1.00	**84.7**
#4	4.75	64.3	--	64.3	1.00	**75.2**
#10	2.00	51.4	--	51.4	0.75	**67.6**
#20	0.850	48.6	--	48.6	0.75	**60.3**
#40	0.425	50.7	--	50.7	0.75	**52.8**
#60	0.250	35.2	--	35.2	0.75	**47.6**
#100	0.150	44.8	--	44.8	0.75	**40.9**
#140	0.106	31.1	--	31.1	0.75	**36.3**
#200	0.075	33.7	--	33.7	0.75	**31.3**

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: --
Group Symbol: --
USCS Classification: --

Coefficient of Curvature - C_c: --
Coefficient of Uniformity - C_u: --

Data entry by:	SPH	Date:	11/5/2018
Checked by:	iAL	Date:	11/5/18
File name:	2679130__Grain Size Analysis ASTM D6913_1.xlsm		

Grain Size Analysis
ASTM D 6913

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	BORING NO.	B-104
JOB NO.	2679-130	DEPTH	32.0-33.0
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-9
PROJECT NO.	18115	DATE SAMPLED	09/20/18
LOCATION	--	DESCRIPTION	Lean Clay w/ Sand
DATE TESTED	10/19/18		
TECHNICIAN	CAL		

Hygroscopic Moisture

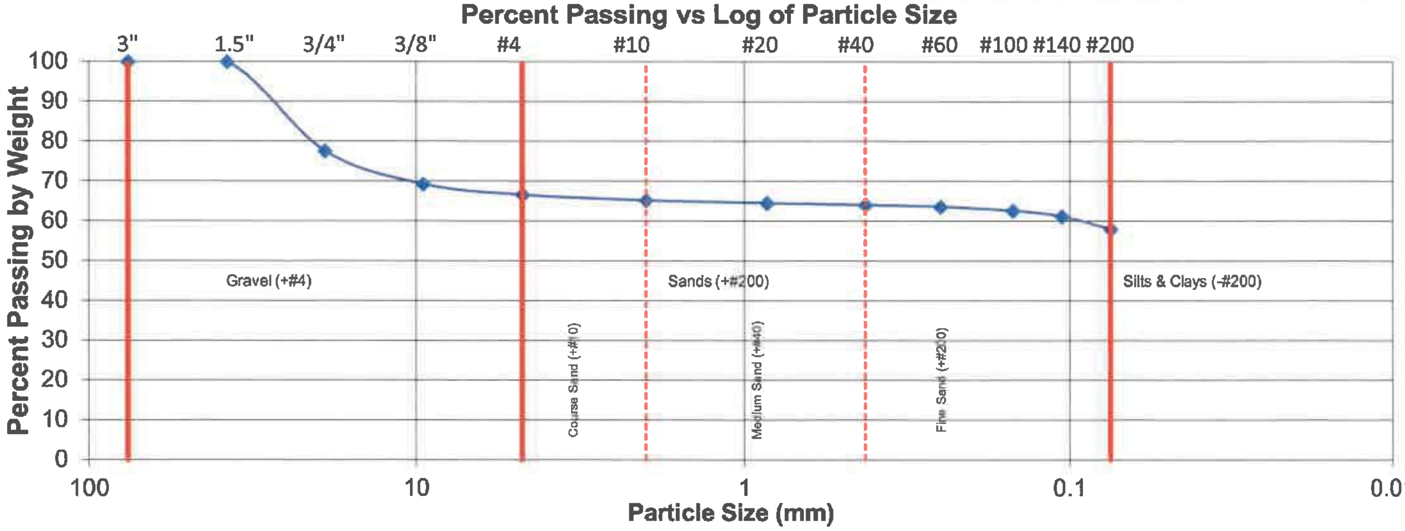
Mass Wet Pan and Soil (g): 531.36
Mass Dry Pan and Soil (g): 466.78
Mass of Pan (g): 139.65
Moisture (%): **19.7**

Sample Data

Total Wet Mass of Sample (g): 391.7
Total Dry Mass of Sample (g): 327.1

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	--	--	--	--	**--**
1.5"	38.1	--	--	--	--	**--**
3/4"	19.05	73.1	--	73.1	1.00	**77.6**
3/8"	9.53	27.1	--	27.1	1.00	**69.4**
#4	4.75	9.0	--	9.0	1.00	**66.6**
#10	2.00	4.4	--	4.4	1.00	**65.2**
#20	0.850	2.2	--	2.2	1.00	**64.6**
#40	0.425	1.5	--	1.5	1.00	**64.1**
#60	0.250	1.4	--	1.4	1.00	**63.7**
#100	0.150	3.3	--	3.3	1.00	**62.7**
#140	0.106	4.6	--	4.6	1.00	**61.3**
#200	0.075	10.5	--	10.5	1.00	**58.1**

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: CL
Group Symbol: CL
USCS Classification: Gravelly Lean Clay

Coefficient of Curvature - C_c: --
Coefficient of Uniformity - C_u: --

Data entry by:	SPH	Date:	10/26/2018
Checked by:	CAL	Date:	10/26/18
File name:	2679130__Grain Size Analysis ASTM D6913_0.xlsm		

Grain Size Analysis with Hydrometer
ASTM D6913 and D7928

Grain Size Analysis with Hydrometer
ASTM D 6913 And D 7928

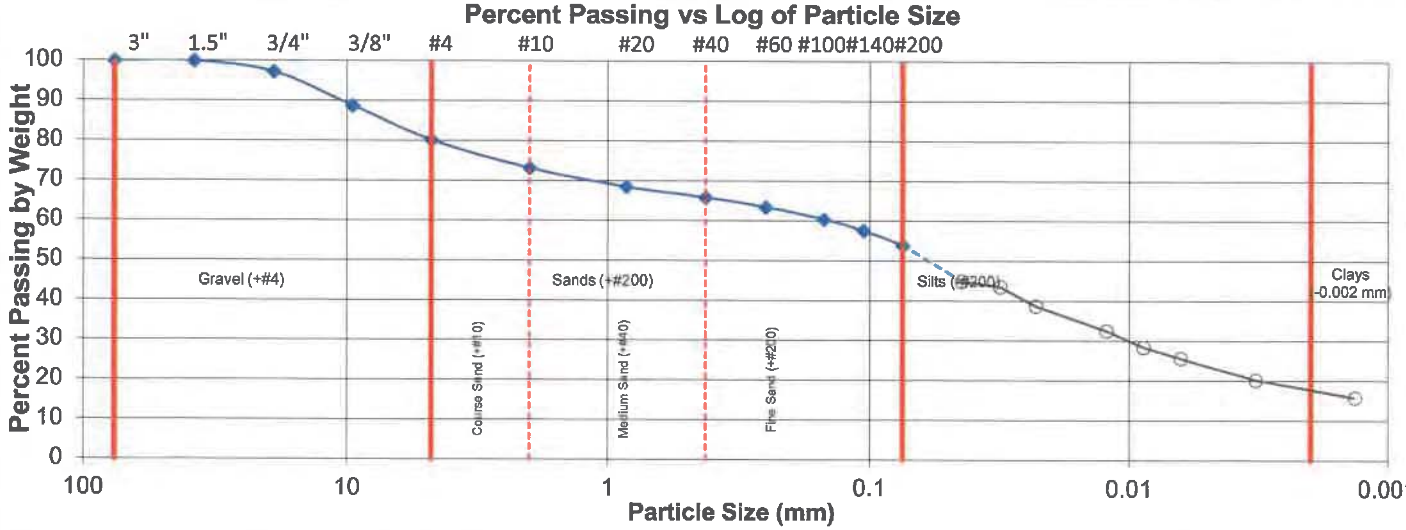
ADVANCED TERRA TESTING

CLIENT	RJH Consultants	BORING NO.	B-101
JOB NO.	2679-130	DEPTH	51-65'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-20
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	11/07/18		
TECHNICIAN	BDF		

Hygroscopic Moisture of Fines		Sample Data		
Mass Wet Pan and Soil (g):	116.73	Total Wet Mass of Sample (g):	19133.2	
Mass Dry Pan and Soil (g):	114.50	Total Dry Mass of Sample (g):	18857.9	
Mass of Pan (g):	3.16	Split Fraction:	#10	3/8"
Moisture (%):	**2.0**	Mass of Sub-Sample Fraction (g):	60.91	1123.80

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	0.0	--	--	--	--
1.5"	38.1	0.0	--	--	--	--
3/4"	19.05	507.2	--	507.2	1.00	**97.3**
3/8"	9.53	1605.3	--	1605.3	1.00	**88.8**
#4	4.75	106.8	--	106.8	0.89	**80.2**
#10	2.00	87.4	--	87.39	0.888	**73.2**
#20	0.850	3.8	--	3.80	0.731	**68.5**
#40	0.425	2.2	--	2.15	0.731	**65.9**
#60	0.250	2.0	--	1.95	0.731	**63.5**
#100	0.150	2.5	--	2.50	0.731	**60.5**
#140	0.106	2.3	--	2.31	0.731	**57.6**
#200	0.075	3.0	--	2.98	0.731	**54.0**

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: CL — Coefficient of Curvature - C_c: --

Group Symbol: CL — Coefficient of Uniformity - C_u: --

USCS Classification: Sandy Lean Clay With Gravel

Data entry by: KMS — Date: 11/8/2018

Checked by: KR — Date: 11/8/18

File name: 2679130__Grain Size with Hydrometer ASTM D6913 D7928_0.xlsm

ADVANCED TERRA TESTING

Grain Size Analysis with Hydrometer
ASTM D 6913 And D 7928

CLIENT	RJH Consultants	BORING NO.	B-101
JOB NO.	2679-130	DEPTH	51-65'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-20
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	11/07/18		
TECHNICIAN	BDF		

Hydrometer and Flask Parameters

Hydrometer ID:	0805	Flask ID:	1186
Average Mass Offset (g/L):	9.87	Flask Volume (cm^3):	996.8
Hydrometer Bulb Volume (cm^3):	56.50	Flask Surface Area (cm^2):	28.60
Meniscus Correction (g/L):	1.00	Assumed Specific Gravity	2.65
H_b (cm):	24.5	Hydrometer Type:	152H
H_{cb} (cm):	6.8		
H_s (cm):	8.2	Percent Finer by Mass at 2 μm:	**17.3**

Hydrometer Data

Elapsed Time (minutes)	Hydrometer Reading (g/L)	Offset Reading (g/L)	Temperature (°C)	Effective Depth (cm)	Maximum Particle Diameter in Suspension (mm)	Percent Finer by Mass (%)
1	38.00	5.34	23.1	10.62	0.044	**44.9**
2	37.00	5.34	23.1	10.79	0.032	**43.5**
4	33.50	5.34	23.1	11.36	0.023	**38.7**
15	29.00	5.34	23.1	12.10	0.012	**32.5**
30	26.00	5.34	23.1	12.60	0.009	**28.4**
60	24.00	5.34	23.1	12.93	0.006	**25.7**
240	20.00	5.30	23.2	13.58	0.003	**20.2**
1440	17.00	5.53	22.6	14.08	0.001	**15.8**

NOTES:

File name: 2679130__Grain Size with Hydrometer ASTM D6913 D7928_0.xlsm

Grain Size Analysis with Hydrometer
ASTM D 6913 And D 7928

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	BORING NO.	B-103
JOB NO.	2679-130	DEPTH	10-17.5'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-11
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	11/07/18		
TECHNICIAN	BDF		

Hygroscopic Moisture of Fines

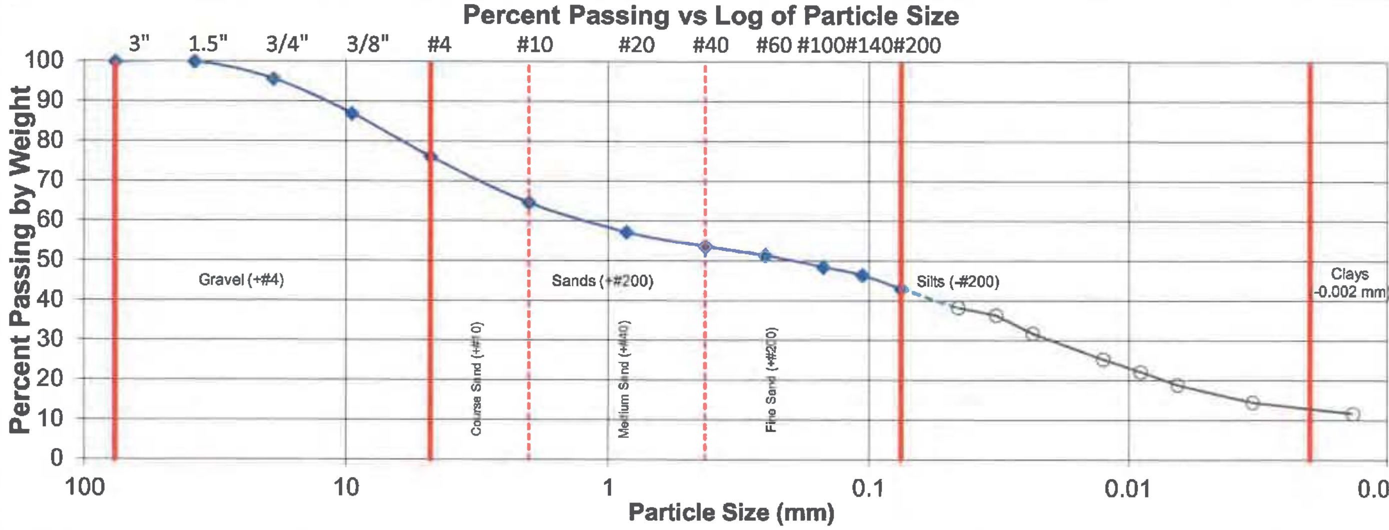
Mass Wet Pan and Soil (g): 121.30
Mass Dry Pan and Soil (g): 119.10
Mass of Pan (g): 3.15
Moisture (%): **1.9**

Sample Data

Total Wet Mass of Sample (g): 26704.1
Total Dry Mass of Sample (g): 26381.7
Split Fraction: #10 | 3/8"
Mass of Sub-Sample Fraction (g): 57.98 | 1427.90

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
3"	76.2	0.0	--	--	--	--
1.5"	38.1	0.0	--	--	--	--
3/4"	19.05	1138.5	--	1138.5	1.00	**95.7**
3/8"	9.53	2287.5	--	2287.5	1.00	**87.0**
#4	4.75	175.9	--	175.9	0.87	**76.1**
#10	2.00	186.6	--	186.55	0.870	**64.6**
#20	0.850	6.5	--	6.52	0.646	**57.2**
#40	0.425	3.1	--	3.12	0.646	**53.7**
#60	0.250	2.0	--	2.00	0.646	**51.4**
#100	0.150	2.5	--	2.52	0.646	**48.6**
#140	0.106	1.8	--	1.83	0.646	**46.5**
#200	0.075	3.1	--	3.05	0.646	**43.0**

Percent Passing vs Log of Particle Size



USCS Classification ASTM D 2487

Atterberg Classification: CL
Group Symbol: SC
USCS Classification: Clayey Sand With Gravel

Coefficient of Curvature - C_c: --
Coefficient of Uniformity - C_u: --

Data entry by:	KMS	Date:	11/8/2018
Checked by:	KP	Date:	11/8/18
File name:	2679130__Grain Size with Hydrometer ASTM D6913 D7928_1.xlsm		

ADVANCED TERRA TESTING

Grain Size Analysis with Hydrometer
ASTM D 6913 And D 7928

CLIENT	RJH Consultants	BORING NO.	B-103
JOB NO.	2679-130	DEPTH	10-17.5'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-11
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	11/07/18		
TECHNICIAN	BDF		

Hydrometer and Flask Parameters

Hydrometer ID:	0805	Flask ID:	1185
Average Mass Offset (g/L):	9.87	Flask Volume (cm^3):	995.9
Hydrometer Bulb Volume (cm^3):	56.50	Flask Surface Area (cm^2):	28.45
Meniscus Correction (g/L):	1.00	Assumed Specific Gravity	2.65
H_b (cm):	24.5	Hydrometer Type:	152H
H_{cb} (cm):	6.8		
H_s (cm):	8.2	Percent Finer by Mass at 2 μm:	**12.6**

Hydrometer Data

Elapsed Time (minutes)	Hydrometer Reading (g/L)	Offset Reading (g/L)	Temperature (°C)	Effective Depth (cm)	Maximum Particle Diameter in Suspension (mm)	Percent Finer by Mass (%)
1	35.00	5.49	22.7	11.11	0.045	**38.3**
2	33.50	5.49	22.7	11.36	0.032	**36.4**
4	30.00	5.49	22.7	11.93	0.024	**31.8**
15	25.00	5.49	22.7	12.76	0.013	**25.3**
30	22.50	5.45	22.8	13.17	0.009	**22.1**
60	20.00	5.45	22.8	13.58	0.006	**18.9**
240	16.50	5.34	23.1	14.16	0.003	**14.5**
1440	14.50	5.53	22.6	14.48	0.001	**11.7**

NOTES:

File name: 2679130__Grain Size with Hydrometer ASTM D6913 D7928_1.xlsm

Percent Minus #200
ASTM D1140

Percent Minus #200
ASTM D 1140

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	BORING NO.	B-101
JOB NO.	2679-130	DEPTH	42.5-43.5
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-16
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	10/31/18		
TECHNICIAN	AD		

Hygroscopic Moisture of Fines

Mass Wet Pan and Soil (g): 1261.71
Mass Dry Pan and Soil (g): 1250.69
Mass of Pan (g): 829.11
Moisture (%): **2.6**

Sample Data

Total Wet Mass of Sample (g): 625.3
Total Dry Mass of Sample (g): 614.0
Split Fraction: #4
Mass of Sub-Sample Fraction (g): 432.59

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
#4	4.75	184.7	--	184.7	1.00	**69.9**
#200	0.075	184.9	--	184.9	0.70	**39.3**

USCS Classification ASTM D 2487

Atterberg Classification: --
Group Symbol: --
USCS Classification: --

NOTES

Data entry by:	SPH	Date:	11/1/2018
Checked by:	CH	Date:	11/02/18
File name:	2679130__Percent Minus #200 ASTM D1140_1.xls		

Percent Minus #200
ASTM D 1140

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	BORING NO.	B-102A
JOB NO.	2679-130	DEPTH	29-30'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-14
PROJECT NO.	18115	DATE SAMPLED	07/24/18
LOCATION	--	DESCRIPTION	--
DATE TESTED	10/30/18		
TECHNICIAN	KJT		

Hygroscopic Moisture

Mass Wet Pan and Soil (g): 1620.42
Mass Dry Pan and Soil (g): 1613.74
Mass of Pan (g): 1024.97
Moisture (%): **1.1**

Sample Data

Total Wet Mass of Sample (g): 595.5
Total Dry Mass of Sample (g): 588.8

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
#4	4.75	335.6	0.0	335.6	1.00	**43.0**
#200	0.075	1484.5	1025.0	459.6	1.00	**21.9**

USCS Classification ASTM D 2487

Atterberg Classification: --
Group Symbol: --
USCS Classification: --

NOTES

Data entry by:	CAL	Date:	11/5/2018
Checked by:	S?H	Date:	11-5-18
File name:	2679130__Percent Minus #200 ASTM D1140_2.xls		

ADVANCED TERRA TESTING

Percent Minus #200
ASTM D 1140

CLIENT	RJH Consultants	BORING NO.	B-103
JOB NO.	2679-130	DEPTH	15-16'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-8
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	10/29/18		
TECHNICIAN	CAL		

Hygroscopic Moisture

Mass Wet Pan and Soil (g): 598.84
Mass Dry Pan and Soil (g): 566.35
Mass of Pan (g): 266.20
Moisture (%): **10.8**

Sample Data

Total Wet Mass of Sample (g): 332.6
Total Dry Mass of Sample (g): 300.2

Sieve Number	Sieve Size (mm)	Mass of Pan and Soil (g)	Mass of Pan (g)	Mass of Individual Retained Soil (g)	Correction Factor	Percent Passing by Weight (%)
#4	4.75	138.1	--	138.1	1.00	**54.0**
#200	0.075	468.5	266.2	202.2	1.00	**32.6**

USCS Classification ASTM D 2487

Atterberg Classification: --
Group Symbol: --
USCS Classification: --

NOTES

Data entry by:	SPH	Date:	10/30/2018
Checked by:	KR	Date:	11/26/18
File name:	2679130__Percent Minus #200 ASTM D1140_0.xls		

Standard Proctor Compaction
ASTM D698

ADVANCED TERRA TESTING

Laboratory Compaction Characteristics

ASTM D 698

CLIENT	RJH Consultants	BORING NO.	B-101
JOB NO.	2679-130	DEPTH	15-25'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-6
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	10/22/18		
TECHNICIAN	WAR		

Laboratory Compaction Characteristics

Hygroscopic Moisture

Mass of Wet Pan and Soil (g):	321.59
Mass of Dry Pan and Soil (g):	316.49
Mass of Pan (g):	14.17
Moisture (%):	1.7

Rock Correction ASTM D 4718

Method:	B
Course Fraction (%):	12.4
Rock Correction Applied:	YES
Mass of Dry Aggregate (g):	3374.2
Mass of SSD Aggregate (g):	3494.0
Mass of Aggregate in Water (g):	2173.3
Rock Specific Gravity:	2.55
Zero Air Voids Specific Gravity:	2.8

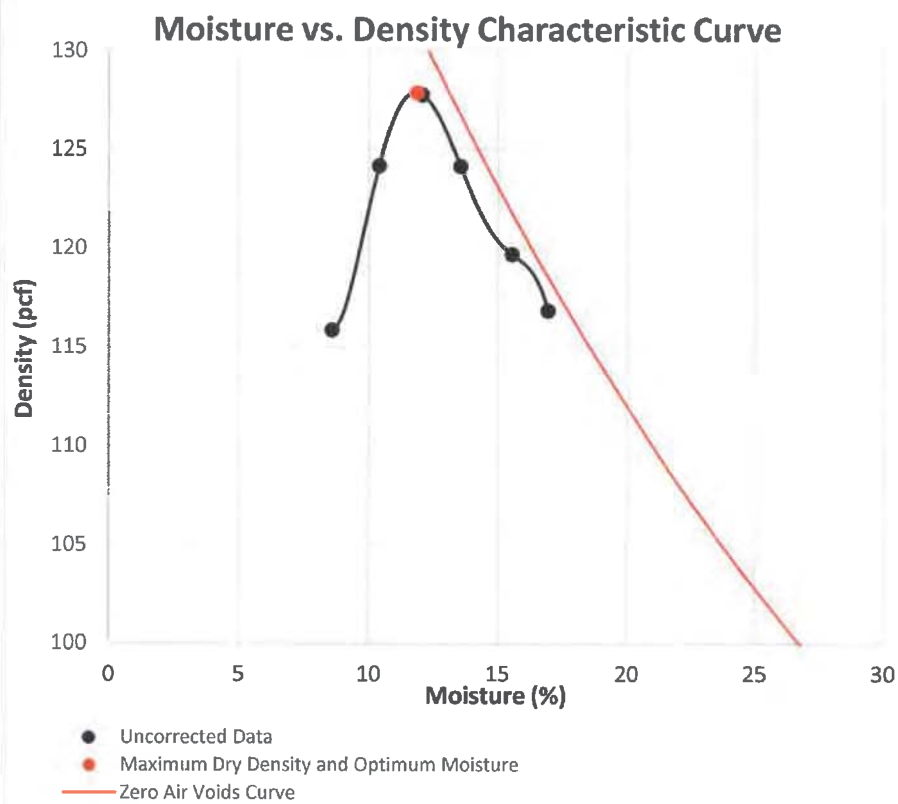
Optimum Dry Density and Moisture

Uncorrected

Dry Density (pcf):	**127.9**
Dry Density (kg/m³):	**2048**
Moisture (%):	**11.9**

Corrected

Dry Density (pcf):	**131.1**
Dry Density (kg/m³):	**2100**
Moisture (%):	**10.4**



Sample Number:	1	2	3	4	5	6
Mass of Wet Pan and Soil (g):	515.29	469.19	502.78	484.74	579.30	328.99
Mass of Dry Soil and Pan (g):	441.62	406.98	443.62	433.27	525.32	303.47
Mass of Pan (g);	6.79	6.74	6.78	6.62	6.69	6.62
Moisture (%):	16.9	15.5	13.5	12.1	10.4	8.6
Mass of Wet Soil and Mold (g):	6650.0	6675.1	6715.4	6748.9	6657.1	6486.6
Mass of Mold (g):	4584.1	4584.1	4584.1	4584.1	4584.1	4584.1
Wet Density (pcf):	125.8	137.1	143.2	141.0	138.3	136.6
Dry Density (pcf):	115.9	124.2	127.8	124.1	119.7	116.8
Wet Density (kg/m³):	2016	2196	2293	2258	2215	2189
Dry Density (kg/m³):	1856	1989	2047	1989	1917	1872

Data entry by: SPH Date: 10/25/2018
Checked by: KMS Date: 11/8/18
File name: 2679130__compaction ASTM D698 D1557_1.xls

ADVANCED TERRA TESTING

Laboratory Compaction Characteristics

ASTM D 698

CLIENT	RJH Consultants	BORING NO.	B-101
JOB NO.	2679-130	DEPTH	51-65'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-20
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	10/25/18		
TECHNICIAN	BDF		

Laboratory Compaction Characteristics

Hygroscopic Moisture

Mass of Wet Pan and Soil (g):	293.70
Mass of Dry Pan and Soil (g):	288.60
Mass of Pan (g):	6.61
Moisture (%):	1.8

Rock Correction ASTM D 4718

Method:	B
Course Fraction (%):	11.9
Rock Correction Applied:	YES
Mass of Dry Aggregate (g):	2131.3
Mass of SSD Aggregate (g):	2205.6
Mass of Aggregate in Water (g):	1377.7
Rock Specific Gravity:	2.57
Zero Air Voids Specific Gravity:	2.76

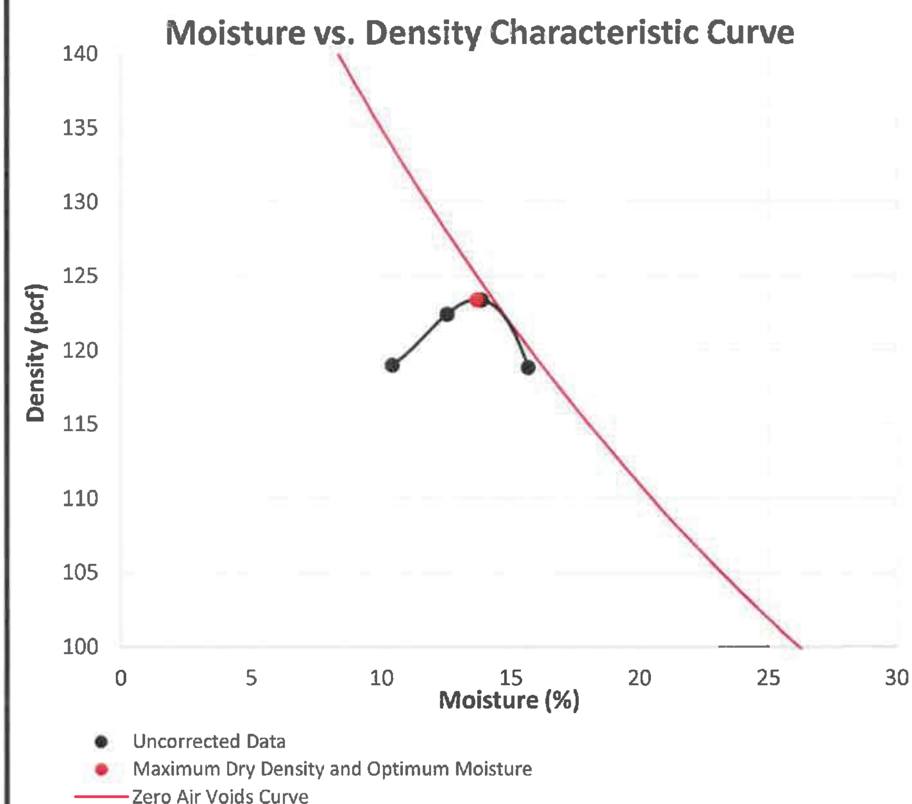
Optimum Dry Density and Moisture

Uncorrected

Dry Density (pcf):	**123.4**
Dry Density (kg/m³):	**1977**
Moisture (%):	**13.7**

Corrected

Dry Density (pcf):	**126.9**
Dry Density (kg/m³):	**2033**
Moisture (%):	**12.1**



Sample Number:	1	2	3	4
Mass of Wet Pan and Soil (g):	310.62	360.16	431.81	288.79
Mass of Dry Soil and Pan (g):	276.78	317.10	374.17	262.13
Mass of Pan (g);	6.92	6.62	6.55	6.56
Moisture (%):	12.5	13.9	15.7	10.4
Mass of Wet Soil and Mold (g):	6667.1	6708.3	6662.5	6570.8
Mass of Mold (g):	4584.0	4584.0	4584.0	4584.0
Wet Density (pcf):	131.4	137.8	140.5	137.5
Dry Density (pcf):	119.0	122.4	123.4	118.8
Wet Density (kg/m³):	2105	2207	2251	2202
Dry Density (kg/m³):	1906	1961	1976	1904

Data entry by:	CAL	Date:	10/29/2018
Checked by:	SPH	Date:	10-30-18
File name:	2679130__compaction ASTM D698 D1557_2.xls		

Laboratory Compaction Characteristics

ASTM D 698

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	BORING NO.	B-103
JOB NO.	2679-130	DEPTH	10-17.5'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-11
PROJECT NO.	18115	DATE SAMPLED	--
LOCATION	--	DESCRIPTION	--
DATE TESTED	10/22/18		
TECHNICIAN	WAR		

Laboratory Compaction Characteristics

Hygroscopic Moisture

Mass of Wet Pan and Soil (g):	396.44
Mass of Dry Pan and Soil (g):	389.75
Mass of Pan (g):	6.56
Moisture (%):	1.7

Rock Correction ASTM D 4718

Method:	B
Course Fraction (%):	14.1
Rock Correction Applied:	YES
Mass of Dry Aggregate (g):	3506.1
Mass of SSD Aggregate (g):	3587.6
Mass of Aggregate in Water (g):	2237.2
Rock Specific Gravity:	2.60
Zero Air Voids Specific Gravity:	2.75

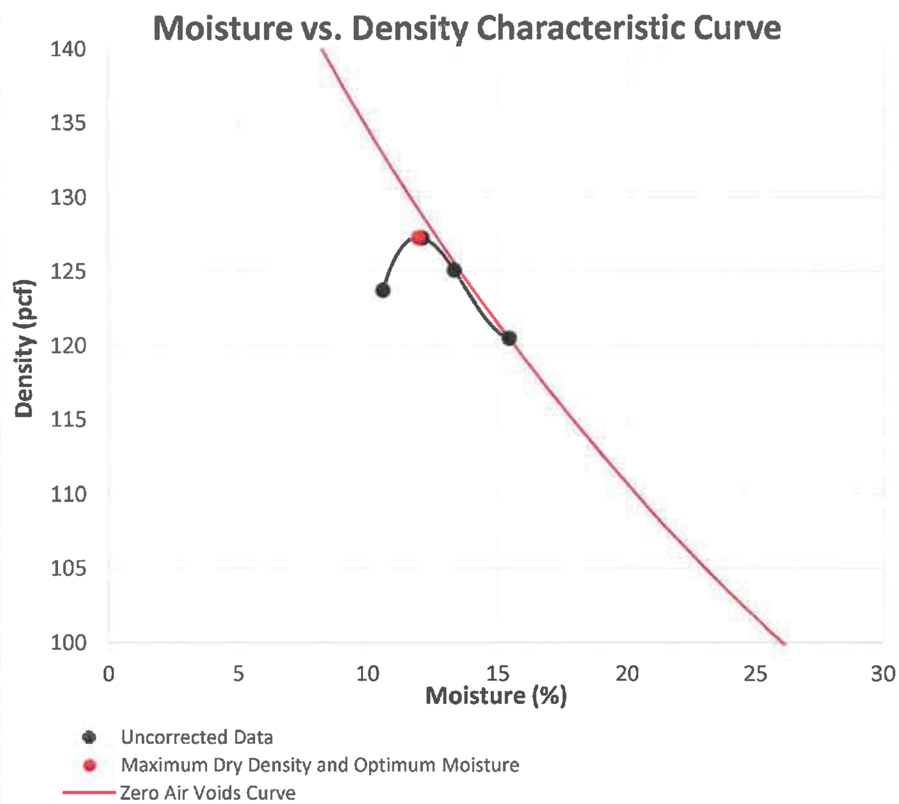
Optimum Dry Density and Moisture

Uncorrected

Dry Density (pcf):	**127.3**
Dry Density (kg/m³):	**2039**
Moisture (%):	**11.9**

Corrected

Dry Density (pcf):	**131.3**
Dry Density (kg/m³):	**2103**
Moisture (%):	**10.3**



Sample Number:	1	2	3	4
Mass of Wet Pan and Soil (g):	397.72	461.20	491.64	419.00
Mass of Dry Soil and Pan (g):	345.67	407.78	439.33	379.57
Mass of Pan (g);	8.51	6.74	6.78	7.11
Moisture (%):	15.4	13.3	12.1	10.6
Mass of Wet Soil and Mold (g):	6687.3	6727.4	6741.1	6653.1
Mass of Mold (g):	4584.1	4584.1	4584.1	4584.1
Wet Density (pcf):	136.8	142.7	141.8	139.1
Dry Density (pcf):	123.7	127.3	125.1	120.5
Wet Density (kg/m³):	2192	2285	2271	2228
Dry Density (kg/m³):	1982	2039	2004	1930

Data entry by:	SPH	Date:	10/25/2018
Checked by:	CH	Date:	10/26/18
File name:	2679130__compaction ASTM D698 D1557_0.xls		

One-Dimensional Consolidation ASTM D2435

ADVANCED TERRA TESTING

One-Dimensional Consolidation

ASTM D 2435

CLIENT	RJH Consultants	BORING NO.	B-103
JOB NO.	2679-130	DEPTH	27.5-29.9'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	u-14
PROJECT NO.	18115	DATE SAMPLED	07/23/18
LOCATION	--	SAMPLED BY	--
DATE TESTED	10/22/18	DESCRIPTION	--
TECHNICIAN	AD		

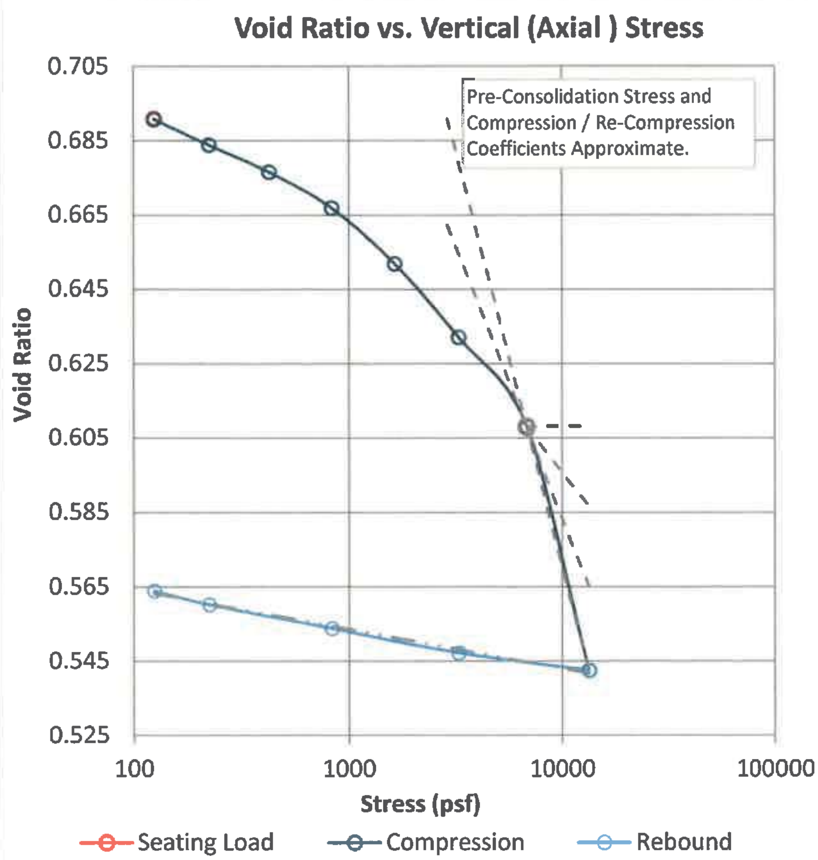
Sample Conditions

Before Test Mass of Wet Soil and Ring (g):	189.07	Initial Wet Density (pcf):	123.2
After Test Mass of Wet Soil and Ring (g):	185.90	Initial Dry Density (pcf):	97.8
Mass of Dry Soil, Ring, and Pan (g):	161.80	Initial Wet Density (kg/m³):	1973
Diameter (in):	2.41	Initial Dry Density (kg/m³):	1567
Initial Height (in):	1.00	Initial Moisture (%):	25.9
Mass of Ring (g):	41.57	Final Wet Density (pcf):	130.3
Mass of Pan (g):	3.08	Final Dry Density (pcf):	105.8
Assumed Specific Gravity:	2.65	Final Wet Density (kg/m³):	2088
Initial Saturation (%):	99.6	Final Dry Density (kg/m³):	1694
Final Saturation (%):	100.0	Final Moisture (%):	23.2

Swell / Collapse Data

Coefficient of Compression:	0.224	Pre-Consolidation Stress (psf):	6780
Coefficient of Re-Compression:	0.011	Pre-Consolidation Stress (kPa):	325

Load (psf)	Void Ratio	Deformation (in)	Strain (%)
125	0.691	0.0000	0.00
Inundation	0.691	0.0001	0.01
225	0.684	0.0042	0.42
428	0.677	0.0085	0.85
832	0.667	0.0142	1.42
1636	0.652	0.0231	2.31
3248	0.632	0.0348	3.48
6780	0.608	0.0490	4.90
13314	0.543	0.0878	8.78
Rebound			
13314	0.543	0.0878	8.78
3248	0.547	0.0850	8.50
832	0.554	0.0811	8.11
225	0.560	0.0773	7.73
125	0.564	0.0751	7.51



Data entry by:	SPH	Date:	11/5/2018
Checked by:	DPM	Date:	11/7/18
File name:	2679130__Consol ASTM D2435_0.xlsm		Page 1 of 3

ADVANCED TERRA TESTING

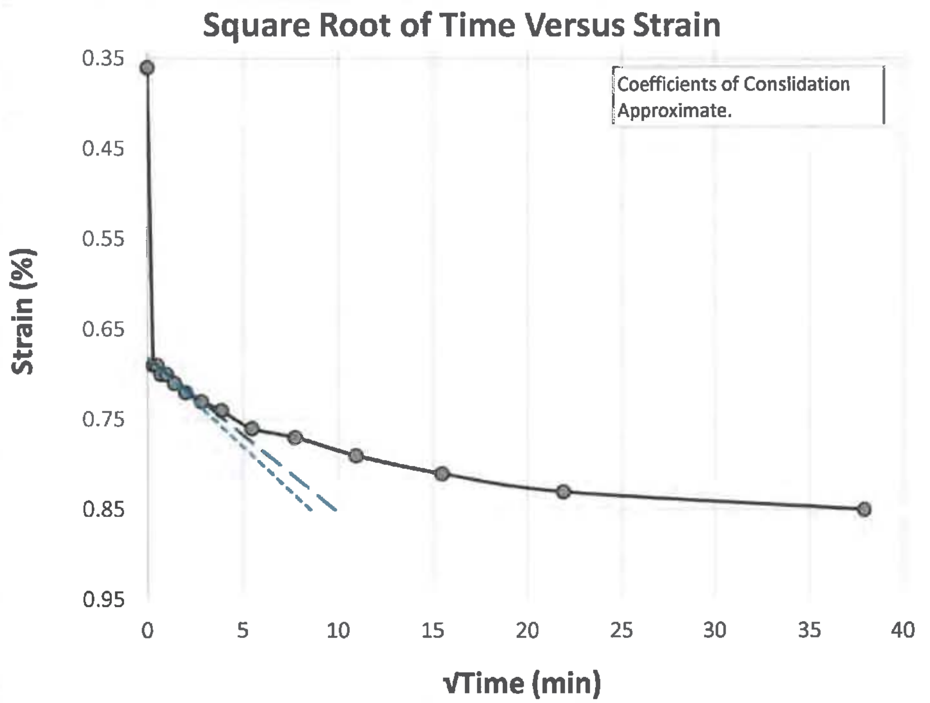
One-Dimensional Consolidation

ASTM D 2435

CLIENT	RJH Consultants	BORING NO.	B-103
JOB NO.	2679-130	DEPTH	27.5-29.9'
PROJECT	Hogchute Dam Safety Evaluatior	SAMPLE NO.	u-14
PROJECT NO.	18115	DATE SAMPLED	07/23/18
LOCATION	--	SAMPLED BY	--
DATE TESTED	10/22/18	DESCRIPTION	--
TECHNICIAN	AD		

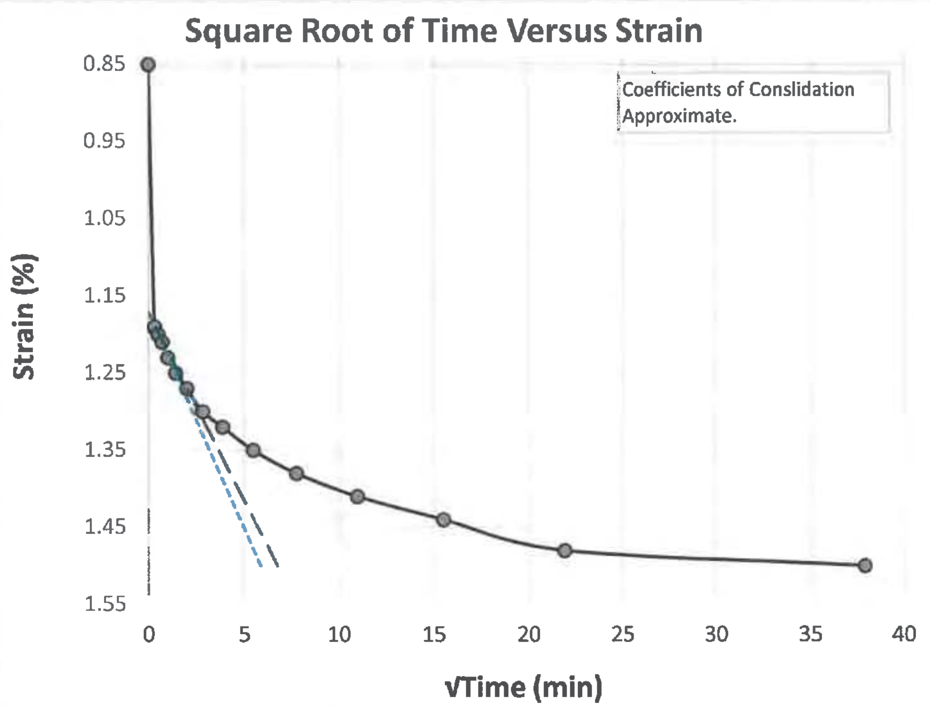
Coefficient of Consolidation (cm^2/s)	T90 (min)	Load (psf)
0.003	8.321	428

Ellapsed Time (min)	Deformation (in)	Strain (%)
0	-0.0045	0.36
0.1	-0.0078	0.69
0.25	-0.0078	0.69
0.5	-0.0079	0.70
1	-0.0079	0.70
2	-0.0080	0.71
4	-0.0081	0.72
8	-0.0082	0.73
15	-0.0083	0.74
30	-0.0085	0.76
60	-0.0086	0.77
120	-0.0088	0.79
240	-0.0090	0.81
480	-0.0092	0.83
1439	-0.0094	0.85



Coefficient of Consolidation (cm^2/s)	T90 (min)	Load (psf)
0.005	4.280	832

Ellapsed Time (min)	Deformation (in)	Strain (%)
0	-0.0094	0.85
0.1	-0.0128	1.19
0.25	-0.0129	1.20
0.5	-0.0130	1.21
1	-0.0132	1.23
2	-0.0134	1.25
4	-0.0136	1.27
8	-0.0139	1.30
15	-0.0141	1.32
30	-0.0144	1.35
60	-0.0147	1.38
120	-0.0150	1.41
240	-0.0153	1.44
480	-0.0157	1.48
1438	-0.0159	1.50



File name: 2679130__Consol ASTM D2435_1.xlsm

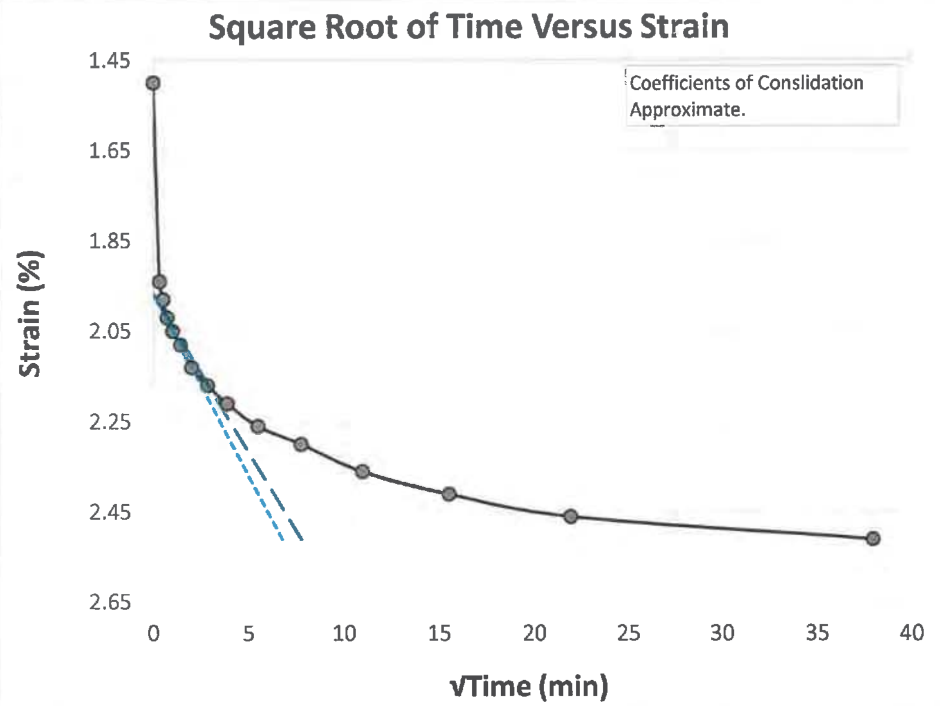
One-Dimensional Consolidation

ASTM D 2435

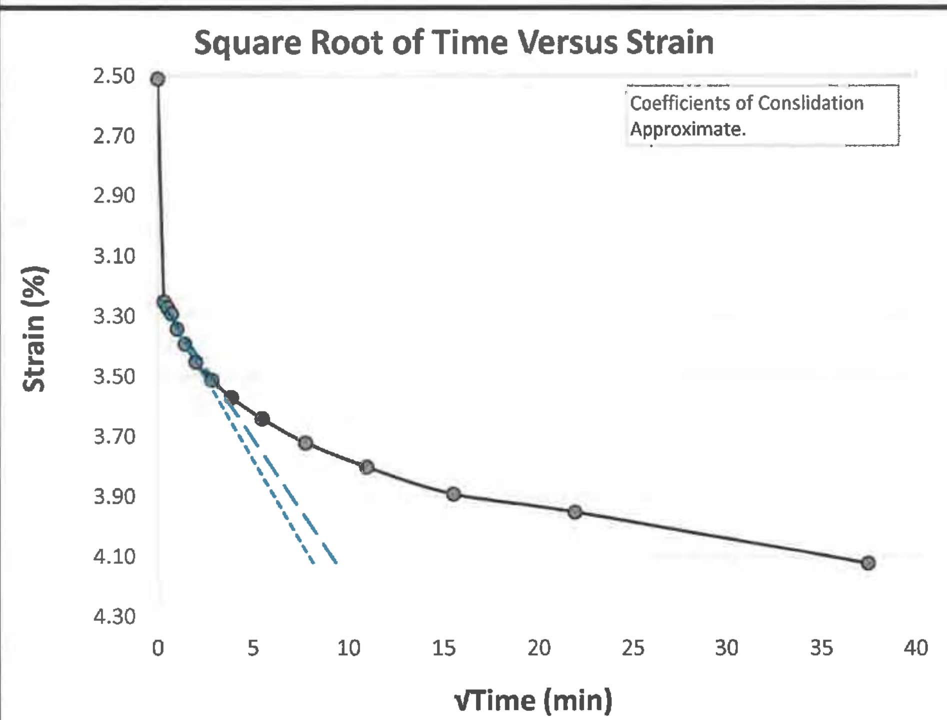
ADVANCED TERRA TESTING

CLIENT	RJH Consultants	BORING NO.	B-103
JOB NO.	2679-130	DEPTH	27.5-29.9'
PROJECT	Hogchute Dam Safety Evaluatior	SAMPLE NO.	u-14
PROJECT NO.	18115	DATE SAMPLED	07/23/18
LOCATION	--	SAMPLED BY	--
DATE TESTED	10/22/18	DESCRIPTION	--
TECHNICIAN	AD		

Coefficient of Consolidation (cm²/s)	T90 (min)	Load (psf)
0.003	8.720	1636
Ellapsed Time (min)	**Deformation (in)**	**Strain (%)**
0	-0.0159	1.50
0.1	-0.0203	1.94
0.25	-0.0207	1.98
0.5	-0.0211	2.02
1	-0.0214	2.05
2	-0.0217	2.08
4	-0.0222	2.13
8	-0.0226	2.17
15	-0.0230	2.21
30	-0.0235	2.26
60	-0.0239	2.30
120	-0.0245	2.36
240	-0.0250	2.41
480	-0.0255	2.46
1442	-0.0260	2.51



Coefficient of Consolidation (cm²/s)	T90 (min)	Load (psf)
0.002	9.319	3248
Ellapsed Time (min)	**Deformation (in)**	**Strain (%)**
0	-0.0260	2.51
0.1	-0.0334	3.25
0.25	-0.0336	3.27
0.5	-0.0338	3.29
1	-0.0343	3.34
2	-0.0348	3.39
4	-0.0354	3.45
8	-0.0360	3.51
15	-0.0366	3.57
30	-0.0373	3.64
60	-0.0381	3.72
120	-0.0389	3.80
240	-0.0398	3.89
480	-0.0404	3.95
1406	-0.0421	4.12



File name: 2679130__Consol ASTM D2435_0.xlsm

Consolidated Undrained Triaxial Compression ASTM D4767

Consolidated Undrained Triaxial Compression Test for Cohesive Soils
ASTM D 4767

Client	RJH Consultants	Boring Number:	B-103
Job Number	2679-130	Depth:	27.5-29.9'
Project	Hogchute Dam Safety Evaluation	Sample Number:	u-14 Pts A, B & C
Location	--	Sampled Date:	7/23/2018
Project Number	18115	Sampled By:	--

Tested By: SPH/CAL

TEST TYPE TX/CUPP

σ_3 Confining Stresses (psf)	
SAMPLE A	10000
SAMPLE B	6000
SAMPLE C	3000

Peak Points	p' (psf)	q (psf)
SAMPLE A	8852	5102
SAMPLE B	4720	2810
SAMPLE C	3584	2096

Stress Condition at Maximum Deviator Stress (PSF)				
	σ3	σ1	σ'3	σ'1
SAMPLE A	10000	20204	3750	13954
SAMPLE B	6000	11620	1910	7530
SAMPLE C	3000	7192	1488	5680

SAMPLE A DATA

σ_3' (psf)	σ_1' (psf)	Deviator Stress (σ_1-σ_3) (psf)	p' = (σ_1'+σ_3')/2 (psf)	q = (σ_1-σ_3)/2 (psf)
10000	10000	0	10000	0
9870	10502	632	10186	316
9640	10879	1239	10260	620
9078	11602	2524	10340	1262
8387	12029	3642	10208	1821
7710	12259	4549	9985	2275
7062	12282	5220	9672	2610
6486	12213	5727	9350	2864
5982	12075	6093	9029	3047
5550	11963	6413	8757	3207
5176	11790	6614	8483	3307
4874	11668	6794	8271	3397
3894	11161	7267	7528	3634
3448	10977	7529	7213	3765
3218	10957	7739	7088	3870
3102	11053	7951	7078	3976
3045	11363	8318	7204	4159
3074	11728	8654	7401	4327
3146	12171	9025	7659	4513
3232	12551	9319	7892	4660
3333	12897	9564	8115	4782
3419	13135	9716	8277	4858
3506	13367	9861	8437	4931
3578	13536	9958	8557	4979
3621	13692	10071	8657	5036
3693	13814	10121	8754	5061
3750	13954	10204	8852	5102
3808	14010	10202	8909	5101

SAMPLE B DATA

σ_3' (psf)	σ_1' (psf)	Deviator Stress (σ_1-σ_3) (psf)	p' = (σ_1'+σ_3')/2 (psf)	q = (σ_1-σ_3)/2 (psf)
6000	6000	0	6000	0
5942	6119	177	6031	89
5784	6259	475	6022	238
5237	6932	1695	6085	848
4618	7232	2614	5925	1307
4070	7260	3190	5665	1595
3638	7171	3533	5405	1767
3278	7061	3783	5170	1892
3005	6969	3964	4987	1982
2789	6864	4075	4827	2038
2616	6802	4186	4709	2093
2098	6583	4485	4341	2243
1882	6525	4643	4204	2322
1795	6574	4779	4185	2390
1752	6664	4912	4208	2456
1694	6802	5108	4248	2554
1723	7019	5296	4371	2648
1795	7231	5436	4513	2718
1838	7389	5551	4614	2776
1910	7530	5620	4720	2810
1954	7554	5600	4754	2800
1982	7458	5476	4720	2738
1968	7238	5270	4603	2635
1910	7018	5108	4464	2554
1882	6851	4969	4367	2485
1853	6684	4831	4269	2416
1781	6471	4690	4126	2345

SAMPLE C DATA

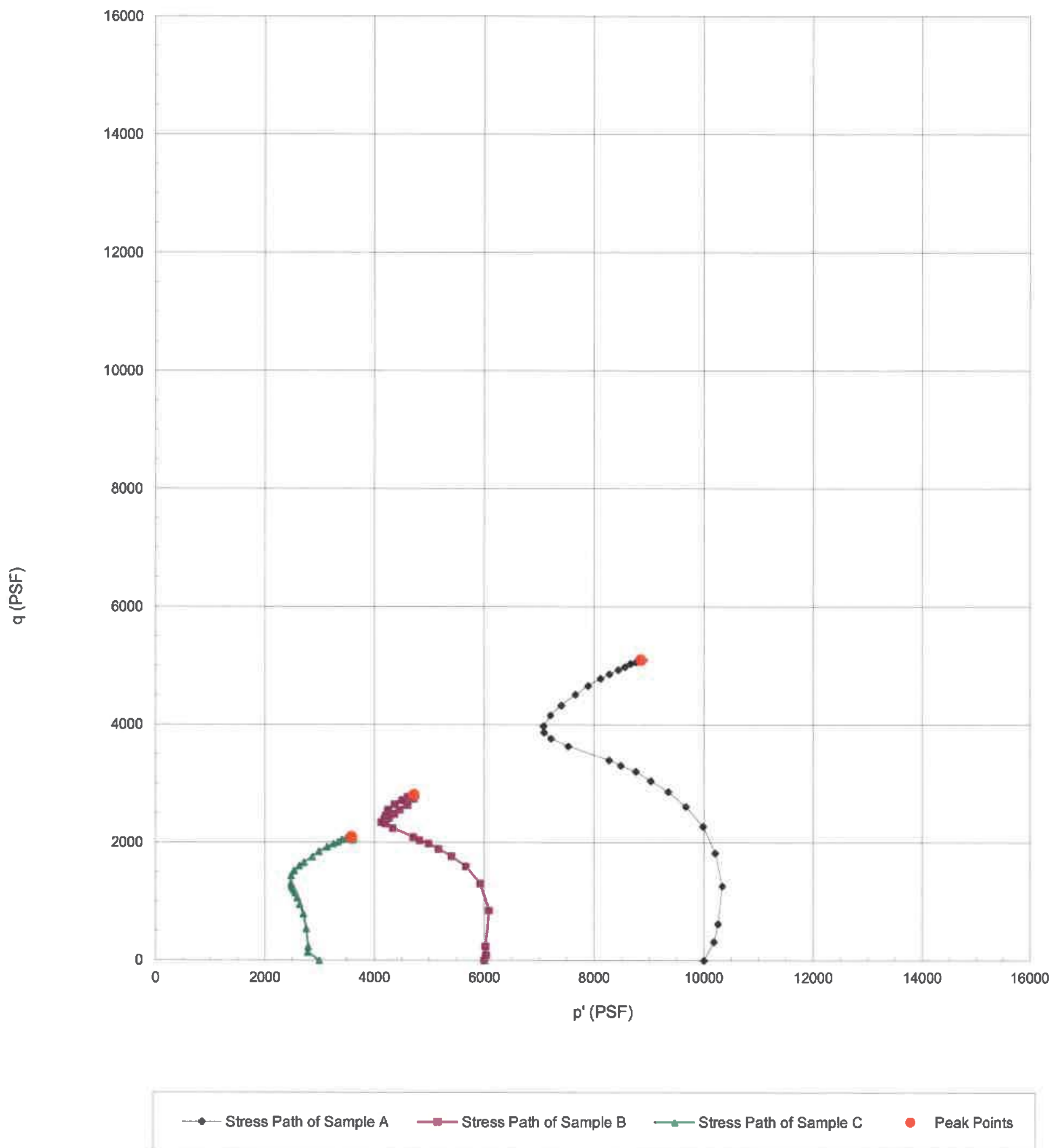
σ_3' (psf)	σ_1' (psf)	Deviator Stress (σ_1-σ_3) (psf)	p' = (σ_1'+σ_3')/2 (psf)	q = (σ_1-σ_3)/2 (psf)
3000	3000	0	3000	0
2654	2931	277	2793	139
2568	3028	460	2798	230
2222	3302	1080	2762	540
1920	3503	1583	2712	792
1690	3593	1903	2642	952
1531	3662	2131	2597	1066
1416	3705	2289	2561	1145
1330	3730	2400	2530	1200
1258	3747	2489	2503	1245
1214	3769	2555	2492	1278
1171	3792	2621	2482	1311
1042	3921	2879	2482	1440
1013	4058	3045	2536	1523
1027	4237	3210	2632	1605
1056	4383	3327	2720	1664
1114	4630	3516	2872	1758
1142	4841	3699	2992	1850
1214	5068	3854	3141	1927
1272	5235	3963	3254	1982
1330	5354	4024	3342	2012
1358	5465	4107	3412	2054
1416	5560	4144	3488	2072
1459	5618	4159	3539	2080
1488	5680	4192	3584	2096
1531	5715	4184	3623	2092
1546	5701	4155	3624	2078
1560	5647	4087	3604	2044

Data entry by: SPH
Date: 10/24/18
FileName: 2679_130_PQPlots-ASTM-D4767-withmetric-R2_0.xls

Data checked by: CK
Date: 10/25/18

Effective Stress Path Analysis - p' q Plots

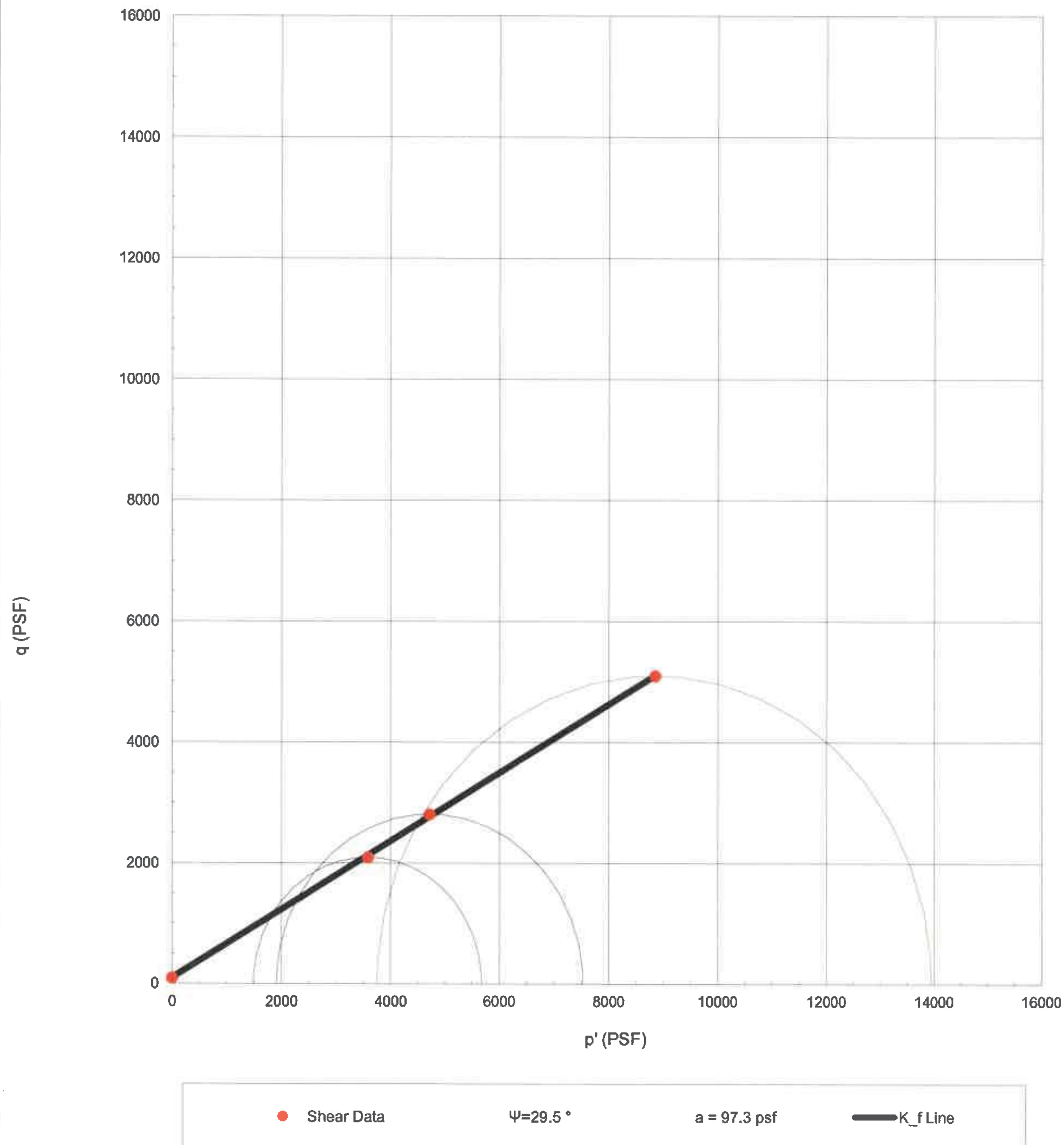
--,B-103,u-14 Pts A, B & C,27.5-29.9'



NOTE 1: The peak points shown in the plot represent maximum values of q [(σ1-σ3)/2].

Effective Stress Path Analysis - p'-q Regression Plot at Maximum q

--,B-103,u-14 Pts A, B & C,27.5-29.9'



NOTE 2: The line presented in the graph is the K_f line taken at Peak q values defined by the equation q=a+p' tan(Ψ) where a = the intercept on the q-axis in stress units and Ψ = the angle of the K_f line with respect to the horizontal in degrees.

NOTE 3: The K_f is NOT the Mohr-Coulomb failure envelope defined by the equation τ=c+σ tan(Φ). The equations sin(Φ)=tan(Ψ) and c=a/cos(Φ) may be used to approximate values for Φ and c at the effective stress condition described in NOTE 1.

ADVANCED TERRA TESTING

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS
ASTM D4767

CLIENT	RJH Consultants	JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation	Date Sampled	7/23/2018
PROJECT NO.	18115	Date Tested	10/19/2018
BORING NO.	B-103	CELL NUMBER	24S
DEPTH	27.5-29.9' (29.15-29.65)	SATURATED TEST	Yes
SAMPLE NO.	u-14 Pt. A	CONF. PRES. (psf)	10000
LOCATION	--		
SAMPLE TYPE	Shelby Tube		

MOISTURE/DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture (g)	1266.40	1226.21
Wt. Wet Soil & Pan (g)	1280.85	1240.66
Wt. Dry Soil & Pan (g)	1017.19	1017.19
Wt. Lost Moisture (g)	263.66	223.47
Wt. of Pan Only (g)	14.45	14.45
Wt. of Dry Soil (g)	1002.74	1002.74
Moisture Content %	26.3	22.3
Wet Density (pcf)	127.3	133.3
Dry Density (pcf)	100.8	109.0
Init. Diameter (in)	2.872	
Init. Area (sq in)	6.478	
Init. Height (in)	5.852	
Vol. Bef. Consol. (cu ft)	0.02194	
Vol. After Consol. (cu ft)	0.02028	

Notes & Comments: Did not use slotted filter paper drains due to permeability test prior to shear.

Data entry by: SPH Date: 10/23/2018 Technician CAL

Data checked by: CAL Date: 10/23/18

FileName: 2679_130_TX_CUpp_ASTMD_4767_R0_1.xls

ADVANCED TERRA TESTING

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS
ASTM D4767

CLIENT	RJH Consultants	JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation	Date Sampled	7/23/2018
PROJECT NO.	18115	Date Tested	10/19/2018
BORING NO.	B-103	CELL NUMBER	24S
DEPTH	27.5-29.9' (29.15-29.65)	SATURATED TEST	Yes
SAMPLE NO.	u-14 Pt. A	CONF. PRES. (psf)	10000
LOCATION	--		
SAMPLE TYPE	Shelby Tube		

SATURATION DATA

Cell Pressure (psi)	Back Pressure (psi)	Burette Reading (cc) Close	Burette Reading (cc) Open	Pore Pressure (psi) Close	Pore Pressure (psi) Open	Change	B
40.0	38.0	3.2	19.3				
50.0		20.0	20.3	38.7	48.4	9.7	0.97

CONSOLIDATION DATA

Elapsed Time (min)	SQRT TIME (min)	Burette Reading (cc)	Volume Deflection (cc)
0.00	0.0	0.80	0.00
0.25	0.5	34.60	-33.80
0.5	0.7	36.70	-35.90
1	1.0	37.80	-37.00
2	1.4	38.60	-37.80
4	2.0	39.30	-38.50
9	3.0	40.10	-39.30
16	4.0	40.80	-40.00
30	5.5	41.50	-40.70
88	9.4	42.70	-41.90
120	11.0	43.10	-42.30
240	15.5	43.90	-43.10
360	19.0	44.30	-43.50
1450	38.1	45.90	-45.10

Initial Height (in)	5.852	Initial Vol. (cc)	621.358
Height Change (in)	0.151	Vol. Change (cc)	62.800
Ht. After Cons. (in)	5.701	Cell Exp. (cc)	15.703
Initial Area (sq in)	6.478	Net Change (cc)	47.097
Area After Cons. (sq in)	6.146	Cons. Vol. (cc)	574.261

ADVANCED TERRA TESTING

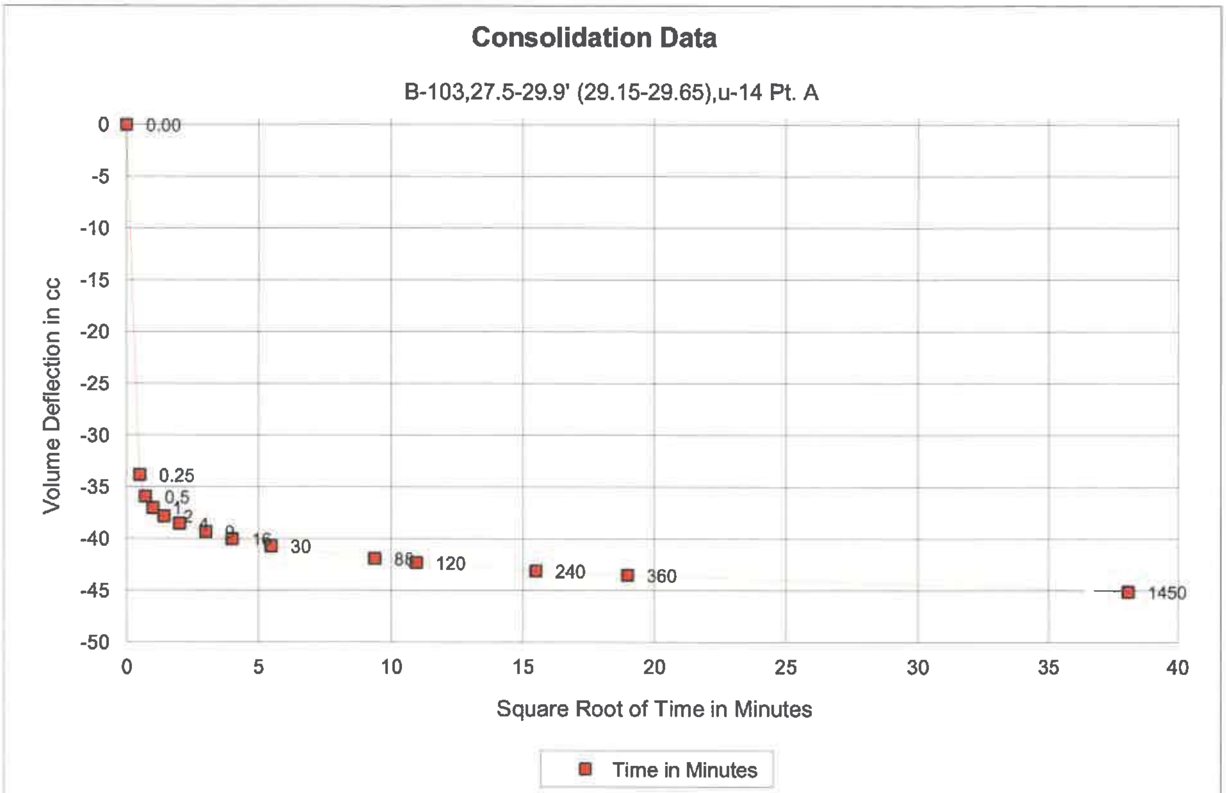
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS
ASTM D 4767

CLIENT	RJH Consultants	JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation	Date Sampled	7/23/2018
PROJECT NO.	18115	Date Tested	10/19/2018
BORING NO.	B-103	CELL NUMBER	24S
DEPTH	27.5-29.9' (29.15-29.65)	SATURATED TEST	Yes
SAMPLE NO.	u-14 Pt. A	CONF. PRES. (psf)	10000
LOCATION	--		
SAMPLE TYPE	Shelby Tube		

Init. Ht. (in)	5.852	Init. Area (sq in)	6.478
Consol. Ht. (in)	5.701	Consol. Area (sq in)	6.146
Back Pres. (psi)	38.3	Strain Rate (in/min)	0.0027

Axial Load (lbs.)	Axial Load (psf)	Delta Ht. (in)	Axial Strain (%)	Area Final (sq in)	Dev. Stress (psf)	Pore Pres. (psi)	Delta Pres. (psf)	Sigma 3' (psf)	Sigma 1' (psf)	Prin. Stress Ratio
0.0	0	0.000	0.00	6.146	0	38.3	0	10000	10000	1.00
27	633	0.005	0.09	6.151	632	39.2	130	9870	10502	1.06
53	1242	0.011	0.19	6.158	1239	40.8	360	9640	10879	1.13
108	2531	0.015	0.26	6.162	2524	44.7	922	9078	11602	1.28
156	3655	0.021	0.37	6.169	3642	49.5	1613	8387	12029	1.43
195	4569	0.026	0.46	6.174	4548	54.2	2290	7710	12259	1.59
224	5248	0.031	0.54	6.179	5220	58.7	2938	7062	12282	1.74
246	5764	0.037	0.65	6.186	5727	62.7	3514	6486	12213	1.88
262	6139	0.043	0.75	6.193	6093	66.2	4018	5982	12075	2.02
276	6467	0.048	0.84	6.198	6412	69.2	4450	5550	11963	2.16
285	6678	0.054	0.95	6.205	6614	71.8	4824	5176	11790	2.28
293	6865	0.059	1.03	6.210	6794	73.9	5126	4874	11668	2.39
315	7381	0.088	1.54	6.242	7267	80.7	6106	3894	11161	2.87
328	7685	0.116	2.03	6.273	7529	83.8	6552	3448	10977	3.18
339	7943	0.146	2.56	6.307	7740	85.4	6782	3218	10957	3.41
350	8201	0.174	3.05	6.339	7950	86.2	6898	3102	11053	3.56
370	8669	0.231	4.05	6.405	8318	86.6	6955	3045	11363	3.73
389	9114	0.288	5.05	6.473	8654	86.4	6926	3074	11728	3.82
410	9607	0.345	6.05	6.542	9025	85.9	6854	3146	12171	3.87
428	10028	0.403	7.07	6.613	9319	85.3	6768	3232	12551	3.88
444	10403	0.460	8.07	6.685	9564	84.6	6667	3333	12897	3.87
456	10684	0.517	9.07	6.759	9715	84.0	6581	3419	13135	3.84
468	10966	0.574	10.07	6.834	9861	83.4	6494	3506	13367	3.81
478	11200	0.632	11.09	6.912	9958	82.9	6422	3578	13536	3.78
489	11458	0.690	12.10	6.992	10071	82.6	6379	3621	13692	3.78
497	11645	0.746	13.09	7.071	10121	82.1	6307	3693	13814	3.74
507	11879	0.804	14.10	7.155	10204	81.7	6250	3750	13954	3.72
513	12020	0.862	15.12	7.241	10202	81.3	6192	3808	14010	3.68

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
FOR COHESIVE SOILS
ASTM D4767



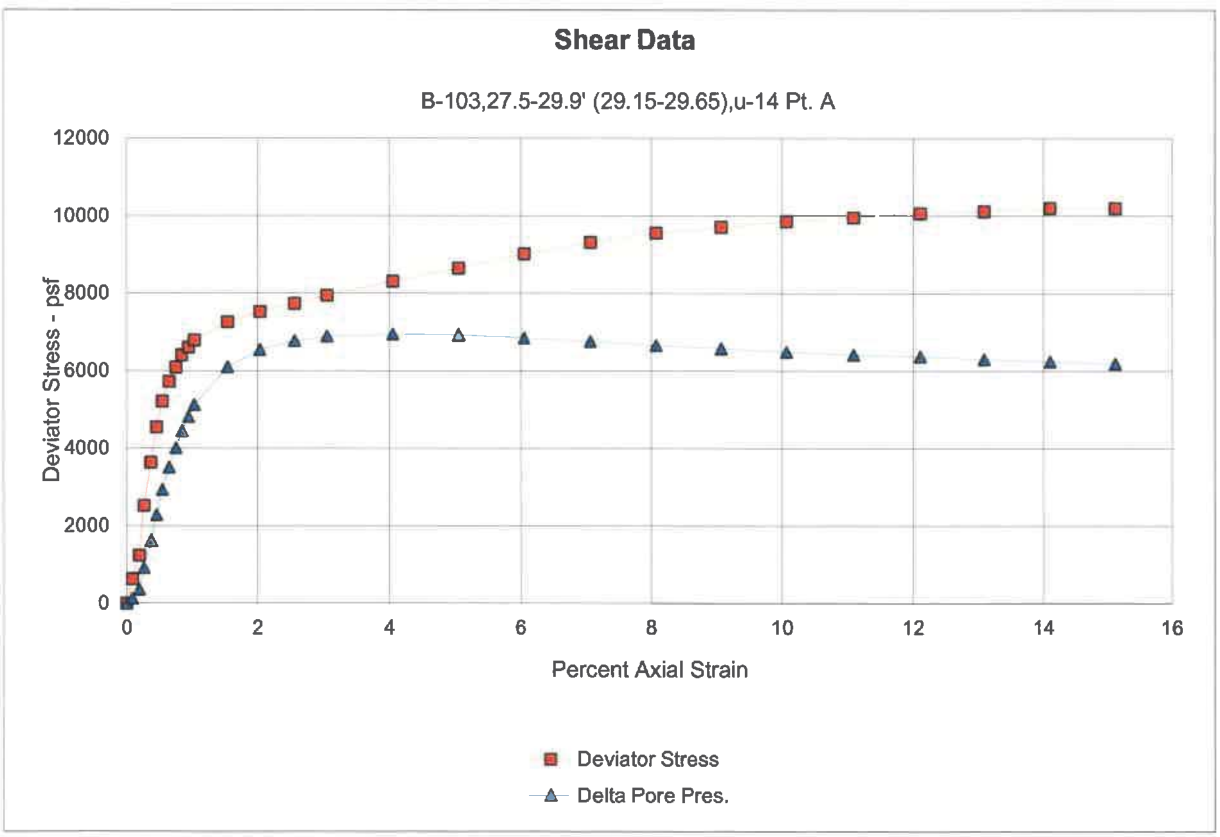
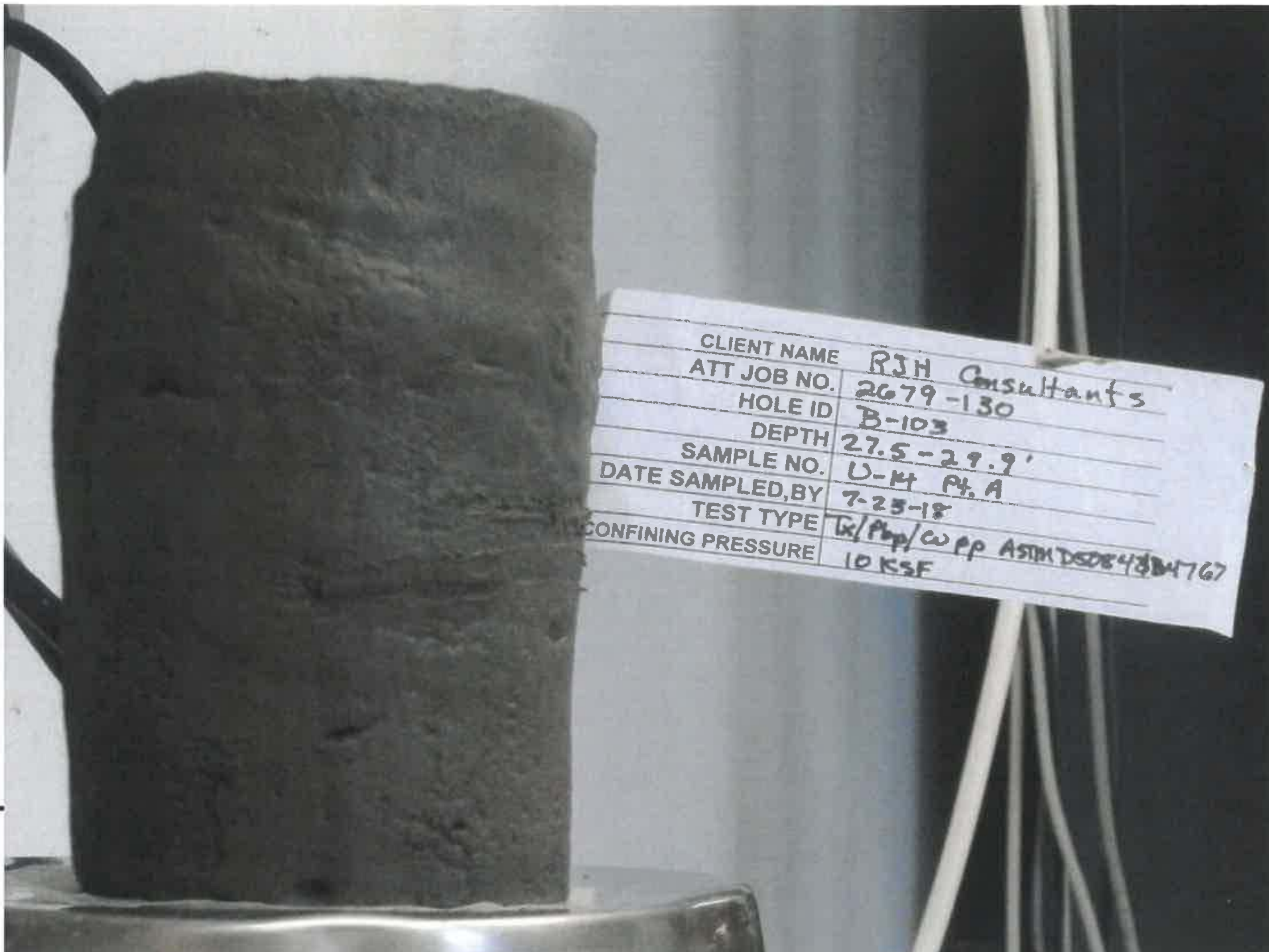


Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants
JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation
PROJECT NO.	18115
LOCATION	--



File name: 2679130__Image_18_10_22_06_53_56

ATT
ADVANCED TERRA TESTING

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS
ASTM D4767

CLIENT	RJH Consultants	JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation	Date Sampled	7/23/2018
PROJECT NO.	18115	Date Tested	10/22/2018
BORING NO.	B-103	CELL NUMBER	18S
DEPTH	27.5-29.9' (28.65-29.15')	SATURATED TEST	Yes
SAMPLE NO.	u-14 Pt. B	CONF. PRES. (psf)	6000
LOCATION	--		
SAMPLE TYPE	Shelby Tube		

MOISTURE/DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture (g)	1281.53	1261.98
Wt. Wet Soil & Pan (g)	1295.34	1275.79
Wt. Dry Soil & Pan (g)	1037.24	1037.24
Wt. Lost Moisture (g)	258.10	238.55
Wt. of Pan Only (g)	13.81	13.81
Wt. of Dry Soil (g)	1023.43	1023.43
Moisture Content %	25.2	23.3
Wet Density (pcf)	126.4	132.4
Dry Density (pcf)	101.0	107.3
Init. Diameter (in)	2.869	
Init. Area (sq in)	6.465	
Init. Height (in)	5.973	
Vol. Bef. Consol. (cu ft)	0.02235	
Vol. After Consol. (cu ft)	0.02102	

Notes & Comments: Did not use slotted filter paper drains due to permeability test prior to shear.

Data entry by: CAL Date: 10/24/2018 Technician CAL
Data checked by: SPH Date: 10-24-18
FileName: 2679_130_TX_CUpp_ASTMD_4767_R0_2.xls

ADVANCED TERRA TESTING

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS
ASTM D4767

CLIENT	RJH Consultants	JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation	Date Sampled	7/23/2018
PROJECT NO.	18115	Date Tested	10/22/2018
BORING NO.	B-103	CELL NUMBER	18S
DEPTH	27.5-29.9' (28.65-29.15')	SATURATED TEST	Yes
SAMPLE NO.	u-14 Pt. B	CONF. PRES. (psf)	6000
LOCATION	--		
SAMPLE TYPE	Shelby Tube		

SATURATION DATA

Cell Pressure (psi)	Back Pressure (psi)	Burette Reading (cc)		Pore Pressure (psi)		Change	B
		Close	Open	Close	Open		
40.0	38.0	4.0	18.3				
50.0	48.0	19.3	20.1	38.4	47.8	9.4	0.94
60.0		20.4	20.5	48.5	58.0	9.5	0.95

CONSOLIDATION DATA

Elapsed Time (min)	SQRT TIME (min)	Burette Reading (cc)	Volume Deflection (cc)
0.00	0.0	0.30	0.00
0.25	0.5	24.30	-24.00
0.5	0.7	25.40	-25.10
1	1.0	26.10	-25.80
2	1.4	26.60	-26.30
4	2.0	27.20	-26.90
9	3.0	27.80	-27.50
16	4.0	28.30	-28.00
30	5.5	28.90	-28.60
60	7.7	29.50	-29.20
120	11.0	30.10	-29.80
240	15.5	30.80	-30.50
360	19.0	31.10	-30.80
1440	37.9	32.20	-31.90

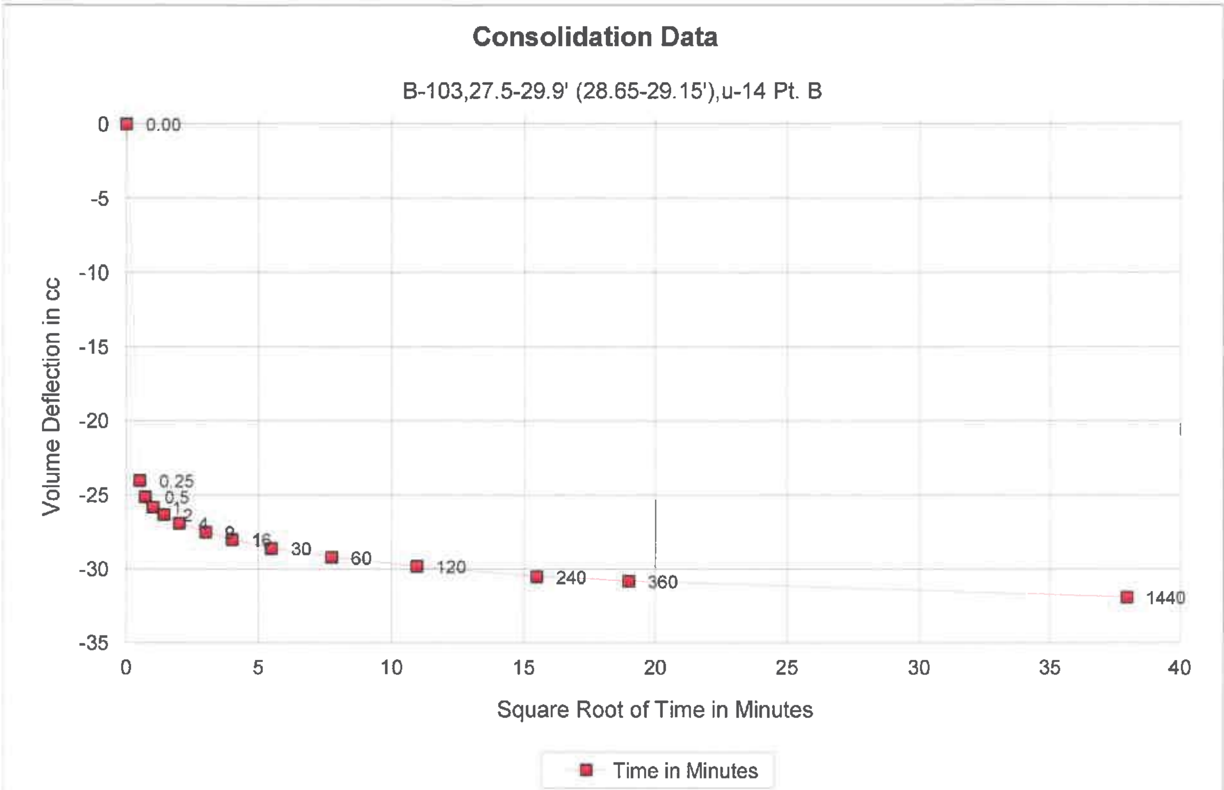
Initial Height (in)	5.973	Initial Vol. (cc)	632.882
Height Change (in)	0.116	Vol. Change (cc)	49.500
Ht. After Cons. (in)	5.857	Cell Exp. (cc)	11.962
Initial Area (sq in)	6.465	Net Change (cc)	37.538
Area After Cons. (sq in)	6.202	Cons. Vol. (cc)	595.343

ADVANCED TERRA TESTING

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS
ASTM D 4767

CLIENT	RJH Consultants	JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation	Date Sampled	7/23/2018
PROJECT NO.	18115	Date Tested	10/22/2018
BORING NO.	B-103	CELL NUMBER	18S
DEPTH	27.5-29.9' (28.65-29.15')	SATURATED TEST	Yes
SAMPLE NO.	u-14 Pt. B	CONF. PRES. (psf)	6000
LOCATION	--		
SAMPLE TYPE	Shelby Tube		
Init. Ht. (in)	5.973	Init. Area (sq in)	6.465
Consol. Ht. (in)	5.857	Consol. Area (sq in)	6.202
Back Pres. (psi)	48.3	Strain Rate (in/min)	0.0023

Axial Load (lbs.)	Axial Load (psf)	Delta Ht. (in)	Axial Strain (%)	Area Final (sq in)	Dev. Stress (psf)	Pore Pres. (psi)	Delta Pres. (psf)	Sigma 3' (psf)	Sigma 1' (psf)	Prin. Stress Ratio
0.0	0	0.000	0.00	6.202	0	48.3	0	6000	6000	1.00
7.6	176	0.005	0.09	6.207	176	48.7	58	5942	6119	1.03
20.5	476	0.010	0.17	6.212	475	49.8	216	5784	6259	1.08
73.2	1700	0.016	0.27	6.219	1695	53.6	763	5237	6932	1.32
113	2624	0.021	0.36	6.224	2614	57.9	1382	4618	7232	1.57
138	3204	0.027	0.46	6.230	3189	61.7	1930	4070	7260	1.78
153	3553	0.033	0.56	6.237	3533	64.7	2362	3638	7171	1.97
164	3808	0.039	0.67	6.243	3783	67.2	2722	3278	7061	2.15
172	3994	0.044	0.75	6.249	3964	69.1	2995	3005	6969	2.32
177	4110	0.050	0.85	6.255	4075	70.6	3211	2789	6864	2.46
182	4226	0.056	0.96	6.262	4186	71.8	3384	2616	6802	2.60
196	4551	0.085	1.45	6.293	4485	75.4	3902	2098	6583	3.14
204	4737	0.115	1.96	6.326	4644	76.9	4118	1882	6525	3.47
211	4899	0.144	2.46	6.358	4779	77.5	4205	1795	6574	3.66
218	5062	0.173	2.95	6.390	4912	77.8	4248	1752	6664	3.80
229	5317	0.231	3.94	6.456	5108	78.2	4306	1694	6802	4.01
240	5573	0.291	4.97	6.526	5296	78.0	4277	1723	7019	4.07
249	5782	0.350	5.98	6.596	5436	77.5	4205	1795	7231	4.03
257	5967	0.409	6.98	6.667	5551	77.2	4162	1838	7389	4.02
263	6107	0.467	7.97	6.739	5620	76.7	4090	1910	7530	3.94
265	6153	0.526	8.98	6.814	5601	76.4	4046	1954	7554	3.87
262	6083	0.585	9.99	6.890	5476	76.2	4018	1982	7458	3.76
255	5921	0.644	11.00	6.968	5270	76.3	4032	1968	7238	3.68
250	5805	0.703	12.00	7.048	5108	76.7	4090	1910	7018	3.67
246	5712	0.761	12.99	7.128	4970	76.9	4118	1882	6851	3.64
242	5619	0.821	14.02	7.213	4831	77.1	4147	1853	6684	3.61
238	5526	0.886	15.13	7.307	4690	77.6	4219	1781	6471	3.63


Consolidation Data
B-103,27.5-29.9' (28.65-29.15'),u-14 Pt. B
Volume Deflection in cc
Square Root of Time in Minutes
0.00
0.25
0.5
1
2
4
8
16
30
60
120
240
360
1440
0
-5
-10
-15
-20
-25
-30
-35
0
5
10
15
20
25
30
35
40
Time in Minutes

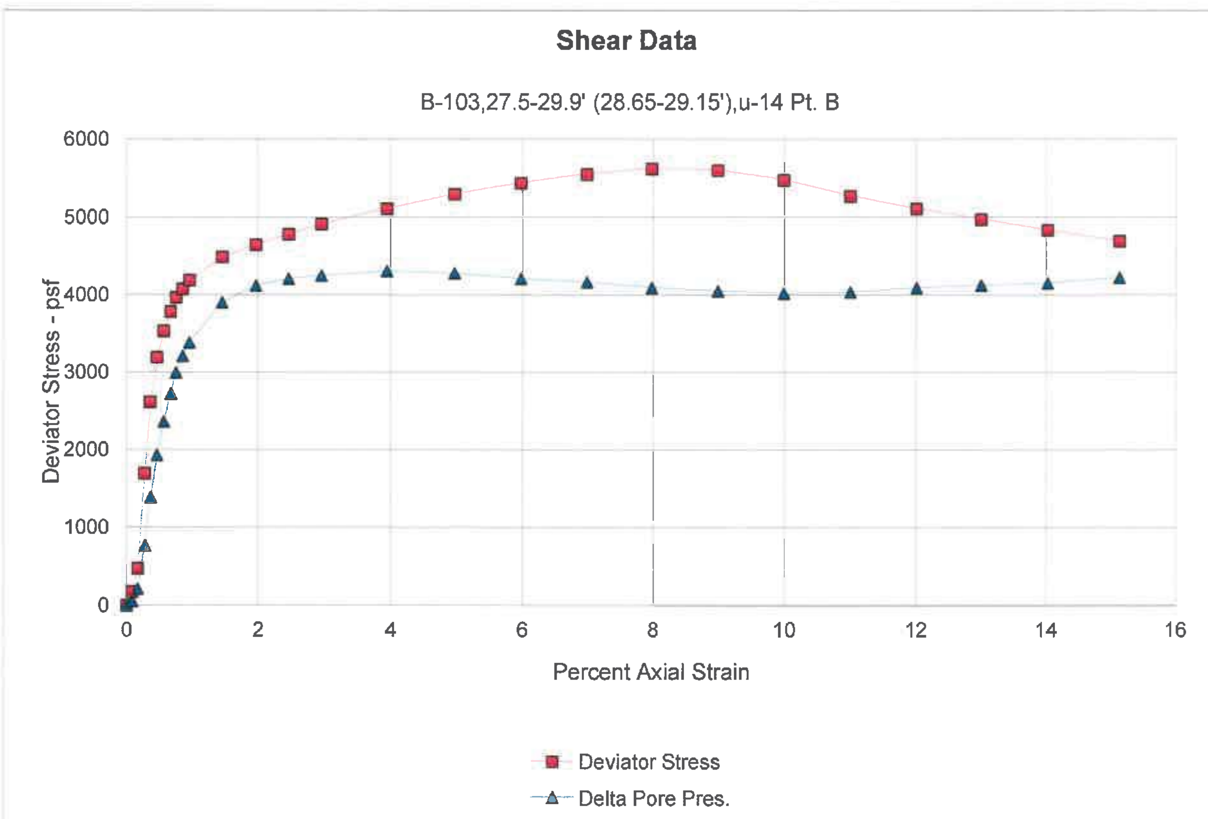
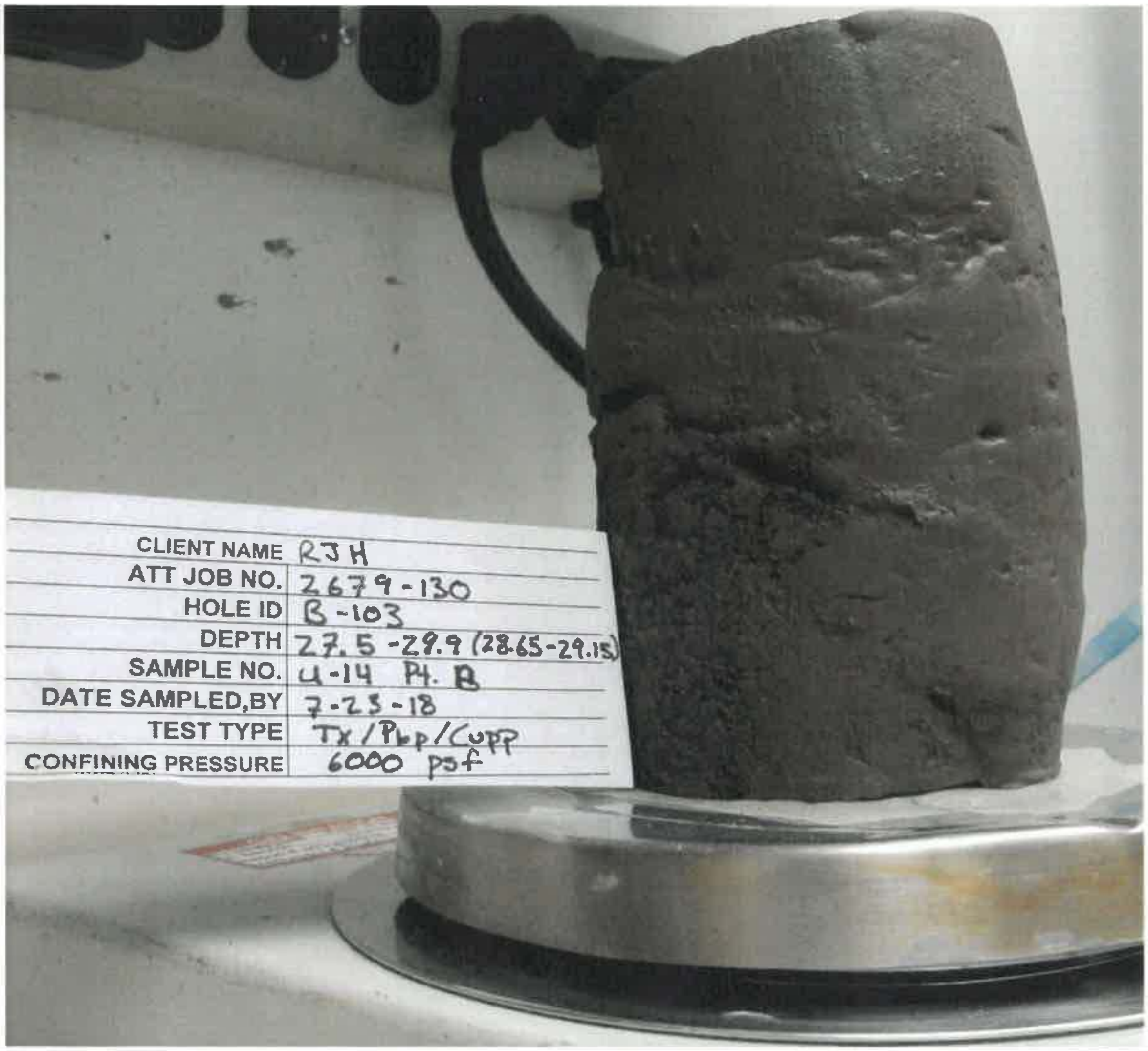

Shear Data
B-103,27.5-29.9' (28.65-29.15'),u-14 Pt. B
Deviator Stress - psf
Percent Axial Strain
6000
5000
4000
3000
2000
1000
0
0
2
4
6
8
10
12
14
16
Deviator Stress
Delta Pore Pres.

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants
JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation
PROJECT NO.	18115
LOCATION	--



NOTES

File name: 2679130__Image_18_10_24_07_21_35

ADVANCED TERRA TESTING

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS
ASTM D4767

CLIENT	RJH Consultants	JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation	Date Sampled	7/23/2018
PROJECT NO.	18115	Date Tested	10/22/2018
BORING NO.	B-103	CELL NUMBER	16S
DEPTH	28.15-28.65'	SATURATED TEST	Yes
SAMPLE NO.	u-14 Pt. C	CONF. PRES. (psf)	3000
LOCATION	--		
SAMPLE TYPE	Shelby Tube		

MOISTURE/DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture (g)	1321.10	1316.30
Wt. Wet Soil & Pan (g)	1335.31	1330.51
Wt. Dry Soil & Pan (g)	1081.21	1081.21
Wt. Lost Moisture (g)	254.10	249.30
Wt. of Pan Only (g)	14.21	14.21
Wt. of Dry Soil (g)	1067.00	1067.00
Moisture Content %	23.8	23.4
Wet Density (pcf)	127.5	132.5
Dry Density (pcf)	103.0	107.4
Init. Diameter (in)	2.868	
Init. Area (sq in)	6.460	
Init. Height (in)	6.109	
Vol. Bef. Consol. (cu ft)	0.02284	
Vol. After Consol. (cu ft)	0.02191	

Notes & Comments: Did not use slotted filter paper drains due to permeability test prior to shear.

Data entry by: SPH Date: 10/23/2018 Technician CAL
Data checked by: CAL Date: 10/23/2018
FileName: 2679_130_TX_CUpp_ASTMD_4767_R0_0.xls

ADVANCED TERRA TESTING

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS
ASTM D4767

CLIENT	RJH Consultants	JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation	Date Sampled	7/23/2018
PROJECT NO.	18115	Date Tested	10/22/2018
BORING NO.	B-103	CELL NUMBER	16S
DEPTH	28.15-28.65'	SATURATED TEST	Yes
SAMPLE NO.	u-14 Pt. C	CONF. PRES. (psf)	3000
LOCATION	--		
SAMPLE TYPE	Shelby Tube		

SATURATION DATA

Cell Pressure (psi)	Back Pressure (psi)	Burette Reading (cc) Close	Burette Reading (cc) Open	Pore Pressure (psi) Close	Pore Pressure (psi) Open	Change	B
40.0	38.0	4.0	19.8				
50.0	48.0	20.6	21.6	38.9	48.2	9.3	0.93
60.0		21.9	22.0	48.7	58.3	9.6	0.96

CONSOLIDATION DATA

Elapsed Time (min)	SQRT TIME (min)	Burette Reading (cc)	Volume Deflection (cc)
0.00	0.0	0.50	0.00
0.25	0.5	12.45	-11.95
0.5	0.7	13.70	-13.20
1	1.0	14.80	-14.30
2	1.4	15.40	-14.90
4	2.0	15.90	-15.40
9	3.0	16.25	-15.75
16	4.0	16.65	-16.15
30	5.5	17.00	-16.50
60	7.7	17.50	-17.00
120	11.0	17.90	-17.40
240	15.5	18.30	-17.80
360	19.0	18.50	-18.00
1440	37.9	19.30	-18.80

Initial Height (in)	6.109	Initial Vol. (cc)	646.841
Height Change (in)	0.054	Vol. Change (cc)	37.800
Ht. After Cons. (in)	6.055	Cell Exp. (cc)	11.361
Initial Area (sq in)	6.460	Net Change (cc)	26.439
Area After Cons. (sq in)	6.252	Cons. Vol. (cc)	620.401

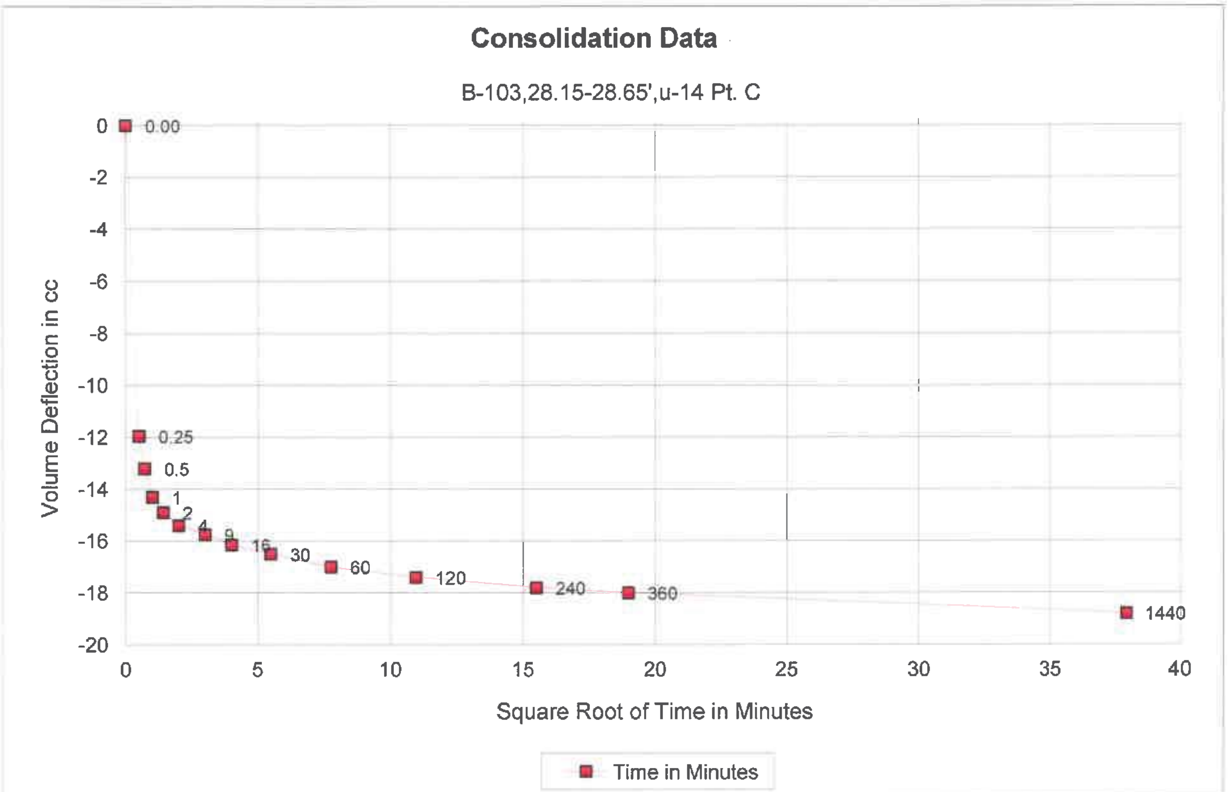
ADVANCED TERRA TESTING

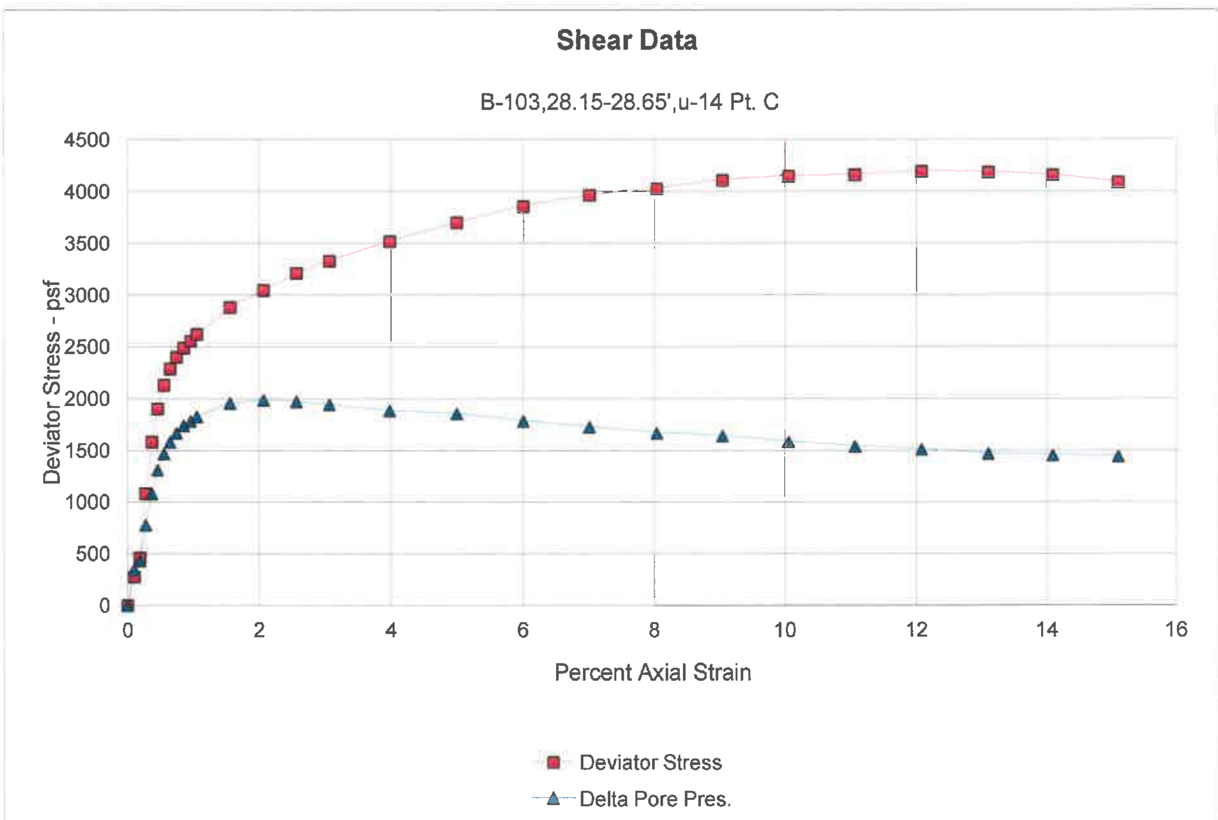
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST FOR COHESIVE SOILS
ASTM D 4767

CLIENT	RJH Consultants	JOB NO.	2679-130
PROJECT	Hogchute Dam Safety Evaluation	Date Sampled	7/23/2018
PROJECT NO.	18115	Date Tested	10/22/2018
BORING NO.	B-103	CELL NUMBER	16S
DEPTH	28.15-28.65'	SATURATED TEST	Yes
SAMPLE NO.	u-14 Pt. C	CONF. PRES. (psf)	3000
LOCATION	--		
SAMPLE TYPE	Shelby Tube		

Init. Ht. (in)	6.109	Init. Area (sq in)	6.460
Consol. Ht. (in)	6.055	Consol. Area (sq in)	6.252
Back Pres. (psi)	48.3	Strain Rate (in/min)	0.0036

Axial Load (lbs.)	Axial Load (psf)	Delta Ht. (in)	Axial Strain (%)	Area Final (sq in)	Dev. Stress (psf)	Pore Pres. (psi)	Delta Pres. (psf)	Sigma 3' (psf)	Sigma 1' (psf)	Prin. Stress Ratio
0.0	0	0.000	0.00	6.252	0	48.3	0	3000	3000	1.00
12	276	0.006	0.10	6.258	276	50.7	346	2654	2931	1.10
20	461	0.011	0.19	6.263	460	51.3	432	2568	3028	1.18
47	1083	0.017	0.27	6.269	1080	53.7	778	2222	3302	1.49
69	1589	0.022	0.37	6.275	1583	55.8	1080	1920	3503	1.82
83	1912	0.028	0.45	6.280	1903	57.4	1310	1690	3593	2.13
93	2142	0.033	0.55	6.286	2130	58.5	1469	1531	3662	2.39
100	2303	0.039	0.64	6.292	2289	59.3	1584	1416	3705	2.62
105	2419	0.045	0.74	6.299	2401	59.9	1670	1330	3730	2.81
109	2511	0.052	0.85	6.305	2489	60.4	1742	1258	3747	2.98
112	2580	0.058	0.96	6.312	2555	60.7	1786	1214	3769	3.10
115	2649	0.064	1.05	6.318	2621	61.0	1829	1171	3792	3.24
127	2925	0.094	1.56	6.351	2880	61.9	1958	1042	3921	3.76
135	3110	0.125	2.06	6.384	3045	62.1	1987	1013	4058	4.01
143	3294	0.155	2.56	6.416	3209	62.0	1973	1027	4237	4.12
149	3432	0.186	3.07	6.449	3327	61.8	1944	1056	4383	4.15
159	3662	0.241	3.98	6.511	3517	61.4	1886	1114	4630	4.16
169	3893	0.302	4.99	6.580	3698	61.2	1858	1142	4841	4.24
178	4100	0.364	6.00	6.651	3854	60.7	1786	1214	5068	4.17
185	4261	0.424	7.01	6.723	3963	60.3	1728	1272	5235	4.12
190	4376	0.487	8.04	6.798	4025	59.9	1670	1330	5354	4.03
196	4515	0.547	9.04	6.873	4107	59.7	1642	1358	5465	4.02
200	4607	0.609	10.05	6.950	4144	59.3	1584	1416	5560	3.93
203	4676	0.670	11.06	7.029	4158	59.0	1541	1459	5618	3.85
207	4768	0.731	12.07	7.110	4192	58.8	1512	1488	5680	3.82
209	4814	0.793	13.10	7.194	4183	58.5	1469	1531	5715	3.73
210	4837	0.853	14.09	7.277	4156	58.4	1454	1546	5701	3.69
209	4814	0.915	15.11	7.364	4087	58.3	1440	1560	5647	3.62


Consolidation Data
B-103,28.15-28.65',u-14 Pt. C
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
Volume Deflection in cc
0.00
0.25
0.5
1
2
4
9
16
30
60
120
240
360
1440
0
5
10
15
20
25
30
35
40
Square Root of Time in Minutes
Time in Minutes


Shear Data
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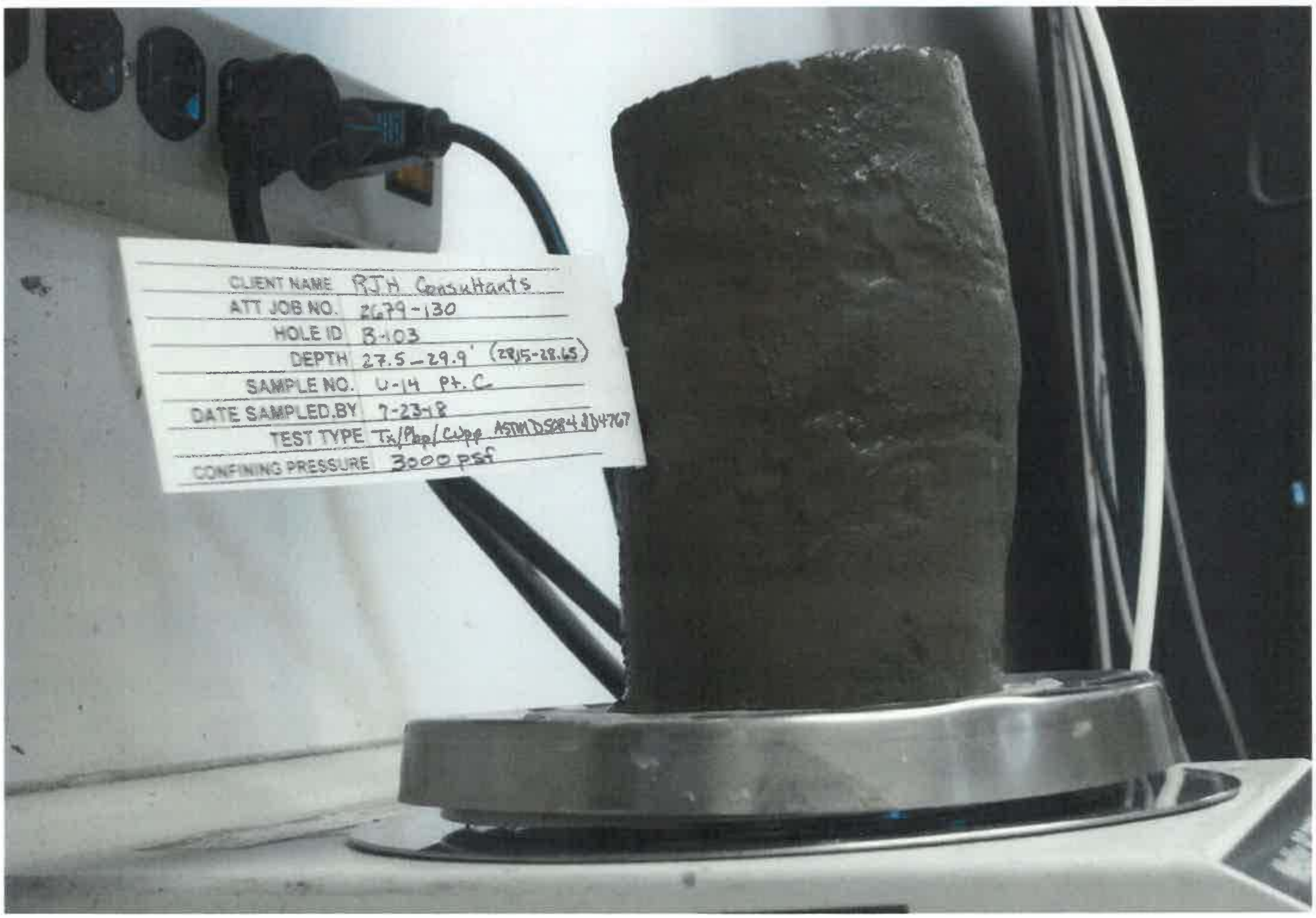
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Deviator Stress - psf
0
2
4
6
8
10
12
14
16
Percent Axial Strain
Deviator Stress
Delta Pore Pres.

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	--
JOB NO.	2679-130	--
PROJECT	Hogchute Dam Safety Evaluation	--
PROJECT NO.	18115	--
LOCATION	--	--



NOTES	

File name: 2679130__Image_18_10_23_07_17_37

Permeability Test
Flow Pump
ASTM D5084, Method D

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	RJH Consultants	JOB NO.	2679-130

PROJECT	Hogchute Dam Safety Evaluation			
PROJECT NO.	18115	SAMPLED	7/23/2018	By: --
BORING NO.	B-103	TEST STARTED	10/16/2018	By: CAL
DEPTH	27.5-29.9' (29.15-29.65)	TEST FINISHED	10/19/2018	By: CAL
SAMPLE NO.	u-14 Pt. A	CELL NUMBER	24S	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Shelby Tube	CONF. PRES. - (psf)	10000	

MOISTURE / DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture - (g)	1266.40	1226.21
Wt. Wet Soil & Pan - (g)	1280.85	1240.66
Wt. Dry Soil & Pan - (g)	1017.19	1017.19
Wt. Lost Moisture - (g)	263.66	223.47
Wt. of Pan Only - (g)	14.45	14.45
Wt. of Dry Soil - (g)	1002.74	1002.74
Moisture Content - (%)	26.3	22.3
Wet Density - (pcf)	127.3	133.3
Dry Density - (pcf)	100.8	109.0
Init. Diameter - (in)	2.872	
Init. Area - (sq in)	6.478	
Init. Height - (in)	5.852	
Vol. Bef. Consol. - (cu ft)	0.02194	
Vol. After Consol. - (cu ft)	0.02028	
Porosity - (%)	38.91	

FLOW PUMP CALCULATIONS	
Pump Setting (gear number)	7
Percentage of Pump Setting	100
Q - (cc/s)	3.54E-04
Height - (in)	5.701
Diameter - (in)	2.797
Pressure - (psi)	0.107
Area after consol. - (sq cm)	39.650
Gradient	0.520
Permeability k - (cm/s)	1.7E-05
Permeability k - (m/s)	1.7E-07
Back Pressure - (psi)	38.0
Cell Pressure - (psi)	107.4
Ave. Effective Stress - (psi)	69.347
Average temperature degree - (c°)	22.0

Data entry by:	SPH	Date:	10/23/2018
Checked by:	eh	Date:	10/23/2018

FileName: 2679_130_HarvardFlowPump-Perm-ASTMD-5084-R3_1.xls

ATT ADVANCED TERRA TESTING	**PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD** ASTM D5084 Method D

CLIENT	RJH Consultants	JOB NO.	2679-130

PROJECT	Hogchute Dam Safety Evaluation			
PROJECT NO.	18115	SAMPLED	7/23/2018	By: --
BORING NO.	B-103	TEST STARTED	10/16/2018	By: CAL
DEPTH	27.5-29.9' (29.15-29.65)	TEST FINISHED	10/19/2018	By: CAL
SAMPLE NO.	u-14 Pt. A	CELL NUMBER	24S	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Shelby Tube	CONF. PRES. - (psf)	10000	

SATURATION DATA

Cell Press.	Back Press.	Burette Reading (cc)		Pore Press. (psi)			
(psi)	(psi)	Close	Open	Close	Open	Change	B
40.0	38.0	3.2	19.3				
50.0		20.0	20.3	38.7	48.4	9.7	0.97

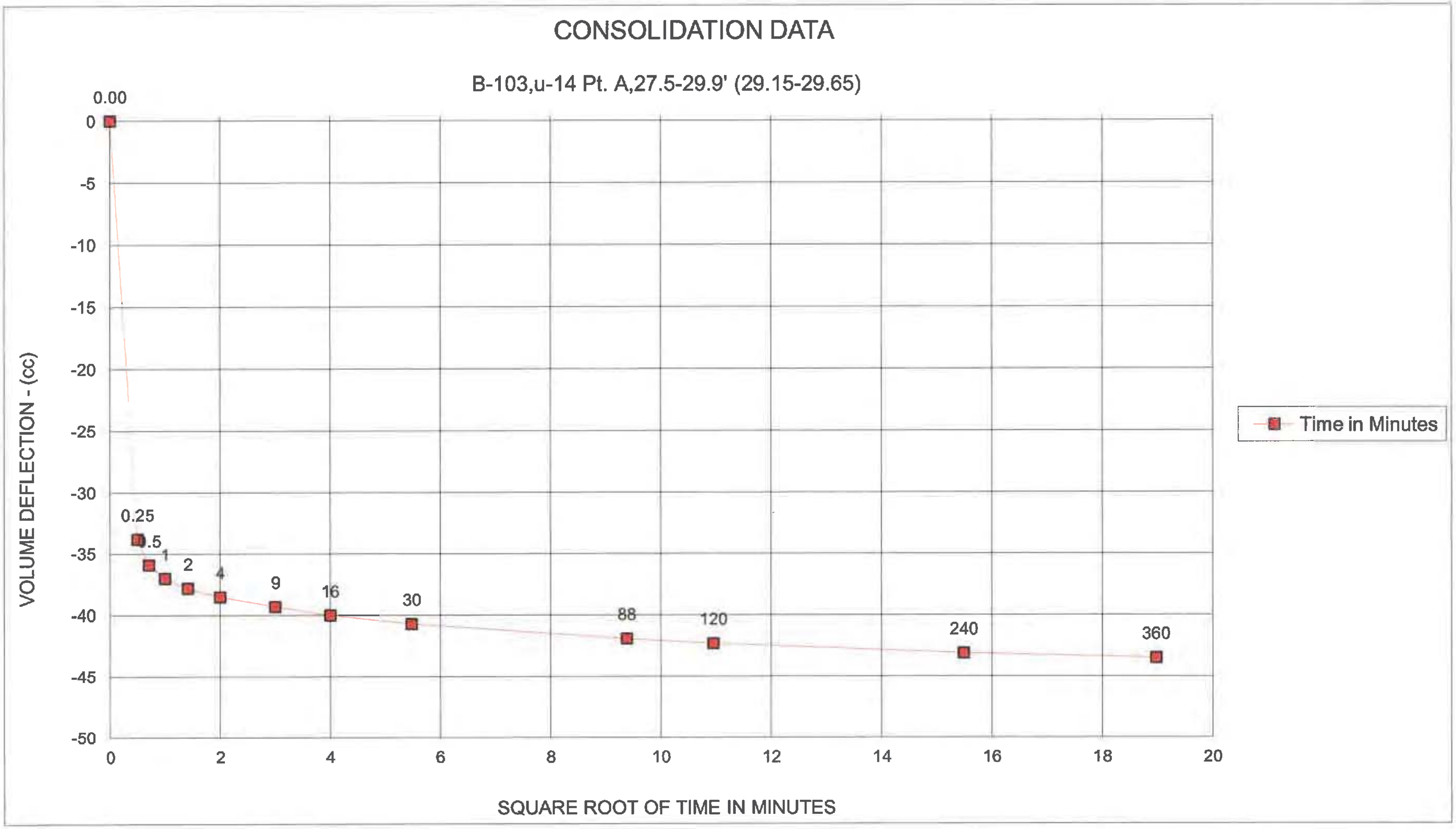
CONSOLIDATION DATA

Elapsed Time (Min)	SQRT Time (Min)	Burette Reading (cc)	Volume Defl. (cc)
0.00	0.00	0.80	0.00
0.25	0.50	34.60	-33.80
0.5	0.71	36.70	-35.90
1	1.00	37.80	-37.00
2	1.41	38.60	-37.80
4	2.00	39.30	-38.50
9	3.00	40.10	-39.30
16	4.00	40.80	-40.00
30	5.48	41.50	-40.70
88	9.38	42.70	-41.90
120	10.95	43.10	-42.30
240	15.49	43.90	-43.10
360	18.97	44.30	-43.50

Initial Height - (in)	5.852	Init. Vol. - (cc)	621.36
Height Change - (in)	0.151	Vol. Change - (cc)	62.80
Ht. After Cons. - (in)	5.701	Cell Exp. - (cc)	15.70
Initial Area - (sq in)	6.478	Net Change - (cc)	47.10
Area After Cons. - sq in	6.146	Cons. Vol. - (cc)	574.26

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD
ASTM D5084 Method D

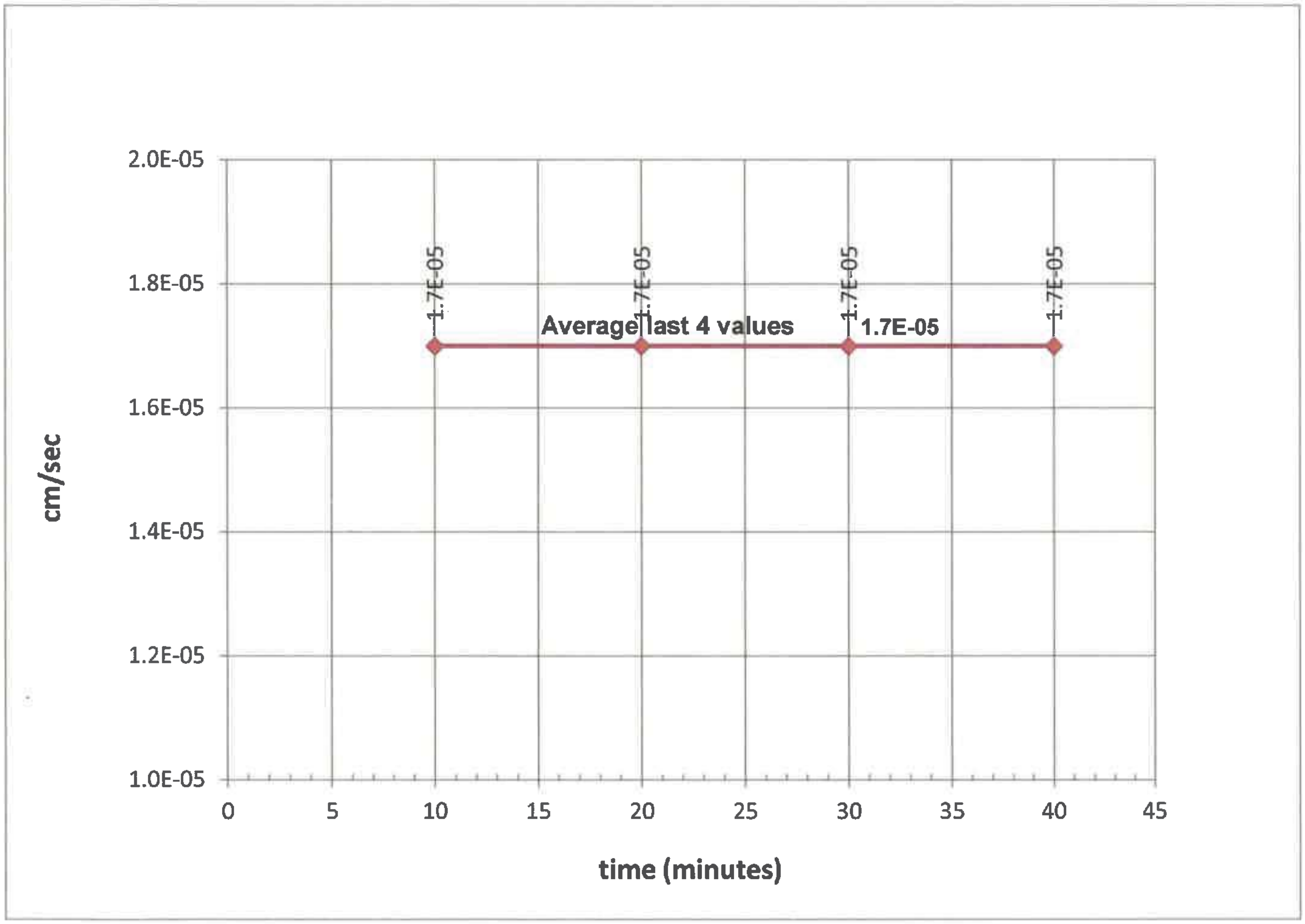
CLIENT	RJH Consultants	JOB NO.	2679-130



FileName: 2679_130_HarvardFlowPump-Perm-ASTMD-5084-R3_1.xls

Preliminary Flow Pump Test Data
ASTM D5084

Client:	RJH Consultants	Boring Number:	b-103		
Job Number:	2679-130	Depth:	27.5'-29.9'		
Project:	Hogchute Dam Safety Evaluation	Sample Number:	U-14 Pt. A		
Location:	--	Sampled Date:	7/23/2018	Sampled By:	--
Project Number:	18115	Test Date:	10/19/2018	Technician:	CAL



Data Entered By:	CAL		
Date:	10/19/2018	Checked By:	SPH
File Name:	2679_130_PrelimPerm_ASTMD-5084-methodD-R0_0.xls	Date:	10-23-18

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ATT ADVANCED

ASTM D5084 Method D

CLIENT	RJH Consultants		JOB NO.	2679-130

PROJECT	Hogchute Dam Safety Evaluation			
PROJECT NO.	18115	SAMPLED	7/23/2018	By: --
BORING NO.	B-103	TEST STARTED	10/16/2018	By: SPH/CAL
DEPTH	27.5-29.9' (28.65-29.15')	TEST FINISHED	10/22/2018	By: SPH/CAL
SAMPLE NO.	u-14 Pt. B	CELL NUMBER	18S	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	shelby tube	CONF. PRES. - (psf)	6000	

MOISTURE / DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture - (g)	1281.53	1261.98
Wt. Wet Soil & Pan - (g)	1295.34	1275.79
Wt. Dry Soil & Pan - (g)	1037.24	1037.24
Wt. Lost Moisture - (g)	258.10	238.55
Wt. of Pan Only - (g)	13.81	13.81
Wt. of Dry Soil - (g)	1023.43	1023.43
Moisture Content - (%)	25.2	23.3
Wet Density - (pcf)	126.4	132.1
Dry Density - (pcf)	101.0	107.1
Init. Diameter - (in)	2.869	
Init. Area - (sq in)	6.465	
Init. Height - (in)	5.973	
Vol. Bef. Consol. - (cu ft)	0.02235	
Vol. After Consol. - (cu ft)	0.02106	
Porosity - (%)	40.00	

FLOW PUMP CALCULATIONS	
Pump Setting (gear number)	1
Percentage of Pump Setting	100
Q - (cc/s)	3.59E-02
Height - (in)	5.857
Diameter - (in)	2.813
Pressure - (psi)	0.060
Area after consol. - (sq cm)	40.085
Gradient	0.284
Permeability k - (cm/s)	3.2E-03
Permeability k - (m/s)	3.2E-05
Back Pressure - (psi)	48.0
Cell Pressure - (psi)	89.7
Ave. Effective Stress - (psi)	41.670
Average temperature degree - (c°)	22.2

Data entry by:	CAL	Date:	10/24/2018
Checked by:	SPH	Date:	10-24-18

FileName: 2679_130_HarvardFlowPump-Perm-ASTMD-5084-R3_2.xls

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	RJH Consultants		JOB NO.	2679-130	
PROJECT	Hogchute Dam Safety Evaluation				
PROJECT NO.	18115	SAMPLED	7/23/2018	By: --	
BORING NO.	B-103	TEST STARTED	10/16/2018	By: SPH/CAL	
DEPTH	27.5-29.9' (28.65-29.15')	TEST FINISHED	10/22/2018	By: SPH/CAL	
SAMPLE NO.	u-14 Pt. B	CELL NUMBER	18S		
LOCATION	--	PERMEANT	Tap Water		
SAMPLE TYPE	shelby tube	CONF. PRES. - (psf)	6000		

SATURATION DATA

Cell Press. (psi)	Back Press. (psi)	Burette Reading (cc) Close	Burette Reading (cc) Open	Pore Press. (psi) Close	Pore Press. (psi) Open	Change	B
40.0	38.0	4.0	18.3				
50.0	48.0	19.3	20.1	38.4	47.8	9.4	0.94
60.0		20.4	20.5	48.5	58.0	9.5	0.95

CONSOLIDATION DATA

Elapsed Time (Min)	SQRT Time (Min)	Burette Reading (cc)	Volume Defl. (cc)
0.00	0.00	0.30	0.00
0.25	0.50	24.30	-24.00
0.5	0.71	25.40	-25.10
1	1.00	26.10	-25.80
2	1.41	26.60	-26.30
4	2.00	27.20	-26.90
9	3.00	27.80	-27.50
16	4.00	28.30	-28.00
30	5.48	28.90	-28.60
60	7.75	29.50	-29.20
120	10.95	30.10	-29.80
240	15.49	30.80	-30.50
360	18.97	31.10	-30.80

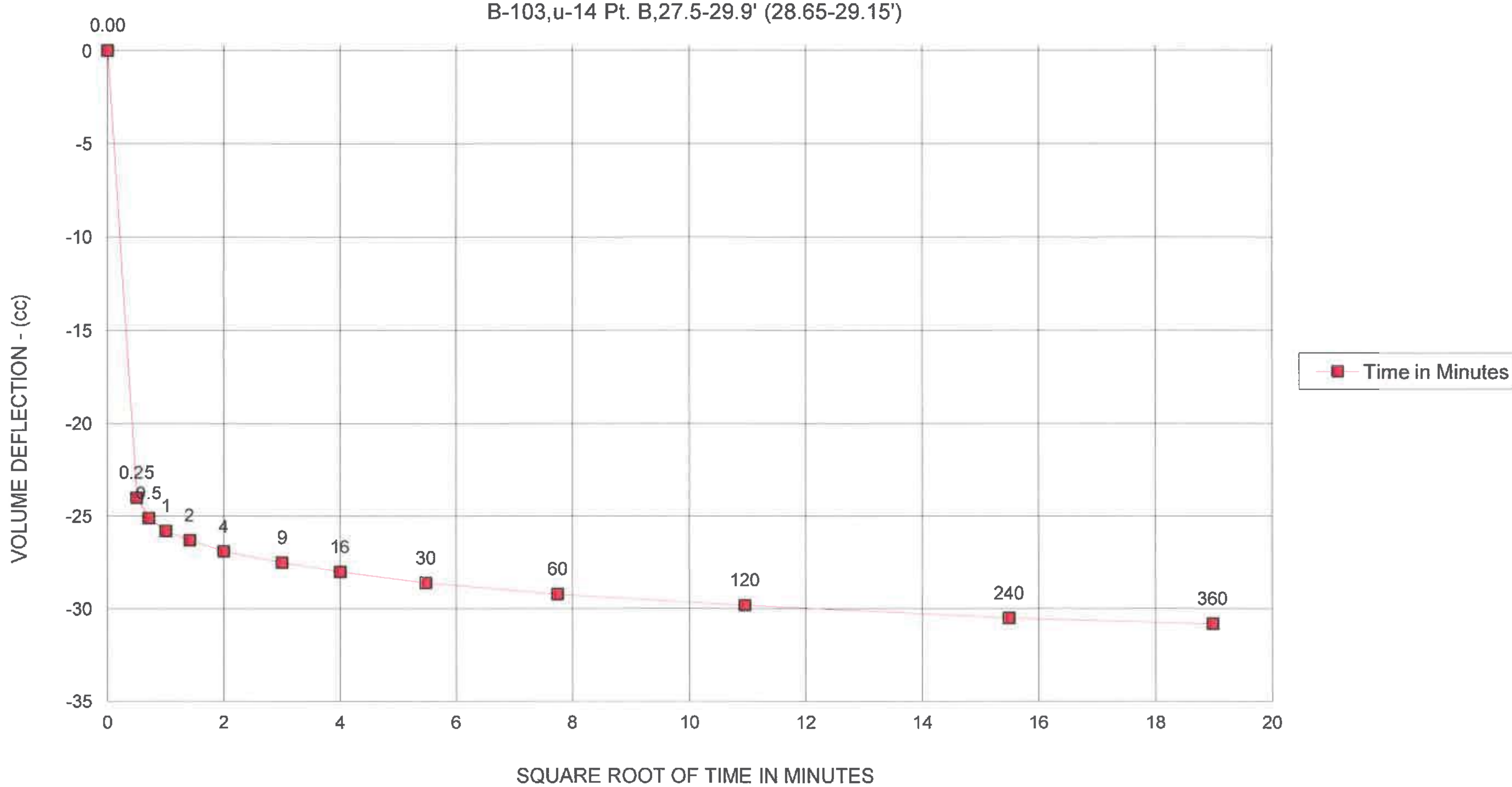
Initial Height - (in)	5.973	Init. Vol. - (cc)	632.88
Height Change - (in)	0.116	Vol. Change - (cc)	48.40
Ht. After Cons. - (in)	5.857	Cell Exp. - (cc)	11.96
Initial Area - (sq in)	6.465	Net Change - (cc)	36.44
Area After Cons. - sq in	6.213	Cons. Vol. - (cc)	596.44

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD
ASTM D5084 Method D

CLIENT	RJH Consultants		JOB NO.	2679-130

CONSOLIDATION DATA

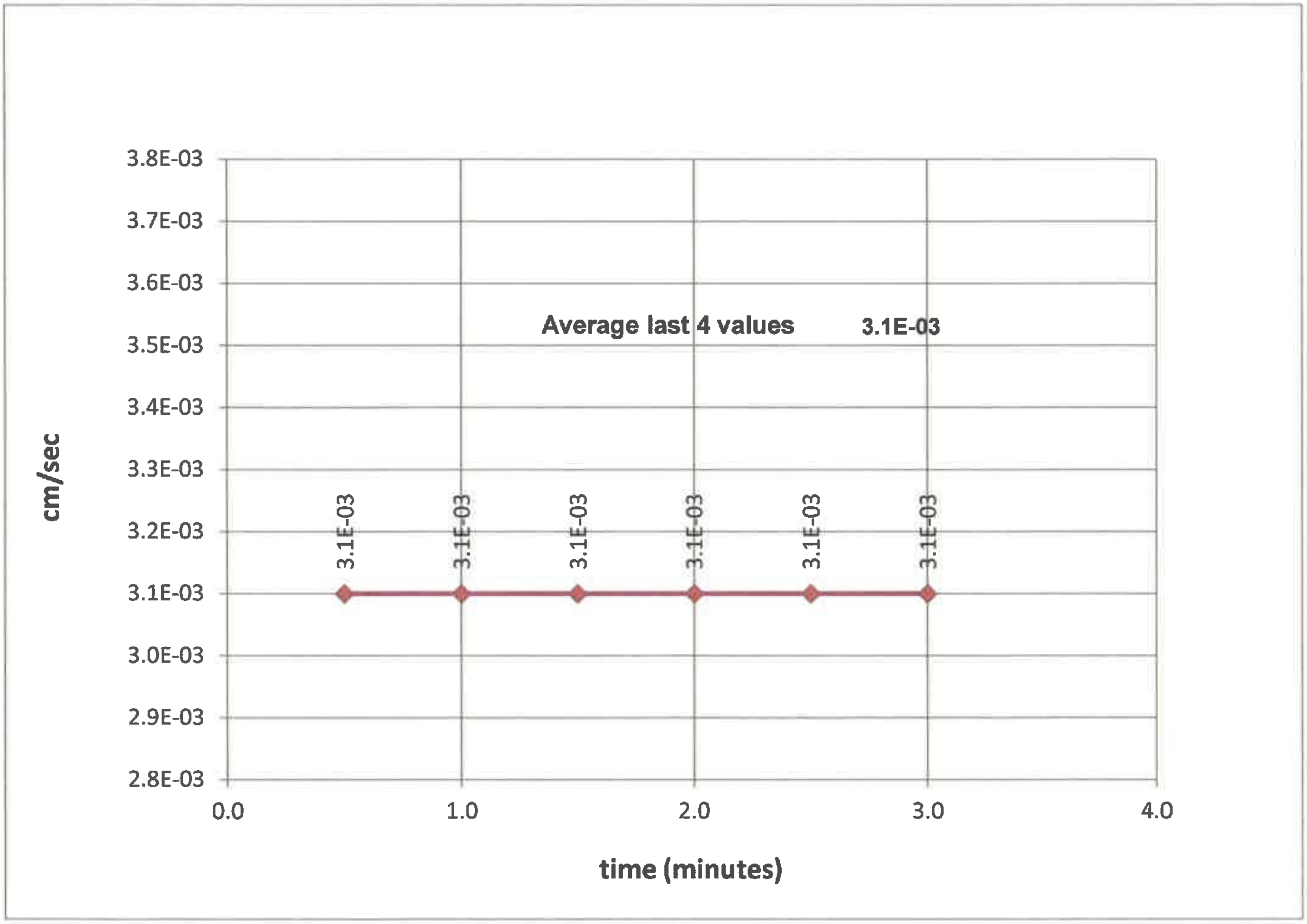
B-103,u-14 Pt. B,27.5-29.9' (28.65-29.15')



FileName: 2679_130_HarvardFlowPump-Perm-ASTMD-5084-R3_2.xls

Preliminary Flow Pump Test Data
ASTM D5084

Client:	RJH Consultants	Boring Number:	B-103		
Job Number:	2679-130	Depth:	27.5-29.9'		
Project:	Hogchute Dam Safety Evaluation	Sample Number:	U-14 Pt. B		
Location:	--	Sampled Date:	7/23/2018	Sampled By:	--
Project Number:	18115	Test Date:	10/19/2018	Technician:	CAL



Data Entered By: CAL
Date: 10/19/2018
File Name: 2679_130_PrelimPerm_ASTMD-5084-methodD-R0_1.xls

Checked By: SPH
Date: 10-24-18

ATT ADVANCED TERRATESTING

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	RJH Consultants	JOB NO.	2679-130

PROJECT	Hogchute Dam Safety Evaluation			
PROJECT NO.	18115	SAMPLED	7/23/2018	By: --
BORING NO.	B-103	TEST STARTED	10/16/2018	By: SPH/CAL
DEPTH	28.15-25.65'	TEST FINISHED	10/19/2018	By: SPH/CAL
SAMPLE NO.	u-14 Pt. C	CELL NUMBER	16S	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Shelby Tube	CONF. PRES. - (psf)	3000	

MOISTURE / DENSITY DATA	BEFORE TEST	AFTER TEST
Wt. Soil + Moisture - (g)	1321.10	1316.30
Wt. Wet Soil & Pan - (g)	1335.31	1330.51
Wt. Dry Soil & Pan - (g)	1081.21	1081.21
Wt. Lost Moisture - (g)	254.10	249.30
Wt. of Pan Only - (g)	14.21	14.21
Wt. of Dry Soil - (g)	1067.00	1067.00
Moisture Content - (%)	23.8	23.4
Wet Density - (pcf)	127.5	132.3
Dry Density - (pcf)	103.0	107.2
Init. Diameter - (in)	2.868	
Init. Area - (sq in)	6.460	
Init. Height - (in)	6.109	
Vol. Bef. Consol. - (cu ft)	0.02284	
Vol. After Consol. - (cu ft)	0.02194	
Porosity - (%)	40.12	

FLOW PUMP CALCULATIONS	
Pump Setting (gear number)	6
Percentage of Pump Setting	100
Q - (cc/s)	7.07E-04
Height - (in)	6.055
Diameter - (in)	2.824
Pressure - (psi)	0.111
Area after consol. - (sq cm)	40.399
Gradient	0.507
Permeability k - (cm/s)	3.4E-05
Permeability k - (m/s)	3.4E-07
Back Pressure - (psi)	48.0
Cell Pressure - (psi)	68.8
Ave. Effective Stress - (psi)	20.745
Average temperature degree - (c°)	22.1

Data entry by:	SPH	Date:	10/23/2018
Checked by:	CAL	Date:	10/23/2018

FileName: 2679_130_HarvardFlowPump-Perm-ASTMD-5084-R3_0.xls

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD

ASTM D5084 Method D

CLIENT	RJH Consultants	JOB NO.	2679-130

PROJECT	Hogchute Dam Safety Evaluation			
PROJECT NO.	18115	SAMPLED	7/23/2018	By: --
BORING NO.	B-103	TEST STARTED	10/16/2018	By: SPH/CAL
DEPTH	28.15-25.65'	TEST FINISHED	10/19/2018	By: SPH/CAL
SAMPLE NO.	u-14 Pt. C	CELL NUMBER	16S	
LOCATION	--	PERMEANT	Tap Water	
SAMPLE TYPE	Shelby Tube	CONF. PRES. - (psf)	3000	

SATURATION DATA

Cell Press. (psi)	Back Press. (psi)	Burette Reading (cc) Close	Burette Reading (cc) Open	Pore Press. (psi) Close	Pore Press. (psi) Open	Change	B
40.0	38.0	4.0	19.8				
50.0	48.0	20.6	21.6	38.9	48.2	9.3	0.93
60.0		21.9	22.0	48.7	58.3	9.6	0.96

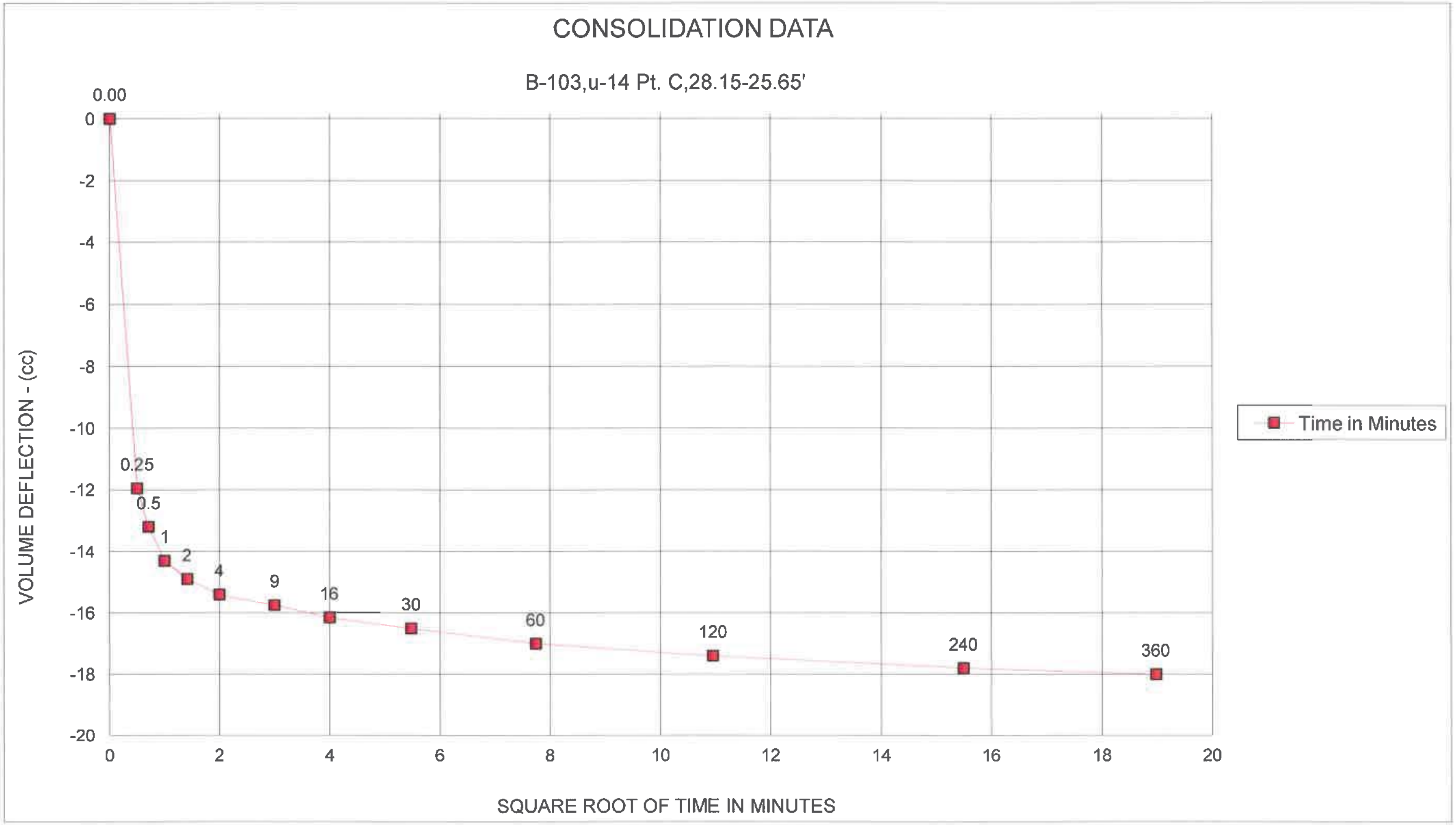
CONSOLIDATION DATA

Elapsed Time (Min)	SQRT Time (Min)	Burette Reading (cc)	Volume Defl. (cc)
0.00	0.00	0.50	0.00
0.25	0.50	12.45	-11.95
0.5	0.71	13.70	-13.20
1	1.00	14.80	-14.30
2	1.41	15.40	-14.90
4	2.00	15.90	-15.40
9	3.00	16.25	-15.75
16	4.00	16.65	-16.15
30	5.48	17.00	-16.50
60	7.75	17.50	-17.00
120	10.95	17.90	-17.40
240	15.49	18.30	-17.80
360	18.97	18.50	-18.00

Initial Height - (in)	6.109	Init. Vol. - (cc)	646.84
Height Change - (in)	0.054	Vol. Change - (cc)	36.80
Ht. After Cons. - (in)	6.055	Cell Exp. - (cc)	11.36
Initial Area - (sq in)	6.460	Net Change - (cc)	25.44
Area After Cons. - sq in	6.262	Cons. Vol. - (cc)	621.40

PERMEABILITY TEST - BACK PRESSURE SATURATED - FLOW PUMP METHOD
ASTM D5084 Method D

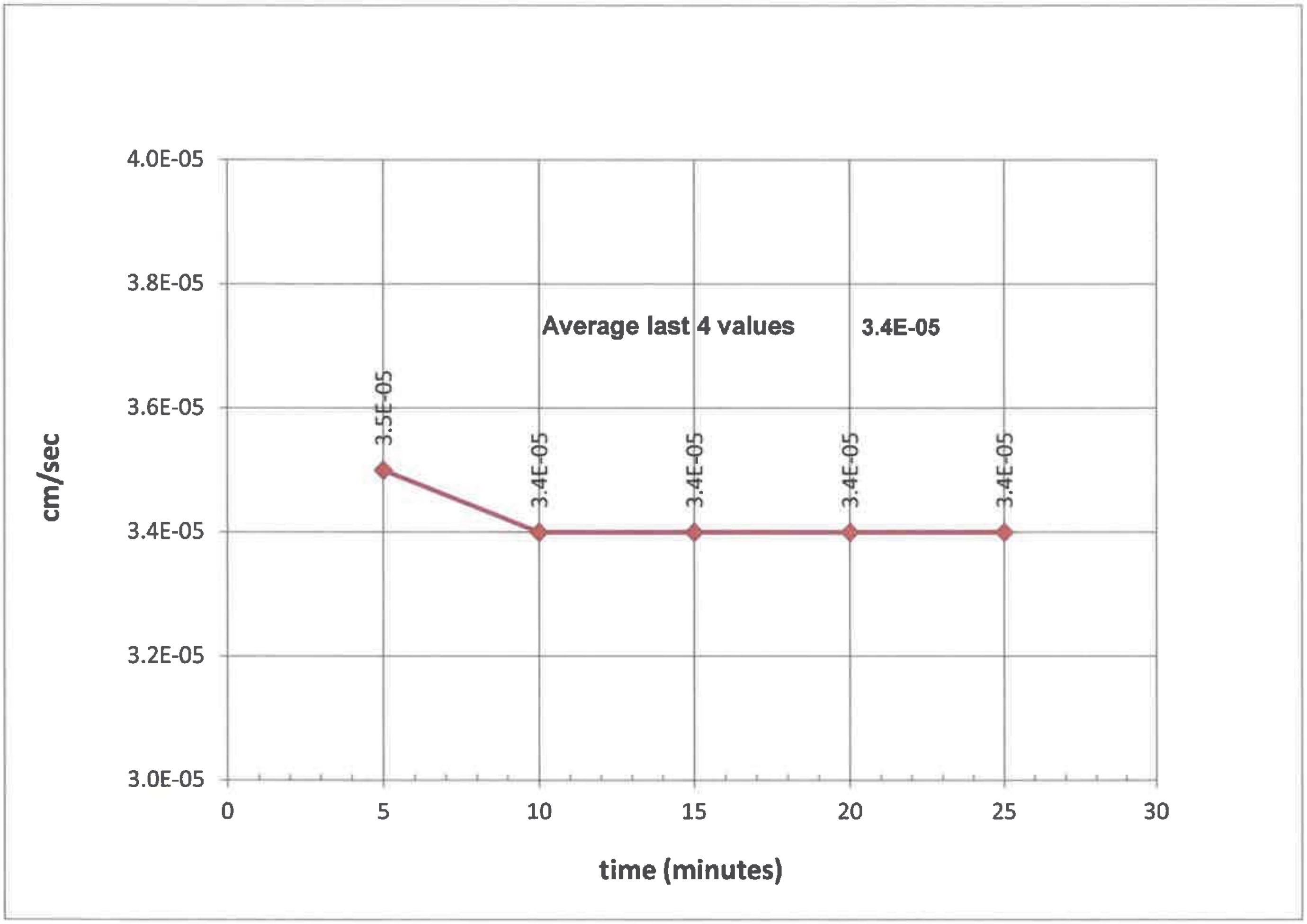
CLIENT	RJH Consultants		JOB NO.	2679-130



FileName: 2679_130_HarvardFlowPump-Perm-ASTMD-5084-R3_0.xls

Preliminary Flow Pump Test Data
ASTM D5084

Client:	RJH Consultants	Boring Number:	B-103		
Job Number:	2679-130	Depth:	27.5-29.9'		
Project:	Hogchute Dam Safety Evaluation	Sample Number:	U-14 Pt. C		
Location:	--	Sampled Date:	7/23/2018	Sampled By:	--
Project Number:	18115	Test Date:	10/19/2018	Technician:	CAL



Data Entered By: CAL
Date: 10/19/2018
File Name: 2679_130_PrelimPerm_ASTMD-5084-methodD-R0_2.xls

Checked By: SPH
Date: 10-23-18

Unconfined Compressive Strength
ASTM D2166

Unconfined Compressive Strength
ASTM D 2166

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	BORING NO.	B-104
JOB NO.	2679-130	DEPTH	32-33.0'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-9
PROJECT NO.	18115	DATE SAMPLED	9/20/2018
LOCATION	--	DESCRIPTION	lean clay w/gravel
DATE TESTED	10/17/18		
TECHNICIAN	SPH/CAL		

Test Parameters

Strain Rate (in/min):	0.037
Strain Rate (cm/min):	0.09398

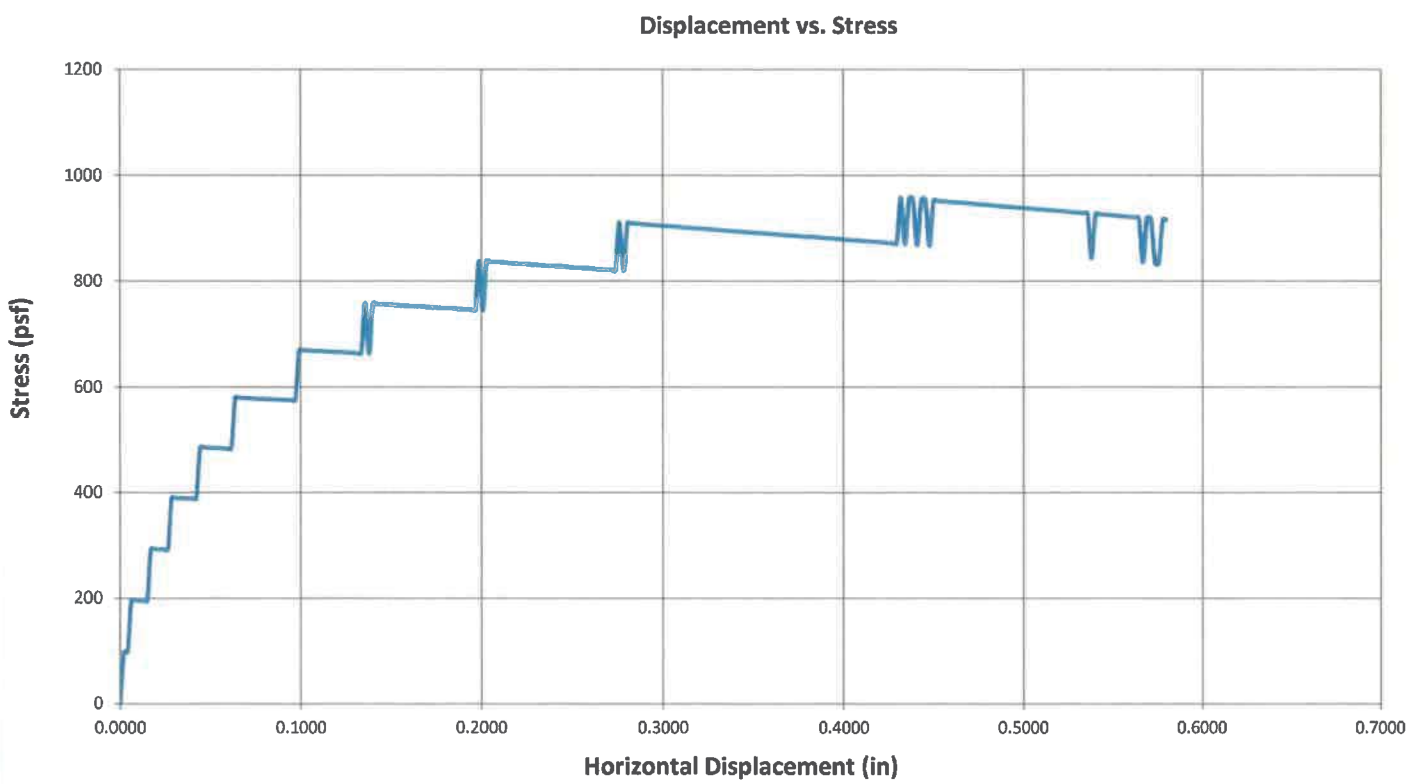
Raw Data Files: RJH_2679_130_CA-9_B-104.txt

Moisture & Density Data

Mass of Wet Soil and Pan (g):	531.30	Initial Wet Density (pcf):	133.9
Mass of Dry Soil and Pan (g):	466.78	Initial Dry Density (pcf):	111.8
Mass of Pan (g):	139.65	Initial Wet Density (kg/m³):	2144
Mass of Wet Soil (g):	391.7	Initial Dry Density (kg/m³):	1791
Initial Diameter (in):	1.93	Initial Moisture (%):	19.7
Initial Height (in):	3.80		

Test Results

Peak Stress (psf):	958	Axial Strain at Peak Stress(%):	11.4
Peak Stress (kPa):	46	Height to Diameter Ratio:	2.0:1



NOTES:	Short Sample! Filling required due to gravel.

Data entry by:	CAL	Date:	10/18/2018
Checked by:	SPH	Date:	10-19-18
File name:	2679130__UCS ASTM D2166_0.xlsm		

Unconfined Compressive Strength
ASTM D2166

CLIENT	RJH Consultants	BORING NO.	B-104
JOB NO.	2679-130	DEPTH	32-33.0'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-9
PROJECT NO.	18115	DATE SAMPLED	9/20/2018
LOCATION	--	DESCRIPTION	lean clay w/gravel
DATE TESTED	10/17/18		
TECHNICIAN	SPH/CAL		

Displacement (in)	Displacement (cm)	Strain (%)	Average Cross Sectional Area (in²)	Load (lbs)	Load (N)	Stress (psf)	Stress (kPa)
0.0000	0.000	0.00	2.93	0	0	0	0
0.0022	0.006	0.06	2.93	2	9	98	5
0.0043	0.011	0.11	2.93	2	9	98	5
0.0064	0.016	0.17	2.94	4	18	196	9
0.0086	0.022	0.23	2.94	4	18	196	9
0.0106	0.027	0.28	2.94	4	18	196	9
0.0127	0.032	0.33	2.94	4	18	196	9
0.0150	0.038	0.39	2.94	4	18	196	9
0.0170	0.043	0.45	2.94	6	27	293	14
0.0192	0.049	0.50	2.95	6	27	293	14
0.0218	0.055	0.57	2.95	6	27	293	14
0.0240	0.061	0.63	2.95	6	27	293	14
0.0263	0.067	0.69	2.95	6	27	293	14
0.0284	0.072	0.75	2.95	8	36	390	19
0.0307	0.078	0.81	2.96	8	36	390	19
0.0328	0.083	0.86	2.96	8	36	390	19
0.0352	0.089	0.93	2.96	8	36	389	19
0.0376	0.096	0.99	2.96	8	36	389	19
0.0399	0.101	1.05	2.96	8	36	389	19
0.0419	0.106	1.10	2.96	8	36	389	19
0.0441	0.112	1.16	2.97	10	44	486	23
0.0464	0.118	1.22	2.97	10	44	485	23
0.0486	0.123	1.28	2.97	10	44	485	23
0.0507	0.129	1.33	2.97	10	44	485	23
0.0531	0.135	1.40	2.97	10	44	484	23
0.0551	0.140	1.45	2.97	10	44	484	23
0.0572	0.145	1.50	2.98	10	44	484	23
0.0592	0.150	1.56	2.98	10	44	484	23
0.0614	0.156	1.61	2.98	10	44	483	23
0.0636	0.162	1.67	2.98	12	53	580	28
0.0656	0.167	1.73	2.98	12	53	579	28
0.0679	0.172	1.79	2.98	12	53	579	28
0.0700	0.178	1.84	2.99	12	53	579	28
0.0723	0.184	1.90	2.99	12	53	578	28
0.0745	0.189	1.96	2.99	12	53	578	28
0.0768	0.195	2.02	2.99	12	53	578	28
0.0791	0.201	2.08	2.99	12	53	577	28
0.0813	0.207	2.14	3.00	12	53	577	28
0.0836	0.212	2.20	3.00	12	53	576	28
0.0859	0.218	2.26	3.00	12	53	576	28
0.0880	0.224	2.31	3.00	12	53	576	28
0.0903	0.229	2.38	3.00	12	53	575	28
0.0924	0.235	2.43	3.00	12	53	575	28

Unconfined Compressive Strength
ASTM D2166

CLIENT	RJH Consultants	BORING NO.	B-104
JOB NO.	2679-130	DEPTH	32-33.0'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-9
PROJECT NO.	18115	DATE SAMPLED	9/20/2018
LOCATION	--	DESCRIPTION	lean clay w/gravel
DATE TESTED	10/17/18		
TECHNICIAN	SPH/CAL		

Displacement (in)	Displacement (cm)	Strain (%)	Average Cross Sectional Area (in²)	Load (lbs)	Load (N)	Stress (psf)	Stress (kPa)
0.0947	0.241	2.49	3.01	12	53	575	28
0.0968	0.246	2.55	3.01	12	53	574	28
0.0991	0.252	2.61	3.01	14	62	670	32
0.1012	0.257	2.66	3.01	14	62	669	32
0.1035	0.263	2.72	3.01	14	62	669	32
0.1057	0.268	2.78	3.02	14	62	669	32
0.1079	0.274	2.84	3.02	14	62	668	32
0.1100	0.279	2.89	3.02	14	62	668	32
0.1120	0.284	2.95	3.02	14	62	667	32
0.1142	0.290	3.00	3.02	14	62	667	32
0.1162	0.295	3.06	3.02	14	62	667	32
0.1183	0.300	3.11	3.03	14	62	666	32
0.1204	0.306	3.17	3.03	14	62	666	32
0.1224	0.311	3.22	3.03	14	62	666	32
0.1247	0.317	3.28	3.03	14	62	665	32
0.1268	0.322	3.34	3.03	14	62	665	32
0.1291	0.328	3.40	3.03	14	62	664	32
0.1312	0.333	3.45	3.04	14	62	664	32
0.1335	0.339	3.51	3.04	14	62	664	32
0.1356	0.344	3.57	3.04	16	71	758	36
0.1379	0.350	3.63	3.04	14	62	663	32
0.1399	0.355	3.68	3.04	16	71	757	36
0.1420	0.361	3.73	3.05	16	71	757	36
0.1443	0.367	3.80	3.05	16	71	756	36
0.1464	0.372	3.85	3.05	16	71	756	36
0.1487	0.378	3.91	3.05	16	71	755	36
0.1508	0.383	3.97	3.05	16	71	755	36
0.1531	0.389	4.03	3.05	16	71	754	36
0.1552	0.394	4.08	3.06	16	71	754	36
0.1572	0.399	4.13	3.06	16	71	753	36
0.1594	0.405	4.19	3.06	16	71	753	36
0.1616	0.410	4.25	3.06	16	71	753	36
0.1638	0.416	4.31	3.06	16	71	752	36
0.1660	0.422	4.37	3.07	16	71	752	36
0.1682	0.427	4.42	3.07	16	71	751	36
0.1704	0.433	4.48	3.07	16	71	751	36
0.1726	0.438	4.54	3.07	16	71	750	36
0.1748	0.444	4.60	3.07	16	71	750	36
0.1771	0.450	4.66	3.07	16	71	749	36
0.1792	0.455	4.71	3.08	16	71	749	36
0.1815	0.461	4.77	3.08	16	71	748	36
0.1836	0.466	4.83	3.08	16	71	748	36
0.1859	0.472	4.89	3.08	16	71	747	36

Unconfined Compressive Strength
ASTM D2166

CLIENT	RJH Consultants	BORING NO.	B-104
JOB NO.	2679-130	DEPTH	32-33.0'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-9
PROJECT NO.	18115	DATE SAMPLED	9/20/2018
LOCATION	--	DESCRIPTION	lean clay w/gravel
DATE TESTED	10/17/18		
TECHNICIAN	SPH/CAL		

Displacement (in)	Displacement (cm)	Strain (%)	Average Cross Sectional Area (in²)	Load (lbs)	Load (N)	Stress (psf)	Stress (kPa)
0.1880	0.478	4.94	3.08	16	71	747	36
0.1900	0.483	5.00	3.09	16	71	747	36
0.1922	0.488	5.06	3.09	16	71	746	36
0.1943	0.494	5.11	3.09	16	71	746	36
0.1964	0.499	5.17	3.09	16	71	745	36
0.1987	0.505	5.23	3.09	18	80	838	40
0.2007	0.510	5.28	3.09	16	71	744	36
0.2027	0.515	5.33	3.10	18	80	837	40
0.2048	0.520	5.39	3.10	18	80	837	40
0.2069	0.526	5.44	3.10	18	80	836	40
0.2091	0.531	5.50	3.10	18	80	836	40
0.2112	0.536	5.55	3.10	18	80	835	40
0.2134	0.542	5.61	3.11	18	80	835	40
0.2155	0.547	5.67	3.11	18	80	834	40
0.2176	0.553	5.72	3.11	18	80	834	40
0.2196	0.558	5.78	3.11	18	80	833	40
0.2219	0.564	5.84	3.11	18	80	833	40
0.2239	0.569	5.89	3.12	18	80	832	40
0.2259	0.574	5.94	3.12	18	80	832	40
0.2280	0.579	6.00	3.12	18	80	831	40
0.2300	0.584	6.05	3.12	18	80	831	40
0.2320	0.589	6.10	3.12	18	80	830	40
0.2341	0.595	6.16	3.12	18	80	830	40
0.2363	0.600	6.22	3.13	18	80	829	40
0.2385	0.606	6.27	3.13	18	80	829	40
0.2407	0.611	6.33	3.13	18	80	828	40
0.2427	0.616	6.38	3.13	18	80	828	40
0.2449	0.622	6.44	3.13	18	80	827	40
0.2472	0.628	6.50	3.14	18	80	827	40
0.2495	0.634	6.56	3.14	18	80	826	40
0.2517	0.639	6.62	3.14	18	80	826	40
0.2540	0.645	6.68	3.14	18	80	825	40
0.2563	0.651	6.74	3.14	18	80	825	39
0.2586	0.657	6.80	3.15	18	80	824	39
0.2608	0.662	6.86	3.15	18	80	824	39
0.2628	0.668	6.91	3.15	18	80	823	39
0.2651	0.673	6.97	3.15	18	80	823	39
0.2673	0.679	7.03	3.15	18	80	822	39
0.2695	0.685	7.09	3.16	18	80	821	39
0.2715	0.690	7.14	3.16	18	80	821	39
0.2736	0.695	7.20	3.16	18	80	821	39
0.2759	0.701	7.26	3.16	20	89	911	44
0.2781	0.706	7.31	3.16	18	80	819	39

Unconfined Compressive Strength
ASTM D2166

CLIENT	RJH Consultants	BORING NO.	B-104
JOB NO.	2679-130	DEPTH	32-33.0'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-9
PROJECT NO.	18115	DATE SAMPLED	9/20/2018
LOCATION	--	DESCRIPTION	lean clay w/gravel
DATE TESTED	10/17/18		
TECHNICIAN	SPH/CAL		

Displacement (in)	Displacement (cm)	Strain (%)	Average Cross Sectional Area (in^2)	Load (lbs)	Load (N)	Stress (psf)	Stress (kPa)
0.2804	0.712	7.38	3.17	20	89	910	44
0.2825	0.718	7.43	3.17	20	89	909	44
0.2847	0.723	7.49	3.17	20	89	909	44
0.2867	0.728	7.54	3.17	20	89	908	43
0.2888	0.734	7.60	3.17	20	89	908	43
0.2911	0.739	7.66	3.17	20	89	907	43
0.2932	0.745	7.71	3.18	20	89	907	43
0.2955	0.751	7.77	3.18	20	89	906	43
0.2978	0.756	7.83	3.18	20	89	905	43
0.2999	0.762	7.89	3.18	20	89	905	43
0.3019	0.767	7.94	3.18	20	89	904	43
0.3040	0.772	8.00	3.19	20	89	904	43
0.3062	0.778	8.05	3.19	20	89	903	43
0.3084	0.783	8.11	3.19	20	89	903	43
0.3106	0.789	8.17	3.19	20	89	902	43
0.3127	0.794	8.22	3.19	20	89	902	43
0.3149	0.800	8.28	3.20	20	89	901	43
0.3171	0.805	8.34	3.20	20	89	900	43
0.3192	0.811	8.40	3.20	20	89	900	43
0.3212	0.816	8.45	3.20	20	89	899	43
0.3235	0.822	8.51	3.20	20	89	899	43
0.3256	0.827	8.56	3.21	20	89	898	43
0.3277	0.832	8.62	3.21	20	89	898	43
0.3300	0.838	8.68	3.21	20	89	897	43
0.3321	0.844	8.73	3.21	20	89	897	43
0.3343	0.849	8.79	3.21	20	89	896	43
0.3364	0.854	8.85	3.22	20	89	895	43
0.3387	0.860	8.91	3.22	20	89	895	43
0.3407	0.865	8.96	3.22	20	89	894	43
0.3427	0.870	9.01	3.22	20	89	894	43
0.3448	0.876	9.07	3.22	20	89	893	43
0.3471	0.882	9.13	3.23	20	89	893	43
0.3492	0.887	9.18	3.23	20	89	892	43
0.3514	0.893	9.24	3.23	20	89	892	43
0.3535	0.898	9.30	3.23	20	89	891	43
0.3557	0.903	9.36	3.23	20	89	890	43
0.3579	0.909	9.41	3.24	20	89	890	43
0.3600	0.914	9.47	3.24	20	89	889	43
0.3623	0.920	9.53	3.24	20	89	889	43
0.3644	0.926	9.58	3.24	20	89	888	43
0.3666	0.931	9.64	3.24	20	89	888	43
0.3687	0.936	9.70	3.25	20	89	887	42
0.3708	0.942	9.75	3.25	20	89	887	42

Unconfined Compressive Strength
ASTM D2166

CLIENT	RJH Consultants	BORING NO.	B-104
JOB NO.	2679-130	DEPTH	32-33.0'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-9
PROJECT NO.	18115	DATE SAMPLED	9/20/2018
LOCATION	--	DESCRIPTION	lean clay w/gravel
DATE TESTED	10/17/18		
TECHNICIAN	SPH/CAL		

Displacement (in)	Displacement (cm)	Strain (%)	Average Cross Sectional Area (in²)	Load (lbs)	Load (N)	Stress (psf)	Stress (kPa)
0.3728	0.947	9.81	3.25	20	89	886	42
0.3748	0.952	9.86	3.25	20	89	886	42
0.3771	0.958	9.92	3.25	20	89	885	42
0.3794	0.964	9.98	3.26	20	89	884	42
0.3816	0.969	10.04	3.26	20	89	884	42
0.3838	0.975	10.09	3.26	20	89	883	42
0.3860	0.980	10.15	3.26	20	89	883	42
0.3883	0.986	10.21	3.27	20	89	882	42
0.3905	0.992	10.27	3.27	20	89	881	42
0.3928	0.998	10.33	3.27	20	89	881	42
0.3951	1.004	10.39	3.27	20	89	880	42
0.3973	1.009	10.45	3.27	20	89	880	42
0.3996	1.015	10.51	3.28	20	89	879	42
0.4019	1.021	10.57	3.28	20	89	879	42
0.4040	1.026	10.63	3.28	20	89	878	42
0.4063	1.032	10.69	3.28	20	89	877	42
0.4084	1.037	10.74	3.28	20	89	877	42
0.4104	1.042	10.79	3.29	20	89	876	42
0.4126	1.048	10.85	3.29	20	89	876	42
0.4148	1.054	10.91	3.29	20	89	875	42
0.4168	1.059	10.96	3.29	20	89	875	42
0.4190	1.064	11.02	3.29	20	89	874	42
0.4212	1.070	11.08	3.30	20	89	874	42
0.4235	1.076	11.14	3.30	20	89	873	42
0.4255	1.081	11.19	3.30	20	89	872	42
0.4275	1.086	11.24	3.30	20	89	872	42
0.4297	1.091	11.30	3.31	20	89	871	42
0.4320	1.097	11.36	3.31	22	98	958	46
0.4343	1.103	11.42	3.31	20	89	870	42
0.4366	1.109	11.48	3.31	22	98	957	46
0.4388	1.115	11.54	3.31	22	98	956	46
0.4411	1.120	11.60	3.32	20	89	868	42
0.4435	1.126	11.66	3.32	22	98	955	46
0.4457	1.132	11.72	3.32	22	98	954	46
0.4479	1.138	11.78	3.32	20	89	867	41
0.4502	1.144	11.84	3.33	22	98	953	46
0.4524	1.149	11.90	3.33	22	98	952	46
0.4547	1.155	11.96	3.33	22	98	951	46
0.4568	1.160	12.01	3.33	22	98	951	46
0.4591	1.166	12.08	3.33	22	98	950	45
0.4614	1.172	12.14	3.34	22	98	949	45
0.4636	1.178	12.19	3.34	22	98	949	45
0.4659	1.183	12.25	3.34	22	98	948	45

Unconfined Compressive Strength
ASTM D2166

CLIENT	RJH Consultants	BORING NO.	B-104
JOB NO.	2679-130	DEPTH	32-33.0'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-9
PROJECT NO.	18115	DATE SAMPLED	9/20/2018
LOCATION	--	DESCRIPTION	lean clay w/gravel
DATE TESTED	10/17/18		
TECHNICIAN	SPH/CAL		

Displacement (in)	Displacement (cm)	Strain (%)	Average Cross Sectional Area (in²)	Load (lbs)	Load (N)	Stress (psf)	Stress (kPa)
0.4680	1.189	12.31	3.34	22	98	948	45
0.4703	1.195	12.37	3.35	22	98	947	45
0.4724	1.200	12.43	3.35	22	98	946	45
0.4744	1.205	12.48	3.35	22	98	946	45
0.4766	1.211	12.54	3.35	22	98	945	45
0.4789	1.216	12.60	3.35	22	98	945	45
0.4811	1.222	12.65	3.36	22	98	944	45
0.4834	1.228	12.71	3.36	22	98	943	45
0.4856	1.233	12.77	3.36	22	98	943	45
0.4879	1.239	12.83	3.36	22	98	942	45
0.4900	1.245	12.89	3.37	22	98	941	45
0.4923	1.250	12.95	3.37	22	98	941	45
0.4944	1.256	13.00	3.37	22	98	940	45
0.4964	1.261	13.06	3.37	22	98	940	45
0.4986	1.266	13.11	3.37	22	98	939	45
0.5008	1.272	13.17	3.38	22	98	938	45
0.5030	1.278	13.23	3.38	22	98	938	45
0.5067	1.287	13.33	3.38	22	98	937	45
0.5090	1.293	13.39	3.38	22	98	936	45
0.5112	1.298	13.45	3.39	22	98	935	45
0.5135	1.304	13.51	3.39	22	98	935	45
0.5184	1.317	13.63	3.39	22	98	933	45
0.5207	1.323	13.70	3.40	22	98	933	45
0.5228	1.328	13.75	3.40	22	98	932	45
0.5251	1.334	13.81	3.40	22	98	931	45
0.5273	1.339	13.87	3.40	22	98	931	45
0.5295	1.345	13.93	3.41	22	98	930	45
0.5315	1.350	13.98	3.41	22	98	930	45
0.5336	1.355	14.03	3.41	22	98	929	44
0.5358	1.361	14.09	3.41	22	98	928	44
0.5380	1.367	14.15	3.41	20	89	843	40
0.5403	1.372	14.21	3.42	22	98	927	44
0.5424	1.378	14.27	3.42	22	98	926	44
0.5447	1.384	14.33	3.42	22	98	926	44
0.5468	1.389	14.38	3.42	22	98	925	44
0.5491	1.395	14.44	3.43	22	98	925	44
0.5512	1.400	14.50	3.43	22	98	924	44
0.5533	1.405	14.55	3.43	22	98	923	44
0.5555	1.411	14.61	3.43	22	98	923	44
0.5578	1.417	14.67	3.44	22	98	922	44
0.5600	1.422	14.73	3.44	22	98	921	44
0.5623	1.428	14.79	3.44	22	98	921	44
0.5644	1.434	14.84	3.44	22	98	920	44

Unconfined Compressive Strength
ASTM D2166

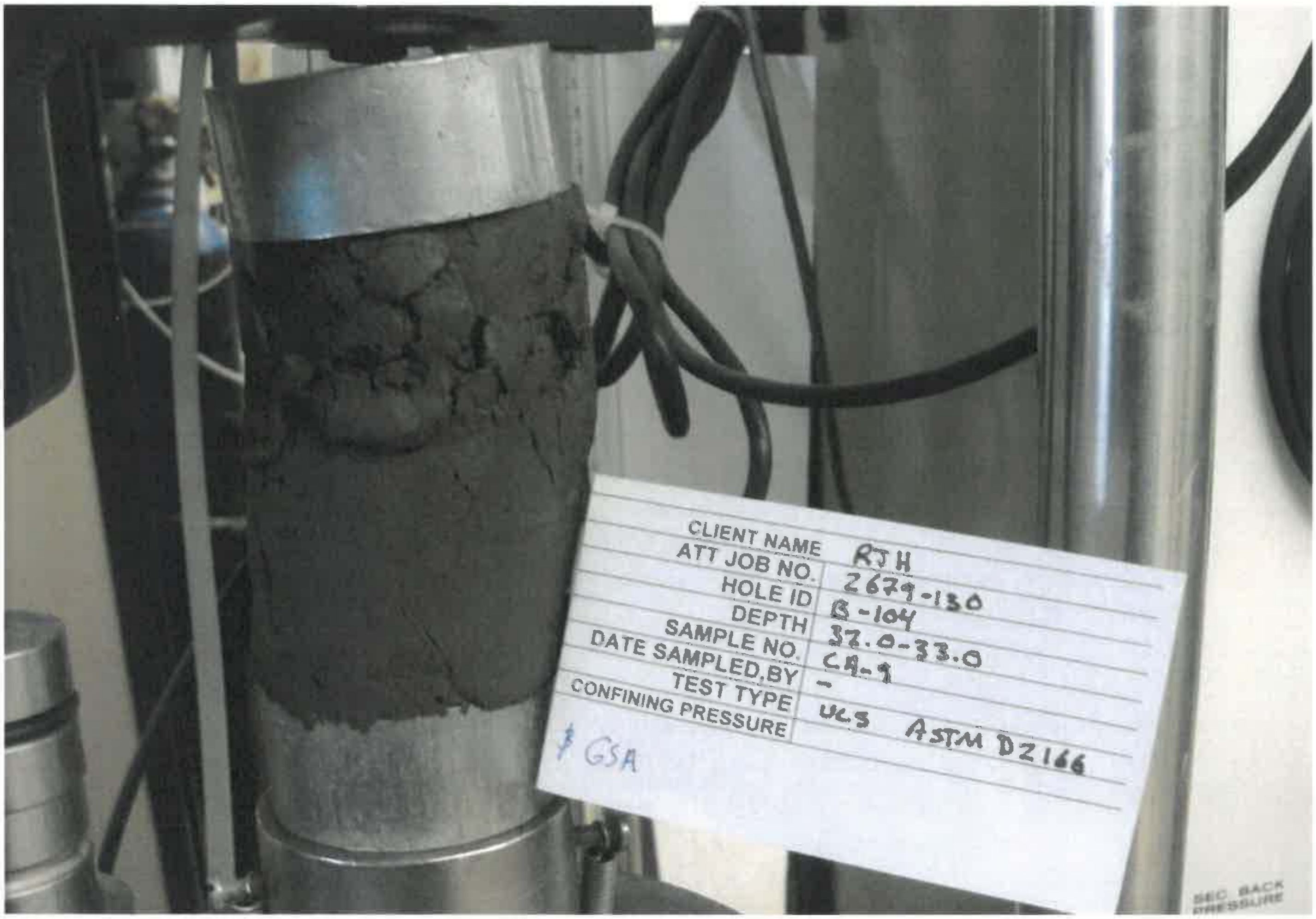
CLIENT	RJH Consultants	BORING NO.	B-104
JOB NO.	2679-130	DEPTH	32-33.0'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-9
PROJECT NO.	18115	DATE SAMPLED	9/20/2018
LOCATION	--	DESCRIPTION	lean clay w/gravel
DATE TESTED	10/17/18		
TECHNICIAN	SPH/CAL		

Displacement (in)	Displacement (cm)	Strain (%)	Average Cross Sectional Area (in²)	Load (lbs)	Load (N)	Stress (psf)	Stress (kPa)
0.5666	1.439	14.90	3.44	20	89	836	40
0.5687	1.444	14.96	3.45	22	98	919	44
0.5709	1.450	15.02	3.45	22	98	918	44
0.5732	1.456	15.08	3.45	20	89	834	40
0.5753	1.461	15.13	3.45	20	89	834	40
0.5775	1.467	15.19	3.46	22	98	916	44
0.5797	1.472	15.25	3.46	22	98	916	44

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	--
JOB NO.	2679-130	--
PROJECT	Hogchute Dam Safety Evaluation	--
PROJECT NO.	18115	--
LOCATION	--	--



NOTES

File name: 2679130__Image_18_10_18_07_47_43

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	--
JOB NO.	2679-130	--
PROJECT	Hogchute Dam Safety Evaluation	--
PROJECT NO.	18115	--
LOCATION	--	--

NOTES	

File name: 2679130__Image_18_10_18_07_48_14

Corrosion Suite
ASTM C1580, D4972, D1411, G187

ADVANCED TERRA TESTING

Corrosion Suite
ASTM C1580 D4972 D1411 G187

CLIENT	RJH Consultants	BORING NO.	B-101
JOB NO.	2679-130	DEPTH	45-50'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	Bu-15
PROJECT NO.	18115	DATE SAMPLED	07/26/18
LOCATION	--	DESCRIPTION	--
DATE TESTED	10/29/18		
TECHNICIAN	SKS		

Measured Sulfate Concentration (ppm):	23
Dilution:	1.00:1
Sulfate Concentration (ppm):	23
Measured Chloride Concentration (ppm):	7.7
Dilution:	5.00:1
Chloride Concentration (ppm):	38.5
pH:	6.8
Minimum Measured Resistivity (Ω):	1200
Box Correction Factor (cm):	2.00
Minimum Resistivity (Ω·cm):	2400
Measured Sulfide Concentration (ppm):	0.104
Dilution:	1.00:1
Sulfide Concentration (ppm):	0.104

NOTES

Data entry by:	SKS	Date:	11/7/2018
Checked by:	WAR	Date:	11/7/18
File name:	2679130__Corrosion Test ASTM C1580 D4972 D1411 G187_2.xlsm		

Corrosion Suite
ASTM C1580 D4972 D1411 G187

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	BORING NO.	B-101
JOB NO.	2679-130	DEPTH	50.6-51.5'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	S-19
PROJECT NO.	18115	DATE SAMPLED	07/26/18
LOCATION	--	DESCRIPTION	--
DATE TESTED	10/27/18		
TECHNICIAN	SKS		

Measured Sulfate Concentration (ppm):	11
Dilution:	10.00:1
Sulfate Concentration (ppm):	107
Measured Chloride Concentration (ppm):	14.4
Dilution:	10.00:1
Chloride Concentration (ppm):	144.0
pH:	7.3
Minimum Measured Resistivity (Ω):	1300
Box Correction Factor (cm):	2.00
Minimum Resistivity (Ω·cm):	2600
Measured Sulfide Concentration (ppm):	0.092
Dilution:	2.00:1
Sulfide Concentration (ppm):	0.184

NOTES

Data entry by:	SKS	Date:	11/7/2018
Checked by:	MAC	Date:	11/7/18
File name:	2679130__Corrosion Test ASTM C1580 D4972 D1411 G187_0.xlsm		

ADVANCED TERRA TESTING

Corrosion Suite
ASTM C1580 D4972 D1411 G187

CLIENT	RJH Consultants	BORING NO.	B-102A
JOB NO.	2679-130	DEPTH	44-45'
PROJECT	Hogchute Dam Safety Evaluation	SAMPLE NO.	CA-20
PROJECT NO.	18115	DATE SAMPLED	07/24/18
LOCATION	--	DESCRIPTION	--
DATE TESTED	10/28/18		
TECHNICIAN	SKS		

Measured Sulfate Concentration (ppm):	5
Dilution:	1.00:1
Sulfate Concentration (ppm):	5
Measured Chloride Concentration (ppm):	10.8
Dilution:	10.00:1
Chloride Concentration (ppm):	108.0
pH:	7.4
Minimum Measured Resistivity (Ω):	770
Box Correction Factor (cm):	2.00
Minimum Resistivity (Ω·cm):	1540
Measured Sulfide Concentration (ppm):	0.01
Dilution:	1.00:1
Sulfide Concentration (ppm):	0.01

NOTES

Data entry by:	SKS	Date:	11/7/2018
Checked by:	WAL	Date:	11/7/18
File name:	2679130__Corrosion Test ASTM C1580 D4972 D1411 G187_1.xlsm		

Pinhole Dispersion Test
ASTM D4647, Method A

Identification and Classification of Dispersive Clay Soils by the Pinhole Test
ASTM D 4647 Method A

Client: RJH Consultants
Job No.: 2679-130
Project: Hogchute Dam Safety Evaluation
Location: --
Project No.: 18115

Boring No.: B-101
Depth: 30-31'
Sample No.: CA-11
Date Tested: 11/6/2018
By: BDF

Before Test Moisture Content

Wet Weight Soil & Dish: 29.84g
Dry Weight Soil & Dish: 25.99g
Weight Of Water: 3.86g
Dish Weight: 3.14g
Dry Weight Soil: 22.84g
Moisture Content: 16.89%

Classification: ND1
Original Pinhole Diameter: 0.04in, 0.0010m
Final Pinhole Diameter: 0.04in, 0.0010m
Sample Type: Remolded

Before Test Density

Height: 1.50in, 0.0381m
Diameter: 1.94in, 0.0492m
Weight: 0.3297lbs, 149.57g
Wet Density: 128.78lbs/ft^3, 2063kg/m^3
Dry Density: 110.17lbs/ft^3, 1765kg/m^3

Test Data

Two Inch Head Height	Flow	Elapsed Time	Flow Rate	Turbidity	Observations
	30ml	60s	0.008gal/min, 0.5ml/s	Clear	
	29ml	60s	0.008gal/min, 0.5ml/s	Clear	
	28ml	60s	0.007gal/min, 0.5ml/s	Clear	
	28ml	60s	0.007gal/min, 0.5ml/s	Clear	
	27ml	60s	0.007gal/min, 0.5ml/s	Clear	
	27ml	60s	0.007gal/min, 0.5ml/s	Clear	
	27ml	60s	0.007gal/min, 0.5ml/s	Clear	
	27ml	60s	0.007gal/min, 0.5ml/s	Clear	
	25ml	60s	0.007gal/min, 0.4ml/s	Clear	
	26ml	60s	0.007gal/min, 0.4ml/s	Clear	
Seven Inch Head Height	**Flow**	**Elapsed Time**	**Flow Rate**	**Turbidity**	**Observations**
	48ml	60s	0.013gal/min, 0.8ml/s	Barely Visible	Particles at bottom
	48ml	60s	0.013gal/min, 0.8ml/s	Clear	
	47ml	60s	0.012gal/min, 0.8ml/s	Clear	
	47ml	60s	0.012gal/min, 0.8ml/s	Clear	
	46ml	60s	0.012gal/min, 0.8ml/s	Clear	
Fifteen Inch Head Height	**Flow**	**Elapsed Time**	**Flow Rate**	**Turbidity**	**Observations**
	79ml	60s	0.021gal/min, 1.3ml/s	Barely Visible	
	79ml	60s	0.021gal/min, 1.3ml/s	Clear	
	78ml	60s	0.021gal/min, 1.3ml/s	Clear	
	78ml	60s	0.021gal/min, 1.3ml/s	Clear	
	78ml	60s	0.021gal/min, 1.3ml/s	Clear	
Forty Inch Head Height	**Flow**	**Elapsed Time**	**Flow Rate**	**Turbidity**	**Observations**
	69ml	30s	0.036gal/min, 2.3ml/s	Barely Visible	
	70ml	30s	0.037gal/min, 2.3ml/s	Clear	
	72ml	30s	0.038gal/min, 2.4ml/s	Clear	
	70ml	30s	0.037gal/min, 2.3ml/s	Clear	Particles at bottom
	70ml	30s	0.037gal/min, 2.3ml/s	Clear	

File Name: 2679_130_pinhole-ASTMD-4647-R3_0.xls
Entered By: SPH
Date: 11/7/2018

Data Checked By: KMS
Date: 11/8/18

ATT
ADVANCED TERRA TESTING

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	B-101
JOB NO.	2679-130	30-31'
PROJECT	Hogchute Dam Safety Evaluation	CA-11
PROJECT NO.	18115	
LOCATION	--	AFTER TEST

NOTES

File name: 2679130__Image_18_11_07_16_16_39

Identification and Classification of Dispersive Clay Soils by the Pinhole Test
ASTM D 4647 Method A

Client: RJH Consultants
Job No.: 2679-130
Project: Hogchute Dam Safety Evaluation
Location: --
Project No.: 18115

Boring No.: B-103
Depth: 15-16'
Sample No.: CA-8
Date Tested: 11/6/2018
By: BDF

Before Test Moisture Content

Wet Weight Soil & Dish: 39.71g
Dry Weight Soil & Dish: 35.33g
Weight Of Water: 4.38g
Dish Weight: 3.13g
Dry Weight Soil: 32.20g
Moisture Content: 13.60%

Classification: ND1
Original Pinhole Diameter: 0.04in, 0.0010m
Final Pinhole Diameter: 0.04in, 0.0010m
Sample Type: Remolded

Before Test Density

Height: 1.50in, 0.0381m
Diameter: 1.94in, 0.0492m
Weight: 0.3068lbs, 139.16g
Wet Density: 119.81lbs/ft³, 1919kg/m³
Dry Density: 105.47lbs/ft³, 1689kg/m³

Test Data

Two Inch Head Height	Flow	Elapsed Time	Flow Rate	Turbidity	Observations
	10ml	30s	0.005gal/min, 0.3ml/s	Clear	Particles on bottom
	8ml	30s	0.004gal/min, 0.3ml/s	Clear	Particles on bottom
	8ml	30s	0.004gal/min, 0.3ml/s	Clear	Particles on bottom
	9ml	30s	0.005gal/min, 0.3ml/s	Clear	
	9ml	30s	0.005gal/min, 0.3ml/s	Clear	
	8ml	30s	0.004gal/min, 0.3ml/s	Clear	
	12ml	30s	0.006gal/min, 0.4ml/s	Clear	
	7ml	30s	0.004gal/min, 0.2ml/s	Clear	
	8ml	30s	0.004gal/min, 0.3ml/s	Clear	
	9ml	30s	0.005gal/min, 0.3ml/s	Clear	
Seven Inch Head Height	**Flow**	**Elapsed Time**	**Flow Rate**	**Turbidity**	**Observations**
	42ml	60s	0.011gal/min, 0.7ml/s	Barely Visible	Particles on bottom
	41ml	60s	0.011gal/min, 0.7ml/s	Barely Visible	
	42ml	60s	0.011gal/min, 0.7ml/s	Clear	
	42ml	60s	0.011gal/min, 0.7ml/s	Clear	
	40ml	60s	0.011gal/min, 0.7ml/s	Clear	
Fifteen Inch Head Height	**Flow**	**Elapsed Time**	**Flow Rate**	**Turbidity**	**Observations**
	78ml	60s	0.021gal/min, 1.3ml/s	Barely Visible	Particles on bottom
	89ml	60s	0.024gal/min, 1.5ml/s	Clear	Particles on bottom
	90ml	60s	0.024gal/min, 1.5ml/s	Clear	
	88ml	60s	0.023gal/min, 1.5ml/s	Clear	
	87ml	60s	0.023gal/min, 1.5ml/s	Clear	
Forty Inch Head Height	**Flow**	**Elapsed Time**	**Flow Rate**	**Turbidity**	**Observations**
	74ml	30s	0.039gal/min, 2.5ml/s	Barely Visible	Particles on bottom
	75ml	30s	0.040gal/min, 2.5ml/s	Clear	Particles on bottom
	74ml	30s	0.039gal/min, 2.5ml/s	Clear	
	73ml	30s	0.039gal/min, 2.4ml/s	Clear	
	74ml	30s	0.039gal/min, 2.5ml/s	Clear	

File Name: 2679_130_pinhole-ASTMD-4647-R3_1.xls
Entered By: SPH
Date: 11/7/2018

Data Checked By: KMS
Date: 11/8/18

ADVANCED TERRA TESTING

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	B-103
JOB NO.	2679-130	15-16'
PROJECT	Hogchute Dam Safety Evaluation	CA-8
PROJECT NO.	18115	
LOCATION	--	AFTER TEST

NOTES

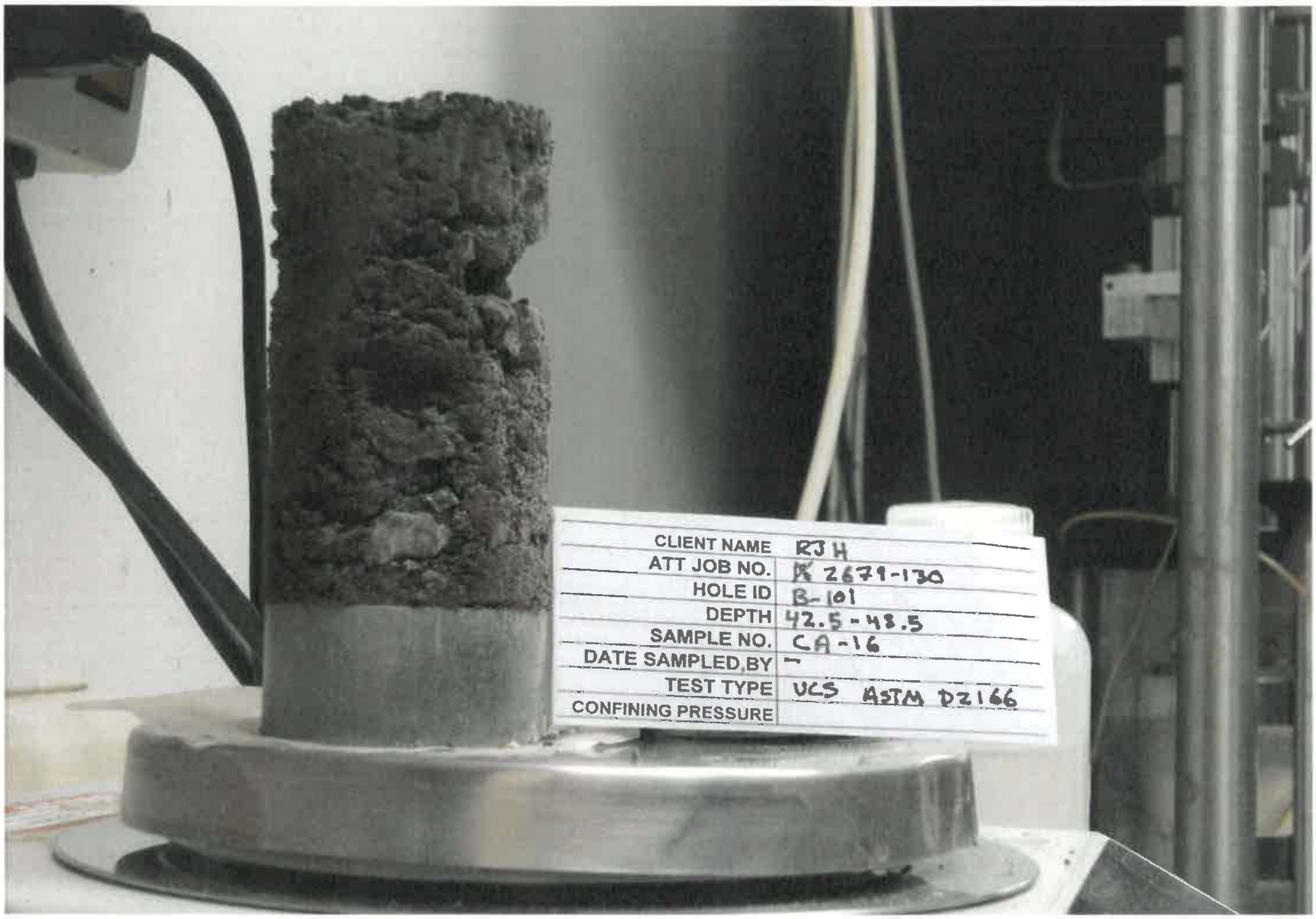
File name: 2679130__Image_18_11_07_16_19_51

Other - Sample Photographs

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	--
JOB NO.	2679-130	--
PROJECT	Hogchute Dam Safety Evaluation	--
PROJECT NO.	18115	--
LOCATION	--	--



NOTES	

File name: 2679130__Image_18_10_18_07_42_26

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	--
JOB NO.	2679-130	--
PROJECT	Hogchute Dam Safety Evaluation	--
PROJECT NO.	18115	--
LOCATION	--	--

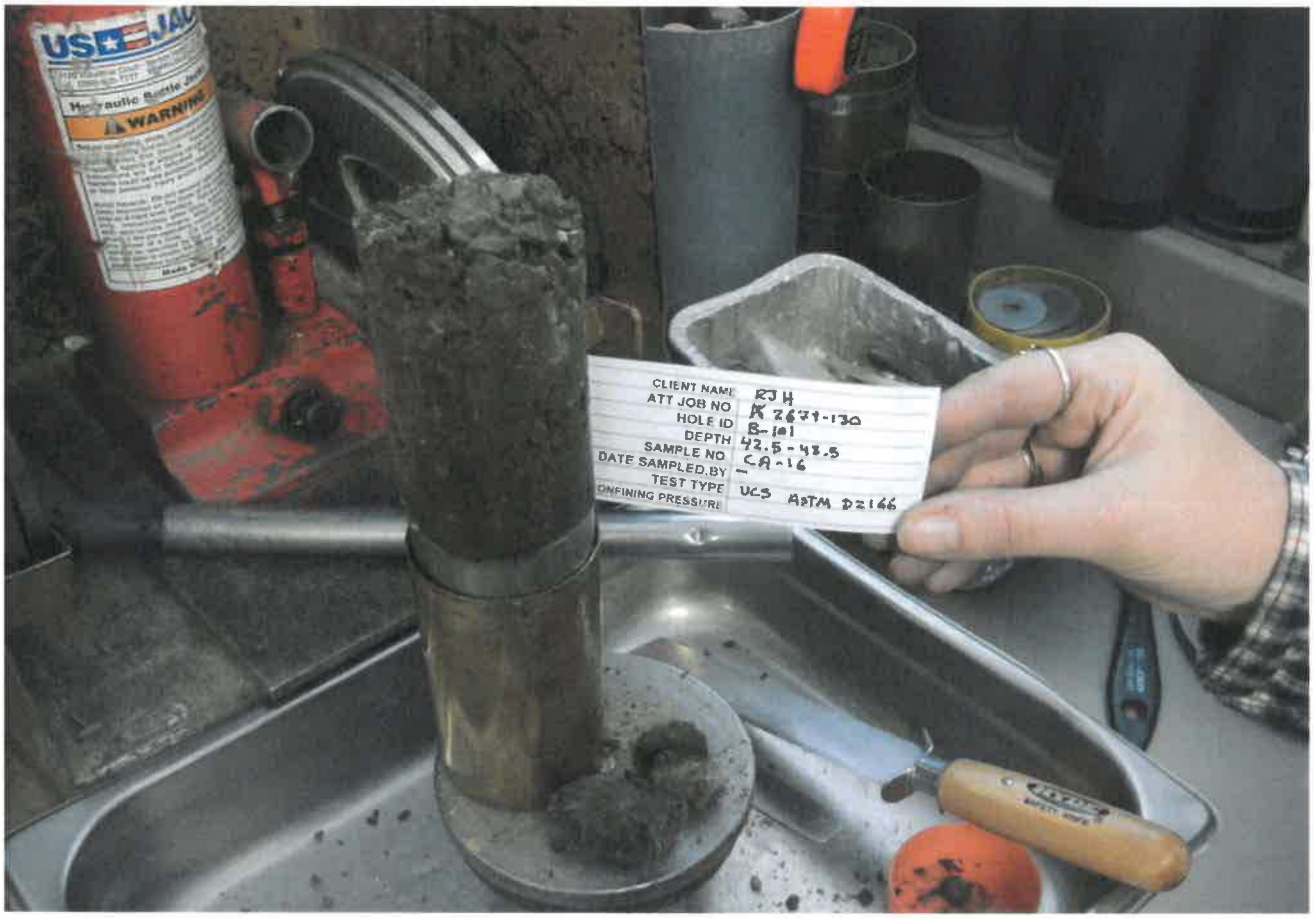
NOTES

File name: 2679130__Image_18_10_18_07_43_12

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	--
JOB NO.	2679-130	--
PROJECT	Hogchute Dam Safety Evaluation	--
PROJECT NO.	18115	--
LOCATION	--	--



NOTES	

File name: 2679130__Image_18_10_18_07_44_01

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	--
JOB NO.	2679-130	--
PROJECT	Hogchute Dam Safety Evaluation	--
PROJECT NO.	18115	--
LOCATION	--	--

NOTES

File name: 2679130__Image_18_10_18_07_44_41

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	--
JOB NO.	2679-130	--
PROJECT	Hogchute Dam Safety Evaluation	--
PROJECT NO.	18115	--
LOCATION	--	--

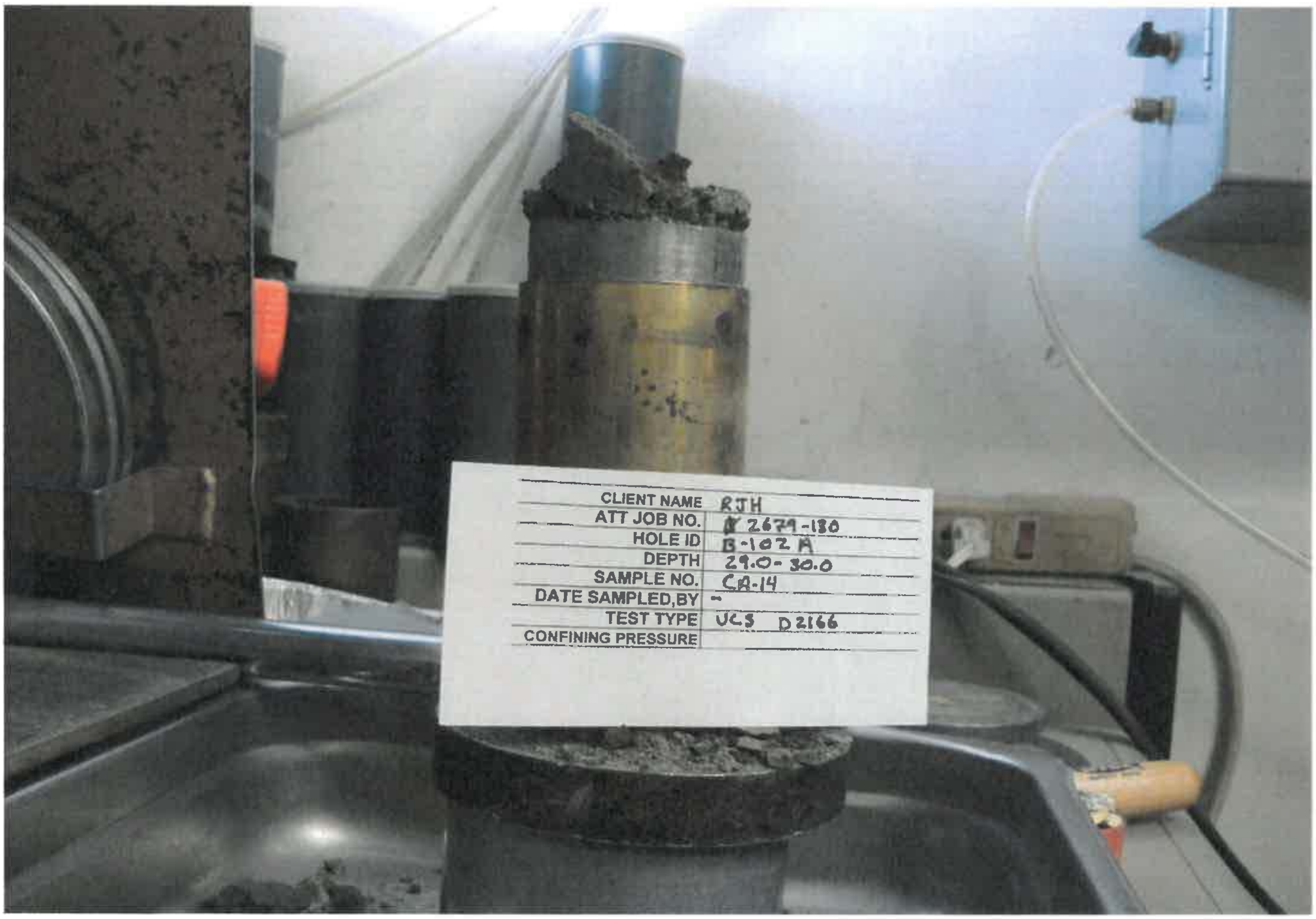
NOTES

File name: 2679130__Image_18_10_18_07_45_19

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	--
JOB NO.	2679-130	--
PROJECT	Hogchute Dam Safety Evaluation	--
PROJECT NO.	18115	--
LOCATION	--	--



NOTES

File name: 2679130__Image_18_10_18_07_46_14

Image Attachment

ADVANCED TERRA TESTING

CLIENT	RJH Consultants	--
JOB NO.	2679-130	--
PROJECT	Hogchute Dam Safety Evaluation	--
PROJECT NO.	18115	--
LOCATION	--	--

NOTES

File name: 2679130__Image_18_10_18_07_46_52

APPENDIX E

SEEPAGE INVESTIGATION DAILY FIELD REPORTS

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 001-GOJ**
Task 1002 Seepage Investigation **Date: Wednesday, August 8, 2018**

Prepared By: Garrett Jackson (GOJ)
Weather: low 80's, mostly sunny, light-moderate breeze

People on Site (arrival/departure time)

- RJH:
  - GOJ (09:45/18:00)
- Sorter:
  - Bill Ogle (10:25/17:45)
- Slade Connell, Ron Key from City of Grand Junction (~11:30-12:00) observing from dam crest

Equipment on Site

Mobile
- GOJ Chevy Silverado
- Sorter Ford F250

At Dam Site Overnight
- Cat 320N backhoe

Excavation Progress Summary

- Sorter mobilized to the site, unloaded the backhoe from the low-boy at the intersection of the Hogchute road and Land's End Road, walked the hoe down to the dam.
- The backhoe was used to move rocks on the right side of the downstream dam slope and over the outlet conduit to construct a working pad from which to reach the left (south) side of the conduit. The backhoe moved rocks from this area to expose the native soil under the riprap to a level below the top of the outlet conduit encasement. No wetness was encountered in the area left of the outlet conduit.
- The backhoe moved slightly and excavated rock to expose the top of the concrete-encased outlet conduit and the area right (north) of the conduit. Water has historically been observed right of the outlet conduit, pooled under the riprap behind (upstream of) the remains of the original outlet control structure at the downstream end of the conduit. Water was encountered during excavation along the right of the outlet about 12"-16" below the top of the encasement. Water appeared to be entering the excavation from along the conduit, but a specific location could not be identified. The backhoe continued removing rock along the conduit to follow the ponded water back under the riprap to about 25' upstream of the concrete structure headwall.
- The backhoe repositioned to the top of the outlet channel bank above the right end of the headwall to finish cleaning the excavation. Sorter used the backhoe and a hand

shovel to clear the excavation bottom and drain standing water around the right end of the headwall. To drain the water from the deeper portions of the excavation, a trench was excavated around the right end of the headwall, which bypassed the existing seepage measuring sump used for monitoring the flow. The sump and old drain pipe are now dry, and water from the excavated area drains under the outlet channel riprap into the channel downstream of the headwall.

Seepage Observations

- At the beginning of the day, water was standing in the riprap behind the headwall and draining to the sump as usual. No flow measurement was taken, but visually the discharge appeared to be about 4-5 gpm, and was clear.
- Minor wetness was observed in a backhoe track on the native ground above the riprap on the right side of the dam toe. Wetness persisted through the day but dried slightly in the sun and breeze.
- At the end of the day, after the excavation had drained, very minor seepage was observed coming from under the thin layer of riprap at the north corner of the upstream end of the excavation. It is unknown at this time if this is a remnant of ponded water draining to the excavation, or if this is potentially groundwater discharging from the excavated natural hillside at the toe of the dam.
- Water was observed seeping from under the headwall slab when the rock and soil were excavated along the right side of the conduit. Discharge was from the gravel beneath the slab, was somewhat episodic, and was clear. Maximum discharge was estimated to be about 1 gpm.
- Minor wetness (no flow) was observed high on the slope in the dense willows above the two historic seepage channels through the willows.

Plan for Next Work Day

- GOJ will call USFS and USACE first thing in the morning to discuss the work to date and invite them to observe conditions at the site.
- GOJ and Sorter to meet at the site tomorrow at 8:30 am.
- GOJ and Sorter will inspect the excavation to identify any sources of seepage from the outlet conduit, the dam toe, or the natural hillside.
- The outlet conduit concrete encasement will be cleaned with hand shovels to expose any seepage discharge location(s).
- All seepage locations will be documented with photos and measurements.
- SEO will be onsite to observe the excavation and seepage conditions.

Site Coordination Activities

- Did not have a gate key or combination, so GOJ cut the chain on the gate to the reservoir. Slade Connell (City) placed a padlock on the gate later in the morning, combination is 1564. Gate is locked.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project | **Report No.: 001-GOJ**
Task 1002 Seepage Investigation | **Date: Wednesday, August 8, 2018**

Photographs

Downstream toe of slope above the remains of the old outlet control structure and headwall prior to excavation for seepage investigation.

Standing water has been observed for many years under the rocks in the area behind the headwall and along the right side of the conduit.

DAILY SITE REPORT

Excavating the right (north) side of the outlet conduit, where water has been observed pooled behind the headwall for many years.

Note the left side of the conduit is dry.

Top of concrete-encased outlet conduit.

Water pooled right of the conduit behind the headwall.

	Pooled seepage water draining around right end of headwall.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project **Report No.: 001-GOJ**
Task 1002 Seepage Investigation **Date: Wednesday, August 8, 2018**

	Backhoe cleaning channel for draining excavation along right side of conduit.

DAILY SITE REPORT

18115 Hogchute Dam Safety Evaluation Project
Task 1002 Seepage Investigation

Report No.: 002-GOJ
Date: Wednesday, August 9, 2018

Prepared By: Garrett Jackson (GOJ)
Weather: mid 80's, sunny, light-moderate breeze

People on Site (arrival/departure time)

- RJH:
  - GOJ (08:00-14:45)
- Sorter:
  - Bill Ogle (08:50-14:45)
- Jackie Blumberg (JB) and Jason Ward (JW) (SEO) (~08:50-13:30)

Equipment on Site

Mobile
- GOJ Chevy Silverado
- Sorter Ford F250
- SEO Chevy Blazer and Ford F150

At Dam Site Overnight
- All equipment demobilized from site

Excavation Progress Summary

- After draining overnight, the excavated area right of the outlet conduit was essentially dry, except for water standing in several puddles. The seepage entering the excavation from under the rocks at the upstream end is a steady but barely-noticeable trickle. The only measurable water entering the excavation came from under the old control structure foundation slab at the downstream end of the conduit. The seepage flow was visually estimated to be about 4-5 gpm and was clear.
- After clearing the top of the concrete encasement under the slab, water was observed bubbling from an old broken approximately 3/4" inch diameter pipe in the top of the encasement. Based on a review of the 1947 design drawings, this pipe is believed to be the remnant of the reservoir level measurement line extending from the upstream end of the conduit to the old control structure at the downstream end. The line is shown as passing along the conduit within the concrete encasement. The pipe is located inside the old structure, about18" downstream of the upstream structure wall. An earlier patch is visible in the floor of the structure remains over the broken pipe, and the file mentions a previous repair to the reservoir level pressure line.
- With the excavation drained, I observed that the outlet conduit is founded on clayey soils that are very similar to the materials encountered in the piezometer borings drilled on the crest of the dam.

- Sorter backfilled the investigation excavation with the rock removed yesterday. Generally, and as feasible, Sorter placed smaller (< ~12") rocks in the bottom of the excavation at the concrete structure where the flowing water enters the excavation. Larger rocks were placed above these smaller rocks, taking care to not drop large rocks on top of the outlet conduit.
- Since the bottom of the new trench draining the excavation is lower than the existing drain pipe and sump, the drain was reconstructed by laying the old 4" PVC pipe in the bottom of the new trench. The old plastic sump was relocated to a new hole excavated in the riprap on the right side of the outlet channel downstream of the headwall, and the 4" pipe was anchored to drain into the relocated sump.

SEO Discussion

- GOJ, JB, and JW discussed the seepage investigation. All agreed that the major source of the water historically pooled behind the headwall has been identified, and this leakage from the broken pipe is not an immediate threat to the dam's safety. The broken reservoir level measurement pipe will be repaired or properly abandoned during rehabilitation of the outlet works.
- Other evidences of seepage (in the upstream corner of the excavation and in the dense willows at the top of the hill right of the outlet channel) will need to be evaluated and addressed, but there is no evidence at this time indicating this seepage is a dam safety concern.
- The City is considering not draining the reservoir for the outlet works assessment task of this dam safety evaluation. They will likely skip the assessment and proceed directly to design of the outlet works rehabilitation, which will include eliminating the twin 20-inch lines and extending the 30-inch conduit upstream to a new intake structure. In this case, there would be no need to drain the reservoir until it is required for construction. JB agreed that, if this is the City's plan, there will be no need to inspect the existing conduit this year. The post-construction inspection will restart the 10-year inspection cycle.

Seepage Observations

- Minor wetness (no flow) was observed in the two historic seepage channels through the willows.
- The shallow wetness exposed yesterday by the backhoe track on top of the hill above the excavation is dry.
- The ground in the dense willows at the top of the hill above the two historic seepage channels is very wet where it has been disturbed by the backhoe.

Plan for Next Work Day

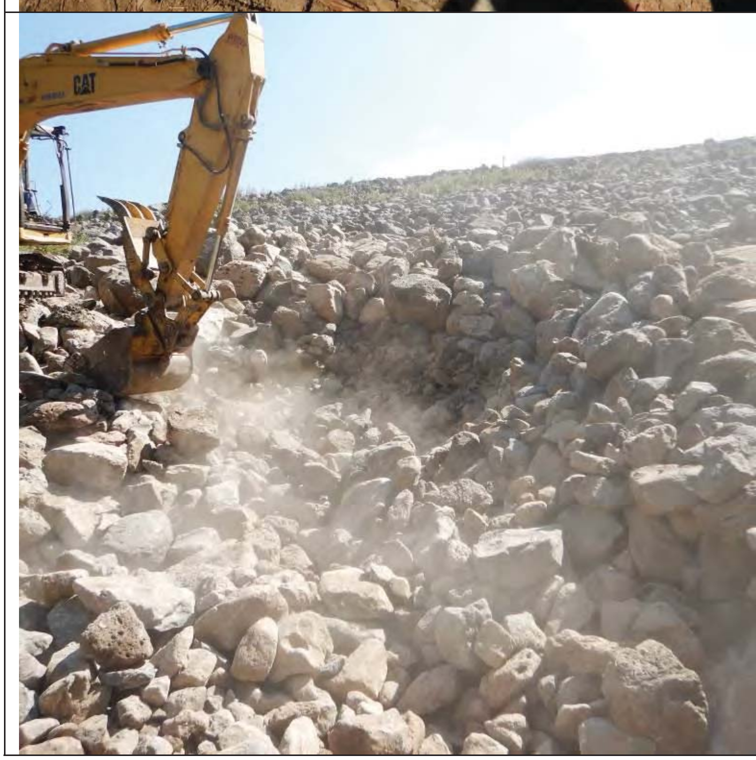
Seepage investigation is complete.

Site Coordination Activities

- Sorter tracked the backhoe back up to the parking lot at about 12:45. Bill Ogle drove out to the observatory and called for the truck to come pick up the hoe. GOJ drove Bill back down to the parking lot, and Bill started driving the hoe up to Land's End Road for loading.
- 14:15 GOJ departed site.

Photographs

	Seepage emerging from under the old control structure foundation slab is the only measurable water entering the excavation.
	Water is bubbling from a broken pipe in the top of the outlet conduit encasement. The pipe is believed to extend to the upstream end of the conduit, passing along the conduit within the concrete encasement.

	Water from the broken pipe emerges from under the slab and drains to the right side of the conduit, where it is collected in the excavation and routed around the right end of the headwall for measurement.
	Backhoe replacing excavated rock in the investigation excavation.

Attachment 4
Project Manual

CONSTRUCTION SPECIFICATIONS

FOR

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION

DAMID 420127

CONSTRUCTION NO. C-0454A

WATER DIVISION 4, WATER DISTRICT 42

MESA COUNTY, CO

FEBRUARY 2021

Owned by City of Grand Junction, CO

AYRES

3433 Oakwood Hills Parkway
Eau Claire, WI 54701-7698
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www.AyresAssociates.com

Ayres Project No. 26-1144.00

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION

DAMID 420127

CONSTRUCTION NO. C-0454A

WATER DIVISION 4, WATER DISTRICT 42

MESA COUNTY, CO

FEBRUARY 2021

These Construction Specifications have been prepared by me or under my direct supervision.

Todd Rudolph
Colorado P.E. No. 58436

Dustin Robinson
Colorado P.E. No. 37109

Approved on the _______ day of __________ 2021

____
State Engineer

By:_______________________________
Bill McCormick, Chief, Colorado Dam Safety
Colorado P.E. No. 29127

HOGCHUTE (AKA CARSON) RESERVOIR DAM REHABILITATION
DAM ID 420127
CONSTRUCTION NO. C-0454A
WATER DIVISION 4, WATER DISTRICT 42
MESA COUNTY, CO

TABLE OF CONTENTS

Specifications

SECTION 01 01 00

GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 PROJECT DESCRIPTION

A. In general, the project consists of:

1. Mobilization.
2. Drawdown, diversion, and dewatering.
3. Erosion and sediment controls.
4. Clearing and grubbing.
5. Stripping and stockpiling.
6. Developing borrow area.
7. Construction of new auxiliary spillway weir and improved spillway chute.
8. Excavation of embankment.
9. Demolition of existing outlet works (buttress) intake structure.
10. Construction of new outlet works (buttress) intake structure.
11. Replacement and rehabilitation of existing outlet works conduit.
12. Construction of embankment filter, filter diaphragm around conduit, and toe drain.
13. Backfill and site restoration.

1.02 STATE ENGINEER AUTHORITY

A. The plans and specifications cannot be significantly changed without the prior written approval of the State Engineer. If changed conditions are encountered after the State Engineer's approval is issued, the changes shall be documented in accordance with Rule 8.2.5 of Rules and Regulations for Dam Safety and Dam Construction.

B. Construction shall not be considered complete until the State Engineer has accepted the construction in writing.

C. The Engineer will monitor the quality of construction as specified in Rule 8.1.2 of Rules and Regulations for Dam Safety and Dam Construction. The Engineer monitoring the construction for the Owner is responsible for compliance with the approved design and specifications, preparation of the necessary documentation for the State Engineer's review and approval of all design change orders, and preparation of the project completion documents, and for recommending the project for acceptance to the State Engineer.

1.03 WORK BY OTHERS

A. Owner will draw down the reservoir and bypass flows prior to and during construction.

1.04 WORK SEQUENCE

A. The work shall be performed in accordance with general sequence or phasing included on the Drawings.

1.05 PROJECT MEETINGS

A. A preconstruction conference will be scheduled after award of contract and prior to beginning work. This meeting shall be attended by A/E, Owner, an authorized representative of the Contractor, and a DSB representative.

B. Periodic progress meetings will be held at project site at times designated by Owner or A/E. A responsible representative of Contractor who can bind Contractor to decisions shall attend.

1.06 WORK HOURS

A. Work shall be conducted between the hours of 7:00 a.m. to 6:00 p.m. on normal work days, unless approved for unusual circumstances.

B. Give written notice to A/E whenever it is desired to perform work at night, or on a Saturday, Sunday, or holiday, or to vary period of hours during which work is carried on each day. If approved, such work shall be subject to requirements furnished in writing by A/E, and no extra compensation will be allowed.

1.07 SUBMITTAL PROCEDURES

A. See Section 01 33 00.

1.08 PERMITS AND CODES

A. Owner will obtain permits, licenses, and approvals, which may include the following:

1. State of Colorado Division of Water Resources Office of the State Engineer Dam Safety Branch Approval for the Alteration, Modification, or Repair of a Dam and Reservoir.
2. US Army Corps of Engineers (USACE) Clean Water Act Section 404 Nationwide Permit and Clean Water Act Section 401 Water Quality Certification Authorization.
3. Colorado State Historic Preservation Office (SHPO) Section 106 review.
4. US Forest Service (USFS) Special Use Permit.
5. Colorado Discharge Permit System (CDPS) General Permit for Stormwater Discharges Associated with Construction Activities, COR400000.
6. Mesa County Construction Stormwater Permit.

B. Contractor shall comply with the requirements of the above permits, licenses, and approvals. If a copy of a permit, license, or approval is not available for review prior to the Bid Deadline, and if it contains a requirement not covered by the Contract Documents, such a requirement will be considered extra work if Contractor makes a claim under the terms of the General Conditions. Work shall not begin on items applicable to the above until the required permit, license, or approval is received.

C. Contractor shall provide all other necessary permits and licenses and pay all fees, taxes, and royalties, unless otherwise indicated.

D. Comply with local and municipal ordinances and applicable state and national codes.

1.09 TEMPORARY UTILITIES

A. Contractor shall be responsible for providing temporary electric power as required for construction purposes. Provide portable power supply or make arrangements with local utility company.

B. Contractor shall be responsible for obtaining water for its needs. Pay cost of water used and meter rental, if applicable.

C. Contractor shall provide temporary outside toilets sufficient for construction workers. Toilets shall be self-contained chemical type and shall comply with applicable Codes. Maintain sanitary facilities in a clean and sanitary condition; supply toilet paper until completion of project. Contractor may not use USFS pit toilets located in project parking lot.

1.10 FIELD OFFICES

A. Contractor's Office:

1. Contractor shall provide and maintain a temporary office where directed for itself and its subcontractors.

2. Office shall have a meeting area for holding construction project meetings. Meeting will be attended by representatives of Contractor, A/E, Owner, and each subcontractor actively working on site.

B. A/E's Office:

1. Contractor shall provide and maintain a temporary office for use by A/E. Office may be in same mobile trailer as Contractor's office.
2. Provide the following equipment in A/E office: standard desk and chair, first aid kit and access to a copy machine.
3. Contractor shall arrange and pay for the following services: Power, heating, air conditioning, trash cans, and weekly trash pick-up service.
4. When directed, move A/E's office into a suitable area in building.

C. Internet Access:

1. Contractor shall arrange and pay for a wireless internet access point in the Contractor’s or A/E’s temporary office.

a. The access point shall allow dynamic IP addresses (DHCP) and be able to accommodate IPSec based VPN products.
b. The wireless internet access speed shall be a minimum of 10 Mbps download and 3 Mbps upload such as provided through a 4G LTE cellular connection.
c. The wireless service shall be secured with a password. Password shall be provided to A/E.
d. The wireless router shall have sufficient capacity to handle at least four computers operating simultaneously and accessing the internet simultaneously. A/E could have two wireless devices simultaneously accessing the internet.

1.11 PROTECTION

A. Furnish and maintain proper barricades, fences, signal lights, warning signs, and personnel as required to properly protect and safeguard the work, persons, animals, and property against injury.

1.12 ENVIRONMENTAL CONTROLS

A. See Section 01 57 19.

1.13 TRAFFIC CONTROL

A. Conduct operations to ensure minimum interference with streets, walks, and adjacent facilities not part of construction project.

B. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

1.14 PRODUCT REQUIREMENTS

A. General: Provide new products manufactured and conditioned for the particular application as recommended by manufacturer, unless otherwise noted. Transport, handle, store, and protect products as specified and in accordance with manufacturer's recommendations.

B. Acceptable Manufacturers: Products, materials, and equipment identified by reference to a manufacturer's name, catalog number, or model are identified for the purpose of establishing a standard of type, function, appearance, and quality. Unless otherwise noted, any other product, material, or equipment which will perform adequately the duties imposed by the general design will be considered for substitution in accordance with the provisions below.

C. Bid Phase Substitutions: Substitutions and "or equal" items proposed prior to the Bid Deadline shall be submitted in accordance with the Instructions to Bidders.

D. Construction Phase Substitutions: Substitutions and "or equal" items proposed after Contract has been awarded shall be submitted for approval prior to their use. Consideration will be given only to proposed substitutions and "or equal" items where:

1. The products named in the Contract Documents are no longer available or cannot be provided within the Contract Time.
2. The manufacturers' standard products are no longer in conformance with the specified requirements.
3. Owner's interests may be adversely affected.

E. Substitution Procedures: Requests for substitution of alternate products or use of "or equal" items shall be submitted with complete references to manufacturer's product identification and product data indicating composition, guarantee, availability, applicable standards or agency approvals met or exceeded, restrictions imposed on product, and manufacturer's recommended method of application or installation. A substitution or an "or equal" item will be considered acceptable if the product will perform adequately the duties imposed by the general design and, in opinion of A/E, is of equal substance, quality, appearance, and function, unless the named item is necessary for interchangeability or if the named product has been demonstrated to be most cost-effective.

1.15 SURVEYS, STAKING, LINE AND GRADE

A. Owner will provide baseline reference points and benchmarks as indicated on Drawings. Contractor shall provide all other survey staking and layout as required to complete the Work.

1.16 FIELD MEASUREMENTS AND INSPECTION OF SURFACES

A. Contractor shall layout its Work based on reference points furnished by Owner and shall be solely responsible for the accuracy of its measurements. Verify grades, lines, levels, locations, and dimensions as shown on Drawings, and inspect surfaces that are to receive work before proceeding with fabricating, assembling, fitting, or erecting. Notify A/E in writing in case of unsuitable conditions, defective substrates, or discrepancies in Contract Documents. Starting of work shall imply acceptance of conditions.

B. Correct any errors or defects due to faulty measurements, improper layout, or failure to report discrepancies.

1.17 CONSTRUCTION CLEANING

A. Keep work area free of accumulations of surplus materials, rubbish, and debris.

1.18 ACCESS ROAD MAINTENANCE

A. Notify A/E and Owner before removing any existing trees along the access road.

B. Restore access road to dam to conditions prior to construction.

1.19 PUNCH LIST

A. A "punch list" will be prepared and distributed to Contractor at Substantial Completion. Items on punch list shall be completed within 30 days. Required submittals (see below) shall be completed prior to or when requesting final payment.

1.20 CLOSEOUT SUBMITTALS

A. Submit the following items to A/E prior to or with final Application for Payment:

1. Project record drawings marked to show all changes made during construction. Dimension underground and concealed work and utilities from permanent reference points; record vertical distances. Make and record measurements to the nearest 0.5 ft on a clean drawing set.
2. Evidence of continuing insurance coverage complying with insurance requirements (see Conditions of the Contract).
3. Contractor's affidavit, along with final releases and waivers of liens as required by Owner, indicating that all debts and claims against project (less amounts withheld by Owner) have been paid in full or otherwise satisfied.
4. Consent of surety company to final payment.

1.21 DEFINITIONS

A. Dimensions on drawings and details are subject to field measurements.

B. The term "working days" shall exclude weekends (Saturday and Sunday) and holidays.

C. References to "Division 00" shall mean the Bidding Requirements and Contracting Requirements.

D. References to "DSB” shall mean State of Colorado Division of Water Resources Office of the State Engineer Dam Safety Branch.

E. References to “USACE” shall mean US Army Corps of Engineers.

F. References to "Colorado DOT Std. Spec." shall mean Colorado Department of Transportation, Standard Specifications for Road and Bridge Construction, latest edition.

G. References to “USFS” shall mean US Forest Service.

H. References to “CDPS” shall mean Colorado Discharge Permit System.

I. References to "A/E", "Architect", or "Engineer" shall mean Ayres.

J. References to "Owner" shall mean City of Grand Junction.

PART 2 (NOT USED)

PART 3 (NOT USED)

END OF SECTION

SECTION 01 22 50

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Payment for all work done in compliance with the Contract Documents, including all labor, equipment, materials, and performance of operations relative to construction of this project, will be made under the Bid Items listed below. Work required by the Contract Documents for which there is not a Bid Item will be considered incidental to the Contract and no additional compensation will be allowed.

B. Owner reserves the right to alter Drawings, modify incidental work as may be necessary, and increase or decrease quantities of work to be performed, including deduction or cancellation of any one or more Bid Items. Changes in the Work shall not be considered as a waiver of any conditions of the Contract nor invalidate any provisions thereof. When changes result in revised quantities of work to be performed, Contractor shall accept payment according to contract unit prices appearing in the original Contract. A supplemental agreement between Contractor and Owner may be requested by either party when cumulative changes involve a net increase or decrease of more than 20 percent in total contract amount.

C. Final measured quantities determined in field by A/E at time of construction shall govern over approximate quantities shown on the Bid Schedule, unless otherwise noted. Contractor shall take no advantage of any apparent error or omission in Drawings or Specifications, and A/E shall be permitted to make corrections and interpretations as may be deemed necessary for fulfillment of the intent of the Contract Documents.

PART 2 (NOT USED)

PART 3 EXECUTION

3.01 MOBILIZATION

A. This work consists of work and operations necessary for movement of personnel, equipment, supplies, and incidentals to project site and for establishment of Contractor's offices and other temporary facilities (including sanitary) necessary for work on project; and of all other work and operations which must be performed, or for which costs must be incurred before beginning work on various items on project site; and demobilization at completion of work.

B. Measurement for payment will be as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price for MOBILIZATION, payable to Contractor in accordance with the following schedule:

1. When 5 percent or more of original contract amount is earned, 40 percent of amount bid for mobilization will be paid.
2. When 25 percent or more of original contract amount is earned, 80 percent of amount bid for mobilization will be paid.
3. When 90 percent or more of original contract amount is earned, 100 percent of amount bid for mobilization will be paid.

3.02 EROSION CONTROL

A. This work consists of furnishing, installing, and maintaining erosion and other environmental control measures in accordance with Section 01 57 19.

B. Measurement for payment will be as a complete unit of work acceptably completed.

C. Payment will be made at the contract lump sum price for EROSION CONTROL, payable to Contractor in accordance with the following schedule:

1. When erosion control measures are installed, 75 percent of amount bid for erosion control will be paid.
2. When erosion control measures have been removed, 100 percent of amount bid for erosion control will be paid.

3.03 CONSTRUCTION DEWATERING

A. This work consists of diverting surface water, constructing cofferdams, and dewatering construction site in accordance with Section 01 57 60 as required to complete the work.

B. Measurement for payment will be as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price for CONSTRUCTION DEWATERING, payable to Contractor in accordance with the following schedule:

1. When site is dewatered for construction, 75 percent of amount bid for dewatering will be paid.
2. When all dewatering measures are removed, 100 percent of amount bid for dewatering will be paid.

3.04 DEMOLITION

A. This work consists of removing the existing low-level outlet's intake and outfall structures, the existing low-level outlet's piping and controls (extent of removal indicated on the Drawings), and the existing grouted riprap overflow spillway in accordance with Section 02 41 00.

B. Measurement for payment will be as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price for DEMOLITION.

3.05 CONCRETE OVERFLOW SPILLWAY

A. This work consists of constructing the Concrete Overflow Spillway as designated in the Drawings and in accordance with Section 03 30 00, Section 31 20 00, and Section 31 37 00. Included in this bid item are required excavation and backfill, riprap armoring of the structure's abutments, and other items necessary and incidental for construction of the Concrete Overflow Spillway.

B. Measurement for payment will be as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price for CONCRETE OVERFLOW SPILLWAY.

3.06 EMBANKMENT EXCAVATION

A. This work consists of excavating and stockpiling the downstream rock shell and embankment fill as shown on the Drawings and as defined in Section 31 24 00 and Section 31 20 00.

B. Measurement for payment will bDraine as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price for EMBANKMENT EXCAVATION.

3.07 TYPE I DRAIN FILL

A. This work consists of furnishing and placing Type I Drain Fill, including the filter diaphragm, in accordance with Section 33 41 66 and as shown on the Drawings.

B. Measurement for payment will be the number of cubic yards of Type I Drain Fill acceptably placed within the Type I filter and diaphragm limits indicated on the Drawings.

  1. Type I Drain Fill required to fill voids resulting from over excavation outside specified lines and grades will not be measured for payment, unless such over excavation is authorized to remove unsuitable material where unsuitable condition is not a result of Contractor’s operations.

C. Payment will be made at the contract unit price per cubic yard for TYPE I DRAIN FILL.

3.08 TYPE II DRAIN FILL

A. This work consists of furnishing and installing Type II Drain Fill in accordance with Section 33 41 66 and as shown on the Drawings.

B. Measurement for payment will be the number of cubic yards of Type II Drain Fill acceptably placed within the Type II filter limits indicated on the Drawings.

  1. Type II Drain Fill required to fill voids resulting from over excavation outside specified lines and grades will not be measured for payment, unless such over excavation is authorized to remove unsuitable material where unsuitable condition is not a result of Contractor’s operations.

C. Payment will be made at the contract unit price per cubic yard for TYPE II DRAIN FILL.

3.09 HDPE PERFORATED DRAIN PIPE

A. This work consists of furnishing and installing perforated HDPE drain pipes and fittings as indicated on the Drawings and in accordance with Section 33 41 66 and Section 33 42 15.

B. Measurement for payment will be the number of linear feet of perforated HDPE drain pipe in place, not to exceed limits shown on Drawings.

C. Payment for drainage pipe will be made at the contract unit price per linear foot for HDPE PERFORATED DRAIN PIPE.

3.10 HDPE SOLID DRAIN PIPE

A. This work consists of furnishing and installing non-perforated (solid) HDPE drain pipes, fittings, and cleanouts as indicated on the Drawings and in accordance with Section 33 41 66 and Section 33 42 15.

B. Measurement for payment will be the number of linear feet of solid drain pipe in place, not to exceed limits shown on Drawings.

C. Payment for drainage pipe will be made at the contract unit price per linear foot for HDPE SOILID DRAIN PIPE.

3.11 EMBANKMENT BACKFILL

A. This work consists of placing and compacting embankment fill and placing the downstream rock shell, restoring stockpile areas, and other items necessary and incidental for construction of the embankment as shown on the Drawings and as indicated in Section 31 24 00, Section 31 20 00, and Section 31 23 33.

B. Measurement for payment will be as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price for EMBANKMENT BACKFILL.

3.12 IMPORTED EMBANKMENT FILL

A. This work consists of furnishing additional embankment fill, as required, to construct the embankment as shown on the Drawings and as indicated in Section 31 24 00.

B. Measurement for payment will be the number of cubic yards of imported embankment fill acceptably placed within the limits indicated on the Drawings.

C. Payment will be made at the contract unit price per cubic yard for IMPORTED EMBANKMENT FILL.

3.13 STAINLESS STEEL SLIDE GATE

A. This work consists of furnishing and installing a stainless steel slide gate and frame, a hydraulic actuator, hydraulic tubing, a portable gas-powered hydraulic pump, anchorages, fittings, and other items necessary and incidental for installing the stainless steel slide gate and hydraulic controls as shown on the Drawings and in accordance with Section 35 22 28 and Section 33 42 15.

B. Measurement for payment will be as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price each for STAINLESS STEEL SLIDE GATE.

3.14 CONCRETE BUTTRESS INTAKE STRUCTURE

A. This work consists of constructing the concrete buttress intake structure, the concrete conduit encasement (from the intake structure to the locking valve box at the top of dam), furnishing and installing required PVC piping (for air venting and for carrying hydraulic lines), furnishing and installing the steel elbow, and other items necessary and incidental for construction of the intake structure as designated in the Drawings and in accordance with Section 03 30 00, Section 33 42 15, and Section 05 50 00.

B. Measurement for payment will be as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price for CONCRETE BUTTRESS INTAKE STRUCTURE

3.15 LOCKING VALVE BOX

A. This work consists of furnishing and installing a locking valve box at the top of dam to house the stainless steel slide gate’s hydraulic connections and furnishing and installing the ductile iron vent riser as shown on the Drawings and as indicated in Section 26 05 43 and Section 33 42 15.

B. Measurement for payment will be as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price for LOCKING VALVE BOX.

3.16 TRASH RACK

A. This work consists of furnishing and installing the slide gate steel trash rack as shown on the Drawings and as indicated in Section 05 50 00.

B. Measurement for payment will be as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price for TRASH RACK.

3.17 WETLAND SOIL STOCKPILING

A. This work consists of stripping, stockpiling, watering, and replacing wetland soils as shown on the Drawings and as indicated in Section 32 92 26.

B. Measurement for payment will be the number of square yards of viable wetland soils, not to exceed the limits shown on the Drawings, successfully stockpiled and replaced following construction of the rock berms.

C. Payment for wetland soil stockpiling will be made at the contract unit price per square yard for WETLAND SOIL STOCKPILING.

3.18 AUXILIARY SPILLWAY GRADING

A. This work consists of earthwork in the auxiliary spillway area to the lines and grades shown on the Drawings and as indicated in Section 31 20 00.

B. Measurement for payment for auxiliary spillway grading will be the square yards of spillway grading not to exceed limits shown on Drawings will be made at the contract unit price per square yard.

C. Payment for auxiliary spillway grading will be made at the contract unit price per square yard for AUXILIARY SPILLWAY GRADING.

3.19 AUXILIARY SPILLWAY ROCK BERMS

A. This work consists of furnishing and placing riprap and other items necessary and incidental for construction of the rock berms in the auxiliary spillway in accordance with the Drawings and as indicated in Section 31 37 00.

B. Measurement for payment will be the number of linear feet of rock berms constructed.

C. Payment for riprap will be made at the contract unit price per linear foot for AUXILIARY SPILLWAY ROCK BERMS.

3.20 30-INCH STEEL PIPE

A. This work consists of furnishing and installing new 30-inch steel pipe and concrete pipe encasement at the locations designated in the Drawings and in accordance with Section 33 42 15 and Section 03 30 00.

B. Measurement for payment will be the linear feet of pipe and encasement placed.

C. Payment will be made at the contract unit price per linear foot for 30-INCH STEEL PIPE.

3.21 CIPP PIPE LINING

A. This work consists of lining the 30-inch steel pipe in accordance with Section 33 01 36 and as shown on the Drawings. Any special equipment, personnel, materials, inspections, and reports required for this work shall be incidental to this item.

B. Measurement for payment will be the number of linear feet of pipe acceptably lined.

C. Payment for CIPP pipe lining will be made at the contract unit price per linear foot for CIPP PIPE LINING.

3.22 IMPACT BASIN

A. This work consists of constructing the downstream concrete impact basin as designated in the Drawings and in accordance with Section 03 30 00, Section 31 20 00, Section 31 37 00, and Section 05 52 04. Included in this bid item are required excavation and backfill, riprap armoring downstream of the concrete structure, constructing the steel railing, and other items necessary and incidental for construction of the concrete impact basin.

B. Measurement for payment will be as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price for IMPACT BASIN.

3.23 SITE RESTORATION

A. This work consists of placing topsoil, fertilizing, seeding, sodding, planting, and mulching in accordance with Sections 32 92 26 and 32 99 10.

B. Measurement for payment will be as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price for SITE RESTORATION.

3.24 EARLY WARNING SYSTEM

A. This work consists of furnishing and installing the early warning system, staff gage, and station markers as shown on the Drawings and in accordance with Section 40 70 10. This bid item includes all items necessary for the construction, installation, and implementation of a functional early warning system, staff gage, and station markers.

B. Measurement for payment will be as a complete unit of work acceptably performed.

C. Payment will be made at the contract lump sum price for EARLY WARNING SYSTEM.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Submit items to A/E for review as required by the various Contract Documents. Refer to individual specification sections, General Conditions, Supplementary Conditions, and sections of Division 01 - General Requirements for submittal requirements.

B. At the preconstruction meeting, DSB will identify key submittals requiring joint DSB and A/E review and approval.

1.02 GENERAL PROCEDURES

A. Follow the requirements for each submittal type as specified below.

B. Submittals shall be identified with project name, numbered consecutively, and bear the stamp of approval of Contractor as evidence of accuracy, compatibility, and conformance with contract requirements. Submittals not so stamped will be returned without being examined.

C. Give specific written notice of each variation that submittals may have from requirements of the Contract Documents.

D. Partial submittals will not be considered. Submit each portion of work complete in one submittal.

E. Products subject to submittal review shall not be used in the work until submittals have been reviewed and bear the stamp and signature of A/E. Submittals will only be reviewed for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Contractor shall be responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and the means and methods of construction, coordinating its work with that of all other trades, and performing all work in a safe and satisfactory manner. Corrections or comments made on submittals shall not relieve Contractor from compliance with requirements of Drawings and Specifications and shall not be considered an order for extra work.

F. If information on previously reviewed shop drawings is altered, submit changes for review.

G. Maintain complete copies of all final submittals at the project site.

1.03 SHOP DRAWINGS

A. Required shop drawings are designated in the various specification sections. Submit shop drawings for review prior to fabrication, delivery, or installation in one of the following formats:

1. PDF electronic file. An annotated PDF electronic file will be returned to Contractor.

B. Each brochure of shop drawings shall contain an index of contents and shall consist of layout details, schedules, setting instructions, manufacturer's literature, and other data specifically prepared for the work. Reproductions of contract drawings may not be used without prior approval.

1.04 PRODUCT DATA

A. Required product data are designated in the various specification sections. Submit product data for review prior to delivery or installation in one of the following formats:

1. PDF electronic file. An annotated PDF electronic file will be returned to Contractor.

B. Product data shall consist of manufacturer's literature, illustrations, and brochures of catalog cuts; instructions for handling, storage, and installation; and specifications and design data. Where manufacturer's standard literature includes multiple products or options, identify the specific products and options as required for this project.

1.05 SAMPLES

A. Prior to fabrication, delivery, or installation, submit samples as designated in the various specification sections. Allow reasonable time for review and testing.

1. Submit samples in sufficient quantity and of adequate size to show quality, type, and extremes of color range, finish, and texture. Submit a minimum of two sets of appearance and color samples.

B. Label each sample stating material, description, project name, and Contractor's name. Expedite submittal of appearance and color samples following Notice to Proceed.

C. Submit samples with transmittal letter requesting review; prepay transportation charges. Samples shall become Owner's property, unless otherwise designated.

D. Samples will be reviewed for acceptability or selection of color, pattern, and texture only. Compliance with specifications is the responsibility of Contractor.

E. Order no materials subject to sample review until receipt of written notice of completion of review. Installed materials shall match reviewed samples. No review of samples shall be taken in itself to change contract requirements.

1.06 CERTIFICATES OF COMPLIANCE

A. Submit certificates of compliance as designated in the various specification sections in one of the following formats:

1. PDF electronic file.

B. Certificates shall be furnished by manufacturer, producer, or supplier of material or product and shall indicate that material or product conforms to or exceeds specified requirements. Include supporting reference data as appropriate. Certificates may be recent or previous test results on material or product, but must be acceptable to A/E.

1.07 PERMITS AND APPROVALS

A. Submit permits, code inspections, and agency approval documents as designated in the various specification sections in one of the following formats:

1. PDF electronic file.

1.08 TEST REPORTS

A. Submit test reports as designated in the various technical specifications in one of the following formats:

1. PDF electronic file.

1.09 OPERATION AND MAINTENANCE (O/M) MANUALS

A. Submit operation and maintenance manuals covering each item of equipment furnished or installed under the Contract. Submit individual preliminary O/M brochures in PDF electronic format within 30 days after completion of shop drawing or product data review. Submit final O/M manuals prior to substantial completion in the following formats:

1. PDF electronic file of entire manual, and
2. Two bound paper sets (unless otherwise specified in the various specification sections).

B. For each item of equipment, include the following information:

1. A/E-reviewed shop drawings and product data.
2. Installation and operating instructions.
3. Maintenance instructions and address of authorized service center.
4. Wiring diagrams and parts lists.
5. Test data and certifications.
6. Manufacturer's warranty information.

C. Designate correct model number where literature covers more than one model.

D. Write and furnish duplicate operation and maintenance instructions for items fabricated or assembled by Contractor.

E. Electronic Manual:

1. Submit manual in the form of a single PDF file for entire project.
2. Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
3. Group data according to specification section and organize with bookmarks. Bookmark both specification sections and individual products so that resulting bookmarks reflect a readily navigated document tree.
4. Include an overall table of contents of the O/M manuals furnished.

F. Paper Manuals:

1. Furnish data in 8-1/2 in. x 11 in. or 11 in. x 17 in. size; photographically reduce information if required. Place data into D-style, 3-ring hard cover binders; fold 11 in. x 17 in. sheets as required. Group data according to specification section and organize with tabbed index dividers on which the product name is typed.
2. Label binders as follows:

[Systems or Equipment Designation]
OPERATION AND MAINTENANCE MANUAL
[Project Name]
[Project Location]

3. Integrate general, mechanical, and electrical construction into same binder(s) when practicable. Individual subcontract O/M manuals will be acceptable provided they are placed in binder(s) as specified above.
4. Include an overall table of contents of the O/M manuals furnished.

1.10 PROJECT RECORD DOCUMENTS

A. Keep a current set of paper documents at project site that are marked to show all changes made during construction. Dimension underground and concealed work and utilities from permanent reference points; record vertical distances. Make and record measurements to the nearest 0.1 ft. Submit project record documents upon completion of Work.

PART 2 (NOT USED)

PART 3 (NOT USED)

END OF SECTION

SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Provide temporary environmental controls as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

1.02 DEFINITIONS

A. References to "Colorado DOT Std. Spec." shall mean Colorado Department of Transportation Standard Specifications for Road and Bridge Construction (available at https://www.codot.gov/business/designsupport/cdot-construction-specifications/2019-construction-specifications/2019-specs-book/2019-standard-specifications).

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00: Submittals.

B. Inspection Reports: Submit one copy of weekly inspection reports for erosion and sediment controls.

C. Technical product literature for all commercial products to be used for sedimentation and erosion control.

D. Contractor's Sedimentation and Erosion Control Plan: A plan describing Best Management Practices (BMPs) in accordance with local, state, and federal regulations and permits and this Section and Drawings stamped and sealed by a professional engineer as required.

1.04 PERMITS

A. Owner will:

1. Submit a Colorado Discharge Permit System (CDPS) General Permit for Stormwater Discharges Associated with Construction Activities, COR400000 Permit Application at least 10 working days prior to the start of construction.
2. Provide Contractor with a copy of the notice of General Permit coverage.
3. File Notice of Termination after construction site has undergone final stabilization.
4. Apply for Mesa County Construction Stormwater Permit https://etrakit.mesacounty.us/etrakit3/.

B. Contractor shall:

1. Comply with the requirements of the General Permit and the Sedimentation and Erosion Control Plan and keep a copy of these documents at project site during construction.
2. Post a copy of the Certificate of Permit Coverage in a conspicuous place on the construction site.

PART 2 PRODUCTS

2.01 SILT FENCE

A. Posts: 2-inch by 2-inch; 4 feet 6-inch long, wood stakes, suitably durable for driving without cracking, as approved by the A/E.

B. Fabric: Woven, polypropylene, ultraviolet resistant material. Mirafi, Inc. Mirafi 100X, or approved equal.

C. Prefabricated commercial silt fence, if substituted for built-in-field fence: Mirafi Inc. "Envirofence" or approved equal.

2.02 EROSION BALES

A. Certified weed hay or straw certified under the North American Weed Free Forage Certification Program and the New Mexico State University Seed Certification (NMSUSC) Program. Each certified weed free erosion bale shall be identified with purple and yellow twine, and regional Forage Certification Program tag indicating the Regional Forage Certification Program Number unless otherwise specified by the program.

B. Erosion bales shall be inspected for and Regionally Certified as weed free based on the Regionally Designated Noxious Weed and Undesirable Plant List. Do not unload certified weed free erosion bales or remove their identifying twine, wire or tags until the A/E has inspected and accepted them. Provide a certificate of compliance showing the transit certificate number or a copy of the transit certificate as supplied from the forage producer.

2.03 EROSION LOGS

A. Curled aspen wood excelsior with a consistent width of fibers evenly distributed throughout the log and a seamless casing comprised of a photodegradable tube netting. Fungus free, resin free and free of growth or germination inhibiting substances. Furnish logs with the minimum diameter and length shown on approved erosion and sediment control plans.

2.04 VEHICLE TRACKING PAD

A. Constructed tracking pad complying with Colorado DOT Std. Spec. 208.02.

B. Use crushed natural aggregate with at least two fractured faces that meets the Colorado DOT Std. Spec. gradation requirements for vehicle tracking pads.

C. Geotextile fabric for tracking pads shall be Colorado DOT Std. Spec., Subsection 712.08, Class 2 fabric.

2.05 PERMANENT SEED

A. See Section 32 92 36.

PART 3 EXECUTION

3.01 EROSION CONTROL

A. General: Maintain erosion control measures to protect the project site and prevent sediment pollution of adjacent water courses and properties. At a minimum, provide erosion control measures as indicated on the Drawings.

B. Applicable Standards: Unless otherwise shown or specified, erosion control measures shall comply with:

1. CDPS General Permit for Stormwater Discharges Associated with Construction Activities, COR400000.
2. Colorado DOT Std. Spec.

C. Time Period: Install erosion control measures prior to start of construction and maintain them until final completion of work. Unless otherwise instructed, remove temporary erosion control measures prior to final application for payment.

D. Stripping: Strive to limit stripping of sod and vegetation to a period that will expose bare soil to the least possibility of erosion that construction requirements will allow.

E. Diversions: Construct and maintain dams, channels, flumes, sumps, surface roughening, and other temporary diversion and protective works to divert streamflow and other surface water through or around construction site and away from work while construction is in progress. Unless otherwise specified, a diversion must discharge into the same natural drainageway in which its head waters are located.

F. Sediment Barriers: Construct and maintain one or more sediment barriers to receive runoff leaving site.

1. Affix silt fence to ground and maintain in suitable structural condition to last until vegetation establishes.
2. Affix erosion logs to ground, either by wood stakes (recommended method) or by equivalent anchorage if frozen winter subgrade prevents driving stakes. Equivalent anchorages include using steel posts (removed after vegetation establishes) or erosion bales spaced at same intervals as planned stakes or other approved equivalent method.

G. Trackout Control: Prevent tracking of soils and sediments onto public and private streets by constructing and maintaining stabilized work surfaces and trackout controls in accordance with Colorado DOT Std. Spec. Check dual tire vehicles for picked up tracking pad materials prior to leaving site. Refresh and loosen tracking pad as needed to allow stones to contact full tire tread (at least up to start of sidewall) of exiting vehicles. If a vehicle or tire washing station is established, water from washing shall drain into a suitable sediment trap or settling device. Remove at the end of each workday soils and sediment reaching public and private streets not part of the construction site.

H. Re-establishment of Vegetation: Re-establish temporary or permanent vegetation on disturbed areas within the time limits allowed by applicable standards.

I. Sediment Deposits: Remove and dispose of sediment deposits when deposits reach one-half the volume capacity of sediment barrier, unless otherwise indicated.

3.02 EROSION CONTROL MONITORING AND REPORTING

A. Contractor shall conduct the following inspections:

1. Weekly inspections of implemented erosion and sediment controls.
2. Inspections of erosion and sediment controls within 24 hours after a precipitation event that produces 0.5 in. of rain or more during a 24 hour period.

B. Contractor shall prepare weekly written reports of all inspections that include:

1. Date, time, and exact place of inspection.
2. Name of individual who performed inspection.
3. An assessment of condition of erosion and sediment controls.
4. A description of any erosion and sediment control implementation and maintenance performed.
5. A description of the present phase of construction at site.

3.03 DUST CONTROL

A. Minimize dispersion of dust from construction operations by application of water or other dust control materials. Controls shall confine dust and dirt within the immediate area of project. Masonry and debris shall be thoroughly soaked during demolition and loading operations.

3.04 NOISE CONTROL

A. Provide noise control measures to limit the amount of noise and prevent nuisance. Properly equip all equipment with mufflers. Limit construction activities generating significant noise to normal working hours.

3.05 MATERIAL HANDLING AND SPILL PREVENTION

A. Hazardous materials shall be handled and stored in accordance with the recommendations of the manufacturer and Material Safety Data Sheets (MSDS). Containers or equipment leaking any contaminants shall be repaired, removed from the site, or utilize drip pans for containment purposes.

B. Spills of any contaminants shall be immediately reported to the Colorado Water Quality Control Division Hotline at 877.518.5608. Contractor shall maintain an emergency spill kit at the project site containing contaminant containment products and absorbent materials (inlet socks, dry absorbent materials, and similar products).

3.06 HAZARDOUS ENVIRONMENTAL CONDITIONS

A. If underground petroleum storage tanks, petroleum contaminated soils, or other hazardous environmental conditions are encountered, and are not identified to be part of the work, Contractor shall immediately stop all work in connection with the hazardous condition and shall notify Owner and A/E. (See the General Conditions of the Contract for specific procedures that may apply.)

END OF SECTION

SECTION 01 57 60

CONSTRUCTION DEWATERING

PART 1 GENERAL

1.01 SUMMARY

A. Provide construction dewatering as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

B. Work under this Section shall consist of removal of surface water and ground water as necessary to perform required work, including:

1. Building and maintaining temporary impounding works, channels, and diversions.
2. Furnishing, installing, and operating pumps, piping, and other facilities and equipment.
3. Removing temporary works and equipment when no longer required.

C. Contractor shall be responsible for design of dewatering system as specified below.

D. Construction dewatering is broken down into Phase 1 and Phase 2, as indicated on the Drawings. Phase 1 dewatering is to facilitate construction of the new outlet works, the embankment, and the downstream impact basin. Phase 2 dewatering is to facilitate construction of the overflow spillway weir and channel improvements.

E. Cofferdam (required for Phase 1 dewatering) will not protect the worksite from the 10-yr flood. Contractor shall monitor weather forecasts and current conditions and evacuate equipment and personnel from the drained reservoir should there be a risk of water levels in the lake rising above the specified construction pool.

1.02 SUBMITTALS

A. Dewatering Plan: Submit Dewatering Plan consisting of the following:

1. Cofferdam Cross Section: Submit cross section showing minimum and maximum cofferdam height, minimum and maximum grades near cofferdam, and distance from cofferdam section to nearest dam structure. Top elevations of cofferdams shown on the Drawings are to be considered minimum and may not be reduced unless Contractor obtains A/E permission and Contractor accepts all liability for workmanship lost and damages due to premature overtopping of cofferdam.
2. Location Map: Submit phased dewatering plan showing all stages and sequences of cofferdam construction and removal with adequate descriptions so that A/E can evaluate possible reductions to flood capacity of dam.
3. Cofferdams less than 10 feet in height do not need to bear Professional Engineer’s Stamp. If cofferdam height is greater than 10 feet, submit cofferdam drawing bearing Professional Engineer’s Stamp. Drawing(s) shall include height and depth of cofferdam, width of cofferdam materials (sheet size or base width), and minimum grade elevations near cofferdam. A/E approval of Contractor cofferdam drawing shall be considered only as review in conformance with dewatering intent and not considered as a full structural review or confirmation that cofferdam is suitable for intended purpose.

B. Permit Applications: After A/E's approval of Dewatering Plan, make application for required Contractor-furnished cofferdam and dewatering permits. Submit copy of applications to A/E.

C. Permits: Submit copy of permits obtained for project prior to starting the applicable work.

D. Make submittals in accordance with Section 01 33 00.

1.03 PERMITS

A. General: Rehabilitation of the dam, including cofferdams and diversions, shall be in accordance with Colorado Division of Water Resources Office of the State Engineer, U.S. Army Corps of Engineers (COE), Mesa County, and US Forest Service permits issued for project. The work is subject to inspection, review, and approval by these agencies.

B. Owner-Furnished Dam Rehabilitation Permit: Owner has obtained permits to rehabilitate dam from DSB, COE, and USFS. Refer to Appendices.

C. Contractor-Furnished Dewatering Permit: Contractor’s method of accommodating seepage may require a Colorado Discharge Permit System (CDPS) General Permit COG080000 for Discharges from Short-Term Construction Dewatering Activities. Contact Colorado Department of Public Health and Environment for more details. Required dewatering permit(s) shall be obtained at Contractor’s cost and no additional schedule allowance will be given to accommodate the permit review period.

D. Contractor-Furnished Water Diversion Plan: Contractor must provide a water diversion plan in accordance with Rule 8.1.1 of DWR’s Rules and Regulations for Dam Safety and Dam Construction.

E. Permit Compliance: Should Contractor's actions or construction not be in compliance with applicable permits, Contractor shall remedy situation as directed by Owner, and all costs associated with those actions shall be borne by Contractor.

1.04 SITE CONDITIONS

A. Information on flood flows and average flows is presented on the Drawings.

B. Owner will draw down the reservoir prior to construction.

C. Owner will operate the diversion gates upstream of the reservoir during construction.

PART 2 PRODUCTS

2.01 DESIGN REQUIREMENTS

A. Contractor shall be responsible for:

1. Protection of work area and safely passing stream flow for duration of construction.
2. Means and methods for dewatering work areas, including the actual dimensions, configurations, stability, and dewatering capacity of cofferdams and protective works.
3. All safety precautions and programs related to the work.

2.02 MATERIALS

A. Contractor shall furnish all materials for and shall construct and maintain, as it deems necessary, all cofferdams, channels, drains, sumps, and protective works for protection of work areas.

B. Contractor may select whatever materials it wishes for use in cofferdam, subject to permit requirements and the following:

1. Sheet piling may not be used within 10 ft of any permanent structure due to potential vibration damage.
2. Cofferdam top elevation shown on the Drawings may not be exceeded.
3. Cofferdam shall be equipped with a temporary 30-inch relief outlet as shown on the Drawings.

PART 3 EXECUTION

3.01 DIVERTING SURFACE WATER DURING PHASE 1 DEWATERING

A. Owner shall draw down the reservoir prior to construction and shall operate the existing bypass channel to divert normal river flows around the lake during construction. Owner estimates that the existing bypass channel can divert up to 50 cfs around the lake. River flows exceeding 50 cfs may flow into the lake and cause levels to rise.

B. If lake levels rise above the specified construction pool elevation shown on the Drawings, Contractor shall drain the lake using a temporary outlet. If the temporary outlet is not capable of draining the lake sufficiently, Contractor shall use pumping for additional release capacity.

C. Construct, maintain, and operate cofferdams, channels, flumes, sumps, and other temporary diversion and protective works to divert streamflow and other surface water through or around construction site and away from work while construction is in progress. Unless otherwise specified, diversions must discharge into the same natural drainageway in which its headwaters are located.

D. Surface water diversion procedures shall not create a condition where erosion or deposition of materials occurs in stream. Riprap or other means of protection shall be provided for erosion protection adjacent to all cofferdams where flows could occur.

E. Diversion works which are moved out of position by any cause during installation shall be righted or enlarged so as to provide necessary clearance.

F. As work area is dewatered, diversion works that are not watertight shall be plugged or sealed as much as practical to reduce infiltration of water into work area.

G. No shoring will be permitted in diversion works which will induce stress, shock, or vibration in permanent structure.

3.02 DIVERTING SURFACE WATER DURING PHASE 2 DEWATERING

A. Owner will operate the reservoir’s low-level outlet works with the gate fully open to pass stream flows through the lake and dam. During this phase, Owner shall operate the bypass gates upstream of the reservoir to minimize flow into the bypass channel and overflow spillway.

3.03 DEWATERING EXCAVATIONS AND WORK AREAS

A. Foundations, cutoff trenches, and other parts of construction site shall be dewatered and kept free of standing water or excessively muddy conditions for proper execution of construction work. Furnish, install, operate, and maintain wells, drains, sumps, pumps, and other equipment needed to perform dewatering as specified. Dewatering methods that cause loss of fines from foundation materials will not be permitted.

B. Maintain pumping operations to keep work area dry until all materials, equipment, and debris have been removed and diversion works is to be removed.

C. Maintain water levels at least 12 inches below prepared subgrades.

3.04 DEWATERING BORROW AREAS

A. Maintain borrow areas in drainable condition or otherwise provide for timely and effective removal of surface waters that accumulate, for any reason, within borrow areas.

3.05 REMOVAL OF TEMPORARY WORKS

A. Remove temporary works when no longer required; level and grade earth as required to restore appearance and to prevent obstruction to flow or any other interference with operation of or access to permanent works.

B. Unless otherwise noted, pipes and casings shall be removed from temporary wells and wells shall be filled to adjacent ground level with gravel or other approved material.

C. Construction dewatering material shall be removed from site and properly disposed of.

D. Contractor shall make its own arrangements for a disposal site and shall pay all costs involved.

3.06 REPAIR OF DAMAGES

A. Contractor shall repair, at its expense, any damage to foundations, structures, or other improvements caused by failure of any part of cofferdams or protective works.

END OF SECTION

SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

A. Provide demolition work as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

1.02 RELATED SECTIONS

31 05 10 Site Preparation.
31 20 00 Earth Moving and Embankments
32 92 36 Native Species Seeding

1.03 PRE-DEMOLITION CONFERENCE

A. Contractor shall schedule a pre-demolition conference prior to beginning demolition to be attended by authorized representatives of A/E, Owner, and Contractor and by interested agencies.

B. Contractor shall give notice of conference to agencies listed under "Permits and Notification of Agencies" article, below.

1.04 SUBMITTALS

A. Demolition Work Plan: Submit a demolition work plan for A/E's information at least one week prior to start of work. Work plan shall include:

1. Work Sequence: Sequence of operation for demolition and removal work.
2. Noise and Dust Control Plan: Planned measures to minimize noise levels and control dust emissions from demolition activities.
3. Material Disposal Plan: Planned material disposal/recycling locations.

B. Permits: Submit copy of each application to and permit received from agencies having jurisdiction.

C. Disposal/Recycling Documentation: Submit copy of each disposal manifest or letter of acceptance for all disposed and recycled materials.

D. Make submittals in accordance with Section 01 33 00.

1.05 PERMITS AND NOTIFICATION OF AGENCIES

A. Demolition Permit: Obtain and pay for demolition permit from local jurisdiction.

B. Colorado Department of Public Health and Environment Notification: Submit and pay for Form DNA08 "Demolition Notification Application Form" to the Permit Coordinator at least 10 working days prior to demolition.

C. Utility and Agency Notifications: Make arrangements with the following utilities and agencies so that work may proceed with least disruption of traffic and services in area. Notify Owner, A/E, adjacent property owners, and each of the following agencies having jurisdiction three days prior to beginning work.

1. Department of Public Works.
2. US Forest Service.

3. Police Department.
4. Fire Department.

1.06 WORKER QUALIFICATIONS

A. Contractor is responsible for health and safety of its personnel during all demolition and construction work, including hazardous materials training, if required, in accordance with applicable laws and regulations.

1.07 EXISTING CONDITIONS

A. Prior to bidding, thoroughly inspect existing conditions.

B. Conditions existing at time of inspection for bidding purposes will be maintained by Owner in so far as practicable. However, variations within facilities may occur by Owner's removal and salvage operations prior to start of demolition work.

C. Structures to be demolished will be vacated and use discontinued prior to start of work. Owner assumes no responsibility for actual condition of structures to be demolished.

D. The existing low-level intake structure and outlet conduit will be submerged/buried at the time of bidding. Thus, these structures will not be accessible for inspection during bidding.

1.08 EXPLOSIVES

A. Use of explosives will not be permitted.

PART 2 PRODUCTS

2.01 FILL MATERIAL

A. Comply with the requirements of Section 31 20 00.

PART 3 EXECUTION

3.01 PROTECTION OF EXISTING IMPROVEMENTS

A. Comply with requirements of Section 01 01 00 / 31 05 10 and governing regulations.

B. Conduct operations to prevent damage to adjacent facilities. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of adjacent facilities to remain and to prevent premature collapse of structures to be demolished. Maintain work and site in orderly condition to prevent accidents.

C. Protect survey monuments, reference points, benchmarks, and monitoring wells. Notify owner of disturbance.

3.02 SALVAGE

A. Items designated for salvage to Owner shall be removed in a workmanlike manner and neatly stored on-site. Items not designated for salvage to Owner shall become property of Contractor and shall be removed from site.

B. Salvaged items capable of disassembly shall be dismantled into individual components or subsections.

3.03 DEMOLITION

A. See Drawings for specific areas, depths, and limits of demolition, removal, salvage, and disposal. Restrict demolition activities to project limits.

B. Minimize dispersion of dust from demolition operations and dust generated by equipment traffic by application of water or other dust control materials. Controls shall confine dust and dirt within immediate area of demolition. Thoroughly soak masonry and debris during demolition and loading operations.

C. Crushing of concrete, brick, and other masonry materials will be allowed on site, provided the material is not contaminated with hazardous materials.

3.04 BELOW-GRADE STRUCTURES

A. Demolish and remove all foundations, footings, concrete slabs-on-ground, and all other below-grade construction within construction limits.

3.05 FILLING EXCAVATIONS AND VOIDS

A. Completely fill below-grade areas and voids resulting from demolition in accordance with the requirements of Section 31 20 00.

3.06 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove from site and legally dispose of all debris, rubbish, and other materials resulting from demolition operations. Storage or sale of removed materials will not be permitted on site.

B. Keep all haul roads clean and free of debris. Take measures to avoid littering waste. No waste or litter shall buried in any open trench, excavation or fill area in the project site.

3.07 RESTORATION

A. Repair adjacent improvements damaged by demolition operations. Clean adjacent areas of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.

B. Topsoil, fertilize, seed, and mulch exposed soils in accordance with Section 32 92 36, except areas designated to receive new construction.

3.08 CLOSEOUT

A. Deliver to Owner all designated salvage items; obtain receipts from Owner for materials delivered.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Provide cast-in-place concrete work as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315.

B. Product Data: Submit product data for each product specified.

C. Mix Designs: Submit proposed mix designs to A/E ten days prior to beginning concrete work. Do not begin concrete production until mixes have been reviewed.

D. Delivery Tickets: Submit delivery ticket to A/E for each load of concrete delivered to project.

E. Test Reports: Testing agency shall submit copy of field and laboratory reports to A/E.

F. Make submittals in accordance with Section 01 33 00.

1.03 QUALITY ASSURANCE

A. Give A/E two working days notification of all planned concrete pours so that appropriate construction observation can be present at the project site.

B. Prior to placing concrete, request review of reinforcement steel by A/E.

1.04 CODES AND STANDARDS

A. Comply with the following codes and standards, except as otherwise designated:

1. ACI 301 Specifications for Structural Concrete.
2. ACI 304 Guide for Measuring, Mixing, Transporting and Placing Concrete.
3. ACI SP-2 Manual of Concrete Inspection.

1.05 TESTING

A. Contractor shall arrange and pay for services of a qualified testing agency acceptable to Owner and independent of Contractor.

B. Testing agency shall test concrete to measure slump, entrained-air content, temperature, unit weight, and compressive strength to determine compliance with specifications. Furnish test apparatus and cylinders, perform on-site sampling and testing, submit samples, and perform laboratory tests.

C. On-site tests shall be performed under observation of A/E unless waived.

D. Slump, Air Content, Temperature, and Unit Weight Tests:

1. Perform slump, air content, temperature, and unit weight tests prior to concrete placement each truck load, whenever there is a change in consistency of concrete, and when concrete cylinders are prepared.

2. Test for slump in accordance with ASTM C143, air content in accordance with ASTM C231, temperature in accordance with ASTM C1064, and unit weight in accordance with ASTM C138.
3. If measured slump, air content, temperature, or unit weight falls outside specified limits, immediately check another portion of same batch. In event of a second failure, concrete shall be rejected.

E. Compressive Strength Tests:

1. During progress of work, prepare two sets of test cylinders per 50 cu yd or fraction thereof for each class of concrete placed each day.
2. Obtain samples in accordance with ASTM C172. Cast, identify, transport, and cure cylinders in accordance with ASTM C31. Test strength of cylinders in accordance with ASTM C39.
3. If 6x12 in. cylinders are used, a set shall consist of three cylinders for laboratory curing. Obtain one 7-day and two 28-day compressive strength tests.
4. If 4x8 in. cylinders are used, a set shall consist of four cylinders for laboratory curing. Obtain one 7-day and three 28-day compressive strength tests.
5. If the requirements specified in the "Cold Weather Placing" article below apply, in addition to the above laboratory cylinders, a set shall also include two extra 6x12 in. or three extra 4x8 in. cylinders for field curing and laboratory testing. Obtain 28-day compressive strength tests on field cured samples.
6. If test results indicate deficiencies, A/E may require additional tests and may order remedial work.

PART 2 PRODUCTS

2.01 CEMENTITIOUS MATERIAL

A. Cement: Portland cement, ASTM C150, Type I.

B. Fly Ash: ASTM C618, Class C.

2.02 AGGREGATES

A. Fine and coarse aggregates, ASTM C33, consisting of clean, hard, durable sand and crushed rock, crushed gravel, or gravel.

B. Coarse aggregate shall meet grading requirements for size number 67, 57, or 467. Maximum coarse aggregate size for each class of concrete shall be as indicated in Part 4 Schedules. Ratio of coarse aggregate to fine aggregate shall not be less than 1:1 nor more than 2:1.

2.03 WATER

A. Mixing water shall be potable, free of oil, acid, excessive alkalinity, organic matter, and salts.

2.04 ADMIXTURES

A. Air-entrained admixture shall conform to ASTM C260.

B. Water reducing admixture shall conform to ASTM C494, Class A.

C. Other admixtures which do not adversely affect strength and durability of concrete may be used with permission of A/E, if used in strict accordance with manufacturer's instructions. Care shall be exercised to assure that the admixture does not increase or decrease air content outside of allowable limits. Do not use salt or chemical anti-freeze admixtures.

2.05 FORMWORK

A. Forms for Exposed Finish Concrete: Construct forms for exposed concrete surfaces with water-resistant plywood, metal, metal-framed plywood-faced, or other acceptable panel type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system if shown. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection. Rust-stained steel forms are not acceptable.

B. Forms for Unexposed Finish Concrete: Construct forms for concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least one side and two edges for tight fit.

2.06 REINFORCING STEEL

A. ASTM A615, Grade 60, new billet steel bars.

B. Provide metal chairs, stirrups, spacers, and hangers to support reinforcement and insure against displacement during placement of concrete. All supports shall be plastic protected (Concrete Reinforcing Steel Institute [CRSI], Class 1) or stainless steel protected (CRSI, Class 2).

2.07 REINFORCING ADHESIVE

A. General: Diameter and embedment depth of adhesive anchors shall be as indicated on the Drawings. Embedment depth into sound concrete shall develop the yield strength of reinforcing bar.

B. Epoxy Adhesive: Hilti “HIT-RE 500-V3”, Powers Fasteners “Pure110+”, Simpson “SET-XP”, or approved equal.

C. Acrylic Adhesive: Hilti “HIT-HY 200”, Powers Fasteners “AC100+ Gold”, Simpson “AT-XP”, or approved equal.

2.08 EXPANSION JOINT FILLER

A. Premolded joint filler, ASTM D1751, asphalt-saturated cellulosic fiber; 1/2 in. thickness by depth of concrete, unless otherwise shown.

2.09 EXPANSION JOINT SEALANT

A. Urethane, one or two part, air curing, elastomeric sealant complying with ASTM C920, Type S or M, Grade NS (vertical joints) or Grade P (horizontal joints), Class 25.

2.10 WATERSTOP

A. PVC Waterstop: PVC 6 in. x 1/4 in., split bulb, ribbed type, unless otherwise shown. Use poly (vinyl chloride) with no reclaimed material. Provide factory-fabricated corners, intersections, and directional changes.

B. Hydrophilic Waterstop: Coiled, rope-like, cold joint waterstop impregnated with sodium bentonite which swells upon contact with water; CETCO "Waterstop RX", Sika "Swellstop", W.R. Meadows "Waterstop EC Plus", or approved equal.

2.11 MOISTURE-RETAINING COVER

A. Waterproof paper, polyethylene film, or polyethylene-coated burlap complying with ASTM C171.

2.12 CURING COMPOUND

A. White, waterborne, membrane-forming curing compound, ASTM C309, Type 2, Class B, dissipating.

2.13 CONCRETE MIXTURES

A. Conform to minimum standards for class and usage in Part 4 Schedules.

B. Prepare design mixes for each type of concrete on the basis of compressive strength by methods recommended in ACI 301. Use an independent materials laboratory for preparing and reporting proposed mix designs.

C. Provide water-reducing admixture for all concrete work. Provide air entraining admixture as scheduled.

D. Add fiber reinforcement for usages indicated on the Drawings and at rate indicated in Part 4 Schedules.

2.14 BONDING AGENT

A. Water-based epoxy resin/portland cement bonding agent; Sika "Armatec 110 EpoCem", or approved equal.

2.15 PATCHING MORTAR

A. Horizontal Surfaces: Polymer-modified, portland-cement, trowel grade patching mortar; Sika "SikaTop 122 Plus", or approved equal.

B. Vertical and Overhead Surfaces: Polymer-modified, portland-cement, fast-setting, non-sag patching mortar; Sika "SikaTop 123 Plus", or approved equal.

2.16 SYNTHETIC FIBER REINFORCEMENT

A. Fibrillated polypropylene fibers designed for secondary reinforcement of concrete slabs, complying with ASTM C1116, Type III, not less than 3/4 in. long.

PART 3 EXECUTION

3.01 FORMWORK INSTALLATION

A. Design, construct, erect, brace, and maintain formwork according to ACI 301.

B. Form 3/4 in. chamfers at corners to produce uniformly straight lines and tight edge joints. Extend terminal edges to required limit and miter chamfer strips at changes in direction. Unexposed corners may be formed either square or chamfered.

C. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

B. Adhesive for reinforcing bars shall not be installed into concrete that is less than 21 days old.

3.03 SLAB SUBGRADE PREPARATION

A. Sprinkle subgrade with water.

3.04 STEEL REINFORCEMENT INSTALLATION

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Position reinforcement steel to provide minimum concrete cover as indicated on the Drawings. Unless otherwise specified on Drawings, minimum reinforcement cover shall be 3 in.

D. Requirements for minimum development and splice lengths:

MINIMUM DEVELOPMENT AND SPLICE LENGTHS

f'_c = 4500 psi
clear spacing $\geq 2d_b$ & clear cover $\geq d_b$

Bar Size Grade 60	Minimum Straight Tension Development Length, l_d		Minimum Lap Splice For Center To Center Bar Spacing	
	TOP BARS	OTHER BARS	TOP BARS	OTHER BARS
#3	1'-6"	1'-2"	1'-11"	1'-6"
#4	2'-0"	1'-6"	2'-7"	2'-0"
#5	2'-6"	1'-11"	3'-2"	2'-6"
#6	2'-11"	2'-3"	3'-10"	2'-11"
#7	4'-3"	3'-4"	5'-7"	4'-3"
#8	4'-11"	3'-9"	6'-4"	4'-11"
#9	5'-6"	4'-3"	7'-2"	5'-6"
#10	6'-2"	4'-9"	8'-0"	6'-2"
#11	6'-10"	5'-4"	8'-11"	6'-10"

NOTES:

1. TOP BARS ARE HORIZONTAL BARS SO PLACED THAT MORE THAN 12" OF CONCRETE IS CAST IN THE MEMBER BELOW THE BAR.

2. EXCEPT AS OTHERWISE INDICATED ON THE DRAWINGS, LAP SPLICE LENGTH AND TENSION DEVELOPMENT l_d SHALL BE NO LESS THAN (NO MINUS TOLERANCE) SHOWN ABOVE.

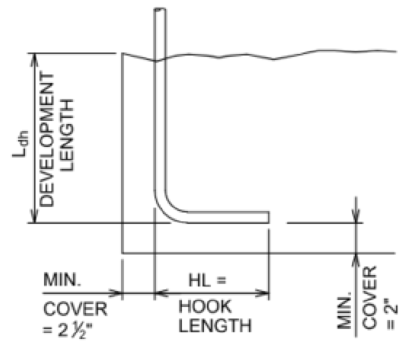
3. LAP SPLICES SHALL NOT BE MADE AT POINTS OF MAXIMUM STRESS AS DETERMINED BY THE ENGINEER.

4. WHERE BARS OF DIFFERENT SIZE ARE LAP SPLICED, SPLICE LENGTH SHALL BE THE SPLICE LENGTH OF THE LARGER BAR.

5. ALL SPLICES SHALL BE CONTACT SPLICES AND WIRED TOGETHER.

E. Requirements for 90-degree hooks:

BAR SIZE GRADE 60	f'_c = 4500 psi	
	L_{dh}	HL
#3	6"	6"
#4	7"	8"
#5	8"	10"
#6	10"	1'-0"
#7	11"	1'-2"
#8	1'-1"	1'-4"
#9	1'-3"	1'-8"
#10	1'-4"	1'-10"
#11	1'-6"	2'-0"



COMPLYING WITH MINIMUM COVER REQUIREMENTS OF ACI 318, OTHERWISE L_{dh} MUST BE RE-CALCULATED. APPLIES TO ALL REINFORCING SHOWN ON ALL SHEETS.

3.05 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install construction joints so that strength and appearance of concrete is not impaired, at locations shown or as approved by A/E.

C. Isolation and Expansion Joints: Provide expansion joint filler to isolate slabs-on-grade from old concrete, walls, and other vertical surfaces, and where shown.

D. Contraction Joints in Slabs: Provide contraction (control) joints in slabs-on-grade to form panels of patterns as shown. If joint pattern is not shown, provide joints not exceeding 15 ft in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third-bays).

1. Form contraction joints by inserting 1/4 in. x 1/4 slab depth premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
2. Contraction joints in unexposed slabs may be formed by 1/8 in. x 1/4 slab depth saw cuts. Saw joints prior to formation of shrinkage cracks; achieve an even crisp joint.

E. Contraction Joints in Walls: Provide contraction (control) joints in walls as shown. If not shown, provide a contraction joint within 10 to 15 ft of wall corner and at a maximum spacing of 25 ft thereafter.

1. Total depth of inside and outside contraction joints shall be 1/4 of wall thickness.

3.06 WATERSTOP INSTALLATION

A. PVC Waterstop: Provide continuous waterstop where shown on the Drawings and anywhere non-horizontal concrete joints extend upstream to downstream. Splice PVC waterstops by heat sealing adjacent surfaces in accordance with manufacturer's recommendations. Do not expose waterstop to a direct flame which could cause charring. Lap splices are not permitted. Embed approximately half of the waterstop on each side of joint. Support and protect waterstop during construction and repair or replace damaged waterstop.

B. Hydrophilic Waterstop: Provide hydrophilic waterstop where shown on the Drawings. Install waterstop in accordance with manufacturer's recommendations. Place joint material to water side of reinforcement; comply with minimum cover requirements.

3.07 MIXING CONCRETE

A. "Ready-mix" concrete shall be produced, delivered and handled in accordance with ASTM C94. Concrete shall be deposited at job site within one hour after introduction of water in mix. Care shall be taken in transferring concrete from truck or mixer to avoid segregation of aggregates in mixture.

3.08 CONCRETE PLACEMENT, GENERAL

A. Place concrete as specified and in accordance with ACI 301. Maintain reinforcing steel in proper position.

B. Place concrete in segments corresponding with locations of the expansion joints shown on the Drawings.

C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints. Deposit concrete as near as practicable to final location to avoid segregation from rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.

D. Screed concrete to proper level to avoid excessive skimming or grouting.

E. Do not use concrete which becomes non-plastic and unworkable, or does not meet required quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from project site.

F. Concrete shall not be placed around castings, frames, joints, and other embedded items until they have been accurately adjusted and set to required alignment and grade. Prior to placing of concrete, castings, frames, and embedded metal fixtures shall be painted on their contact surface with a heavy coat of asphaltic mastic or separated with expansion joint filler.

3.09 PLACING CONCRETE INTO FORMS

A. Deposit concrete in forms in horizontal layers not deeper than 18 in. and in a manner to avoid inclined construction joints.

B. Remove temporary spreaders in forms when concrete placing reaches elevation of spreaders.

C. Consolidate concrete in forms by mechanical vibrating equipment and supplement by hand-spading, rodding or tamping. Use vibrators designed to operate at a speed of not less than 6000 impulses per minute when submerged in concrete. Vibration of forms and reinforcing will not be permitted.

D. Do not use vibrators to move concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visibly effective. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other items without segregation of mix.

3.10 PLACING CONCRETE SLABS

A. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until panel or section is complete.

B. Consolidate concrete during placing operations using mechanical vibrating equipment. Thoroughly work concrete around reinforcement and other embedded items and into corners. Consolidate concrete placed in beams and girders of supported slabs, and against bulkheads of slabs on ground, as specified for formed concrete structures. Consolidate concrete in remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other acceptable methods. Limit time of vibrating consolidation to prevent bringing an excess of fine aggregate to surface.

C. Bring slab surfaces to correct level with straight edge and strike off. Use bull floats or darbies to smooth surface, leaving it free of humps or hollows. Do not sprinkle water on concrete surface while in plastic state. Do not disturb slab surfaces prior to beginning finishing operations.

3.11 COLD WEATHER PLACING

A. Protect concrete work from physical damage or reduced strength caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as specified below.

1. When air temperature falls to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 60 deg F (50 deg F for sections thicker than 31 in.) and not more than 90 deg F at point of delivery.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Ascertain that forms, reinforcing steel, and adjacent concrete surfaces are entirely free of frost, snow and ice before placing concrete.
3. During seasons when atmospheric temperature may be expected to drop below 40 deg F, concrete shall be protected by covering with impermeable paper and insulated blankets. Retain covering for seven days.
4. During seasons when atmospheric temperature may be expected to drop below 40 deg F, prepare extra concrete cylinders for field curing in accordance with “Testing” article above. Store field-cured cylinders in a location specified by A/E and in accordance with ACI 318 Section 26.5.3.2.

3.12 HOT WEATHER PLACING

A. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as specified below.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 80 deg F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated in total amount of mixing water.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Spray forms, reinforcing steel, and subgrade just before concrete is placed.
4. Do not use set-control admixtures, unless approved by A/E.

3.13 FINISHING FORMED SURFACES

A. Provide standard rough finish to formed surfaces to be concealed in finish work or by other construction, unless otherwise designated. Standard rough form finish shall be the concrete surface having texture imparted by form facing material, with defective areas repaired and patched and fins and other projections exceeding 1/4 in. in height rubbed down with wood blocks.

B. Provide standard smooth finish for formed surfaces exposed-to-view or to receive a covering applied directly or bonded to concrete, such as waterproofing, dampproofing, or paint. Standard smooth finish shall be the as-cast concrete surface obtained with form facing material, with defective areas repaired and patched and fins and other projections on surface completely removed and smoothed.

3.14 FINISHING UNFORMED SURFACES

A. Thoroughly float surface after concrete has been struck off. Check and level surface plane to a tolerance not exceeding 1/4 in. in 10 ft when tested with a 10 ft straightedge placed on surface at not less than two different angles.

B. Exterior walks and ramps shall have a lightly broomed surface with grain perpendicular to direction of travel.

C. Edges shall be neatly trimmed with 1/4 in. radius edging tool.

3.15 CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Cure formed and unformed concrete for seven days or until 75 percent of the required 28-day compressive strength is obtained, whichever is less, but no less than three days regardless of the compressive strength obtained from testing.

B. Moisture-Retaining Cover: Apply moisture-retaining cover to wet cure flat surfaces not receiving curing compound and other surfaces where formwork is removed prior to end of curing period.

C. Curing Compound: Apply white-pigmented membrane curing compound to exterior slabs, walks, and ramps, unless otherwise indicated.

3.16 REMOVAL OF FORMS

A. Remove forms from cast-in-place concrete only after concrete has achieved sufficient strength to support itself and superimposed loads; but in no case in less time than stated below.

B. Forms not supporting weight of concrete, such as sides of walls and similar parts of the work, may be removed 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided that curing and protection operations are maintained.

C. Forms supporting weight of concrete, such as elevated slabs and other structural elements, may not be removed in less than 14 days, and not until concrete has attained design minimum 28-day compressive strength.

3.17 EXPANSION JOINT SEALING

A. Provide joint sealant where designated on Drawings.

B. Thoroughly clean joints, removing foreign matter such as dirt, dust, moisture, paint, lacquer, grease, form release agents, bond breakers, deleterious curing compounds, or other surface irregularities or treatments.

C. Install sealant in accordance with manufacturer's specifications and recommendations. Prime or seal joint surfaces as recommended by sealant manufacturer. Clean adjacent surfaces soiled by sealant operations.

3.18 CONCRETE SURFACE REPAIRS

A. Formed Surfaces: Request inspection of concrete surfaces immediately after removal of formwork. After inspection, repair and patch defective areas as soon as practicable.

    1. Remove bulges and projections by chipping or tooling. Rub or grind surface after removal.

2. For patching within 7 days of concrete pour, use dry-pack mortar consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve and only enough water as required for handling and placing. Cut out honeycomb, rock pockets, voids over 1/4 in. diameter, and holes left by tie rods and bolts. Remove defects down to solid concrete but, in no case, to a depth of less than 1 in. Make edges of cuts perpendicular to concrete surface or slightly undercut to provide a key at edge of cut. Thoroughly clean, dampen with water, and brush-coat area to be patched with bonding agent. Place patching mortar before bonding agent has dried. Compact mortar in place and strike off slightly higher than surrounding surface. For exposed-to-view surfaces, patch shall match color of surrounding concrete.
3. Beyond 7 days from pour, concrete repairs need to be completed using an epoxy patching mortar.
4. For patching less than 1 in. in depth, Contractor may propose a proprietary patching product in lieu of removing concrete to minimum depth of 1 in. Submit proposed product to A/E for approval.

B. Unformed Surfaces: Repair surfaces that do not meet specified requirements.

1. Correct low and high areas. Submit proposed repair products to A/E for approval.
2. Fill cracks with an approved epoxy mortar which will match slab finish in density and performance. Grind filler smooth and even with adjacent surface, free of bumps or depressions at joint.

PART 4 SCHEDULES

4.01 CLASSES OF CONCRETE

Class	Min. Comp. Strength @ 28 days, p.s.i.	Max. Slump*	Max. Agg. Size	Min. Cement, Bags/ C.Y.	Max. Water-Cement Ratio	Air Content, % By Volume
AA	4500	4"	3/4"	6**	0.45	5-8%

* Value before pumping concrete.

** Fly ash shall be used to constitute between 15 to 30% by weight of total cementitious material.

4.02 USAGE SCHEDULE

A. Use class AA concrete for all work.

B. Where fiber-reinforced concrete is indicated on Drawings, use synthetic fiber reinforcement at a minimum rate of 1.5 lb fiber per batch yard of concrete.

END OF SECTION

SECTION 03 62 00

NON-SHRINK GROUTING

PART 1 GENERAL

1.01 SUMMARY

A. Provide non-shrink grouting as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

B. Use non-shrink grout for bedding and grouting precast concrete, structural steel, railings, machinery, equipment, column bases, pipe sleeves, and as designated.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions in accordance with Section 01 33 00.

PART 2 PRODUCTS

2.01 NON-SHRINK GROUT

A. Grout shall be non-metallic, non-gas forming, non-shrink, pre-blended and ready-to-use requiring only the addition of water at project site.

B. Provide grout complying with ASTM C1107; Euclid "Euco N-S Grout", L & M "Crystex", W.R. Meadows "Sealtight 588", Sika "SikaGrout 212", or approved equal.

2.02 WATER

A. Clean, potable, and free from oil, acid, alkalines, and organics.

PART 3 EXECUTION

3.01 FORMING

A. Provide forms of sufficient strength and securely anchored and shored to withstand pressure of grout and conditions during placement. Fit forms closely together and seal joints. Provide adequate clearance for ease of grout placement.

B. Forming should allow for a minimum of 1 in. head of grout above bottom of base plates.

3.02 PREPARATION

A. Clean grout contact surfaces of oil, grease, scale, and other foreign matter. Chip away unsound concrete leaving surface level but rough. Remove grease, oil, dirt, and coatings from underside of base plates of machinery, rails, and bolts.

B. Saturate concrete contact area with water 12 hours prior to grouting. Before placing grout, remove excess or free standing water.

3.03 MIXING

A. Mix grout in a conventional mortar mixer or blend using propeller type mixer and electric drill. Position mixing equipment as close as practical to area to be grouted with adequate means of transporting grout for quick and easy placement.

B. Mix water and grout in accordance with manufacturer's instructions. Amount of water used should be minimum quantity to produce desired grout consistency.

C. Mix only that quantity of grout that can be placed within 30 minutes after mixing.

3.04 GROUTING

A. Follow established concreting procedures observing precautions for hot and cold weather concreting.

B. Place grout using most practical method; poured in place or pressure grouted by gravity or plunger. Completely fill space to be grouted; keep grout thoroughly compacted and free from air pockets. When practical, place grout from one side flowing to opposite side to avoid air entrapment.

C. Do not remove forms until grout has taken an initial set and will not slump. After removal, cut off excess grout and finish to a smooth surface.

D. Prevent rapid loss of water from grout during first 48 hours by covering with wet burlap or polyethylene sheet or by use of an approved membrane curing compound.

E. Remove shims or leveling devices after curing for 48 hours.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Provide metal fabrications as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

1.02 COORDINATION

A. Furnish inserts and anchoring devices to be embedded in concrete for installation of miscellaneous metal work. Provide setting drawings, templates, and instructions for installation of anchorage devices. Coordinate delivery with related work to avoid delays.

B. See concrete section for installation of inserts and anchors.

1.03 SUBMITTALS

A. Shop Drawings: Submit shop drawings for fabrication, delivery, and erection of metal assemblies. Include product data, load tables, layouts, elevations, details of sections, connections, anchorage, and accessory items. Provide templates for anchors and bolts installed under other sections.

B. Welder/Weld Certifications: Submit certificate of AWS or ASME Welder at least 2 weeks before welding is scheduled to start. No welding shall be done until such certificates are received.

C. Mill Certificates: Furnish certified mill tests of chemical and physical properties of steel used in fabrication.

D. Testing Report: Submit a report documenting weld quality assurance testing.

E. Make submittals in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Establish and maintain a quality control program to assure compliance with these specifications and the drawings. Maintain records of quality control tests and inspections. Contractor shall be responsible for 100% visual inspection and necessary correction of all weld deficiencies.

B. Arrange and pay for services of an accredited testing laboratory approved by the Company representative to inspect weld quality. All defects revealed as a result of tests shall be rectified by Contractor to the satisfaction of the Company representative and at no additional cost to Company.

C. Nondestructive Examination of Welds: Completed welds and weld profiles shall be 100 percent visually examined and shall be in accordance with requirements of AWS D1.1.

D. Magnetic Particle Examination: Magnetic particle examination shall be made on all groove welds and a random 15 percent of fillet welds in accordance with AWS standards.

E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel." Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.05 FIELD MEASUREMENTS

A. Take measurements prior to shop fabrication. Allow for trimming and fitting to make field adjustments. Correct defects resulting from failure to take proper measurements.

PART 2 PRODUCTS

2.01 STEEL

A. Plate: ASTM A572, Grade 50.

B. Other Shapes, Plates, and Bars: ASTM A36 or ASTM A572, Grade 50.

C. Tubing: ASTM A500, Grade C, cold-formed steel tubing.

2.02 STAINLESS STEEL

A. Sheet, Strip, and Plate: ASTM A240 or ASTM A666, Type 304 or Type 316.

B. Bars and Shapes: ASTM A276, Type 304 or Type 316.

C. Tubing: ASTM A554, Grade MT304 or Grade MT316.

D. Pipe: ASTM A312, Grade TP304 or Grade TP316.

2.03 EPOXY ADHESIVE ANCHORS

A. Description: Epoxy adhesive anchors with threaded rods, nuts, and washers.

B. Performance Requirements: Diameter and embedment depth of anchors shall be as indicated on the Drawings.

C. Adhesive: Adhesive shall be Hilti "HIT-RE 500-V3".

D. Rods, Nuts, and Washers: Anchor rods shall be Hilti HAS-E-55 Rod, ASTM F1554, Grade 55, zinc-plated. Anchor rod shall include nuts and washers supplied by rod manufacturer that are compatible with rod.

2.04 FASTENERS

A. Zinc-Plated Steel Fasteners: Regular hexagon-head bolts, ASTM F3125, Grade A325, Type 1; with hex nuts, ASTM A563; and, where indicated, flat washers, ASTM F436; with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5.

B. Stainless Steel Fasteners: Regular hexagon-head annealed stainless steel bolts, ASTM F593, with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1 or Alloy Group 2.

2.05 FABRICATION

A. Use materials of designated type, size, and thickness or, if not shown, of required strength, stiffness, and durability. Work to field measurements and shop drawings, using proven details of fabrication and support. Miscellaneous framing and support members shall comply with AISC Specification.

B. Where exposed to view, use materials that are smooth and free of surface blemishes such as pitting, seam marks, roller marks, rolled trade names, and roughness.

C. Form work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32 in. unless otherwise shown. Form bent-metal corners to smallest radius possible without causing grain separation or other impairment. Shearings and punchings shall be clean and true.

D. Weld corners and seams continuously; comply with AWS recommendations. Grind exposed welds smooth and flush; match and blend with adjoining surfaces. Weld discoloration of exposed surfaces is not acceptable.

E. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown or, if not shown, Phillips flathead (countersunk) screws or bolts.

F. Provide anchorage devices and fasteners for securing miscellaneous metal items to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required. Cut, reinforce, drill, and tap miscellaneous metal work as required to receive hardware and connections required by other trades.

G. Preassemble and fit items to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly identify units for reassembly and installation.

2.06 SHOP PAINTING

A. Painting shall be in accordance with Section 09 90 00.

2.07 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Provide dull satin finish No. 6, unless otherwise indicated.

C. When finishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install anchorage devices and fasteners for adequate support.

1. Expansion anchors shall not be installed into concrete that is less than 7 days old.
2. Adhesive anchors shall not be installed into concrete that is less than 21 days old.

B. Perform cutting, drilling, and fitting, as required. Set work accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines. Provide temporary bracing or anchors in formwork for items to be built into concrete.

END OF SECTION

SECTION 05 52 04

STEEL RAILINGS

PART 1 GENERAL

1.01 SUMMARY

A. Provide steel railings and handrails as shown and as specified. Comply with applicable provisions of Divisions 00 and 01 and Section 05 50 00.

1.02 SUBMITTALS

A. Shop Drawings: Submit shop drawings and product data in accordance with Section 01 33 00.

PART 2 PRODUCTS

2.01 STEEL PIPE

A. ASTM A53; Type E or S, Grade B, black finish, Sch. 80.

2.02 SAFETY RAILINGS

A. Fabricate welded steel railings from 1-1/2 in. round steel pipe, unless otherwise shown. Welds shall be ground smooth and flush.

B. Post spacing shall not exceed 4 ft, unless otherwise shown. Where not shown otherwise, top of top rail shall be 42 in. above floor or 34 in. above stair treads measured vertically at stair riser line.

C. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting or otherwise deforming exposed surfaces of pipe.

D. Provide wall returns at ends of wall-mounted handrails, except where otherwise indicated.

E. Close exposed ends of pipe by welding 3/16 in. thick steel plate in place or by use of prefabricated fittings.

2.03 BRACKETS, FLANGES, FITTINGS AND ANCHORS

A. Provide wall brackets, end closures, flanges, miscellaneous fittings and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry work.

2.04 PRIMER

A. Shop prime railing and accessories (except galvanized items) with one coat rust-inhibitive, lead and chromate free, alkyd or modified alkyd primer, unless otherwise designated in Section 09 90 00. Primer shall be compatible with finish coats specified.

2.05 NONSHRINK GROUT

A. Grout shall be non-shrink, non-metallic, non-gas forming, pre-blended and ready-to-use requiring only the addition of water at project site. Provide grout complying with CRD-C621;

Euclid "Euco N-S Grout", L & M "Crystex", Meadows "Sealtight 588", Sika "SikaGrout 212", Sonneborn "Sonogrout", or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be in accordance with shop drawings and manufacturer's recommendations. Perform cutting, welding, and fitting required for installation. Set the work accurately in location, alignment, and elevation. Install plumb, level, true, and free of rack.

B. Fit exposed connections accurately together to form tight hairline joints. Weld connections which cannot be shop-welded because of shipping size limitations. Grind joints smooth and touch-up shop paint coat.

C. Adjust railings prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Space posts and supports as shown. Plumb posts in each direction. Secure posts and rail ends to building construction as shown. Fasteners shall be tightened so completed railing is rigid and completely free of play at joints and attachments. For railing posts inserted in sleeves set in concrete, fill annular space between post and sleeve with non-shrink, non-metallic grout.

3.02 PROTECTION FROM ENTRAPPED WATER

A. For exterior use, provide drains from railing system to prevent damage caused by freezing of entrapped water. For interior installations subject to high humidity, make provision to drain water from railing system.

B. When posts are mounted into concrete or when bends or elbows occur at low points, drill 1/8 in. diameter weep holes at lowest elevations.

3.03 EXPANSION JOINT INSTALLATION

A. Provide expansion joints at locations indicated, or if not indicated, at intervals not to exceed 40 ft. Provide slip joint with internal sleeve extending 2 in. beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6 in. of posts.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.01 SUMMARY

A. Provide painting and coating as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

1.02 WORK INCLUDED

A. Work includes:

1. Shop priming and shop finish painting trash rack.
2. Shop priming and shop finish painting of steel railings.

1.03 DEFINITIONS

A. Applicable abbreviations are:

1. DFT: Dry Film Thickness.
2. SSPC: The Society for Protective Coatings.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's specifications, including label analysis and application instructions for each material specified.

B. Color Charts: Furnish color charts for selection of paint colors.

C. Make submittals in accordance with Section 01 33 00.

PART 2 PRODUCTS

2.01 PAINT AND COATINGS

A. Provide products by one of the following or approved equal:

1. Tnemec.
2. Sherwin-Williams Co. (S-W).
3. Carboline.
4. PPG Protective & Marine Coatings.

B. Contractor shall submit a specific list of products he wishes to use if manufactured by a company other than that noted in Painting Schedule.

C. Refer to Drawings and painting schedule for finishes and coating systems to be applied to various surfaces.

PART 3 EXECUTION

3.01 SUBSTRATE EXAMINATION

A. Examine substrates and surfaces and conditions under which work is to be performed. Do not proceed with this work until unsatisfactory conditions have been corrected.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.02 SURFACE PREPARATION

A. Perform preparation procedures for each substrate in strict accordance with paint manufacturer's instructions and as specified.

B. Remove all hardware, hardware accessories, and similar items in place and not to be painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove mounted accessories if necessary for complete painting of items or adjacent surfaces. Following completion of painting, reinstall removed items.

C. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

3.03 MATERIAL PREPARATION

A. Prepare painting materials in accordance with manufacturer's directions. Mix materials before application to produce uniform density. Stir as required during application of materials. Do not stir surface film into material; remove film and, if necessary, strain material before using.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

3.04 APPLICATION

A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for type of material being applied.

B. The finished paint coating shall be free from holidays, pinholes, bubbles, runs, drops, ridges, waves, laps, unnecessary brush marks, and variations in color, texture, and gloss. All paint coats shall be applied in such manner as to produce an even, continuous film of uniform thickness. Edges, corners, crevices, seams, joints, welds, and other surface irregularities shall receive special attention to ensure that they receive an adequate thickness of paint.

C. Paints shall be applied only to surfaces that are above the dewpoint temperature and that are completely free of moisture. The temperature of the surfaces to be painted and of air in contact with them shall be not less than 50 deg. F. during paint application nor shall paint be applied if the surfaces can be expected to drop to 50 deg. F. before the film has dried to a reasonably firm condition. Paint shall not be applied to surfaces heated by direct sunlight or other sources to temperatures that will cause detrimental blistering, pinholing, or porosity of the film.

PART 4 SCHEDULES

4.01 PAINTING SCHEDULE

A. Coating Systems: Provide the following coating systems for the various substrates indicated. Named products are specified to establish a standard of type and quality. See "Paint and Coatings" article, above, for a complete list of acceptable manufacturers.

B. Ferrous Metal: Use for ferrous metal trash rack:

1. Wasser:

a. System Type: Moisture-cured urethane.
b. Surface Preparation: r SSPC SP-10 with a 2-3 mil blast profile.
c. Primer: One coat Wasser MC-Zinc at 3.0 mils DFT.
d. Finish: Two coats Wasser MC-Tar at 6.0 mils DFT per coat.
e. Total DFT: 15.0 mils.

2. Sherwin-Williams:

   a. System Type: Moisture-cured urethane.
   b. Surface Preparation: r SSPC SP-10 (with a 2-3 mil blast profile.
   c. Primer: One coat S-W Corothane I Galvapac Zinc at 3.0 mils DFT.
   d. Finish: Two coats S-W Corothane I Coal Tar at 6.0 mils DFT per coat.
   e. Total DFT: 15.0 mils.

END OF SECTION

SECTION 26 05 43

LOCKING VALVE BOX

PART 1 GENERAL

1.01 SUMMARY

A. Provide locking valve box to house hydraulic connections at top of dam as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

PART 2 PRODUCTS

2.01 VALVE BOX

A. Valve box shall be in accordance with CDOT Std. Spec., Section 604.

2.02 VALVE BOX COVER

A. Furnish valve box entrance cover and frame as shown on the Drawings.

B. Cover: 1/4“ thick aluminum diamond plate, 36”x36”, 300 psf live load rating, mill finish, lifting mechanism with reinforced composite tubes and electro coated compression springs, automatic hold open arm, forged aluminum hinges with stainless steel pins, neoprene gasketed standard slam lock with keyed cylinder lock and underside release knob. Cover and frames shall be Bilco Type J-AL, Nystrom FDDP, Halliday Type WIR, or approved equal.

C. Frame: 1/4” thick extruded aluminum channel with continuous concrete anchor, with continuous EPDM debris gasket and 1-1/2” aluminum coupling for drain.

D. Guarantee: 10-year material.

PART 3 EXECUTION

3.01 VALVE BOX INSTALLATION

A. Install valve box as shown on the Drawings in accordance with CDOT Std. Spec., Section 604.

3.02 VALVE BOX COVER INSTALLATION

A. Install valve box cover as shown on the Drawings in accordance with manufacturer’s recommendations. Ensure cover can freely open without obstruction by the air vent pipe riser.

END OF SECTION

SECTION 31 05 10

SITE PREPARATION

PART 1 GENERAL

1.01 SUMMARY

A. Provide site preparation as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

B. Work includes, but is not limited to:

1. Protecting improvements, plants, and utilities.
2. Temporarily removing and replacing improvements.
3. Locating utilities and coordinating with utility companies.
4. Clearing and grubbing trees and vegetation.
5. Salvaging topsoil.
6. Performing site demolition and abandonments.

PART 2 (NOT USED)

PART 3 EXECUTION

3.01 PROTECTION

A. Protect improvements on site and on adjoining properties. Provide barricades, coverings, or other types of protection as necessary to prevent damage and to safeguard against injury. Restore to original condition improvements damaged by the work or improvements which required temporary removal during construction.

B. Protect existing vegetation indicated to remain against unnecessary cutting, breaking, bruising, or smothering by stockpiling excavated materials or parking of vehicles within drip line. Provide temporary fences, tree wells, barricades, or guards; repair or replace trees and vegetation damaged by construction operations.

C. Maintain survey monuments, reference points, and benchmarks; notify Owner of disturbance to markers.

D. No extra payment or time will be allowed for protection work that could have been suspected or anticipated by site inspection and interpretation of bidding documents prior to execution of contract.

3.02 LOCATING EXISTING UTILITIES

A. Location and description of underground utilities and structures shown on drawings are approximate and are based on records available to Owner or surface features indicating their existence. There may be other utilities within project area that are not shown.

B. Notify all affected utility companies of construction operations at least three working days before beginning work near their facilities. Do not begin excavation work until underground utility locations have been marked.

C. Use caution when excavating so that exact location of underground utilities, both known and unknown, may be determined. Provide adequate protection and support for utilities during construction operations.

D. If uncharted or incorrectly charted utilities are encountered during excavation work, or if proposed construction conflicts with existing utilities, give prompt notice and submit proposed solution to A/E for approval. Cooperate with Owner and public and private utility companies to keep their services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

3.03 SITE CLEARING

A. Remove trees, stumps, snags, shrubs, brush, heavy growths of grass, weeds and other vegetation, improvements, rubbish and debris, and obstructions that interfere with proposed construction; remove items only as necessary for completion of work.

B. Cut brush and vegetation flush with ground. Grub out stumps, roots having a diameter of 2 in. or larger, and root clusters to a depth of at least 2 ft below subgrade elevation for pavements, structures, and embankments and 6 in. below ground surface in other areas.

C. Carefully and cleanly cut roots and branches of trees indicated to be left standing, where such roots and branches obstruct new construction. Cut back roots a minimum of 1 ft from concrete work, paving, and structures and to a depth of not less than 2 ft below structures, foundations, and embankments.

3.04 TOPSOIL STRIPPING

A. Topsoil shall include all friable, fertile, loam soil suitable for grass and plants, found at surface, reasonably free of subsoil, clay lumps, stones, objects over 2-in. diameter, weeds, large roots, root clusters, and other objectionable material.

B. Strip topsoil from project area to whatever depths encountered; prevent intermingling with underlaying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping topsoil.

C. Where trees are indicated to remain, terminate stripping a sufficient distance from such trees to prevent damage to root system.

D. Stockpile topsoil in storage piles in areas where designated. Construct storage piles to freely drain surface water. Cover or sprinkle water on storage piles to prevent windblown dust.

3.05 DEMOLITION

A. Remove structures, pavements, utilities, and other improvements within construction limits as shown and as required for construction.

B. If removing only a portion of pavement, curb, gutter, sidewalk, or similar surface improvements, remove the improvement to an existing joint or saw cut the improvement to provide a smooth straight joint.

C. Owner shall have first right to retain all useful salvage. All items not retained by Owner and construction debris shall become property of Contractor.

3.06 DEBRIS DISPOSAL

A. Remove debris and excess materials from site and legally dispose of it; do not burn debris.

END OF SECTION

SECTION 31 20 00

EARTH MOVING AND EMBANKMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Provide earth moving and embankment work as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

1.02 RELATED SECTIONS

31 05 10 Site Preparation.
33 41 66 Drain Fill.
33 42 15 Piping and Accessories.

1.03 CLASSIFICATION

A. Excavation of materials encountered under this work will be unclassified without regard to type, difficulty to remove, or suitability for use in construction.

1.04 SUBMITTALS

A. Test Reports: Submit reports for laboratory and field tests required under "Testing" article.

B. Make submittals in accordance with Section 01 33 00.

C. For footing, slab and pavement subgrades.

1. Test reports for footing, slab, and pavement subgrades shall be submitted prior to placing concrete or paving materials. .

D. For Embankment Fill materials:

1. Two weeks prior to start of construction, submit source and sample results of proposed materials.
2. Grain size analysis in accordance with ASTM C136 and, if more than 15% passes the #200 sieve, use ASTM C117 to demonstrate acceptability of source.
3. Optimum moisture-maximum density curve for fill materials in accordance with ASTM D1557.
4. Direct shear tests performed at 95% Modified Proctor density, near optimum moisture in accordance with ASTM D3080.

E. If additional Rock and Cobble fill is needed, provide source and gradation.

F. A/E will review submittals for conformance with the specified requirements and the design parameters. A/E will also confirm material compatibility with Drain Fill.

G. During construction, submit test reports for field tests.

1.05 TESTING (SUBGRADES)

A. Contractor shall arrange and pay for soil sampling and testing by a qualified testing agency, acceptable to Owner and independent of Contractor.

B Contractor shall notify A/E ahead of sampling and testing to allow A/E opportunity to observe testing and sampling.

C. Test subgrade and fill materials for gradation in accordance with ASTM C136 for conformance with ASTM D2487 gradation limits. Test materials for Atterberg limits index in accordance with ASTM D4318. Gradation and Atterberg limits tests are required for each distinct type of soil encountered. Multiple sets of tests per stockpile may be required if the stockpile contains different soil types.

D. Provide one optimum moisture-maximum density curve for each type of soil encountered in subgrade and fills under foundations, structure slabs, and paved areas; determine maximum densities in accordance with ASTM D1557.

E. During course of work, testing agency shall inspect and approve subgrades and fill layers before further construction work is performed on each layer. Perform field density tests in accordance with ASTM D6938 or ASTM D1556. Take tests as follows:

1. Footing Subgrade: Perform at least one field test for every 10,000 sq ft of structure area, but in no case less than three tests, to verify that the bearing capacity requirements are met.
2. Structure Slabs and Paved Areas: Perform at least one field density test on fill subgrade for every 2000 sq ft of structure slab or paved area, but in no case less than three tests. In each compacted fill layer, perform at least one field density test for every 2000 sq ft of overlaying structure slab or paved area, but in no case less than three tests.
3. Foundation Wall Backfill: Perform at least two field density tests at locations and elevations as directed.

F. If in opinion of A/E, based on reports of testing agency and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional cost to Owner.

1.06 TESTING (EMBANKMENTS)

A. Laboratory Testing:

1. Perform at least two sets of laboratory tests for each 1,000 cu yd of compacted material used from each source.
2. Fill materials shall be tested for gradation in accordance with ASTM C136 and ASTM C117 for conformance with ASTM D2487 gradation limits, and for liquid limit and plasticity index in accordance with ASTM D4318. Optimum moisture-maximum density curve for fill material shall be determined in accordance with ASTM D1557.
3. Results of laboratory tests shall be received prior to any material placement.

B. Field Testing:

1. Perform a minimum of one field density test for each vertical foot of fill for every 100 lin ft of embankment fill.
2. Field density tests shall be in accordance with ASTM D6938 or ASTM D1556.
3. Where soil materials do not conform to type or density specified, soil shall be replaced or reworked to conform. Cost of extra tests for replaced or reworked areas shall be paid for by Contractor.

1.07 PROTECTION

A. Protect existing improvements, utilities, trees and shrubs, and reference marks in accordance with Section 31 05 10.

1.08 BLASTING

A. Use of explosives is not permitted.

PART 2 PRODUCTS

2.01 SOIL MATERIALS, GENERAL

A. Soil materials shall be free of organic matter, debris, frozen soils, ice, and other objectionable materials. Rock particles larger than maximum size specified shall be removed prior to placement of soil. If not otherwise specified, rock particles shall be no larger than 1/2 the specified lift (layer) thickness.

B. Select existing material from required excavations may be used for fill or backfill if it meets the specified product requirements. If necessary, furnish additional approved material from suitable off-site sources.

2.02 EMBANKMENT FILL

A. Select, natural, free draining soils complying with ASTM D2487 soil classification groups CL or SC, or combinations thereof, and suitable for compaction. Plasticity Index for material shall be greater than 10.

B. Embankment fill shall comply with the following gradation by weight

	Percent Passing
Sieve Designation	Range
3/4"	95-100
3/8"	85-90
No. 4	75-80
No. 40	50-60
No. 100	45-55
No. 200	40-50

2.03 COBBLE AND ROCK SHELL

A. This material is existing on site and consists of well graded riprap from sand size material to 24-inch diameter riprap. If importing of additional Cobble Rock Shell material is needed, it needs to match a similar gradation to existing material.

B. Imported cobble and rock shell shall comply with requirements of Colorado DOT Std. Spec., Section 506, Table 506-2 for d50 = 12" riprap with the following gradation by weight:

Typical Stone Dimension (inches)	Percent Material Smaller Than Typical Stone
21"	70-100
18"	50-70
12"	35-50
4"	2-10

2.04 GRANULAR FILL

A. Select soils complying with ASTM D2487 soil classification groups GW (well-graded gravel), GP (poorly-graded gravel), SW (well-graded sand), or SP (poorly-graded sand). Aggregate shall pass a 1-1/2-in. sieve and not more than 35% shall be retained on a No. 10 sieve. Maximum 5% by weight shall pass a No. 200 sieve.

2.05 STRUCTURAL FILL

A. Select soils complying with ASTM D2487 soil classification groups GW, GP, SW, or SP; or these groups in combination with groups GM, GC, SM, or SC (dual symbol soils). Aggregate shall pass a 1-1/2-in. sieve and not more than 35% shall be retained on a No. 10 sieve. Maximum 12% by weight shall pass a No. 200 sieve; plasticity index shall not exceed 5.

2.06 GENERAL SITE FILL

A. Select, natural, free draining soils complying with ASTM D2487 soil classification groups GW, GP, SW, SP, GM, GC, SM, SC, or combinations thereof, and suitable for compaction. Maximum aggregate size shall be 1/2 specified lift thickness.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare site for work in accordance with Section 31 05 10.

B. Layout and stake lines and grades as required to complete the work.

C. Layout of work is to be performed and certified in writing by a licensed surveyor.

3.02 EMBANKMENT FOUNDATION PREPARATION

A. Foundations for embankment fill shall be stripped in accordance with Section 31 05 10 to remove vegetation and topsoil. If shown, or required to remove unsuitable materials, provide excavation work.

B. Except as otherwise specified, grade earth foundation surfaces to remove surface irregularities and scarify parallel to axis of fill or otherwise acceptably score and loosen to a minimum depth of 2 in. Control moisture content of loosened material as specified for Embankment Fill, and compact and bond surface materials with first layer of fill as specified for subsequent layers of fill.

C. Foundation and abutment surfaces shall be not steeper than 1 horizontal to 1 vertical, unless otherwise specified. Fill test pits and other cavities with material conforming to specifications for earth fill.

D. Keep earth abutment surfaces free of loose, uncompacted earth in excess of 2 in. in depth normal to slope and at a moisture content that embankment fill can be compacted against them to affect a good bond between fill and abutments. Clear rock foundation of loose materials by hand or other effective means. Keep foundations and abutments free of standing water when fill is placed.

3.03 EXCAVATION FOR STRUCTURES

A. Excavate to achieve necessary dimensions, lines, and grades. Conform to elevations and dimensions shown within a tolerance of plus or minus 1 in., and extending a sufficient distance from footings and foundations as required for bracing and supports, concrete formwork, installation of services, other required construction, and for inspection.

B. For footings and foundations, take care not to disturb bottom of excavation. Excavate to final grade just before concrete is placed. Trim bottoms to required lines and grades to leave solid, undisturbed base to receive granular fill, base course, or concrete as shown.

3.04 TRENCHING

A. Excavate trenches so that pipe can be laid safely and accurately to required line and grade. Hand excavate for bells, fittings and projections to allow for proper jointing and to ensure that pipe rests evenly along barrel and is not resting on bell.

B. In sand and gravel soils, bottom of trench may be shaped to fit bottom 1/3 of pipe. In silt or clay soils, bottom of trench shall be 4 in. below pipe barrel and 3 in. below bell. In rock, bottom of trench shall be 6 in. below pipe barrel. Under foundations and footings, bottom of trench shall be 8 in. below pipe. Provide Granular Bedding as specified below.

C. Trench widths in ordinary soil shall be limited at top of pipe to not less than a 6 in. clearance on either side of barrel to allow for installation of bedding material between pipe and trench wall. Maximum trench width at top of pipe shall be outside pipe diameter plus 24 in. (30 in. minimum). Trench above top of pipe may be sloped, stepped or vertical to comply with state and federal regulations regarding trenches.

D. Minimum trench width in rock shall not be less than that for ordinary soil. Maximum trench width shall be outside pipe diameter plus 18 in. for an unsheathed trench, and outside pipe diameter plus 24 in. for sheathed trench.

3.05 UNAUTHORIZED EXCAVATION

A. Unauthorized excavation consists of removal of materials beyond indicated elevations or side dimensions without specific direction of A/E. Unauthorized excavation, as well as remedial work, shall be at Contractor's expense. Notify A/E prior to backfilling if unauthorized excavations are made.

B. Under footings, foundations, underpinning, equipment bases, and retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete or compacted fill may be used to bring elevations to proper position when approved by A/E.

C. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed.

3.06 STABILITY OF EXCAVATIONS

A. Maintain sides and slopes of excavations in a safe condition until completion of backfilling. Slope sides of excavations to angle of repose of material excavated; otherwise, shore and brace where sloping is not possible either because of space restrictions or stability of material excavated. Take precautions to prevent slides or cave-ins when excavations are made in locations adjacent to backfilled excavations, and when sides of excavations are subjected to vibrations from traffic, machinery, or any other source. Comply with applicable codes and ordinances.

3.07 SHORING AND BRACING

A. Carry down shoring and bracing as required as excavation progresses. Maintain shoring and bracing while excavations are open.

B. Provide and maintain shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition. Use timbers that are sound and free of large or loose knots.

C. Provide permanent steel sheet piling or pressure treated timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops as required and leave permanently in place.

3.08 DEWATERING

A. Perform earthwork in a manner to prevent surface water and ground water from flowing into excavations. Promptly remove water from excavations using pumps, sumps, and dewatering system components necessary to convey water away from excavations. If underground springs are encountered, notify A/E before proceeding.

B. Convey water removed from excavations and rain water to collection or run-off areas. Provide and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use foundation or utility trench excavations as temporary drainage ditches.

C. Provide filter material, trash screens, and other devices around pumps and intakes to avoid pumping or discharging sediment from construction site.

D. Provide pumping to maintain water level in work areas at least 12 inches below prepared subgrade.

3.09 STOCKPILING

A. Stockpile excavated materials meeting the requirements for fill and backfill where directed until required for the work. Place, grade, and shape stockpiles for proper drainage. Locate stockpiles a sufficient distance from edge of excavations, even though such excavations may be sheeted and braced, to prevent such material from falling or sliding into excavations and to prevent cave-ins.

3.10 COLD WEATHER PROTECTION

A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg F by covering with dry insulating materials of sufficient depth to prevent frost penetration.

3.11 SUBGRADE EXAMINATION AND PREPARATION

A. Examine subgrade prior to placing fill. Remove organic materials and debris subject to rot or corrosion. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with subgrade.

B. In structure and pavement areas, proof-roll exposed subgrade in overlapping passes in a perpendicular grid pattern with a fully-loaded tandem-axle dump truck weighing not less than 10 tons, or other equipment of similar size and weight, to compact subgrade and detect areas which must be undercut or improved. Inform A/E of unsuitable, unconsolidated subgrade soils.

C. After subgrade soil is stable, scarify top 6 to 8 in., moisture condition, and compact surface to density specified in Part 4 Schedules.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by A/E, without additional compensation.

3.12 ADDITIONAL EXCAVATION (OVER EXCAVATION)

A. If unsuitable bearing materials, such as poorly compacted fill, existing foundations, rubble, debris, or organic deposits, are encountered at required subgrade elevations, carry excavations deeper and replace excavated material with properly compacted Structural Fill as directed by A/E.

B. Where over excavation below footing subgrade is required, widen over excavation beyond footing edges at least 1 ft for each 1 ft of over excavation depth.

C. Removal of unsuitable material and its replacement as directed will be paid for as extra work, unless a pay item is included in the Bid Schedule. Do not proceed with extra or unit price work until authorized.

3.13 EQUIPMENT-PLACED ROCK AND COBBLE SHELL

A. Place Rock and Cobble Shell material at the locations, thicknesses, lines, and grades shown on the Drawings.

B. Stones with typical stone dimensions that are equal to D50 and larger shall be placed at the top surface with faces and shapes matched to minimize voids and form as smooth a surface as practical. Dumping and backhoe placement alone is not sufficient to ensure a properly interlocked system. The material may be machine-placed and then arranged as necessary by use of an excavator with a multi-prong grappling device or by hand to interlock and form a substantial bond.

C. Hand placement will be required where necessary to correct obvious irregularities and to prevent damage to adjacent improvements and wherever equipment placement methods are unsatisfactory.

3.14 PLACEMENT

A. Do not place fill until required excavation and foundation preparation have been inspected and approved. Do not place fill upon frozen surface; no snow, ice, or frozen material shall be incorporated in fill.

B. Place fill in approximately horizontal layers; do not exceed maximum loose layer thickness specified. Spread piles and windrows uniformly. Spreading and compacting equipment shall travel approximately parallel to centerline of embankment.

C. Place fill to be hand compacted or compacted by manually directed power tampers in layers not to exceed maximum thickness specified for manually compacted fill.

D. Adjacent to structures, place fill to prevent damage and allow structures to assume loads gradually and uniformly at approximately the same rate on all sides of structure. Do not travel heavy equipment over cast-in-place concrete work until cured a minimum of 14 days, unless otherwise approved.

E. Earth fill in dams, levees, and embankments designed to retain water shall meet the following requirements:

1. Distribute materials throughout each zone uniformly, free from lenses, pockets, or layers differing substantially in texture or graduation.
2. Scarify layers too hard and smooth for proper bond with succeeding layer; scarify parallel to axis of fill to a depth of 2 in.
3 Where fill material is placed adjacent to existing embankment, cut the face of the existing embankment with minimum of 12 inch vertical cuts stepped up the face of embankment prior to placement of new fill.
4. Maintain top surfaces of fills approximately level during construction, except provide a crown or cross-slope of not less than 2 percent for drainage. If the work requires fill to be placed higher at parts of an embankment, maintain top surface of each part level as specified above.
5. Place fill in continuous layers from abutment to abutment, except where openings to facilitate construction or to allow stream flow are authorized. Route equipment travel approximately parallel to embankment centerline.
6. Construct embankments required to be built at different levels so slopes of bonding surfaces between adjacent levels of embankment are not steeper than 3 horizontal to 1 vertical. Strip bonding surface of loose material and scarify, moisten, and recompact at specified moisture content and density to insure good bond with new fill.

3.15 CONTROL OF MOISTURE CONTENT

A. During placement and compaction of fill, maintain moisture content of materials being placed within the specified range.

B. Apply water to fill materials by sprinkling at excavation site or during placement of fill if necessary. Obtain uniform moisture distribution by discing, blading, or other approved methods prior to compaction of layer. If material is too wet when deposited on fill remove or dry it to specified moisture content prior to compaction.

C. If top surface of preceding layer of compacted fill or a foundation or abutment surface in zone of contact with fill becomes too dry to permit suitable bond, scarify and moisten it by sprinkling to an acceptable moisture content prior to placement of next layer of fill.

3.16 COMPACTION

A. Compact each layer of fill to a mass density not less than the percent of maximum density specified in 4.01 Compaction Schedule.

B Provide compaction equipment required to obtain specified compaction. Compaction by travel of grading equipment is not considered adequate for uniform compaction. Small vibratory compactors are required wherever fill is placed adjacent to foundation walls, footings, and piers. Pipe bedding and initial backfill shall be hand or mechanically tamped.

C. Manually compact fill adjacent to structures to density of surrounding fill by means of manually directed power tampers or plate vibrators. Do not operate heavy equipment within 2 ft of any structure; do not operate vibrating rollers within 5 ft of any structure. Compaction by means of drop weights will not be permitted.

D. Do not pass compacting equipment over cast-in-place concrete until cured 14 days (7 days for precast concrete with a concrete cradle) or over conduits until backfill has been placed above structure to a height equal to one-half the clear span width of structure or pipe or 2 ft, whichever is greater.

E. Compacting of fill adjacent to structures may be started when concrete has attained design strength, determined by test cylinders (ASTM C31). If concrete strength is not determined by tests, passage of heavy equipment and compaction of fill adjacent to structures may not be started until the following curing periods have elapsed:

Structure	Minimum Curing Period
Retaining walls, counterforts, and wing walls	14 days
Cast-in-place conduits and risers (forms removed)	14 days
Cast-in-place concrete conduits and risers (with inside forms in place)	7 days
Walls backfilled on both sides simultaneously	7 days
Footings	4 days

3.17 SOIL FILL

A. Place and compact fill materials in layers to required elevations as follows:

1. Under turf and planted areas: Use General Site Fill.
2. Under footing, foundation, building slab, pavement, and walk areas: Use Structural Fill.
3. For upper 6 in. immediately under building slabs and walks: Use Granular Fill.

4. For backfill behind retaining walls: Use Structural Fill.

B. Do not place soil fill on frozen subgrades.

3.18 GRADING

A. Grade areas within project limits to achieve cross sections, lines, and elevations indicated. Slope grades to direct water away from structures and to prevent ponding. Finish surface to be reasonably smooth and free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

B. Finish subgrades to required elevations within the following tolerances:

1. Turf and Unpaved Areas: Plus or minus 1 in.
2. Pavements and Walks: Plus or minus 0.5 in.
3. Structure Slabs: Tolerance of 0.5 in. when tested with 10 ft straightedge.

3.19 MAINTENANCE

A. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

B. Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add fill or backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.20 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Remove excess excavated material and trash, debris, and other waste materials and legally dispose of them off-site.

PART 4 SCHEDULES

4.01 COMPACTION SCHEDULE

Material Type	Usage	Lift Thickness [1]	Compaction [2]
Granular Fill	Below concrete slabs.	6"	95%
	Other designated areas.	8"	95%
Structural Fill	Under foundations.	8"	95%
	Below concrete slabs.	8"	95%
General Site Fill	Unpaved areas 10 ft. or less outside structure line.	8"	95%
	Unpaved areas more than 10 ft. outside structure line.	12"	90%
Embankment Fill	Embankment	8”-10”[3]	95%[4]

[1] Place manually compacted materials in maximum 4 in. layers.

[2] Percent of maximum density determined in accordance with ASTM D1557 (Modified Proctor test).

[3] Hand compaction of embankment fill is not allowed.

[4] Moisture content of embankment fill to be within 3% of optimum.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1 GENERAL

1.01 SUMMARY

A. Provide loose rock riprap, including geotextile filter fabric, as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

1.02 SUBMITTALS

A. Product Data:

1. Borrow site is shown on the drawings. Provide access to sources to enable A/E to inspect and obtain samples once the riprap is produced. Do not deliver riprap until reviewed by A/E.
2. Submit fabric product data. Include material samples, certification of physical properties, and installation procedures.

B. Make submittals in accordance with Section 01 33 00.

1.03 TESTING

A. A/E may perform tests to verify that riprap and completed work meet specified requirements. However, these tests are not intended to provide Contractor with information it may need to assure that materials and workmanship meet requirements of specifications, and their performance will not relieve Contractor of responsibility of performing its own tests for that purpose.

PART 2 PRODUCTS

2.01 RIPRAP

A. Riprap shall consist of hard, dense, durable stone, angular in shape and resistant to weathering. Rounded stone or boulders shall not be used as riprap material. The stone shall have a specific gravity of at least 2.5. Each piece shall have its greatest dimension not greater than three times its least dimension.

B. Wash riprap, if needed, to remove clays, silts, and fine organic materials.

C. Riprap gradation shall comply with requirements of Colorado DOT Std. Spec., Section 506, Table 506-2.

Riprap Size Designation	Percent of Material Smaller Than Typical Stone	Typical Stone Dimension (inches)	Typical Stone Weight (pounds)
D50 = 12 inch	70-100 50-70 35-50 2-10	21 18 12 6	440 275 85 3
D50 = 24 inch	100 50-70 35-50 2-10	42 33 24 9	3500 1700 650 35

2.02 RIPRAP BEDDING

A. Material used for riprap bedding shall meet the requirements for Drain Gravel in Section 33 41 66 – Drain Fill.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. Grade subgrade surfaces to lines and grades as shown with an allowance for riprap. Remove organic materials. Compact soft subgrade soils. When fill to achieve subgrade lines is required, provide granular materials.

3.02 PLACING DRAIN GRAVEL RIPRAP BEDDING

A. Place riprap bedding at the locations, thicknesses, lines, and grades shown on the Drawings.

B. General: Surfaces to receive bedding materials shall be smooth and firm, free from deleterious materials, and shall be brought to the lines and grades shown on the Drawings. Prepare the surfaces that are to receive bedding materials, by rolling and trimming as necessary to enable a uniform lift of bedding of the specified thickness to be placed thereon. Surface preparation will include, but not be limited to, bringing all low spots up to the lines and grades shown on the Drawings with compacted fill and removing all material projecting above lines and grades shown on the Drawings.

C. Placement: Place the bedding materials in a manner that minimizes segregation and results in uniform lifts of bedding materials of the thicknesses shown on the Drawings. Place riprap bedding materials from the bottom of the slope working up the slope.

D. Moisture condition the materials as necessary to control dust and to minimize segregation.

E. Compaction is not required for the bedding materials; however, bedding materials shall be spread in such a manner as to form a smooth, uniform layer under the riprap.

3.03 EQUIPMENT-PLACED ROCK RIPRAP

A. Place riprap at the locations, thicknesses, lines, and grades shown on the Drawings.

B. Stones with typical stone dimensions that are equal to D50 and larger shall be placed at the top surface with faces and shapes matched to minimize voids and form as smooth a surface as practical. Dumping and backhoe placement alone is not sufficient to ensure a properly interlocked system. The material may be machine-placed and then arranged as necessary by use of an excavator with a multi-prong grappling device or by hand to interlock and form a substantial bond.

C. Hand placement will be required where necessary to correct obvious irregularities and to prevent damage to adjacent improvements and wherever equipment placement methods are unsatisfactory.

3.04 HAND-PLACED RIPRAP

A. Riprap shall be securely bedded with larger rocks firmly in contact one to another. Spaces between larger rocks shall be filled with smaller rocks and spalls. Smaller rocks shall not be grouped as a substitute for larger rock. Flat slab rock shall be laid on edge.

END OF SECTION

SECTION 32 92 36

NATIVE SPECIES SEEDING

PART 1 GENERAL

1.01 SUMMARY

A. Provide native species seeding as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

B. Types of work required include, but are not limited to, the following:

1. Preparing, topsoiling, seeding, and mulching areas designated on Drawings to receive native species seeding.
2. Maintaining native species seeding for a 1-year period.

1.02 RELATED SECTIONS

31 05 10 Site Preparation: For topsoil removal.

1.03 SUBMITTALS

A. Product Data: Submit product labels for seed mixtures proposed for use on project.

B. Make submittals in accordance with Section 01 33 00.

1.04 WORK SEASONS

A. Conduct seeding during favorable weather conditions. Seeding will only be performed between September 1 and when ground freezes, and when the ground thaws and June 1, unless approved by Owner’s Representative ““ground thaw” shall be defined as the earliest date in a new calendar year in which seed can be buried 1/2" into the surface soil (topsoil) through normal drill seeding methods. “ground freeze” shall be defined as that time during the fall months in which the topsoil, due to freeze conditions, prevents burying the seed 1/2" into the topsoil through normal drill seeding operations. Comply with seed supplier's recommendations for planting conditions.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Loam, sandy loam, silty clay loam, or clay loam humus-bearing surface soil; 100% passing the 2 in. sieve; neither excessively acid, nor excessively alkaline; reasonably free of subsoil, clay lumps, brush, and weeds; and free of extraneous matter harmful to plant growth.

B. Reuse topsoil salvaged from within work area. If necessary, obtain topsoil to supplement insufficient quantities at site from naturally well-drained local sources; do not obtain from bogs or marshes.

2.02 NATIVE SEED

A. General: Deliver in bags tagged and labeled to show percentage of purity and germination. Seed shall have been tested within 1-year prior to date of seeding and shall conform to latest State and Federal seed laws.

B. Upland Areas: Upland seed mixture shall be High Altitude Native Grass Mix by Beauty Beyond Belief Wildflower Seed (Boulder, Colorado, 303.530.1222, www.bbbseed.com) or approved equal.

C. Wetland Areas: Wetland seed mix shall be Montane Wet Meadow Mix by Western Native Seed (Coaldale, CO, 719-942-3935, westernnativeseed.com), or approved equal.

2.03 MULCH

A. Field or marsh hay or straw of oats, barley, rye, or triticale.

B. Mulch shall be inspected for and Regionally Certified as weed free based on the Regionally Designated Noxious Weed and Undesirable Plant List for Colorado, Wyoming, Montana, Nebraska, Utah, Idaho, Kansas, and South Dakota

C. Mulch materials shall not contain excessive moisture which prevents uniform feeding through mulching machine.

2.04 FERTILIZER

A. Fertilizer as recommended by seed provider.

PART 3 EXECUTION

3.01 FINISH GRADING

A. Disturbed area shall be graded to be reasonably smooth; fill all washes and gullies to conform to required lines and grades.

3.02 TOPSOIL PLACEMENT

A. After completion of finish grading, place minimum of 4 in. of topsoil over areas indicated to be seeded.

B. Smooth grade topsoil to eliminate irregularities. Remove rocks and hard soil clods. Finished topsoil grade shall be 1 in. below adjoining grade of any surfaced area.

3.03 FERTILIZING

A. Apply fertilizer to prepared topsoil according to seed provider's recommendations.

3.04 SEEDING

A. Subgrade shall be final graded to the design elevation leaving the surface in a roughened condition. Shallow potholes and low ridges can remain following grading to promote variety of soil moisture regime conditions. In no case will a smooth, compacted seed bed common to a typical construction site be allowed to remain as the final grade. Re-work previously prepared areas that have become compacted or damaged by rains or traffic.

B. Apply native seed mixture using a drop spreader or broadcast spreader using method and application rate recommended by seed provider.

C. Do not sow immediately following rain, when ground is too dry, when ground is frozen or untillable, or during windy periods.

D. Do not seed areas in excess of that which can be mulched on same day.

3.05 MULCHING

A. Apply straw mulch uniformly in all seeded areas at rate of 1-1/2 tons per acre to a loose depth of 1 to 2 in. Anchor mulch using non-asphalt-based tackifier or mulch nets installed and stapled according to manufacturer's recommendations.

B. Mulch shall be applied within 4 hours after seeding. Areas not mulched within 4 hours after seeding or prior to precipitation or damaging winds on site shall be reseeded with the specified seed mix and re-mulched at the Contractor’s expense.

C. Avoid applying mulch in windy conditions.

3.06 HYDROMULCHING

A. At Contractor's option, mulch may be applied by hydromulch method at a minimum rate of 1700 lb per acre.

B. Mix components in water using equipment specifically designed for hydromulch application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application. Include nonasphaltic tackifying agent in mixture.

3.07 POST PLANTING MAINTENANCE

A. Maintain seeded areas for 1-year following planting.

B. Follow seed provider recommendations for maintenance and care during the 1-year period following planting.

3.08 ESTABLISHMENT AND REPLACEMENT

A. Seeded areas which fail to become established during the 1-year maintenance period shall be reseeded and maintained to ensure healthy growth. Because native seed mixtures are difficult to assess the first year of growth, satisfactory establishment of the cover crop and general erosion control by vegetation shall constitute establishment.

END OF SECTION

SECTION 33 01 36

CURED-IN-PLACE PIPE LINING

PART 1 GENERAL

1.01 SUMMARY

A. Provide cured-in-place lining as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

B. Existing 30-inch steel outlet pipe to be lined is deteriorating but is generally believed to be intact with no obstructions. Pipe has not been televised by Owner.

C. Cured-in-place lining shall be installed over the length of the 30-inch steel outlet pipe, both existing and newly installed, from just downstream of the intake structure elbow to the outfall structure. Lining of the intake structure elbow is not required.

D. The pipe shall be televised before and after installation of the cured-in-place lining.

1.02 RELATED SECTIONS

33 42 15 Piping and Accessories.

1.03 SUBMITTALS

A. Product Data: Submit product data for lining materials.

B. Installer Qualifications: Submit documentation of installer qualifications as specified in "Quality Assurance" article below.

C. Work Procedures: Submit proposed procedures for review at least 10 days prior to beginning lining operations. Proposed procedures shall include:

1. Proposed materials (e.g., liner, resin, end treatments, etc.).
2. Manufacturer’s technical literature.
3. Installation instructions.
4. Test methods.
5. Certifications for liner materials, resins, tube, cure method, etc.

D. All design calculations for the CIPP including liner thickness for the parameters specified.

E. Pre- and Post-Installation Video Inspection Reports: Contractor shall complete video inspections of the pipe to be lined both before and after installation of the CIPP liner. Submit reports of inspections performed. Video shall be recorded on a standard definition DVD suitable for use in a computer DVD drive.

F. Curing logs.

G. Make submittals in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Liner installer shall have a minimum of 20,000 linear feet of pipe lining experience with the specified product. Liner installer shall provide contact information for the owners of such projects upon request.

1.05 PATENTS

A. Contractor shall warrant to Owner that the methods, materials and equipment used herein, where covered by patents, are furnished in accordance with applicable licenses and that the prices included on Bid Form include applicable royalties and fees in accordance with such license. Warranty shall include defense against claims from infringement of patent and shall save harmless Owner and his Representatives from loss on account thereof.

1.06 TESTING

A. Contractor shall arrange and pay for testing of the CIPP liner by a qualified testing agency, acceptable to Owner and independent of Contractor.

B. A minimum of one (1) 12-inch long restrained sample shall be taken from the installed liner at a location to be approved by A/E and SEO. The sample shall be tested for flexural modulus and flexural strength according to ASTM D790 and thickness according to ASTM D2122. Test results must meet the design requirements.

C. A minimum of three (3) flat plate samples (i.e., coupons) shall be prepared from the tube and resin system. Coupon samples must be fully bonded and cured. The samples shall be tested for flexural modulus and flexural strength according to ASTM D790. Flexural modulus and strength test results must meet the design requirements.

D. Contractor shall field measure liner thickness at a minimum of eight (8) locations along the liner's length in accordance with ASTM D2122. Measured thicknesses must equal or exceed the design thickness.

PART 2 PRODUCTS

2.01 LINING MATERIAL

A. General: Pipe lining system must be recommended by the manufacturer for the type of application shown on the Drawings. A/E and SEO approval of pipe lining system is required.

B. Size: Liner shall be properly sized to diameter and length as shown. Contractor shall field verify pipe length and diameter prior to ordering liner. The liner shall be manufactured to expand sufficiently but not greater than 10 percent, achieving a tight fit against the host pipe after installation.

C. Structural Capacity: Contractor shall design the pipe lining system according to the following parameters:

1. No less than 58 ft of overburden material with an estimated unit weight of 125 lb per cu ft (pcf).
2. Minimum live loading: HS-20.
3. Assume 2% ovality (to be refined following pre-installation inspection).
4. Assume fully deteriorated host pipe.
5. Initial Flexural Strength: 4,500 psi (minimum).
6. Initial Flexural Modulus of Elasticity: 250,000 psi (minimum).

D. Tube Material: Liner shall be constructed to meet the requirements of ASTM F2019. Glass fiber material is required for this application. Felt liners are not acceptable.

E. Curing: The glass fiber liner shall be cured with UV light sources at a constant inner pressure.

F. Service Life: A minimum service life of 50 years is required for the installed product.

2.02 RESIN MATERIAL

A. All resin must be able to cure by UV light.

B. Resin system may be of the corrosion-resistant vinyl ester or polyester type. When properly cured within the tube composite, the resin system must meet the physical property requirements of ASTM F1216 and ASTM F1743.

2.03 UV LIGHT SYSTEM

A. UV light system shall have the ability to record parameters during the curing process to ensure that the liner is properly cured. Minimum recording parameters include the project name, date and time, curing speed, light source and wattage, inner air pressure, inner temperatures, and length of liner. Recording parameters shall be documented in the curing logs to be submitted to A/E and SEO for review (see Section 1.03).

2.04 END TREATMENTS

A. Provide end treatment(s) to transition from CIPP-lined pipe to unlined steel pipe. End treatments shall prevent CIPP liner from separating from the host pipe because of water pressure and high flow velocities. End treatments shall be designed for a minimum static head of 75 ft and a minimum flow velocity of 40 ft/s.

B. End treatments shall be rubber membrane seals manufactured in compliance with ASTM D3900 and ASTM D3568. Rubber membrane seals shall be secured using stainless steel retaining bands. Stainless steel retaining bands shall comply with UNS S30400 (Type 304), UNS S31600 (Type 316), UNS S31603 (Type 316L), or UNS N08367 (AL-6XN) and shall conform to ASTM A240 Standard Specifications for heat-resisting chromium and chromium-nickel stainless steel plate, sheet, and strip for pressure vessels. All material such as push tabs, shims, and wedges shall be made compatible with the base metal selected.

C. Contractor may use alternative end treatment methodology if approved by A/E and SEO.

PART 3 EXECUTION

3.01 PIPE PREPARATION

A. All internal debris shall be removed from the original pipeline. Pipeline shall be cleaned with hydraulically powered equipment, high velocity jet cleaners, or mechanically powered equipment as required for the CIPP lining operation.

3.02 PRE-INSTALLATION PIPE INSPECTION

A. Inspect pipe after cleaning.

B. Inspection of pipe shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed-circuit television. The interior of the pipe shall be carefully inspected to determine the location of any conditions that may prevent proper installation of the proposed pipe lining operation, such as protrusions, collapsed or crushed pipe, infiltration conditions, and reductions in the cross-sectional area. These conditions shall be noted and brought to A/E's attention immediately. The pre-installation video (copy) shall be turned over to the A/E prior to pipe lining.

C. Contractor shall measure the internal diameter of the existing pipe at least three (3) locations. Prior to ordering of the liner, verify the internal dimensions of the existing pipe to ensure that the lining utilized will be of appropriate dimension.

D. Based on the results of the inspection, Contractor shall make design modifications, as required, prior to ordering the liner.

3.03 INSTALLATION OF LINER

A. Install liner according to manufacturer’s recommendations and ASTM F2019.

B. Finished lining shall be continuous over entire length of an insertion run from just downstream of the low-level intake structure elbow (upstream) to the outfall structure (downstream) and shall be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, and delamination. Lining shall be impervious and free of any leakage from pipe to surrounding ground or from ground to inside of lined pipe.

C. Defects which will affect integrity or strength of lining in the foreseeable future or warranty period shall be repaired at Contractor's expense in a manner mutually agreed by Owner and Contractor.

D. Gliding Foil: A continuous heavy gauge (10mm) plastic sheet shall be pulled into place over the entire length of host pipe, covering 1/3 to 1/2 the diameter of lower portion of the host pipe, protecting liner during the pull in process.

E. Liner Installation: Liner shall be securely attached to winch and pulled into place taking care not to exceed pulling forces as stated in manufacturer’s installation protocol.

F. Liner Inflation: Liner shall be inflated per manufacturer’s inflation process. Once inflated to working pressures the liner shall fit tightly against the host pipe.

G. Pre-Curing Inspection: Once working inflation pressures are reached, the liner shall be inspected by closed-circuit television on light assembly checking for proper fit and expansion of the liner. Contractor shall repair any identified deficiencies or irregularities.

3.04 CURING

A. Cure liner using UV light according to ASTM F2019.

B. Initial curing speeds shall start off at a sufficient speed to ensure the first 15 ft of liner is cured properly, ramping up to working speed to properly cure the remainder of liner per manufacturer’s protocol. The same process shall be adhered to during the last 15 ft of liner.

C. Provide curing logs to Owner, A/E, and SEO within 24 hours of installation.

3.05 END TREATMENTS

A. Install end treatments per manufacturer’s recommendations.

3.06 POST-INSTALLATION INSPECTION

A. Upon completion, perform a visual inspection (or closed-circuit television inspection if a visual inspection is not possible) of the installed CIPP. Inspection shall be in accordance with ASTM F1743. Provide post-installation video (copy) to Owner, A/E and SEO within 24 hours of the inspection.

B. Installed liner shall be free from visual defects such as foreign inclusions, dry spots, keel, boat hull, pinholes, wrinkles, fins, and other deformities. Defects and deformities may, at the discretion of the A/E or SEO, be cause for rejection of the entire liner.

3.07 WARRANTY

A. The finished liner shall be warranted against defects in material and installation for a period of 1 year from the date of completion of the installation. The Contractor shall be responsible to repair all installation defects, for the one year warranty period. The Contractor shall be responsible to cover all costs, including materials and labor, associated with these repairs.

Contractor shall also be responsible to repair damage to the installed liner that may occur because of other ongoing construction activities.

END OF SECTION

SECTION 33 41 66

DRAIN FILL

PART 1 GENERAL

1.01 SUMMARY

A. Provide Drain Fill for drainage blankets and as riprap bedding as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

1.02 RELATED SECTIONS

01 57 60 - Construction Dewatering.
31 20 00 - Earth Moving and Embankments.
33 42 15 - Piping and Accessories.

1.03 SUBMITTALS

A. Drain Fill Source: At least two weeks prior to start of construction, submit source and sample results of proposed Drain Fill materials.

B. Test Report:

1. Grain size analysis in accordance with ASTM C136 of proposed Drain Fill to demonstrate acceptability of source.
2. Optimum moisture-maximum density curve for fill materials in accordance with ASTM D1557.

C. Make submittals in accordance with Section 01 33 00.

1.04 TESTING

A. A/E will perform tests to verify Drain Fill in place. These tests are not intended to provide Contractor with information needed to assure proper execution of work and test performance will not relieve Contractor of responsibility of performing tests for that purpose.

B. At least one grain size analysis will be performed for each type of Drain Fill for each 100 lin ft along the embankment where Drain Fill is placed. Contractor shall provide A/E free access to placed material for purpose of obtaining samples for testing. Samples will be obtained from in-place, compacted Drain Fill.

C. Contractor shall arrange and pay for soil sampling and testing by a qualified testing agency, acceptable to Owner and independent of Contractor.

D. Field Testing:

1. Perform a minimum of one field density test for each vertical foot of Drain Fill for every 100 lin ft of Drain Fill placement.
2. Field density tests shall be in accordance with ASTM D6938 or ASTM D1556.
3. Where soil materials do not conform to type or density specified, soil shall be replaced or reworked to conform. Cost of extra tests for replaced or reworked areas shall be paid for by Contractor.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Drain Fill aggregates shall be stored and handled by methods that prevent segregation of particle sizes or contamination by other materials.

PART 2 PRODUCTS

2.01 DRAIN FILL MATERIALS

A. Drain Fill aggregates shall be sand, gravel, crushed stone or mixtures thereof, composed of clean, hard, durable mineral particles free from organic matter, clay balls, soft particles, excessive fine-grain soils, or other substances that would interfere with their free-draining properties.

1. Not more than 15 percent, by weight, shall be flat, elongated particles.
2. Not more than 5 percent of material finer than a No. 4 sieve shall be crushed limestone.
3. Material passing the No. 200 shall be non-plastic.

B. Drain Fill shall comply with the following gradation by weight:

	Percent Passing		
Sieve Designation	Type 1(1)	Type 2(2)	Drain Gravel(3)
1"			
3/4"		100	
1/2"			100
3/8"	100	90-100	85-100
No. 4	95-100	20-55	10-30
No. 8	80-100	5-30	0-10
No. 16	50-85	0-10	0-5
No. 30	25-60		
No. 50	5-30	0-5	
No. 100	0-10		
No. 200	0-5		

(1) ASTM C33 Fine Aggregate
(2) ASTM D448 No. 89
(3) ASTM No. 8

C. Type 1 Drain Fill shall have a minimum moisture content of 10%. Additional water may be added in the field.

PART 3 EXECUTION

3.01 DRAINFILL COMPACTION TEST

A. Contractor shall construct a Type 1 testing area at a location off the dam footprint. The purpose of this test area is to construct a large enough test area to place and compact Type 1 Drain Fill by the methodology selected by Contractor.

B. Provide minimum two weeks notice to A/E of when test will be completed. Test to be completed under observation of A/E and SEO.

C. Test shall be conducted by placing a one foot sacrificial layer of Type 1 Drain Fill. A second lift, placed using a maximum 8” lift thickness, will be placed and compacted by the contractors chosen methodology.

D. Contractor shall arrange and pay for soil sampling and testing of the compacted Type 1 Drain Fill by a qualified testing agency, acceptable to Owner and independent of Contractor. Testing agency shall complete at least two (2) field density tests on the test section (using either ASTM D6938 or ASTM D1556) to determine if specified level of compaction is achieved. Testing agency shall also complete one (1) grain size analysis (using ASTM C136) to ensure compaction method does not result in an unacceptable level of particle breakdown.

E. If specified compaction is not achieved, additional test compaction efforts will be required until specified compaction and gradation is achieved.

F. A/E and Contractor shall document the required compaction effort to achieve design compaction and this methodology shall be used for placement of Type 1 Drain Fill on the project.

G. Placement of Type 1 Drain Fill may not occur until A/E and SEO approve of the Contractor's proposed compaction method.

3.02 PREPARATION

A. Foundation surfaces and trenches shall be clean and free of organic matter, loose soil, foreign substances, and standing water when Drain Fill is placed. Earth surfaces upon or against which Drain Fill will be placed shall not be scarified.

B. Contaminated Drain Fill near edge of each excavation section shall be removed prior to continuation of placement of Drain Fill.

C. Do not prepare any more base than can be satisfactorily covered that same working day.

3.03 PLACEMENT

A. Drain Fill shall not be placed until subgrade has been inspected and approved by A/E. Drain Fill shall not be placed over or around pipe or drain tile until installation of pipe or tile has been inspected and approved.

B. Type 1 Drain Fill shall be placed uniformly in layers not more than 8 in. deep before compaction. When compaction is accomplished by manually controlled equipment, layers shall be not more than 8 in. deep. Material shall be placed in a manner to avoid segregation of particle sizes and to ensure continuity and integrity of all zones. No foreign materials shall be allowed to become intermixed with or otherwise contaminate Drain Fill.

C. Type 2 Drain Fill shall be place to lines shown. Place Type 2 material to form a smooth uniform layer around drain pipes.

D. Traffic shall not be allowed to cross over drains at random. Equipment crossovers shall be maintained, and number and location of such crossovers shall be established and approved prior to beginning of Drain Fill placement. Each crossover shall be cleaned of all contaminating materials and shall be inspected and approved by A/E before additional Drain Fill is placed.

E. Damage to foundation surface or to sides or bottoms of trenches occurring during placement of Drain Fill shall be repaired before Drain Fill placement is continued.

F. Upper surface of Drain Fill constructed concurrently with adjacent zones of earth fill shall be maintained at an elevation at least 1 ft above upper surface of adjacent fill.

G. Drain Fill over or around pipe or drain tile shall be placed in a manner to avoid displacement of pipe or tile in line or grade.

3.04 CONTROL OF MOISTURE

A. Type 1 Drain Fill shall be near saturated during placement. When addition of water is required, it shall be applied in such a way as to avoid excessive wetting of adjacent earth fill.

3.05 COMPACTION

A. Type 1: Compact to 70% relative density. Avoid over compaction of Drain Fill. A/E will compare stockpiled and in-place Drain Fill samples and particle breakdown by over compaction cannot exceed 2%.

B. Type 2 and Drain Gravel: No compaction of Type 2 drain material and Drain Gravel will be required beyond that resulting from placing and spreading operations.

END OF SECTION

SECTION 33 42 15

PIPING AND ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Provide piping and accessories as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

1.02 RELATED SECTIONS

31 20 00 Earth Moving and Embankments.
33 01 36 Cured-in-Place Pipe Lining.
33 41 66 Drain Fill.
40 70 10 Instrumentation.

1.03 QUALITY ASSURANCE

A. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel." Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.04 SUBMITTALS

A. Product Data: Submit product data for pipe, fittings, and other piping accessories.

B. Test Reports: Submit report for leakage testing.

C. Record Drawings: Accurately record locations of pipe and field changes on a set of Drawings. Prior to final application for payment, deliver record drawings to A/E.

D. Make submittals in accordance with Section 01 33 00.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Carefully unload and store pipe to prevent chipping, cracking, or damage to surface coatings. Pipe shall not be skidded upon ground. Repair damaged coatings.

PART 2 PRODUCTS

2.01 HDPE PIPE

A. ANSI/AWWA C906, DR 32.5, high density, perforated or non perforated pipes. Joints shall consist of an integral bell and spigot and shall be water tight according to requirements of ASTM D3212 (10.8 psi pressure test).

B. Pipe perforations shall meet the following specifications

C. Capacity of each perforation: 0.08 gpm

D. Hole Size: 5/32” or 3.9688 mm

E. Hole Spacing: 8 holes equally spaced around pipe circumference, every 1” of pipe

2.02 STEEL PIPE

A. Steel pipe conforming to AWWA C200 and having the following minimum wall thickness:

Diameter	Minimum Wall Thickness
30"	0.375"

B. Joints shall be in accordance with AWWA C200. Joints must be welded. Pipe ends for field-welded joints shall be beveled in accordance with AWWA C206.

C. Steel pipe shall have an interior lining of primer and coal-tar enamel (AWWA C203), cement mortar (AWWA C205), or near-white blast cleaned (SSPC SP-10) and painted with one 7-mil coat of coal-tar epoxy, unless otherwise noted.

D. Exterior of all pipe shall receive two coats of coal tar epoxy, 7 mils dry thickness per coat, applied to commercial blast cleaned surface (SSPC SP-6).

2.03 STAINLESS STEEL HYDRAULIC TUBING

A. Tubing: Stainless steel hydraulic tubing per ASTM A269, TP304, seamless.

1. Nominal pipe sizes as per Drawings.
2. Pipe schedule suitable for service under the following conditions:
   a. 125 barg pressure.
   b. 25 second opening time.
   c. 10 second closing time.
   d. Minimum wall thickness shall be:
      1) 3/4" OD tubing and smaller: 0.049 inches.
      2) 7/8” to 1” OD tubing: 0.065 inches.
      3) 1-1/4” to 1-1/2” OD tubing: 0.095 inches.
3. Confirm pressure requirements of equipment and increase thickness as required if the maximum working pressure is higher.

B. Fittings: Stainless steel “Seal-Lok” tubing fittings per SAE J1453 and ISO 8434-3 manufactured by Parker Hannifan Corporation, or approved substitute.

2.04 PVC PLASTIC PIPE

A. Poly (vinyl chloride) (PVC) plastic pipe, Sch. 40, type 1, grade 1, meeting requirements of ASTM D1785, unless otherwise designated. Joints shall be solvent cement type or threaded type (Sch. 80 only) using teflon tape.

B. Provide Sch. 40, ASTM D2466 or D2467, socket-type fittings, in size and classification the same as connecting pipe, suitable for solvent cement joints, unless otherwise noted.

C. Solvent cement shall be a compatible solution of type 1, grade 1, unplasticized PVC plastic compound in accordance with ASTM D2564, free-flowing and free of lumps, undissolved particles or foreign matter that will adversely affect ultimate joint strength or chemical resistance.

2.05 GALVANIZED STEEL PIPE

A. Steel pipe, welded or seamless, conforming to ASTM A53; Sch. 40, unless otherwise designated.

B. Provide welded or flanged joints for piping 2-1/2 in. diameter and larger and threaded joints for piping 2 in. diameter and smaller, unless otherwise designated. Steel welding fittings shall be ANSI B16.9, std. wt.; steel flanges shall be ANSI B16.5, Class 150; and malleable iron threaded fittings shall be ANSI B16.3, Class 150; unless otherwise designated.

C. Where designated, plastic coating and wrap shall comply with requirements of American Gas Association.

2.06 DUCTILE IRON PIPE

A. Ductile iron pipe shall conform to AWWA C151, Class 52 unless otherwise shown. Pipe sections shall be straight and true circular sections with inner and outer surfaces concentric. Pipe sections shall be at least 16 ft long.

B. Fittings shall conform to AWWA C110 or C153, 250 psi working pressure.

C. Pipe and fittings shall have standard thickness cement mortar lining and interior bituminous coating conforming to AWWA C104. Apply bituminous seal coat on exterior of pipe and fittings conforming to AWWA C151. Coatings shall be smooth, tough and tenacious and impervious to water without tendency to scale off, and shall not be brittle.

D. Pipe joints shall be either push-on type (slip joint) or mechanical joint conforming to AWWA C111.

2.07 RODENT GUARD

A. Rodent guard to be fabricated from galvanized metal with bolt on band and expanded metal screen.

2.08 DUCTILE IRON SEWER ADAPTER

A. Ductile iron body with rubber gasket.

2.09 PIPE STRAP

A. Heavy-duty, 2-hole type, galvanized.

2.10 EXPANSION ANCHORS

A. Description: Wedge type, torque-controlled expansion anchors with washers.

B. Acceptable Manufacturers: Anchors shall be Hilti, ITW Ramset/Red Head, Powers Fasteners, Simpson Strong-Tie, Wej-it, or approved equal.

C. Materials: Provide stainless steel anchors of diameter indicated on the Drawings.

   1. Stainless Steel Anchors: ASTM F593 stainless steel bolts and ASTM F594 stainless steel nuts, Alloy Group 1 or Alloy Group 2.

2.11 FLEXIBLE CONDUIT SEAL

A. Description: Provide a flexible, foam-based conduit seal to prevent water from flowing into bottom of the 8-inch PVC pipe used to house the hydraulic lines. Seal must be removable without causing damage to the PVC carrier pipe or surrounding concrete.

B. Required sealing head: 50 ft.

C. Required operating temperature: 20 to 100 ºF.

D. Acceptable manufacturers: Duraline Hydra-Seal S-60 or approved equal.

PART 3 EXECUTION

3.01 LINE AND GRADE

A. Provide staking as required to install pipe and drainage structures to line and grade as shown on Drawings.

3.02 LAYING OF PIPE

A. Where practicable, begin at lowest point of proposed pipe line; lay with bell end or receiving groove edge upstream in direction of laying.

B. Cut in and connect to existing pipe and drainage structures as required. When connection to an existing pipe is required, contact A/E if adjustments to inverts are needed.

C. Pipe shall be laid immediately following the trench preparation and bedding provisions of Section 31 20 00 / 31 23 33.

D. Exercise care when handling pipe. Ropes, slings, or other devices must be used for lowering pipe into trench. Only pipe which is suitable for use is to remain on site. Damaged or broken pipe shall be immediately separated from acceptable pipe.

E. Lay pipe uniformly to line and grade on a prepared bed providing even support along entire barrel. Excavate bell holes in bedding material so pipe will rest on barrel and not on bell. As work progresses, interior shall be cleared of dirt and debris. Do not lay pipe where water is above bedding material except where A/E determines that foundation is stable, pipe will not be displaced upward, and joint construction will not be affected by water.

F. Each pipe shall be bedded by hand or by equally careful means to 12-in. cover before laying subsequent pipes. Fill space between pipe and trench wall in 6-in. layers and manually compact. Pipe sizes larger than 15-in. diameter may require mechanical compaction of bedding material.

G. When work is not in progress, water may be allowed to flow into newly laid pipe if provisions are made to prevent dirt from washing into pipe.

3.03 JOINTING

A. Joint materials and methods shall conform to manufacturer's recommendations.

B. Pipe joints shall be clean before joints are made. No joints shall be made under water.

3.04 ALIGNMENT AND GRADE

A. Contractor shall view the HDPE drain pipe and PVC hydraulic carrier and vent pipes after installation and backfill using a televised inspection. If defects are found due to failure of installation or materials, Contractor shall promptly correct defects at no additional cost to Owner.

3.05 FIELD CUTTING PERFORATIONS

A. Field drill perforations in HDPE pipe if manufactured product does not meet specifications.

3.06 SECURING PIPE TO CONCRETE

A. Secure pipe to concrete as shown on the Drawings using straps and expansion anchors. Required strap spacing and anchor embedment depths are indicated on the Drawings. Install expansion anchors according to manufacturer’s instructions. Expansion anchors shall not be installed into concrete that is less than 7 days old.

3.07 INSTALLING FLEXIBLE CONDUIT SEAL

A. Install at location shown on Drawings according to manufacturer's instructions.

END OF SECTION

SECTION 35 22 28

STAINLESS STEEL SLIDE GATES

PART 1 GENERAL

1.01 SUMMARY

A. Install Owner-provided stainless steel slide gate, accessories, and operators as shown and as specified. Comply with applicable provisions of Divisions 00 and 01.

1.02 RELATED SECTIONS

03 30 00 – Cast-in-Place Concrete.
33 42 15 – Piping and Accessories.

1.03 SUBMITTALS

A. O/M Manuals: Submit installation instructions and operation and maintenance manuals for slide gate and operators.

B. Design Computations: Submit fabricator's design computations for gate and stem.

C. Certifications: Submit certifications from fabricator that gate meets applicable ASTM and AWWA standards.

D. Make submittals in accordance with Section 01 33 00.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Owner will procure slide gate, accessories, and operators and store for Contractor to obtain and deliver to site. Owner will notify Contractor of storage location prior to construction.

B. The following Articles 2.02 through 2.07 are provided for State submittal requirements and Contractor information.

2.02 DESIGN REQUIREMENTS

A. Design gates to comply with AWWA C561 and the following conditions.

B. Gates shall have self-adjusting seals. Gates that utilize adjustable wedges are not acceptable.

C. To compensate for debris strikes, gate bottom edge shall be designed to resist a static load of 1,000 lb per lin ft that is applied 3 in. above gate bottom lip.

D. Gates shall be operable at variable gate open positions in increments of 0.10 ft to regulate flow. Gate shall be able to remain in any closed, partially open, or fully open position for long periods of time without excessive vibrations.

E. Gates shall not vibrate excessively during opening, closing, or static positioning.

2.03 SLIDE GATES AND ACCESSORIES

A. Provide fabricated stainless steel slide gates complying with AWWA C561 and 4.01 Stainless Steel Slide Gate Schedule.

B. Gates designated for flush-bottom closure shall have a seal mounted either on gate slide or on gate frame. Full length of contacting member shall be accurately machined to make an effective seal when gate is closed.

C. Provide stainless steel hydraulic lines per gate manufacturers recommendation.

2.04 MANUAL OPERATORS

A. A hand-operated hydraulic pump shall be provided as back up operator.

2.05 PORTABLE HYDRAULIC OPERATOR

A. One underwater (fully submerged) hydraulic operating system shall be provided to operate the gate. The system shall be designed to operate the gate smoothly and uniformly and hold the gate in the desired position. The gate shall be operated manually with a provided portable, gasoline-powered hydraulic pump mounted to a hand cart.

B. Connections to hydraulic lines will be accessible via a locked valve box located at the top of the dam embankment.

C. The hydraulic power unit (HPU) shall be designed to operate using environmentally-friendly (confirm with Owner prior to constructing HPU) hydraulic fluid such as Mobil 224H.

2.06 GROUT AND FRAME LEAKAGE SEAL

A. Grout furnished for installation of embedded components shall be as recommended by gate manufacturer for the site conditions.

B. Frame to concrete connection shall be free of leakage. Acceptable leakage seals include a layer of grout between frame and existing concrete, rubberized membranes, or injectable waterstops. Design and furnishing of leakage seal materials shall be responsibility of gate manufacturer.

2.07 FINISH

A. Ferrous metal surfaces shall receive surface preparation and high-solids epoxy protective coating or equivalent suitable for outdoor exposure before shipment to site.

B. Machined surfaces, tapped holes, and threads shall receive protective coat of grease.

PART 3 EXECUTION

3.01 GATE INSTALLATION

A. Install gates in accordance with shop drawings and manufacturer's recommendations and in a manner that will prevent leakage around seats and binding of gates during operation.

B. Surfaces of metal against which concrete will be placed shall be free from oil, grease, loose mill scale, loose paint, surface rust, and other debris or objectionable coatings.

C. Anchor bolts, thimbles, and frames shall be secured in true position and in forms and held in alignment during placement of concrete. Mechanical anchors shall not be installed into concrete that is less than 7 days old. Adhesive anchors shall not be installed into concrete that is less than 21 days old.

D. Concrete surfaces against which seals will bear or against which flat frames or plates are to be installed shall be smooth and uniform.

E. Install frame and anchorages in a manner that prevents leakage between frame and concrete buttress and secures gate for all load conditions.

F. When a gate is attached to a wall thimble, mastic or resilient gasket shall be applied between gate frame and thimble in accordance with recommendation of gate manufacturer.

3.02 LIFT INSTALLATION

A. Gate stems, stem guides, and gate operators shall be carefully aligned so that stem is parallel to guide bars or angles on gate frame after installation.

3.03 OPERATIONAL TESTS

A. Clean, lubricate, and otherwise service gates and operators in accordance with manufacturer's instructions. Operate each gate several times throughout its full range. Test functioning of each operator. Adjust as necessary to insure satisfactory operation of gate system.

B. Should any gate vibrate excessively during opening, closing, or static positioning (see "Design Requirements" article above), manufacturer shall promptly attend a meeting onsite with A/E to discuss cause and solutions for vibrations.

C. A certified field technician from the gate manufacturer shall inspect the final installation.

3.04 LEAKAGE TEST

A. Perform a leakage test on all slide gates. Maximum permissible leakage at normal pool shall be 0.10 gallons per minute per foot of seating perimeter in compliance with AWWA C561, 5.2.2. Adjust gates to meet permissible leakage.

PART 4 SCHEDULES

4.01 STAINLESS STEEL SLIDE GATE SCHEDULE

Quantity	Size (in.)* w x h	Stem*	Type*	Frame Type	Max. Unbalanced Head (ft) Seating	Max. Unbalanced Head (ft) Unseating	Wall Thimble	Operation
1	36x36	HC	FB	Flange Frame	55	10	No	M and P

*Abbreviations:

Size: w - clear opening width, h - clear opening height

Stem: HC - hydraulic cylinder

Type: FB - flush bottom

Operation: M - manual P - portable hydraulic operator

END OF SECTION

SECTION 40 70 10

INSTRUMENTATION

PART 1 GENERAL

1.01 SUMMARY

A. Provide a complete system of instrumentation as shown and as specified, except as designated elsewhere. Responsibility under this Section consists of system design, installation, start-up and testing, and instruction of Owner's authorized personnel. Coordinate with related work of other sections; see below. Comply with applicable provisions of Divisions 00 and 01.

B. Equipment shall be of latest and most modern design; components shall be current models at time of bidding. Equipment shall have overall performance, precision, and accuracy as guaranteed by manufacturer; units shall be stable, vibration free, properly operating in accordance with manufacturer's recommendations. Contractor shall be responsible for all details as required, including any undesignated items necessary for a complete installation, properly installed and ready for operation. Contractor shall be fully responsible for additional costs resulting from unauthorized deviations from these specifications.

C. System shall be the product of one (1) single approved Vendor who has an experience record in real-time early warning systems satisfactory to the Owner and A/E based on established systems. Vendor shall provide instrumentation and electronics as shown on the Drawings and real-time satellite data transmittal services to allow for the Owner and other stakeholders to keep informed of meteorological and hydrological conditions at the dam. Vendor shall provide a web-based interface from where the real-time data can be viewed. Vendor shall also provide capabilities for automated data monitoring and the issuing of alarms when specified data thresholds are met or exceeded. See the early warning system feasibility study provided in the Appendices.

1.02 RELATED SECTIONS

01 33 00 Submittal Procedures.
01 57 60 Construction Dewatering.
01 60 00 Product Requirements.
33 42 15 Piping and Accessories.

1.03 SHOP DRAWINGS

A. Submit shop drawings for instrumentation in accordance with Section 01 33 00 and instructions of individual Sections. Furnish the following information:

1. Manufacturer's product data and specifications.
2. Shop drawings showing general dimensions, openings, connections, components, wiring schematics, templates, required appurtenances, and construction details.
3. Weight of major components.
4. Parts suppliers, service crews, and repair facilities.
5. Recommended installation procedures.

B. Submit systems complete in one submittal; individual segments of systems will not be reviewed.

C. Review of shop drawings by A/E will not relieve Contractor of responsibility for providing materials, workmanship, and design which meet specifications and operating conditions.

D. See the Drawings for the two (2) general locations and layout for the proposed instrumentation stations. Contractor shall submit shop drawings for the concrete foundations needed to accept the selected vendor’s instrumentation pedestals.

1.04 OPERATION AND MAINTENANCE (O/M) MANUALS

A. Submit O/M manuals in accordance with Section 01 33 00 and as specified in individual sections; include the following:

1. A/E-reviewed shop drawings and product data.
2. Installation and operating instructions.
3. Maintenance instructions and address of authorized service center.
4. Wiring diagrams and parts lists.
5. Test data and certifications.
6. Manufacturer's warranty information.

1.05 MAINTENANCE CONTRACT

A. Where designated, supplier/manufacturer shall offer to the Owner for consideration a 5-year renewable maintenance-service contract at an additional cost. Submit maintenance-service contracts for review with shop drawings.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver instrumentation to job site at appropriate time for installation. Equipment items shall be packaged in cartons, crated, or affixed to pallets with protective wrappings. Exercise care to prevent damage from handling.

B. Protect stored components in accordance with manufacturer's instructions. Store mechanical and electrical components in a warm, dry location; store fabrications off ground, under cover, and away from damp or corrosive surfaces. Keep equipment dry at all times. Equipment suppliers shall periodically inspect to insure proper storage of equipment.

1.07 WARRANTY

A. System manufacturer shall warranty for 1 year that all equipment is free from defects in design, materials and workmanship. Furnish and install replacement parts for defective components at no additional cost.

B. Unless otherwise designated, warranty provisions shall begin with date of Substantial Completion or with Owner's acceptance for beneficial use, whichever is earlier, but not prior to receipt of manufacturer's report of startup services (where designated). Beneficial use shall commence when product has been fully installed, tested and adjusted in accordance with Contract Documents (and in the case of operating equipment, has been certified by manufacturer to be ready for operation), is ready to be used for intended application, and is accepted by Owner for use.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Vendor shall select system components from established manufacturers of instruments with proven track records of long-term, successful reliability in conditions like those at Hogchute Dam. All products shall be manufactured in accordance with the specifications by one of the named manufacturers or approved equal; substitutions shall be submitted in accordance with Section 01 60 00 and Instructions to Bidders.

B. The system shown on plan sheets is designed by OneRain Incorporated. Contractors may use a OneRain system or approved equal.

2.02 PROTECTION

A. All infrastructure shall be powder coated to prevent corrosion and to improve aesthetics.

B. Instruments and electronics shall be protected from weather and tampering.

1. Each site shall use traffic-style infrastructure capable of withstanding high winds manufactured by Pelco or an approved equal.
2. Batteries shall be housed within locking, watertight, stainless steel, National Electrical Manufacturer Association (NEMA) rated enclosures.
3. Electronic components shall be housed within locking, watertight, plastic, NEMA rated enclosures. Plastic NEMA rated enclosures shall be housed in locking 1/4”-thick steel enclosures to prevent damage from firearms.
4. Antennas, sensors, and solar panels shall be mounted in such a way as to prevent tampering and damage from firearms.

2.03 EQUIPMENT IDENTIFICATION

A. Each item of equipment shall have a nameplate, securely attached, with manufacturer's designations and characteristics.

2.04 BUBBLER

A. Provide bubbler-type water level sensor to measure depth of water in reservoir.

B. Operating ambient temperature: -40 to +158 ºF (-40 to 60 ºC).

C. Operating altitude: 9,900 ft.

D. Operating humidity: 0 to 95 percent.

E. Required depth measurement: 0 to 60 ft.

F. Bubbler gas delivery: Constant-flow bubbler system with built-in compressor. User-programmable bubbling rates of 30 to 120 bubbles per minute.

G. Purge pressure: 20 to 90 PSI, user selectable.

H. Power supply: 10.8 to 16.5 V DC.

I. Output interface: SDI-12 compatible with data logger.

J. Accuracy: 0.01 ft or 0.1% of measured depth, whichever is greater.

K. Desiccators: The bubbling mechanism and the non-submersible transducer must be equipped with a desiccating system.

L. Enclosure: NEMA4.

M. Manufacturers: FTS or approved equal.

2.05 PRESSURE TRANSDUCER

A. Provide temperature-compensated pressure transducer-type water level sensors to measure depth of water in reservoir (as a backup to the bubbler-type sensor) and in the stream below the dam (as a primary sensor).

B. Operating temperature: 23 to +113 ºF (-5 to +45 ºC).

C. Operating altitude: 9,900 ft.

D. Operating humidity: 0 to 95 percent.

E. Required depth measurement: 0 to 60 ft.

F. Power supply: 12 to 24 V DC.

G. Output interface: SDI-12 compatible with data logger.

H. Accuracy: 0.05% of measured depth.

I. Materials: Corrosion-resistant metal.

J. Manufacturers: OTT or approved equal.

2.06 TIPPING BUCKET

A. Provide tipping bucket-type rain gauge with 0.01-inch measurement resolution at a rate of 0 to 25 inches per hour.

B. Required operating temperatures 32 to 140 ºF.

C. Diameter: 8 inches.

D. Switch rating: 200 V DC max.

E. Output: SDI-12 compatible with data logger.

F. Materials: UV-resistant plastic or corrosion-resistant metal, shock and vibration resistant.

G. Manufacturer: Design Analysis Associates, WaterLog Series, Model H-340 or approved equal.

2.07 DATA LOGGER (PRIMARY STATION)

A. Provide a primary data logger to record measured data from the tipping bucket, pressure transducer, and bubbler installed at the top of dam. The primary data logger shall also receive data from the secondary station via a 900 MHz spread-spectrum radio feed. The primary station shall broadcast recorded data from the site using a satellite transmitter.

B. Manufacturer: Campbell Scientific CR1000X Measurement and Control Data Logger or approved equal.

2.08 DATA LOGGER (SECONDARY STATION)

A. Provide a secondary data logger to record measured data from the pressure transducer installed at the secondary station downstream of the dam. The secondary data logger shall transmit recorded data to the primary station on top of the dam via a 900 MHz spread-spectrum radio feed.

B. Manufacturer: Campbell Scientific CR300-RF407 Series Measurement and Control Data Logger or approved equal.

2.09 APPURTENANCES

A. Battery: Campbell Scientific PS200 12 V Power Supply with Charging Regulator or approved equal. Provide two (2) batteries at each station for power redundancy.

B. Solar Panel: Campbell Scientific SP10 Solar Panel or approved equal.

C. 900 MHz Antenna for Primary Station: Campbell Scientific 900 MHz 6dBd Omni Antenna w/Type N Female and Mounting Hardware or approved equal.

D. 900 MHz Antenna for Secondary Station: Campbell Scientific 900 MHz 6dBd Yagi Antenna with Type N Female and Mountain Hardware or approved equal.

E. Satellite Transmitter: ORBCOMM ST 6100 or approved equal.

F. Conduit: For buried applications, provide PVC Plastic Pipe. For non-buried applications, provide Galvanized Steel Pipe. See Section 33 42 15 – Piping and Accessories.

G. Underground Enclosure Assembly: Precast polymer concrete construction with open bottom. Equipped with stainless steel hex-head cover bolts.

2.10 STATION MARKERS

A. Post: 1.375” deep carbon-steel heavy duty u-channel post, 6-foot tall. Green baked enamel finish. Uline (1-800-295-5510) Model No. H-4585 or approved equal.

B. Plate: aluminum plate, 1/8-inch minimum thickness, sharp edges and corners removed. Plate is coated with Label on side facing the access road on top of dam.

C. Label: non-metalized microprismatic lens reflective coating for production of reflective work zone signs. ASTM D4956 Type III or IV. White “3M High Intensity Prismatic Reflective Sheeting Series 3930” or approved equal.

D. Marker: self-adhesive exterior-rated waterproof and fade-resistant vinyl letters. Letters shall be all black with no background (stand-alone). Coordinate labeling names and numbers with A/E prior to ordering labels. Marker is located on side facing the gravel road.

E. Mounting hardware: each plate requires two sets of stainless steel 3/8-inch standard thread stainless bolt, nut, front washer, and back washer. Owner will consider alternative mounting solutions that are rust-free and stable against winter wind forces on plate.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install equipment and systems in accordance with shop drawings and manufacturer's recommendations.

B. Installation of primary station instrumentation and electronics must take place during Phase 1 dewatering, when the lake is drawn down and the intake structure is dewatered by cofferdam.

3.02 VENDOR SERVICES

A. Supplier of instrumentation and electronics shall provide services of a factory-trained service representative to:

1. Review the Drawings of required appurtenant structures (e.g., foundations, piping, etc.), providing feedback if the design of any of these structures requires modification to ensure compatibility with Vendor’s instrumentation and electronics.
2. Meet with Contractor onsite prior to construction to identify final locations of primary and secondary stations.
3. Install instrumentation and electronics.
4. Check and adjust equipment prior to operation.
5. Check integral equipment supplied by other manufacturers.
6. Observe field tests of equipment.
7. Train Owner's operator(s) in operation of equipment.

B. Notify A/E, Owner, and DSB when this initial service will be performed.

C. After start-up of equipment, service representative shall furnish a letter to A/E and Owner confirming that the installation is in accordance with manufacturer recommendations, necessary alignments and adjustments have been made, and equipment is operating properly.

D. In addition to initial services, manufacturer shall provide for 1-day inspection trips after 1 month and 6 months of operation to inspect and adjust equipment.

3.03 SYSTEM TESTS

A. Prior to acceptance, conduct an operational test, under observation of A/E and DSB, to demonstrate that installed equipment and systems meet purpose and intent of Specifications. Performance shall be demonstrated throughout operating range.

B. Test shall demonstrate that equipment and systems are not defective electrically, mechanically, or otherwise, and are in a safe and satisfactory operating condition.

3.04 CLEANING

A. Clean components and systems for intended use and in accordance with Division 01.

3.05 STATION MARKERS

A. Coordinate marker name and numbering system with Owner.

B. The intent of the crest stationing posts is to visually indicate crest movement by allowing sighting along the tops of each post from end to end of the embankment. Therefore, it is important to align posts carefully so that the tops of each post are in a straight line and level.

C. Assemble the plates with label on one side and marker on same side as label, carefully keeping markers centered and neat. Avoid placing marker near future bolt locations.

D. Drive stationing post and label systems at 100-ft increments of stationing, as shown on plans, noting that posts along crest of dam shall be located at downstream breakline of embankment crest. All posts along the stations shall be in a straight line and have the same top elevation. All labels shall face access road.

END OF SECTION