FOR REVIEW

EVALUATION REPORT

PANGUITCH LAKE DAM

Garfield County, Utah

Prepared for:
West Panguitch Irrigation and Reservoir Company

July 2024

RB&G ENGINEERING, INC.

202404-002

July 3, 2024

RB&G ENGINEERING, INC.

West Panguitch Irrigation and Reservoir Company
Attn: Allen Henrie, President
PO Box 645
Panguitch, Utah 84759

Re: Panguitch Lake Dam

Dear Mr. Henrie:

The report transmitted herewith summarizes conceptual design evaluations which have been performed for the Panguich Lake Dam. We appreciate the opportunity to provide this service for you. Please call if there are any questions relating to the information contained herein.

Sincerely,

RB&G ENGINEERING, INC.

Brandon D. Horrocks, P.E.

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PROVO 801-374-5771 SALT LAKE CITY 801-521-5771 FAX 801-374-5773

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PANGUITCH LAKE DAM
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RB&G ENGINEERING, INC.

INTRODUCTION

This report outlines the results of a field investigation and presents preliminary designs to repair the recent crest damage at the Panguitch Lake Reservoir Dam in Garfield County, Utah. The dam is owned by the West Panguitch Irrigation and Reservoir Company (WPIR).

In the early spring of 2024 a portion of the dam crest began to tip due to pressure from reservoir ice. Emergency response was performed, and RB&G Engineering has been retained to assist in the remedial repair design and construction.

The information contained in the report is discussed under the following headings: (1) Existing Dam and Site Conditions, (2) Subsurface Investigations, (3) Evaluation, (4) Dam Rehabilitation Alternatives, and (5) Recommendations.

I. EXISTING DAM AND SITE CONDITIONS

As shown on Figure 1, Panguitch Lake Reservoir Dam is located about 12 miles southwest of Panguitch, Utah. The State Dam Safety website indicates the dam construction was completed in 1872. It is our understanding that the dam was originally constructed as a gravity masonry structure with a crest width of about 2 feet, tapering to a structure about 7 feet wide 2 feet below the dam crest. The original masonry structure has near vertical upstream and downstream slopes. The masonry is cobbles and boulders within a grout matrix.

Bedrock is at or near the ground surface in the area of the dam. The bedrock has been geologically mapped as Triassic age Isom formation "medium-gray, crystal-poor, densely welded trachydacitic ash-flow tuff"[1].

[1] Robert F. Biek, 2014, Geologic map of the Panguitch Lake Quadrangle, Garfield and Iron Counties, Utah. M-268DM. UGS. 1:24,000 scale.

The dam crest was raised 2 feet in the 1940s by installing a 2-foot wide concrete cap on top of the original dam crest. In the 1970s, a downstream rockfill berm was installed and the outer shell of the rockfill was grouted. The rockfill was designed with a 2H:1V (Horizontal:Vertical) downstream slope. Installation of the downstream rockfill berm required an extension of the outlet conduit. The 1975 design drawings show that compacted fill material was placed between the bedrock foundation and the rockfill embankment. Based on photos and verbal reports, it is our understanding that the fill material was sandy gravel. The drawing shows that the thickness of the fill material may be as much as about 10 feet. A concrete wall that was designed to extend to bedrock was installed at the downstream toe of the rockfill embankment. Photos taken during the 1975 construction that were provided by WPIC are included in Appendix 1.

Following failure of the slide gate attached to the upstream end of the outlet conduit, a new stainless steel gate was installed during the fall and winter months of 2011-12. The lower portion of the stainless steel gate broke and was repaired in the fall months of 2022. The gate is operated using a hydraulic system which can be controlled at the site or remotely. Available plans for the dam and appurtenances are included in Appendix 1.

The existing Panguitch Lake Dam has a maximum height of 24-feet. The dam crest is the spillway for the reservoir. Water flows over the dam crest and down the grouted rockfill when the reservoir elevation exceeds the dam crest.

As mentioned previously, the upper portion of the dam was damaged in April 2024 when the reservoir was within 1 foot of the dam crest and the upper ~14 inches was frozen. The damage was first observed on Monday, April 8, 2024. The ice pushed against the dam crest, which began to overturn. The crest section of the dam tilted downstream up to 8 degrees, beginning at Sta 1+07. The structural failure from about Sta 1+07 and 1+30 appeared to be along the joint between the original dam and the 1940’s crest raise. Near the right abutment of the dam, the structural failure appeared to be at the contact of the pre-1940’s masonry and the bedrock foundation. The failure was as deep as 4.5 feet below the dam crest near the right abutment. Uncontrolled water flowed through the structural failure. The initial remedial response included 1) lowering the reservoir to reduce hydrostatic and ice forces against the dam, 2) cutting slots in the ice using a trencher commonly used to install sprinkler irrigation systems, and 3) installing a rockfill buttress along the downstream side of the dam crest. The initial remediation work was performed on Apil 10 and 11, 2024.

A temporary spillway was created at elevation 8205.0 feet between Sta 1+04 and 1+29 on April 30 – May 1, 2024. The spillway was created by removing the upper 3 feet of the dam within the spillway channel. The primary purpose of the spillway was to increase the outflow capacity of the reservoir so 2024 spring runoff could be passed without overtopping the dam.

Daily reports from RB&G personnel and plan sheets depicting the temporary spillway installation are included in Appendix 1.

An evaluation of the dam was performed in 1998 and 1999 by Rosenberg Associates and Terracon. Recommendations to repair the deteriorating concrete crest and reduce seepage at the dam abutments were provided. Based on the results of stability analyses performed, Terracon concluded that "Panguitch Dam is currently internally stable for static and seismic conditions."

The Panguich Lake Dam is within the Dixie National Forest on a Ditch Bill Easement. The area defined for the dam in the Ditch Bill Easement is 200 feet in an upstream/downstream direction by 310 feet in a right/left direction ("right" and "left" as used in this report refer to directions from the perspective of standing in the reservoir basin looking downstream). The upstream side of the easement is a relatively short distance upstream of the existing dam structure. Considering that the footprint of the dam is about 50 feet in an upstream/downstream direction (2-foot wide dam crest plus 48-foot downstream embankment width (24 feet high, 2H:1V slope)), the Ditch Bill Easement likely extends more than 100 feet downstream of the existing dam. A copy of the Ditch Bill Easement is included in Appendix 1.

II. SUBSURFACE INVESTIGATIONS

The characteristics of the dam and foundation were investigated by drilling five borings through the dam and into the foundation at the locations shown on Figure 2. The logs for the borings are included in Appendix 2. Borings were advanced through the rockfill installed in April 2024 using an HWT casing advancer. HQ3 coring methods were used to sample the masonry dam and foundation materials. The percent recovery and RQD values measured during the investigation is shown on the boring logs. The RQD is the percentage of the core run in which intact core greater than 4 inches in length was recovered.

Most of the borings were drilled through the rockfill placed during the 2024 spring emergency repair. The 2024 rockfill berm materials were not sampled. The borings encountered 0.5 to 11 feet

of masonry materials below the rockfill berm and extended 3 to 18 feet into the underlying ash-flow tuff bedrock. Results of field and laboratory tests performed during the field investigation are summarized below:

Test	# of Tests	Range	Average
Masonry			
Core Recovery (%)	3	66 – 89	81
RQD	3	16 – 65	37
Dry Density (pcf)	3	97.9 – 118.7	108.6
Moisture (%)	3	2.1 – 9.8	4.8
Unconfined Compressive Strength – pre 1940 Masonry (psi)	2	1,630 – 1,920	1,775
Unconfined Compressive Strength – 1940's Dam Crest Raise Masonry (psi)	1	3,980	3,980
Permeability (ft/yr)	1	22,000	22,000
Bedrock			
Core Recovery (%)	8	87 – 100	97
RQD	8	8 – 79	35
Dry Density (pcf)	5	142.7 – 151.0	148.5
Moisture (%)	5	0.8 – 2.0	1.2
Unconfined Compressive Strength (psi)	5	5,260 – 11,620	8,950
Permeability (ft/yr)	3	280 – 1,000	670

Observations made during drilling suggest that the existing masonry at the location of Boring 24-02 has voids within the matrix, and drill water loss occurred while drilling through the masonry at Boring 24-04. Based on the observations made, the existing masonry appears to be in poor condition.

Bedrock sampled during the subsurface investigations was fractured; however, the core recovery and permeability tests indicate the fractures are generally tight to narrowly open. The bedrock strength is adequate to support the existing masonry structure.

III. EVALUATION

Based upon the available information, the following are pertinent for immediate remediation and long-term planning:

- The existing dam crest is not structurally capable of resisting ice loads when the reservoir is near full. To our knowledge, the dam crest in the area of the left side of the dam is similar to the failed section near the right side of the dam. Limiting repair to the failed area is not

recommended unless the repair is intended to be short term and WPIC is confident the reservoir water level can be maintained at least three feet below the dam crest when the reservoir surface is frozen.

- A repair of the dam crest will require enlarging the mass to provide sufficient resistance against ice loads or anchoring the crest. The pre-1940 masonry is in poor condition, and anchoring into this zone is not recommended.
- A repair of the dam crest may be acceptable for short term use of the reservoir; however, we recommend that WPIC plan for a major dam rehabilitation project. The pre-1940 core is in poor condition. To our knowledge, this is a previously unrecognized condition. The poor condition may be a result of deterioration over time. Seepage through the core may increase over time. Possible deficiencies related to increased seepage include 1) hydrostatic pressures against the downstream concrete slope, 2) piping of the earthfill beneath the downstream embankment, and 3) accelerated freeze/thaw deterioration.
- Photos of the downstream rockfill installed in 1975 appear to show a significant amount of fines within the rockfill matrix. The fines may have prevented good penetration of the downstream slope concrete into the rockfill, which decreases the reliability of the system to resist scour forces during the design flood event.

Based on the evaluations performed, objectives for rehabilitation of the Panguitch Lake Dam include:

1. Stabilize the existing dam crest, and
2. Plan for long term rehabilitation.

Other considerations for the dam that were evaluated include:

1. Construction of a principal spillway, and
2. Widening the dam crest.

Consideration was given to designing a principal spillway so that the flows during most operating conditions would not pass over the dam embankment. Keeping the existing reservoir storage capacity would necessitate that the principal spillway crest be at the existing spillway crest (dam crest) elevation. Assuming the principal spillway crest would be shorter than the existing dam crest, the reservoir elevation would rise higher for a given outflow compared to existing conditions. The increased reservoir elevation has potential to negatively affect infrastructure surrounding the reservoir; therefore, installation of a principal spillway on one of the dam abutments was eliminated from further consideration.

The existing dam crest has a width of about 2 feet. The crest is narrow and would not be allowed if the dam were reconstructed to meet current State of Utah requirements. A new dam with a height of 24 feet would be required to have a crest width of at least 12 feet. The existing dam crest could be widened to about 4 feet by steeping the upper portion of the downstream dam slope; however, constructing a 12-foot wide crest would likely include installation of a sliver fill on the downstream side of the existing embankment. It is our understanding that widening the dam crest is not required for the existing dam; therefore, this improvement has been eliminated from further consideration.

IV. DAM REHABILITATION ALTERNATIVES

Alternatives to meet the long term and/or immediate objectives for rehabilitation of Panguitch Lake Dam include:

1. Remove and replace the dam crest – Our conceptual design for this alternative includes:
   - Removing the upper 6 feet of the existing dam structure,
   - Installing a 2-foot wide reinforced concrete crest anchored into bedrock, and
   - Installing grouted rockfill to create a 4-foot wide dam crest.
2. Reconstruct the dam structure – A new Roller Compacted Concrete (RCC) dam could be installed at the location of the existing dam, or the existing dam could be left in place and a new dam could be constructed downstream of the existing dam.
3. Remove and replace the dam crest (Alternative 1 above), and install a reinforced concrete face on the upstream side of the existing dam.
4. Remove and replace the dam crest (Alternative 1 above), install an impermeable membrane on the existing upstream dam face, and install an upstream rockfill buttress.

Each of these alternatives are discussed in greater detail below, and conceptual design cross sections for each alternative are presented in Appendix 3.

1. Remove and Replace the Dam Crest

Removing and replacing the existing dam crest stabilizes the Apil 2024 failure but does not remediate the poor condition of the existing dam core. We consider this alternative, if not combined with additional redial work, to be a short-term approach to the operation and maintenance of the dam. Based upon the cost estimates included in Appendix 3, it is our opinion that the cost for this work would be about $420k.

2. Reconstruct the Dam

As indicated above, a new Panguitch Lake Dam could be constructed downstream of the existing dam, or it could be constructed at the same location as the existing dam. The footprint of either alternative could likely be kept within the existing Ditch Bill Easement boundaries.

Constructing a new dam downstream of the existing dam, with the control gate removed from the existing dam after the new dam is constructed, would allow the existing dam to remain in place, which may have archeological benefits since the historic structure would not be demolished. Assuming a new dam would be constructed downstream of the existing, it is our opinion that a new RCC dam could be constructed at this site for about $4.2 million.

3. Remove and Replace the Dam Crest, and Install an Upstream Concrete Face

In combination with the dam crest rehabilitation described above, an upstream reinforced concrete dam face could be added to the existing structure. The upstream concrete facing would confine the existing masonry, and would be designed to reduce water infiltration into the existing dam core. It is our opinion that the total cost for this alternative, including the removal and replacement of the dam crest, would be about $1.3 million. Final design should also include installation of an impermeable membrane, such as a Carpi liner, on the upstream dam face. Installation of a Carpi liner may add $100k to the project cost.

4. Remove and Replace the Dam Crest, and Install an Impermeable Upstream Liner, and an Upstream Rockfill Butress

In combination with the dam crest rehabilitation described above, an upstream impermeable membrane and rockfill buttress could be installed on the existing dam. The membrane would be designed to reduce water infiltration into the existing dam core, and the buttress would be designed to confine the existing core. It is our opinion that the total cost for this alternative, including the removal and replacement of the dam crest, would be about $1.5 million.

This alternative would likely require additional permitting compared to the other alternatives described above since the upstream rockfill buttress would likely extend beyond the limits of the Ditch Bill Easement. Considering that there are other alternatives that provide the same benefits as this alternative for approximately the same cost with lesser permit requirements, this alternative is not the preferred for the project.

V. RECOMMENDATIONS

Based on the evaluations performed, we recommend that the Panguich Lake Dam be reconstructed. The alternative to remove and replace the dam crest and install an upstream reinforced concrete face may perform satisfactorily; however, increased maintenance and potential dam safety issues may develop due to piping of the fill material placed beneath the downstream rockfill and/or scour of the concrete on the downstream slope of the dam. WPIC should recognize that continued maintenance of the downstream rockfill and concrete will likely be required if the upstream reinforced concrete face alternative is constructed.

If needed due to funding or other constraints, removal and replacement of the dam crest (Option 1) could be performed to allow reservoir storage at the historical high water elevation (dam crest) until the dam can be reconstructed.

The existing stainless steel gate was procured because it was available for replacement of the original gate, which failed in 2011. Due to the poor performance of the stainless steel gate, we also recommend long term planning include replacement of the stainless steel gate with a heavy duty cast iron gate. The cost estimates for the long-term rehabilitation alternatives described above (Options 2 – 4) include replacement of the slide gate.

VI. CLOSURE

We appreciate the opportunity to work with WPIC and other project stakeholders. Please contact us if you have any questions regarding the information presented above.

The study described in this report is preliminary and the designs presented are conceptual. Additional analysis, evaluation, and design is required prior to construction of a Panguitch Lake Dam rehabilitation project.

The information contained in this report is provided for the specific location and purpose of the client named herein and is not intended or suitable for reuse by any other person or entity whether for the specified use, or for any other use. Any such unauthorized reuse, by any other party is at that party's sole risk and RB&G Engineering, Inc. does not accept any liability or responsibility for its use.

FIGURES

RB&G ENGINEERING, INC.

Figure 1 VICINITY MAP

Panguitch Lake Dam Crest Repair

Garfield County, Utah

RB&G ENGINEERING, INC.

Figure 2 SITE PLAN & TEST HOLE LOCATIONS

Panguitch Lake Dam Crest Repair

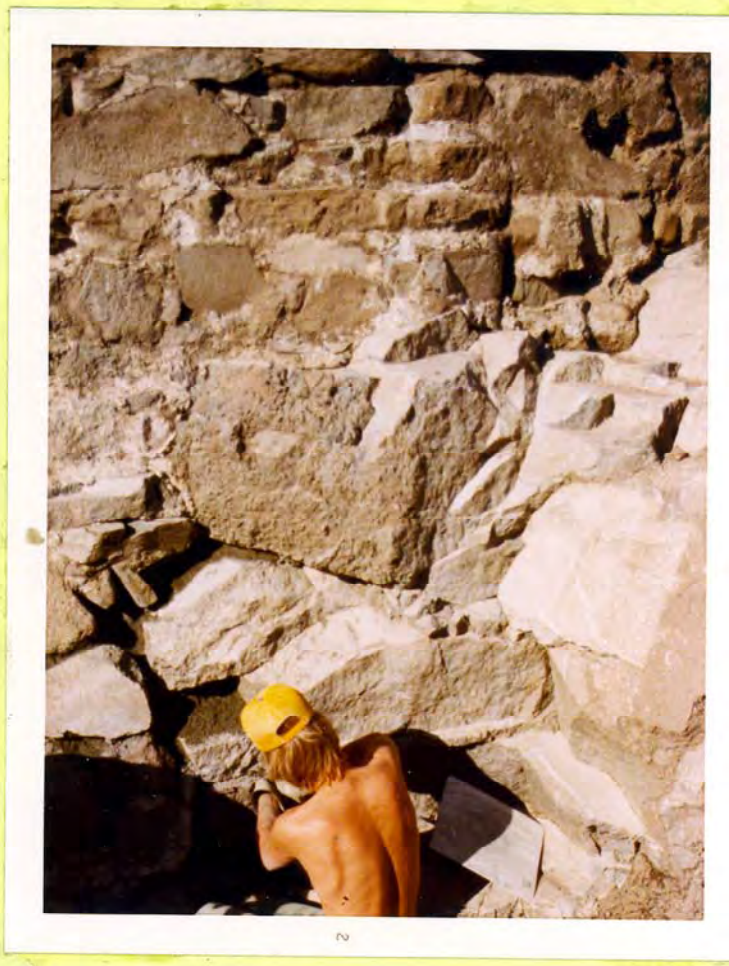
Garfield County, Utah

APPENDIX 1

Existing Data

1975 Construction Photos

#1 Nov. 1975. Panguitch Dam, 48" dia. slide gate. Invert to crest of dam 24' - 2".



#2 Nov. 1975. Panguitch Dam, upstream face: East Abutment contact mortar repair.

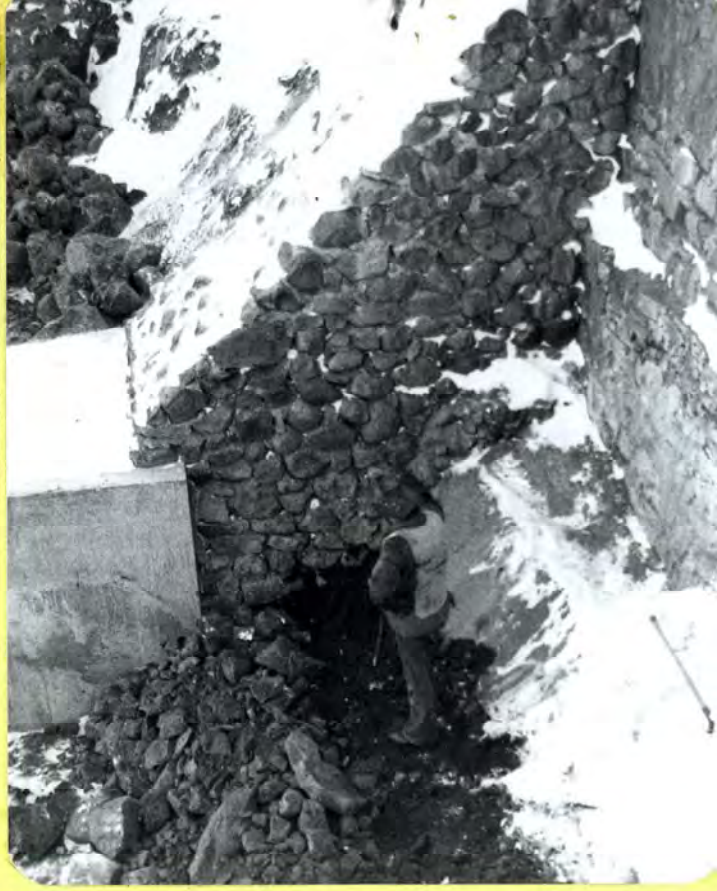
#3 Panguitch Dam. Upstream face prior to motar placement.

#4 Panguitch Lake Dam. Nov. 1975. Removal of existing material; downstream face.

6 Nov. 1975. Panguitch Dam. Upstream mortar repair in progress.

#7 Nov. 1975. Panguitch Dam. View south showing two coffer dams with pumping equipment.

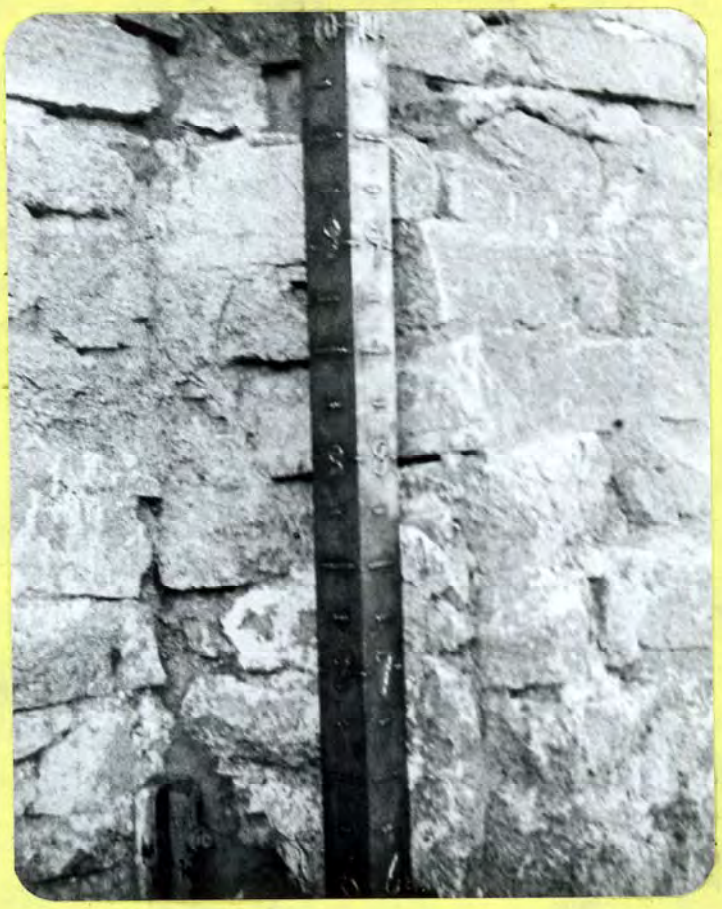
#8 Nov. 1975. Panguitch Dam. Placement of fill material downstream face.



#1 and #2 Placement of fill material against downstream face of dam. Imported fill is light and natural fill is dark.

#3 Natural fill brought up and over imported fill. Rock fill started on the west side

#4 REPAIRED ~~Required~~ downstream face cavity was about 6 feet below outside edge and on the right side near the west



#5 Staff gauge installed 3½" x 3½" x ¼" angle iron.

#6 Placement of natural fill against and over the imported fill material

#7 Placement of natural fill material over imported fill material. (Approx. 18" in depth) east side of culvert extension.

#8 Finished placement of natural fill material against and over imported fill on downstream face of Panguitch Lake Dam.

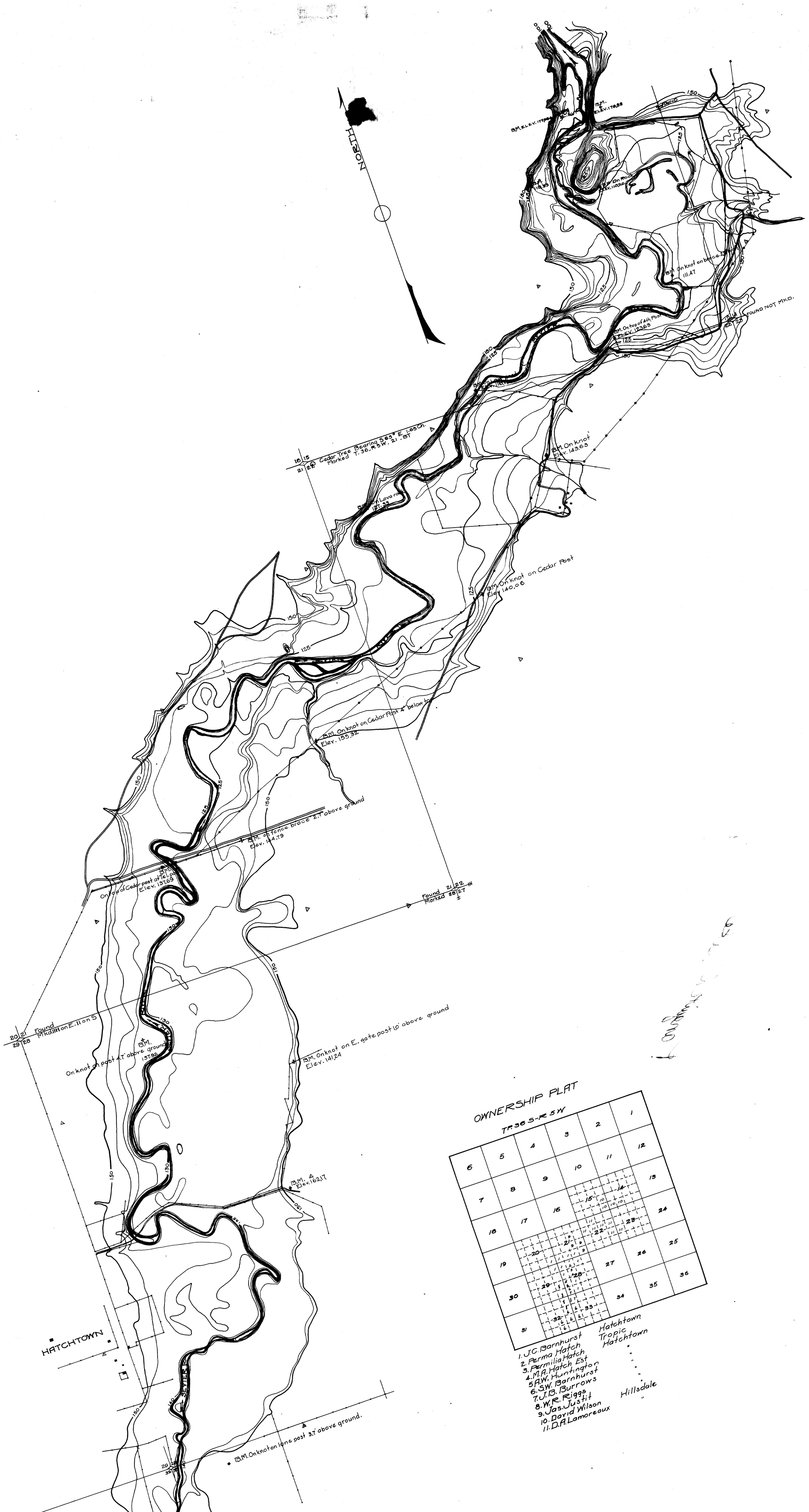
#1 Rockfill placement as completed but prior to final shaping by D-7 Cat.

#2 Rockfill placement as of Dec. 18, 1975

#3 Rockfill placement as of Dec. 18, 1975

#4 Rockfill placement as of Dec. 18, 1975. East side view.

Existing Drawings



OWNERSHIP PLAT

TP. 36 S-R 5 W

1. J.C. Barnhurst — Hatchtown
2. Perma Hatch — Tropic
3. Permilia Hatch — Hatchtown
4. M.A. Hatch Est — "
5. A.W. Huntington — "
6. S.W. Barnhurst — "
7. J.B. Burrows — "
8. W.R. Riggs — "
9. Jas. Justit — Hillsdale
10. David Wilson — "
11. D.A. Lamoreaux — "

AREAS & CAPACITIES

CONTOUR	AREA-ACRES	CAPACITY AC.FT.
100	5.8	
105	18.2	60.1
110	66.4	271.8
115	100.9	690.2
120	162.8	1349.6
125	220.5	2308.0
130	295.8	3598.9
135	396.9	5330.8
140	566.5	7739.4
145	717.8	10950.2
150	816.1	14785.1

STATE BOARD OF LAND COMMISSIONERS

HATCHTOWN PROJECT

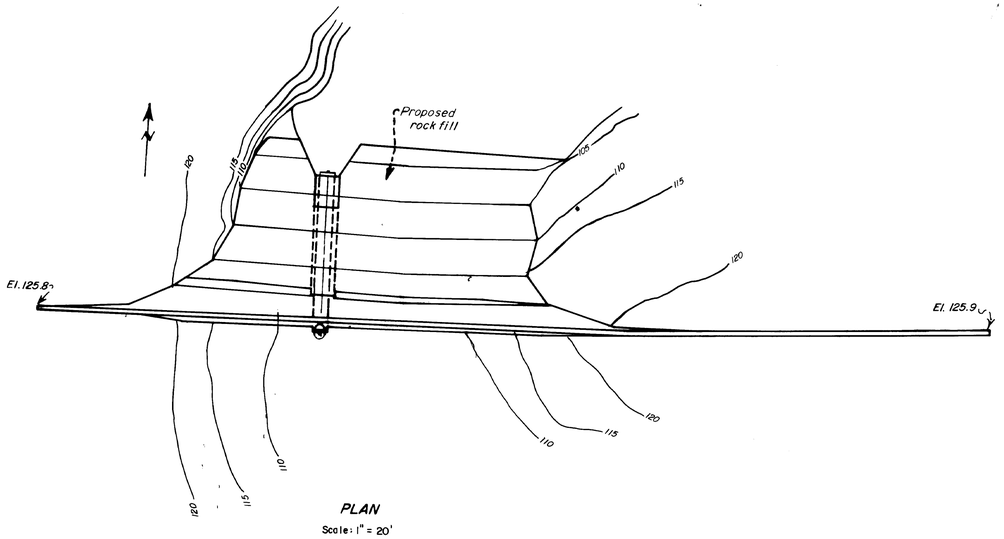
TOPOGRAPHIC MAP OF

BLACK CANYON RESERVOIR SITE

STATE ENGINEER'S OFFICE

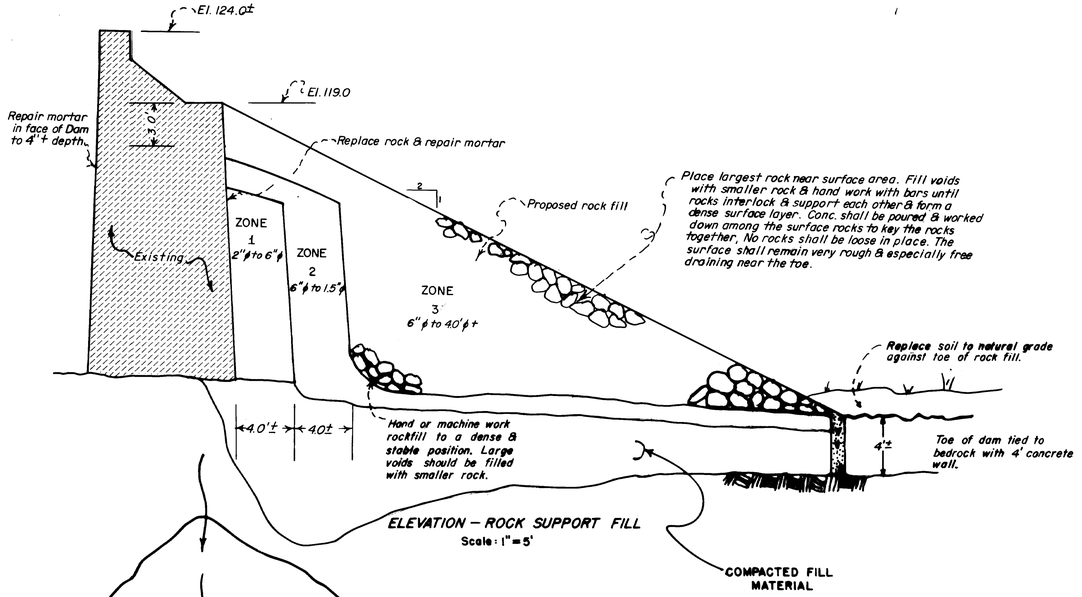
SCALE: 1" TO 400' CONTOUR INTERVAL: 5' DATE: DEC. 1, 1914

W.D. BEERS STATE ENGINEER J.L. RHEAD FIELD ENGINEER



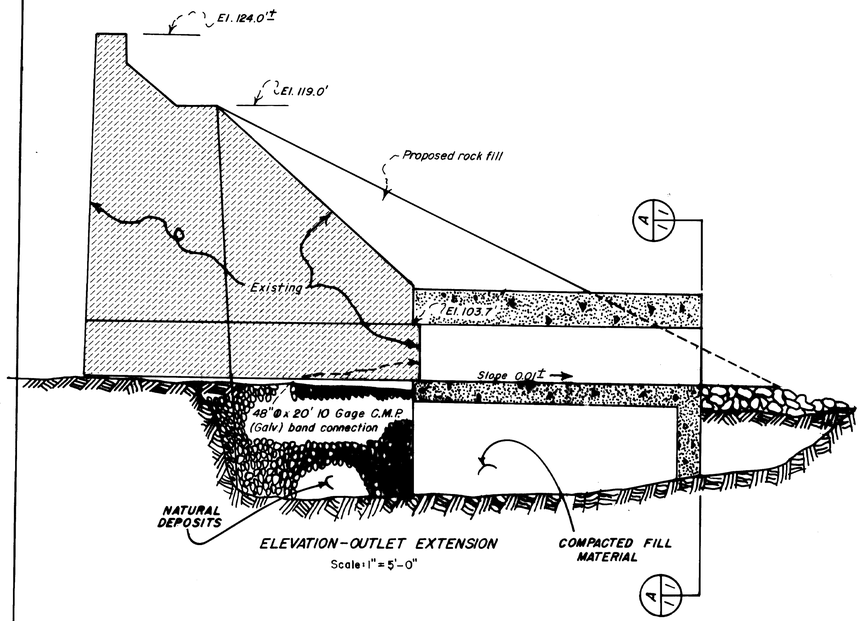
PLAN

Scale: 1" = 20'



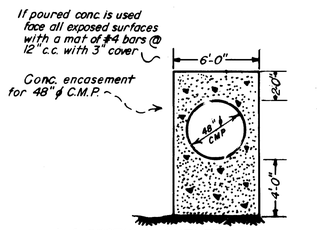
ELEVATION – ROCK SUPPORT FILL

Scale: 1" = 5'



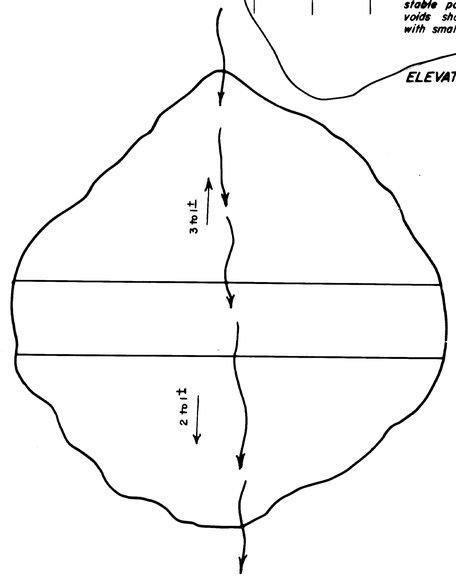
ELEVATION – OUTLET EXTENSION

Scale: 1" = 5'-0"



A-A SECTION – OUTLET EXTENSION

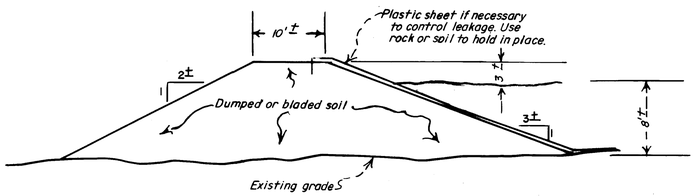
Scale: 1" = 5'-0"



PLAN – COFFER DAM

Scale: 1" = 10'

NOTE: COFFERDAMS TO BE COMPLETELY REMOVED AFTER DAM REPAIR IS COMPLETE.



ELEVATION – COFFER DAM

Scale: 1" = 10'

AS CONSTRUCTED

STATE OF UTAH
DIVISION OF WATER RESOURCES
WEST PANGUITCH IRR. & RES. COMPANY

PANGUITCH LAKE DAM REPAIR

SCALE: As shown — COUNTY Garfield

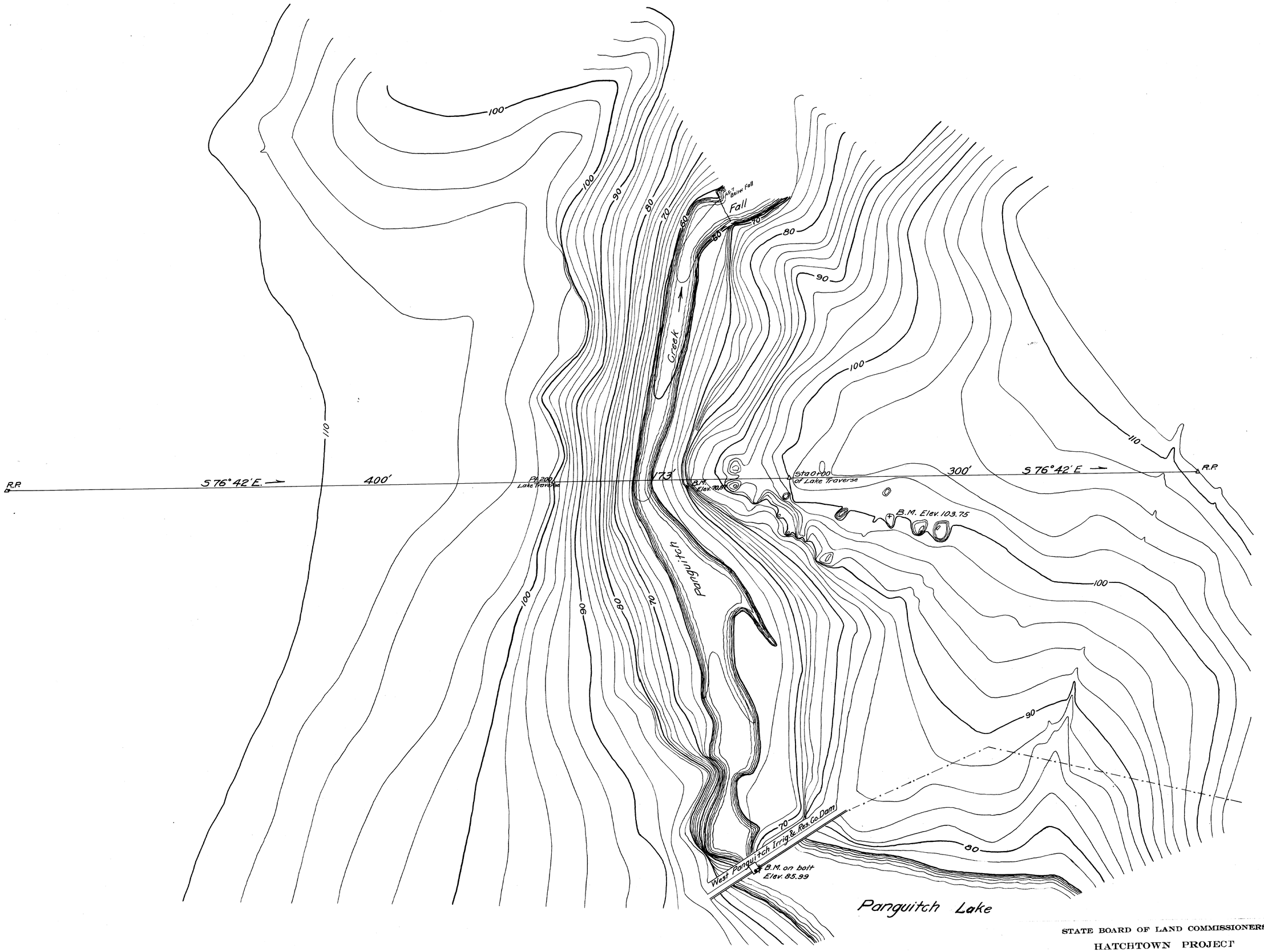
DESIGNED R.J.M. — CHECKED

DRAWN R.J.M. — RECOMMENDED

TRACED A.B.E. — APPROVED

DATE Sept., 1975 — SHT 1 OF 1

UT 038



STATE BOARD OF LAND COMMISSIONERS

HATCHTOWN PROJECT

RECONSTRUCTION OF STORAGE DAM

TOPOGRAPHIC MAP OF PANGUITCH LAKE DAMSITE

STATE ENGINEER'S OFFICE

SCALE: 1" TO 30' CONTOUR INTERVAL 2 FT. DATE: OCT. 20, 1915

W.D. BEERS STATE ENGINEER J.L. REGAD TOPOGRAPHER

D-6

Preliminary Study D ■ 7 UT238

STATE BOARD OF LAND COMMISSIONERS

HATCHTOWN PROJECT

RECONSTRUCTION OF STORAGE DAM

TOPOGRAPHIC MAP OF HATCHTOWN DAMSITE

STATE ENGINEER'S OFFICE

SCALE: 1" TO 50' CONTOUR INTERVAL 5 FT. DATE: NOV. 13, 1915

W.D BEERS STATE ENGINEER J.L[illegible] HEAD TOPOGRAPHER

D-5

D-5

STATE BOARD OF LAND COMMISSIONERS
HATCHTOWN PROJECT
RECONSTRUCTION OF STORAGE DAM
TOPOGRAPHIC MAP OF PANGUITCH LAKE DAMSITE
STATE ENGINEER'S OFFICE

SCALE: 1" TO 400' CONTOUR INTERVAL 5 FT. DATE: OCT. 27, 1915

W. D. BEERS STATE ENGINEER J. L. HEAD TOPOGRAPHER

TABLE OF FLOODED AREAS

At Contour	Area in Acres: Tp. 36 S, R 7 W – S.L.M. Sec. 3	Sec. 4	Sec. 5	Tp. 35 S, R 7 W – S.L.M. Sec. 32	Sec. 33	Sec. 34	Totals
60	48.42	141.36			81.00	87.24	358.02
65	101.82	192.60			118.92	105.24	518.58
70	122.28	329.58	43.80		169.14	112.26	777.06
75	128.22	343.14	130.26	25.68	198.60	118.20	944.10
80	133.80	354.12	210.00	45.54	207.54	123.48	1074.48
85	139.32	362.46	264.12	67.50	216.24	128.70	1178.34
90	144.00	375.90	301.08	80.40	222.30	134.16	1257.84
95	149.04	389.82	330.36	94.20	228.42	140.28	1332.12
100	154.50	417.78	351.78	110.58	234.06	146.34	1415.04
105	158.76	437.52	367.14	126.66	240.12	153.12	1483.32
110	163.74	457.02	379.50	141.78	245.82	160.56	1548.42

CAPACITY OF RESERVOIR

Contour	Area (Acres)	Volume (Acre Feet)	Volume above next contour lower
60	358.02	0.0	
65	518.58	2191.50	2191.50
70	777.06	5430.60	3239.10
75	944.10	9733.50	4302.90
80	1074.48	14779.9[illegible]	5046.45
85	1178.34	20412.00	5632.05
90	1257.84	26502.45	6090.45
95	1332.12	32977.35	6474.90
100	1415.04	39845.25	6867.90
105	1483.32	47091.15	7245.90
110	1548.42	54,670.50	7579.35

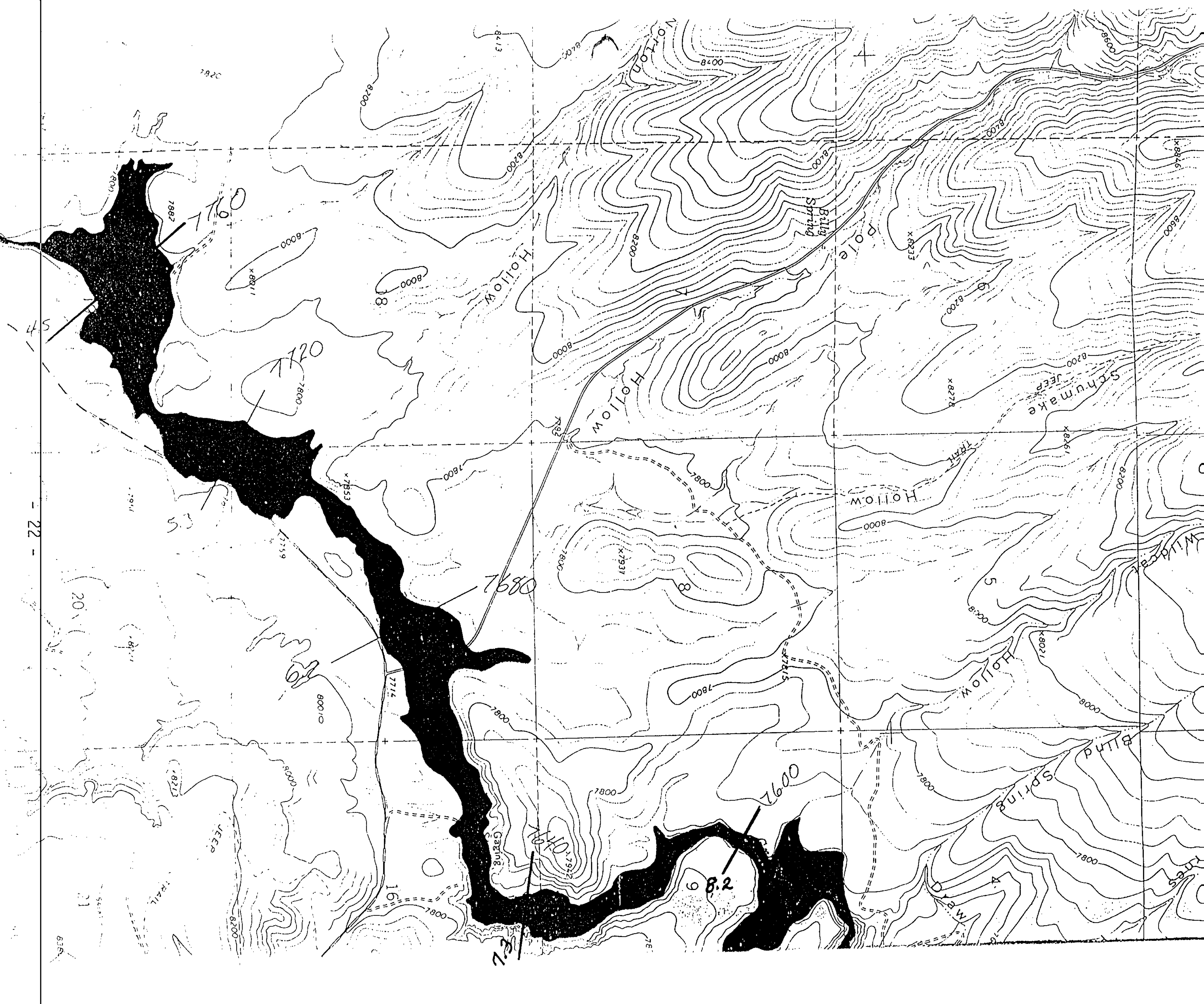
CANAL TRAVERSE

Points	Course	Distance
0-1	N36°12'E	190.00
1-2	N38°58'E	98.20
2-3	N49°59'E	98.66
3-4	N31°25'E	119.12
4-5	N71°29'E	182.12
5-6	N30°29'E	229.66
6-7	S87°12'E	211.95
7-8	S66°54'E	219.20
8-9	S37°49'E	90.53
9-10	S66°57'E	104.40
10-11	S39°32'E	75.03
11-12	N72°53'E	117.90
12-13	S36°41'E	458.20
13-14	S14°25'W	322.66
14-15	S27°34'W	223.80
15-16	S48°54'E	348.00
16-17	S37°46'E	337.90
17-18	S59°37'E	382.10
18-19	S45°19'E	180.42
19-20	S71°16'E	348.[illegible]
20-21	N84°43'E	340.[illegible]
21-22	N73°18'E	175.[illegible]
22-23	S86°00'E	306.[illegible]
23-24	N76°30'E	253.[illegible]
24-25	S16°48'E	126.[illegible]
25-26	N47°50'E	294.[illegible]
26-27	S37°33'E	114.00
27-28	N69°48'E	152.75
28-29	S69°28'E	181.67
29-30	S55°01'E	105.[illegible]
30-31	S87°10'E	235.55
31-32	S51°48'E	3851.[illegible]

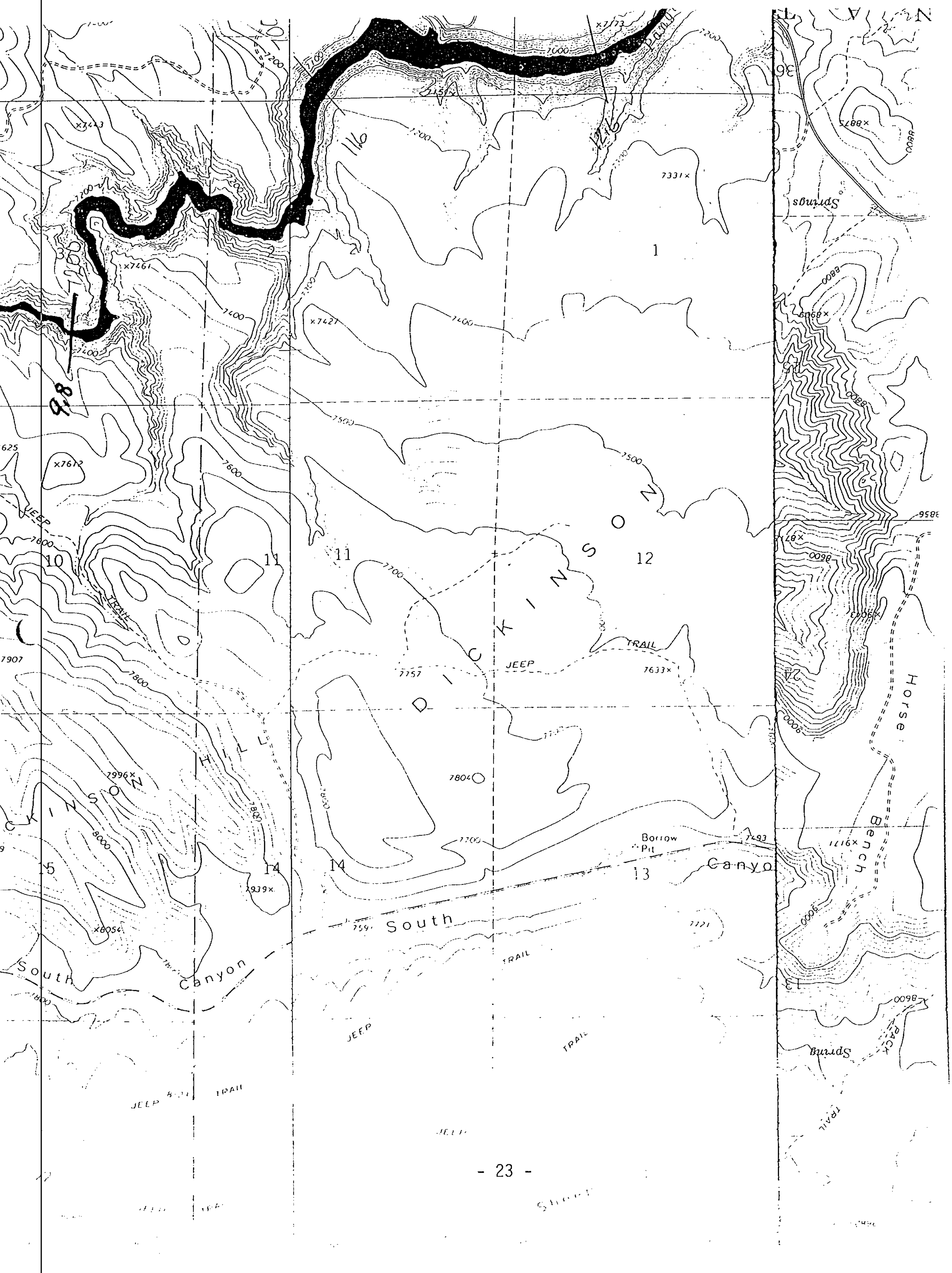
RECORD OF TRAVERSE

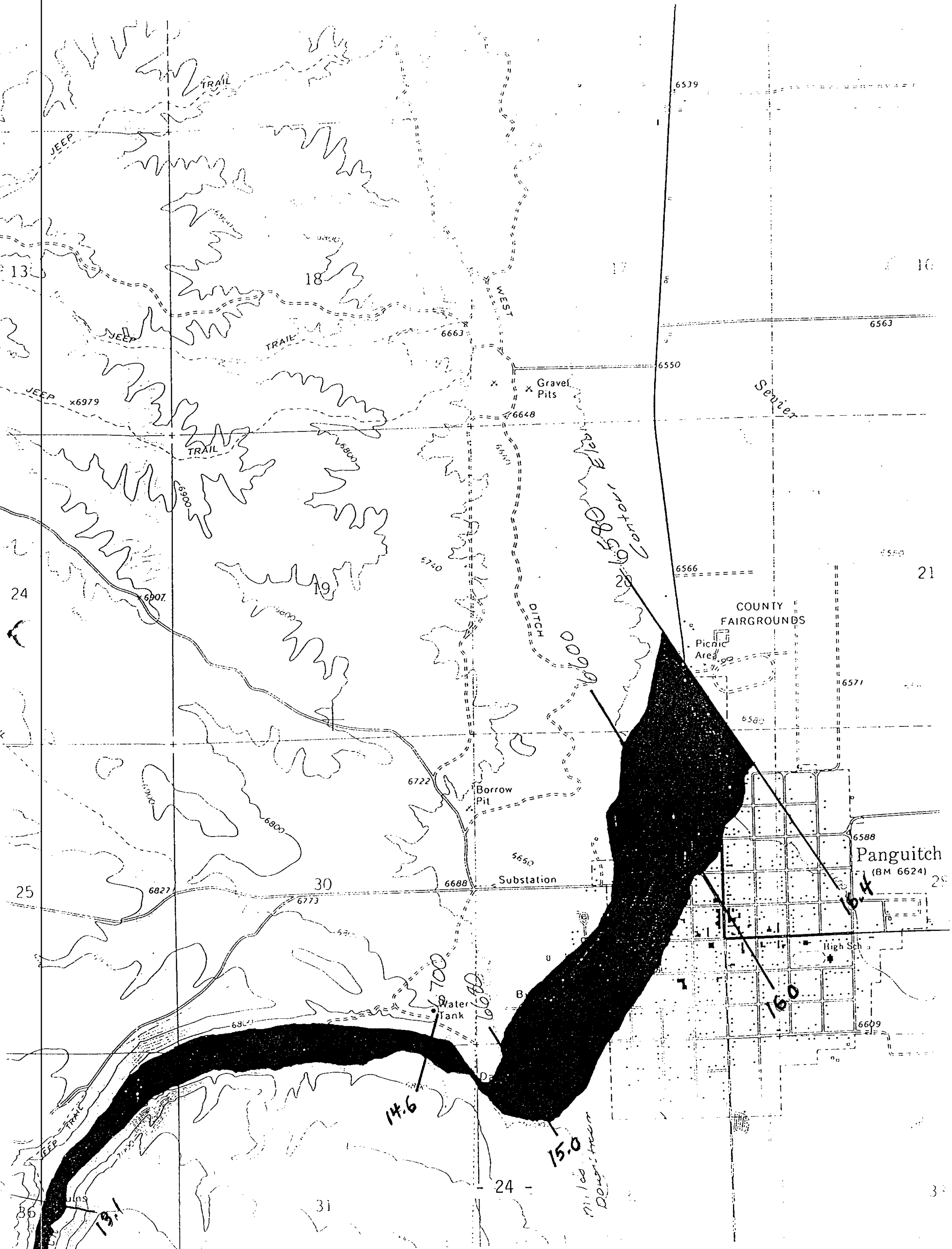
Points	Course	Distance
0-1	S56°02'E	322.30
1-2	S14°44'W	162.22
2-3	S21°59'E	130.50
3-4	S64°08'E	276.60
4-5	S37°46'E	116.75
5-6	S9°02'W	391.35
6-7	S1°44'E	281.21
7-8	S32°52'W	223.85
8-9	S17°00'W	104.74
9-10	S0°52'E	88.35
10-11	S16°28'E	224.25
11-12	S24°10'E	98.95
12-13	S37°36'E	182.34
13-14	S42°27'E	165.25
14-15	S52°14'E	620.18
15-16	S47°06'E	379.09
16-17	S14°50'E	191.60
17-18	S3°04'E	232.88
18-19	S12°31'W	149.84
19-20	S12°08'E	181.15
20-21	S13°45'W	191.02
21-22	S25°05'W	233.70
22-23	S17°20'W	334.42
23-24	S12°10'W	468.69
24-25	S19°19'W	228.25
25-26	S7°26'W	145.[illegible]
26-27	S15°28'W	175.35
27-28	S46°28'W	423.90
28-29	S13°21'W	169.10
29-30	S59°[illegible]	219.53
30-31	S75°21'W	289.49
31-32	S89°18'W	220.24
32-33	N38°24'W	157.95
33-34	N68°54'W	174.63
34-35	N84°20'W	192.64
35-36	S70°29'W	198.85
36-37	S50°48'W	105.41
37-38	N69°22'W	163.92
38-39	N85°26'W	385.71
39-40	N71°32'W	130.20
40-41	N49°17'W	147.10
41-42	N[illegible]W	244.44
42-43	S82°50'W	327.40
43-44	N86°49'W	175.85
44-45	S62°14'W	132.48
[illegible]	S39°[illegible]W	213.99
46-47	S74°43'W	1[illegible]
47-48	S47°09'W	[illegible]
48-49	N39°[illegible]W	240.[illegible]
49-50	N[illegible]°37'W	352.29
50-51	[illegible]°04'W	201.20
51-52	S55°20'W	101.70
52-53	S12°05'E	189.02
53-54	S33°05'E	102.15
54-55	S58°58'E	125.50
55-56	S66°53'E	298.24
56-57	S4°35'E	203.46
57-58	S24°04'E	199.75
58-59	S61°16'E	120.95
59-60	N81°52'E	245.20
60-61	S56°[illegible]'E	203.54
61-62	S40°01'E	222.03
62-63	S62°13'E	175.95
63-64	S83°02'E	221.73
64-65	S42°52'E	131.80
65-66	S31°3[illegible]	175.05
66-67	S60°22'W	176.87
67-68	S26°18'W	466.40
68-69	S89°08'W	133.3[illegible]
69-70	N12°09'W	226.72
70-71	N50°17'W	305.67
71-72	N72°31'W	366.51
72-73	N41°08'W	410.28
73-74	N50°25'W	451.50
74-75	N70°54'W	515.96
75-76	N75°48'W	656.20
76-77	N67°45'W	286.99
78-78	N72°50'W	433.10
78-79	N78°02'W	503.15
79-80	N71°29'W	712.90
80-81	N81°07'W	119.02
81-82	S5°38'W	143.04
82-83	S24°50'E	179.46
83-84	N74°07'W	169.27
84-85	S69°02'W	277.08
85-86	S22°31'W	198.94
86-87	S75°45'W	371.82
87-88	S85°47'W	188.33
88-89	S72°45'W	564.83
89-90	N87°31'W	149.46
90-91	S50°37'W	442.59
91-92	S27°58'W	250.49
92-93	N73°40'W	165.92
93-94	N5°18'E	134.55
94-95	N28°33'E	262.70
95-96	N28°37'W	182.98
96-97	N62°10'W	222.10
97-98	N10°[illegible]'W	323.22
98-99	N44°58'W	228.79
99-100	N5°38'W	209.97
100-101	N38°09'W	[illegible]
101-102	N13°52'W	134.47
102-103	N6°15'E	198.33
103-104	N52°12'W	206.30
104-105	N30°40'W	203.72
105-106	N57°05'W	250.56
106-107	N30°56'W	251.13
107-108	N53°09'W	195.80
108-109	N8°22'W	249.70
109-110	N35°36'W	561.68
110-111	N7°34'W	438.62
111-112	N34°31'E	510.78
112-113	N27°20'W	183.75
113-114	S48°17'E	194.51
114-115	N20°43'E	501.85
115-116	N34°48'E	727.55
116-117	N87°26'E	346.37
117-118	N75°03'E	304.60
118-119	N58°58'E	184.36
119-120	N84°42'E	93.05
120-121	N65°20'E	102.29
121-122	S80°58'E	136.51
122-123	N78°43'E	296.82
123-124	N89°43'E	181.84
124-125	N73°23'E	449.68
125-126	N80°26'E	266.24
126-127	N61°30'E	120.82
127-128	N36°03'E	239.90
128-129	N68°01'E	443.50
129-130	N84°11'E	253.47
130-131	N49°58'E	122.93
131-132	N32°53'E	76.60
132-133	N3°46'W	283.85
133-134	N12°49'W	184.40
134-135	N3°00'W	493.68
135-136	N10°13'W	169.55
136-137	N4°09'E	145.90
137-138	N31°06'E	92.49
138-139	N12°52'W	231.77
139-140	N8°23'E	125.10
140-141	N54°37'E	375.15
141-142	S29°53'E	221.70
142-143	S36°04'E	109.26
143-144	S3°40'E	178.27
144-145	S11°32'E	358.49
145-146	S26°04'E	192.74
146-147	S35°39'E	430.56
147-148	S24°31'E	193.90
148-149	S34°26'E	106.06
149-150	S42°41'E	258.48
150-151	S28°49'E	375.85
151-152	S20°42'E	128.58
152-153	S45°33'E	253.77
153-154	S32°33'E	342.08
154-155	S54°58'E	166.18
155-156	S62°05'E	133.29
156-157	N88°59'E	156.32
157-158	N73°05'E	194.95
158-159	S88°14'E	396.18
159-160	N87°01'E	305.76
160-161	N80°13'E	145.20
161-162	N73°50'E	109.10
162-163	N65°49'E	112.71
163-164	N55°57'E	167.97
164-165	S61°04'E	288.55
165-166	S74°55'E	119.95
166-167	N85°08'E	271.24
167-168	N81°51'E	386.07
168-169	S66°38'E	238.06
169-170	S45°03'E	83.05
170-171	S77°06'E	59.63
171-172	N68°01'E	105.40
172-173	S75°20'E	100.56
173-174	S89°39'E	142.49
[illegible]	N16°14'E	156.06
[illegible]	N14°49'W	139.70
[illegible]-177	N44°55'W	101.39
[illegible]-178	N15°13'W	128.49
[illegible]-179	N2°01'E	190.10
179-180	N36°23'E	208.33
180-181	N13°35'E	318.94
181-182	N46°22'E	142.50
182-183	N43°25'E	318.74
183-184	N24°26'E	101.73
184-185	N3°50'W	128.90
185-186	N28°10'W	262.60
186-187	N35°48'E	86.66
187-188	S59°14'E	141.34
188-189	S46°28'E	219.37
189-190	S12°58'E	252.48
190-191	S7°33'W	272.39
191-192	S32°24'W	143.55
192-193	S2°50'W	209.47
193-194	S13°29'E	86.48
194-195	S58°06'E	110.39
195-196	N46°27'E	179.48
196-197	N62°08'E	191.88
197-198	N48°56'E	154.00
198-199	N38°34'E	150.52
199-200	N28°32'E	424.69
200-0	S76°42'E	173.00

Panguitch Lake Study

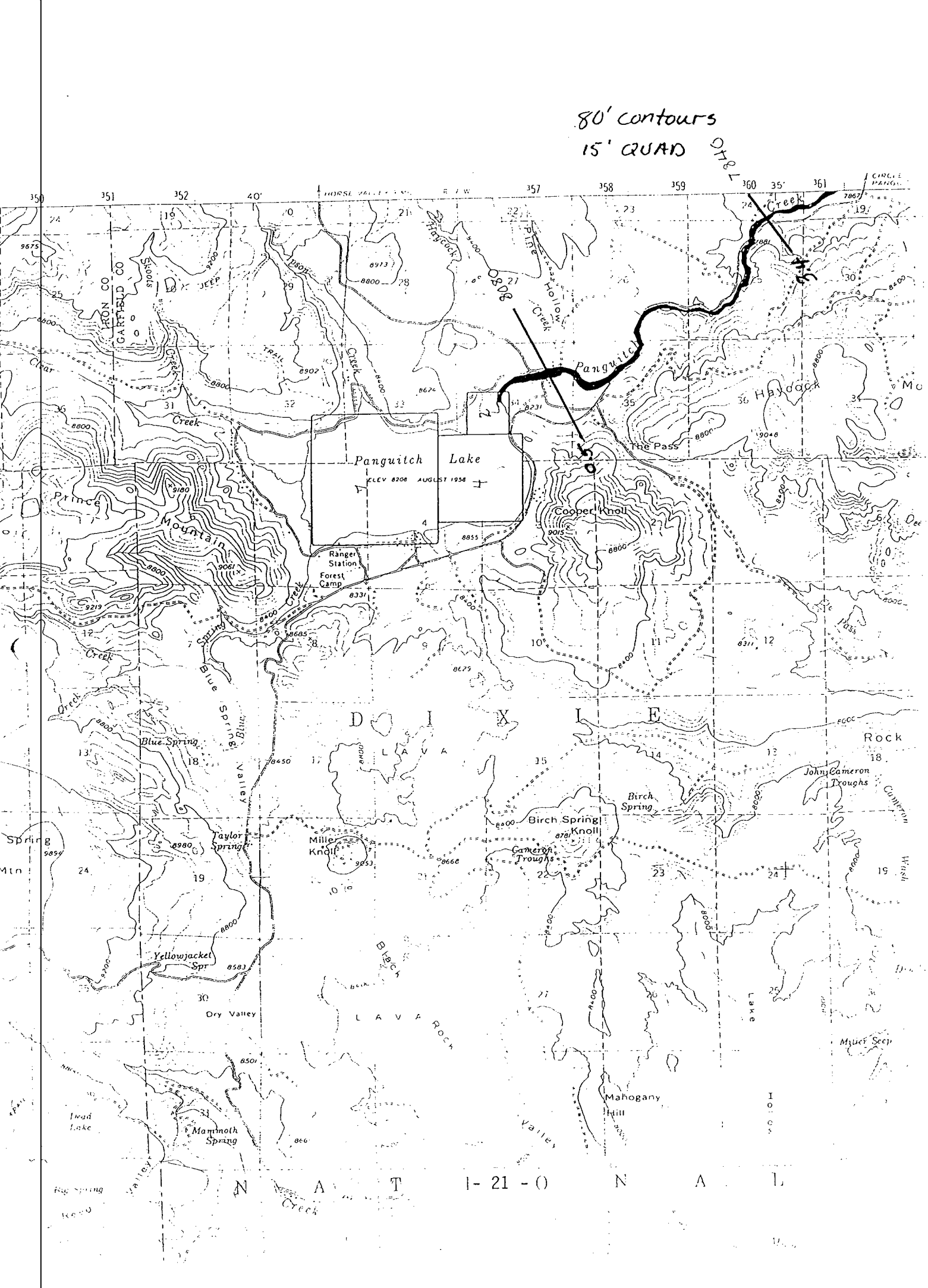


Norton
Billy Spring
Pole
Hollow
Hollow
Hollow
Hollow
Schumake
JEEP
TRAIL
Blind
Spring
Draw
Gaging
JEEP
TRAIL
7760
7720
7680
7640
7600
4.5
5.3
6.4
7.3
8.2
8400
8200
8000
7800


DICKINSON
HILL
South Canyon
Canyo
Horse Bench
JEEP TRAIL
TRAIL
Borrow Pit
Springs
Spring
PACK
1
11
12
10
14
13
15
7500
7600
7700
7800
8000
7400
7200
7331×
×7427
×7461
×7612
7757
7633×
7804
7939×
7996×
7493
×6054

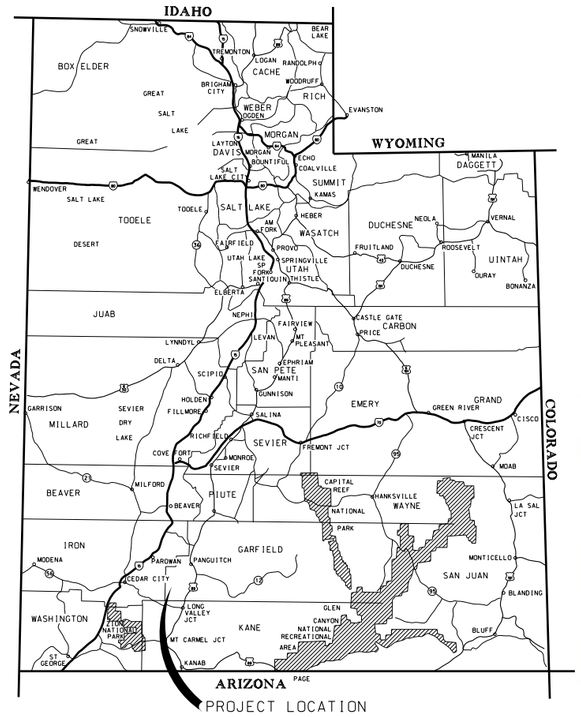


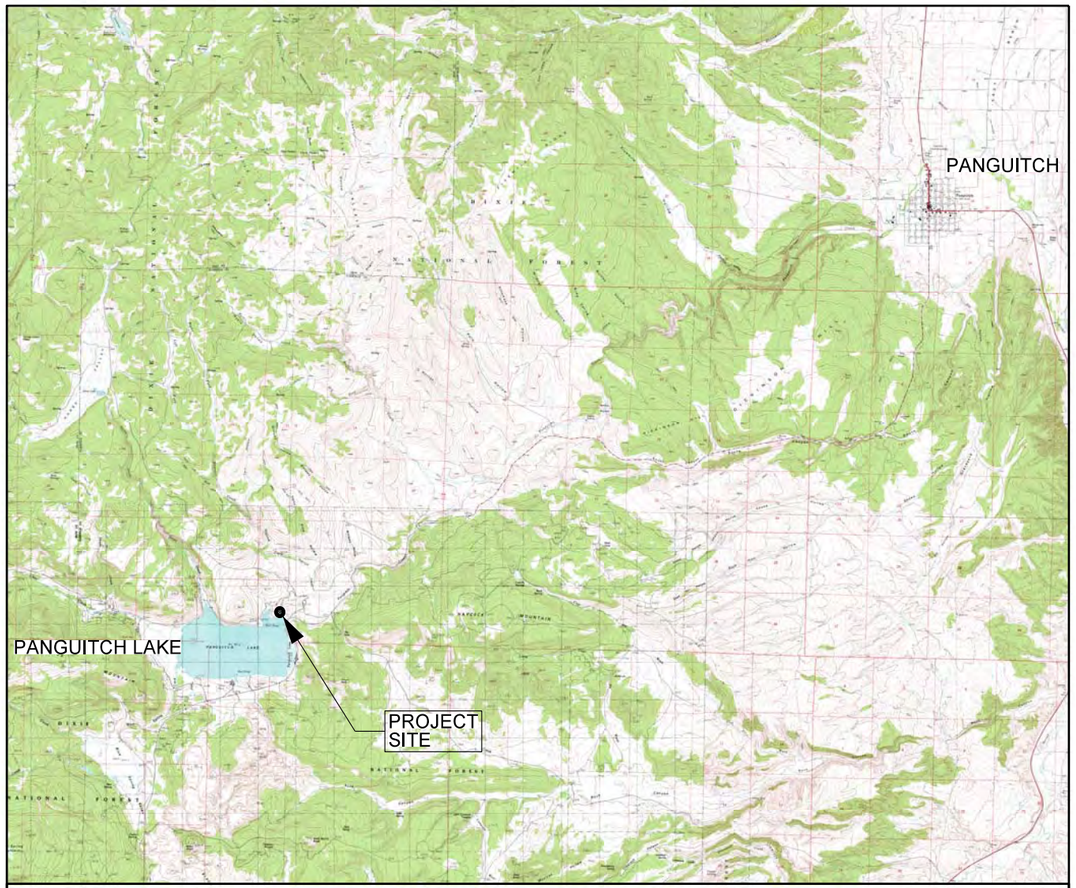
TRAIL
JEEP
13
18
17
16
WEST
6663
6563
JEEP
TRAIL
6550
Gravel Pits
Sevier
JEEP
x6979
6648
TRAIL
6900
6800
6580 Contour
6566
21
24
6907
19
20
DITCH
COUNTY FAIRGROUNDS
Picnic Area
6600
6571
24
6580
6722
Borrow Pit
6800
6588
Panguitch
(BM 6624)
6650
Substation
25
6827
30
6688
6773
16.4
High Sch
6700
6680
Water Tank
16.0
6609
14.6
15.0
JEEP TRAIL
24
Miles Downstream
36
13.1
31


80' contours
15' QUAD
Panguitch Lake
ELEV 8208 AUGUST 1958
Prince Mountain
Cooper Knoll
The Pass
Haycock
Pine Hollow Creek
Ranger Station
Forest Camp
Blue Spring
Blue Spring Valley
Taylor Spring
Miller Knoll
Birch Spring
Birch Spring Knoll
Cameron Troughs
John Cameron Troughs
Yellowjacket Spr
Dry Valley
Mahogany Hill
Mammoth Spring
Iron Co
Garfield Co
D I X I E
L A V A
L A V A R O C K
N A T I O N A L

PANGUITCH LAKE SLUICE GATE REPLACEMENT

GARFIELD COUNTY, UTAH





VICINITY MAP

NORTH

LAT: N 37°43'28.78" LONG: W 112°37'41.68"

INDEX OF SHEETS	
SHEET	DESCRIPTION
G-1	TITLE SHEET & INDEX OF SHEETS
S-1	SITE PLAN
S-2	OUTLET WORKS INTAKE STRUCTURE
S-3	CONTROL BUILDING & WATER LEVEL INDICATOR
S-4	SECTION AND DETAILS

OWNER'S ACCEPTANCE

THE WEST PANGUITCH IRRIGATION AND RESERVOIR COMPANY CERTIFIES THAT THE COMPANY ACCEPTS THE PLANS AND SPECIFICATIONS FOR THE WORK FOR PANGUITCH LAKE SLUICE GATE REPLACEMENT.

PRESIDENT — DATE 10/13/2011

ENGINEER'S CERTIFICATE

RB&G ENGINEERING, INC. CERTIFIES THAT THE CORPORATION WAS EMPLOYED TO PREPARE THE DRAWINGS & SPECIFICATIONS FOR PANGUITCH LAKE SLUICE GATE REPLACEMENT IN GARFIELD COUNTY, UTAH AND THAT THESE DRAWINGS CONSISTING OF 5 SHEETS AND THE ACCOMPANYING SPECIFICATIONS ARE THE INFORMATION TO BE SUBMITTED FOR APPROVAL.

RB&G ENGINEERING — DATE 10/07/2011

PROFESSIONAL ENGINEERS LICENSE NO. 162291

WATER RIGHTS SEVIER RIVER DECREE, PG. 10

AS CONSTRUCTED

1/30/2012
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RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601-1343
801 374-5771 PROVO
801 521-5771 SALT LAKE CITY

NO.	AUTHORIZED BY	REVISION	MADE BY	DATE
1	BEP	AS CONSTRUCTED	JR	1-26-12

DESIGNED BY B.E. PRICE
DRAWN BY J.B. RUSBY
CHECKED BY B.E. PRICE
SCALE HORIZ.
VERT.
DATE OCTOBER 14, 2011

GARFIELD COUNTY

PANGUITCH LAKE SLUICE GATE REPLACEMENT

TITLE SHEET & INDEX OF SHEETS

201101.044 PROJECT NO.
SEE FILE FILE DRAWER NO.
SHEET G-1
OF 5 SHEETS

NOTE:
DENTAL CONCRETE TO BE PLACED AT LOCATIONS DIRECTED BY ENGINEER

REPAIR EXISTING PIEZOMETER

DENTAL CONCRETE REQ'D.

DENTAL CONCRETE REQ'D.

TOP HEADWALL

EXISTING 48" OUTLET PIPE

MONITORING WELLS

ELEC CONDUIT

ELEC BOX

IRCS R/C1
N=10000.000
E=10000.000
EL=8224.514

IRCS R/C2
N=10105.714
E=9577.057
EL=8208.655

ROSENBERG CP4
N=10093.309
E=9667.586
EL=8208.05

ROSENBERG CP5
N=10079.479
E=9630.611
EL=8208.00

TOP OF DAM
EL. 8208.07

DAM CREST

8205

8200

8195

8190

8210

CONTROL BUILDING 6 S-3

POWER PANEL

DAM CREST

ELEV. 8203.5

POE 1+45.53

INTAKE STRUCTURE 1 S-2

TOP 24" CMP

1+00

HYDRAULIC LINE ENCASEMENT CONDUIT

SEE PROFILE THIS SHEET

WATER LEVEL INDICATOR 5a S-3

SCREEN 10 S-4

0+00

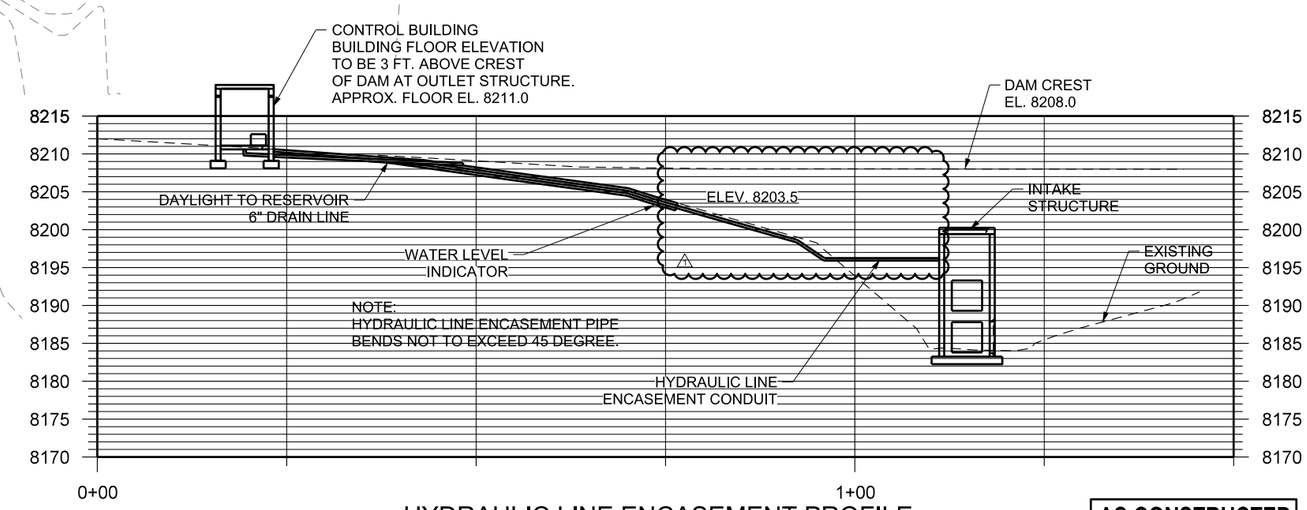
DAYLIGHT TO RESERVOIR 6" DRAIN LINE

87'-10"

N

SCALE
0 5 10 15 20 40 60

SITE PLAN-OUTLET



HYDRAULIC LINE ENCASEMENT PROFILE

AS CONSTRUCTED

1/31/2012
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BRADFORD E. PRICE — ELECTRONIC SEAL — STATE OF UTAH
10/07/2011

RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601-1343
801 374-5771 PROVO
801 521-5771 SALT LAKE CITY

NO.	AUTHORIZED BY	REVISION	MADE BY	DATE
1	BEP	AS CONSTRUCTED	JR	1-26-12

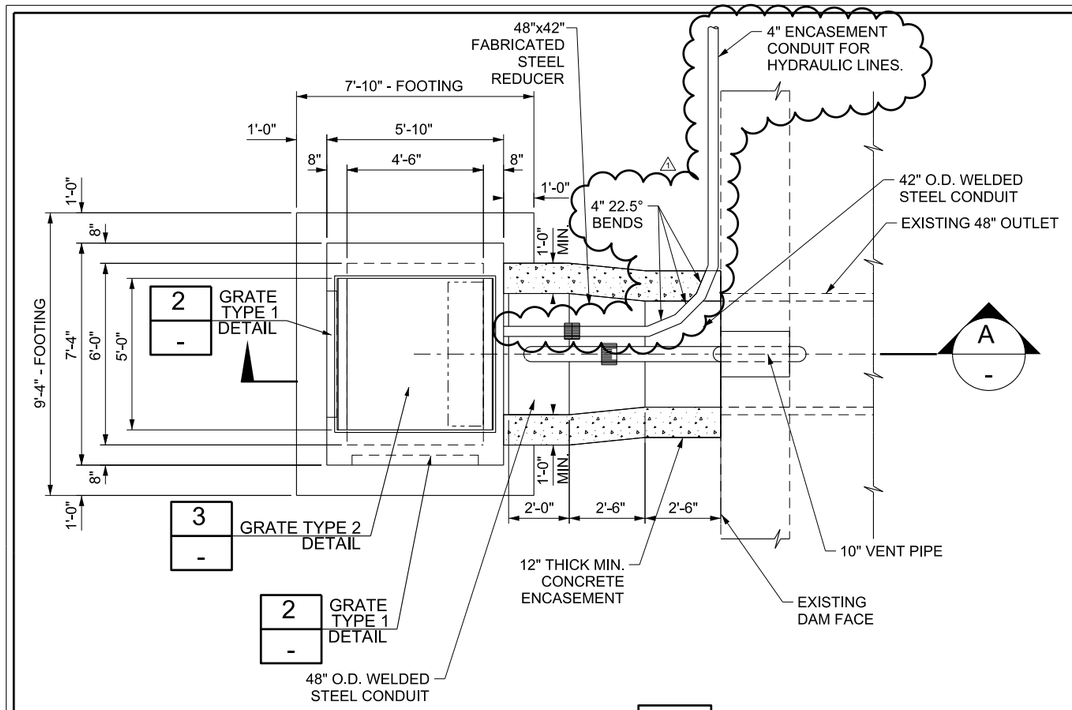
DESIGNED BY B.E. PRICE
DRAWN BY J RUSBY
CHECKED BY B.E. PRICE
SCALE HORIZ. / VERT.
DATE OCTOBER 14, 2011

GARFIELD COUNTY

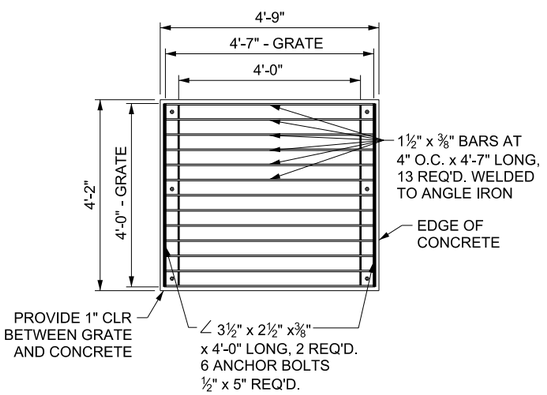
PANGUITCH LAKE
SLUICE GATE REPLACEMENT

SITE PLAN

201101.044 PROJECT NO.
SEE FILE FILE DRAWER NO.
SHEET S-1
OF 5 SHEETS

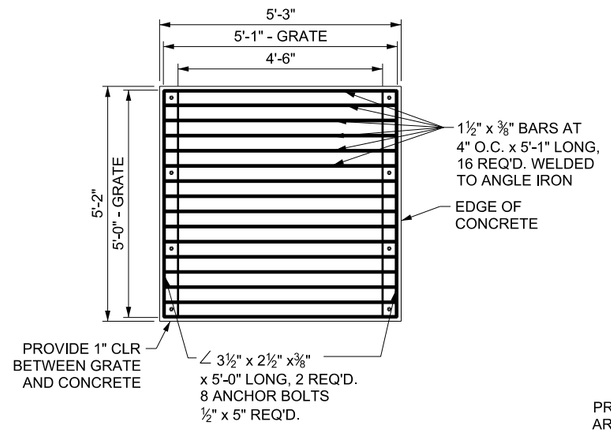


PLAN VIEW INTAKE STRUCTURE — 1 / S-1



PLAN VIEW
3 GRATES

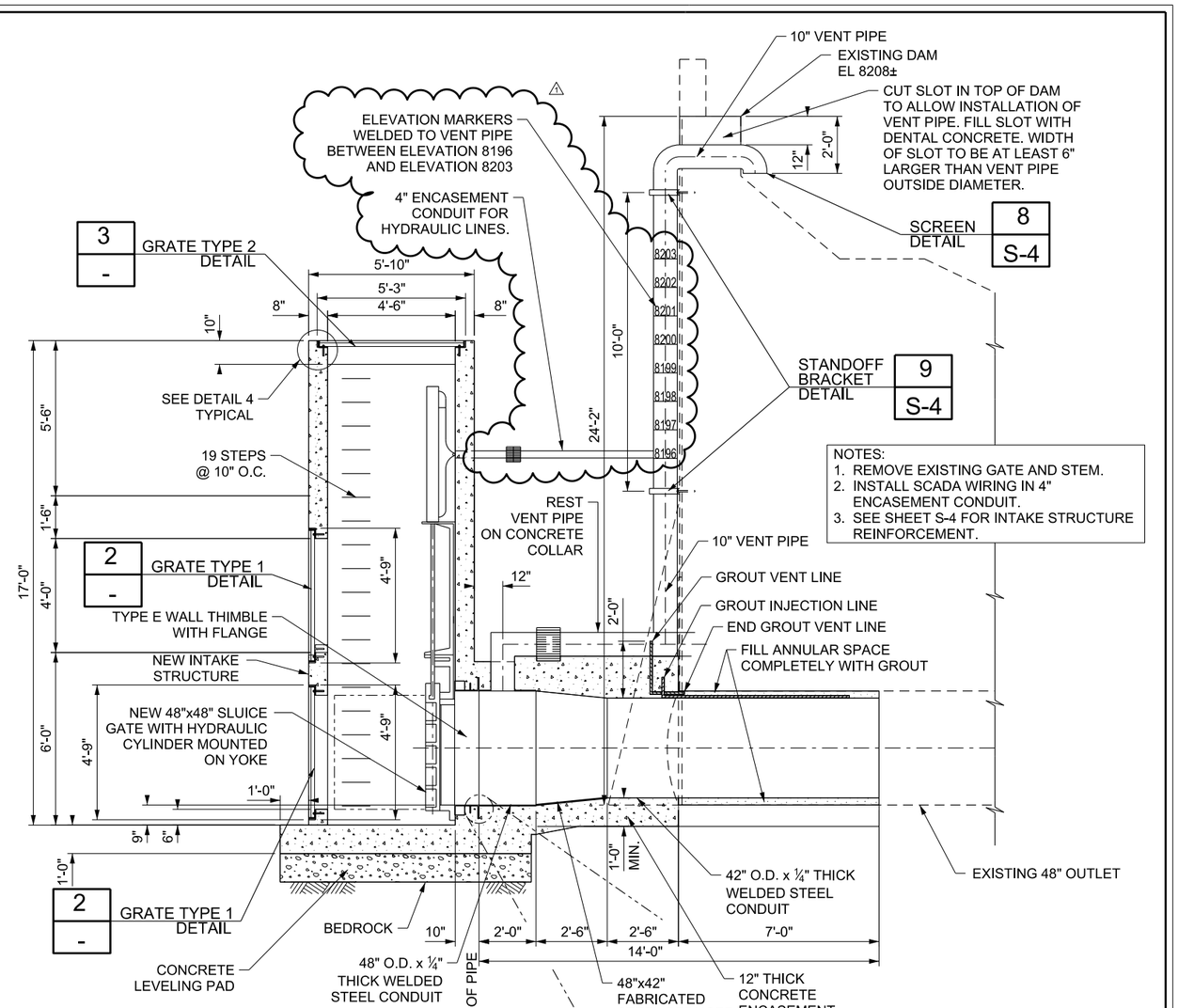
GRATE TYPE 1 DETAIL — 2 / -



PLAN VIEW
1 GRATE

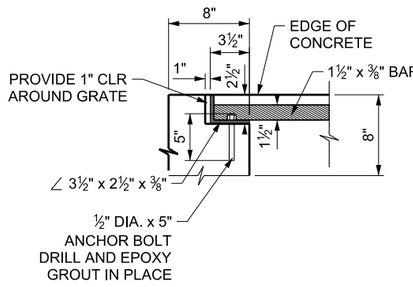
GRATE TYPE 2 DETAIL — 3 / -

NOTES:
1. DRILL AND EPOXY GROUT ANCHOR BOLTS IN PLACE.
2. GRATES SHALL BE HOT DIPPED GALVANIZED FOLLOWING FABRICATION.

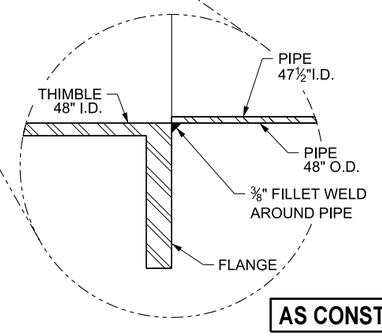


NOTES:
1. REMOVE EXISTING GATE AND STEM.
2. INSTALL SCADA WIRING IN 4" ENCASEMENT CONDUIT.
3. SEE SHEET S-4 FOR INTAKE STRUCTURE REINFORCEMENT.

SECTION A / -



TYPICAL GRATE SECTION — 4 / -



AS CONSTRUCTED

1/30/2012
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BRADFORD E. PRICE — PROFESSIONAL ENGINEER — STATE OF UTAH — ELECTRONIC SEAL — 10/07/2011

RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601-1343
801 374-5771 PROVO
801 521-5771 SALT LAKE CITY

NO.	AUTHORIZED BY	REVISION	MADE BY	DATE
6				
5				
4				
3				
2				
1	BEP	AS CONSTRUCTED	JR	1-26-12

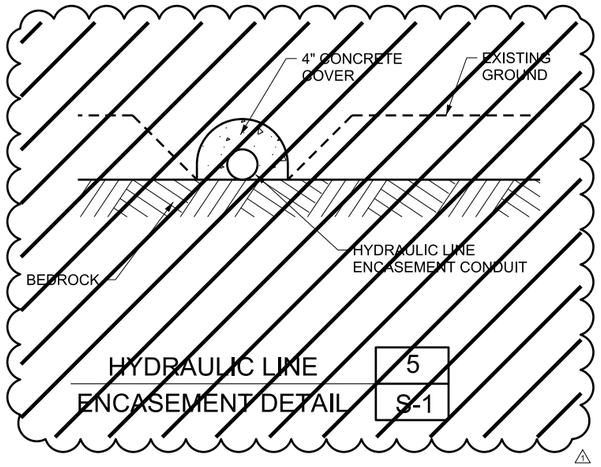
DESIGNED BY B.E. PRICE
DRAWN BY J. RUSBY
CHECKED BY B.E. PRICE
SCALE HORIZ. / VERT.
DATE OCTOBER 14, 2011

GARFIELD COUNTY

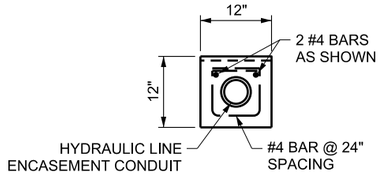
PANGUITCH LAKE SLUICE GATE REPLACEMENT

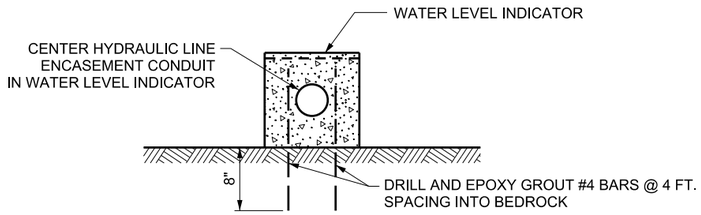
OUTLET WORKS INTAKE STRUCTURE

201101.044 PROJECT NO.
SEE FILE FILE DRAWER NO.
SHEET S-2
OF 5 SHEETS

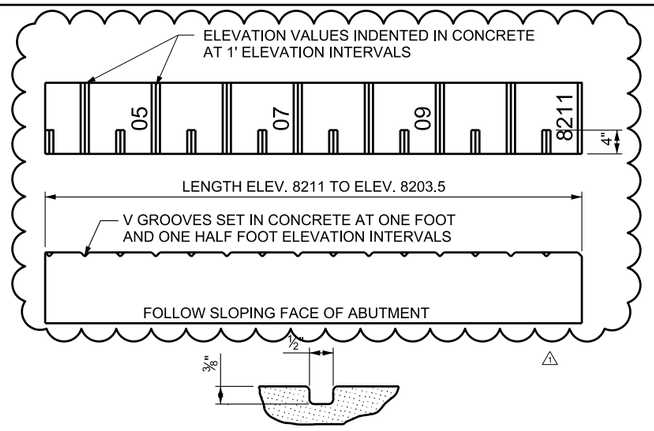


HYDRAULIC LINE ENCASEMENT DETAIL | 5 | S-1

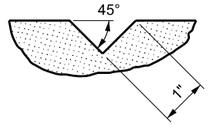




WATER LEVEL INDICATOR BEDDING DETAIL
NOT TO SCALE



TYPICAL SECTION THRU NUMBERS
NOT TO SCALE



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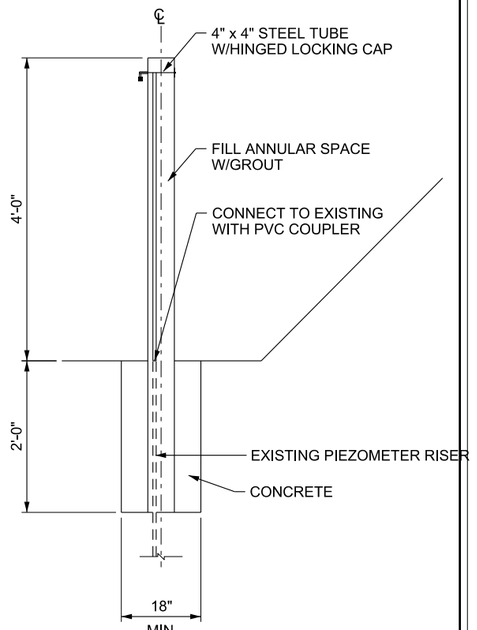
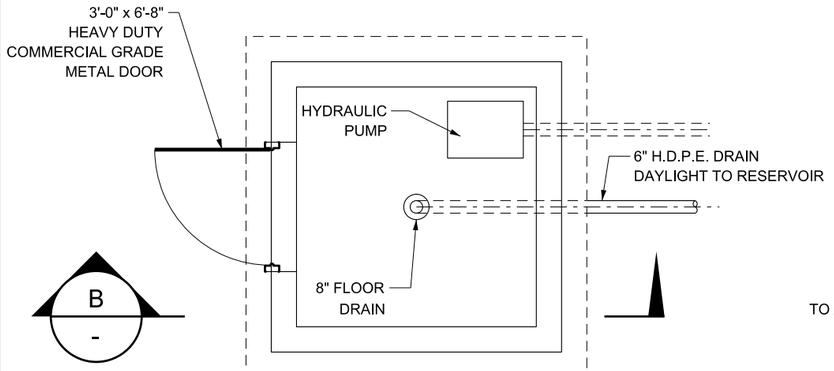
NOT TO SCALE

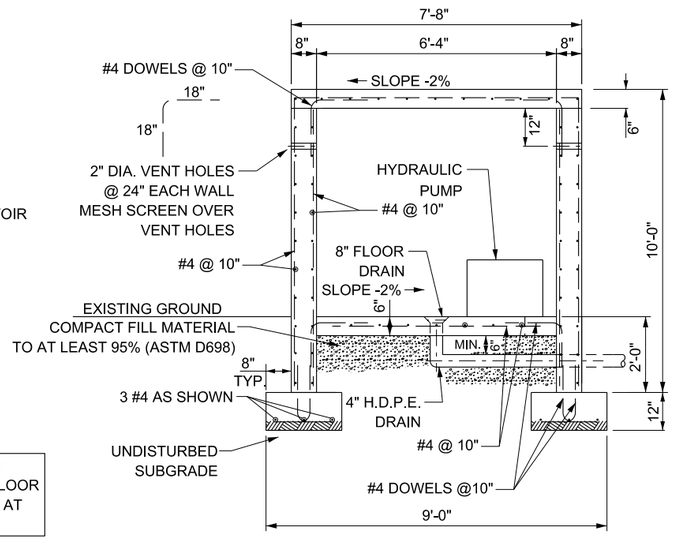


PIEZOMETER REPAIR

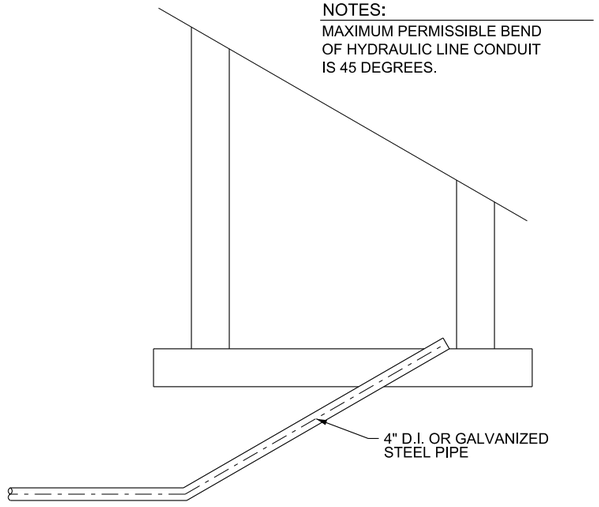
WATER LEVEL INDICATOR | 5a | S-2



CONTROL BUILDING NOTE:
SET CONTROL BUILDING FLOOR 3.0' ABOVE CREST OF DAM AT OUTLET STRUCTURE.



SECTION B -



HYDRAULIC LINE DETAIL | 7 | -

CONTROL BUILDING PLAN | 6 | S-1

AS CONSTRUCTED

1/30/2012
H:\DA...\Reservoir\Cad\Sheet_Files\AS CONSTRUCTED\S-3.dgn

PROFESSIONAL ENGINEER — BRADFORD E. PRICE — ELECTRONIC SEAL — STATE OF UTAH
10/07/2011

RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601-1343
801 374-5771 PROVO
801 521-5771 SALT LAKE CITY

NO.	AUTHORIZED BY	REVISION	MADE BY	DATE
1	BEP	AS CONSTRUCTED	JR	1-26-12

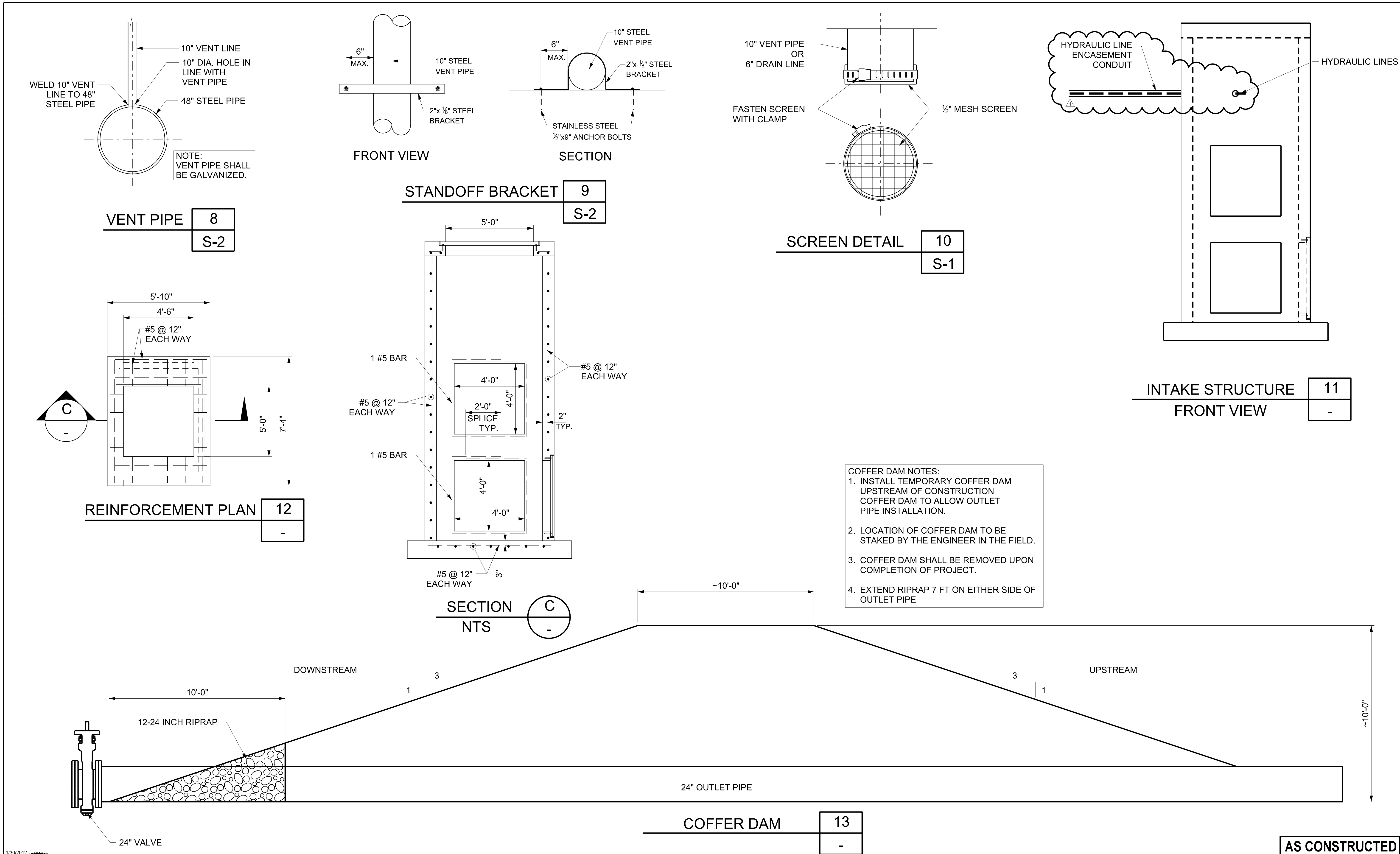
DESIGNED BY B.E. PRICE
DRAWN BY J.B. RUSBY
CHECKED BY B.E. PRICE
SCALE HORIZ.
VERT.
DATE OCTOBER 14, 2011

GARFIELD COUNTY

PANGUITCH LAKE
SLUICE GATE REPLACEMENT

CONTROL BUILDING &
WATER LEVEL INDICATOR

201101.044 PROJECT NO.
SEE FILE FILE DRAWER NO.
SHEET S-3
OF 5 SHEETS



1/30/2012
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PROFESSIONAL ENGINEER No. 162201 BRADFORD E. PRICE ELECTRONIC SEAL STATE OF UTAH
10/07/2011

RB&G ENGINEERING, INC.

1435 WEST 820 NORTH
PROVO, UTAH 84601-1343
801 374-5771 PROVO
801 521-5771 SALT LAKE CITY

NO.	AUTHORIZED BY	REVISION	MADE BY	DATE
6				
5				
4				
3				
2				
1	BEP	AS CONSTRUCTED	JR	1-26-12

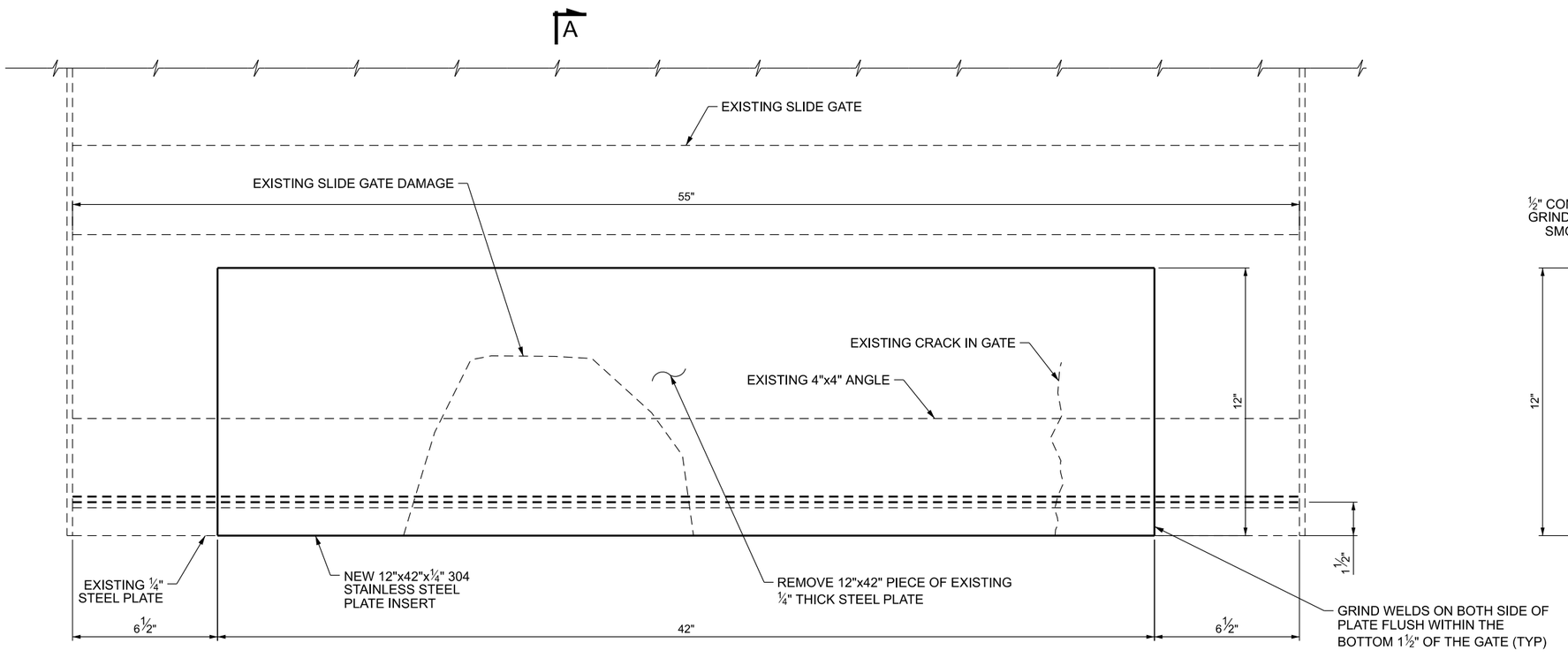
DESIGNED BY B.E. PRICE
DRAWN BY J. RUSBY
CHECKED BY B.E. PRICE
SCALE HORIZ. VERT.
DATE OCTOBER 14, 2011

GARFIELD COUNTY

PANGUITCH LAKE SLUICE GATE REPLACEMENT

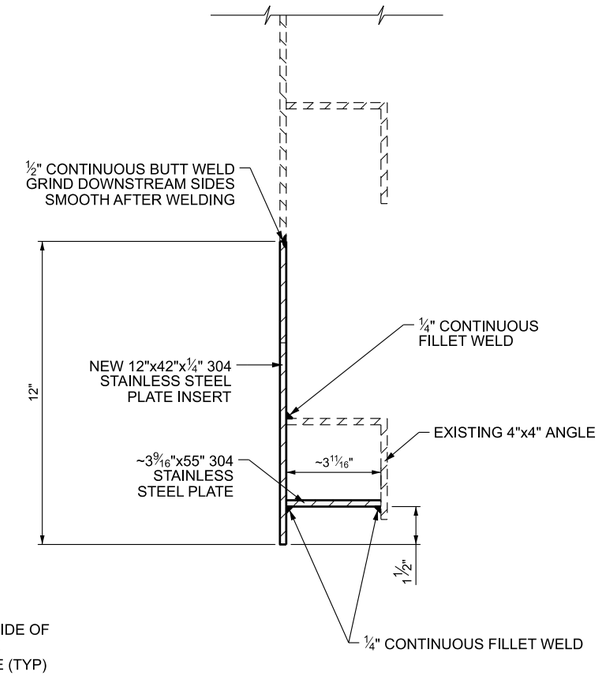
SECTION AND DETAILS

201101.044 PROJECT NO.
SEE FILE FILE DRAWER NO.
SHEET S-4
OF 5 SHEETS



SLIDE GATE REPAIR FRONT VIEW

NOTE:
CONTRACTOR TO FIELD VERIFY DIMENSIONS OF EXISTING GATE PRIOR TO FABRICATING REPAIR PIECES.

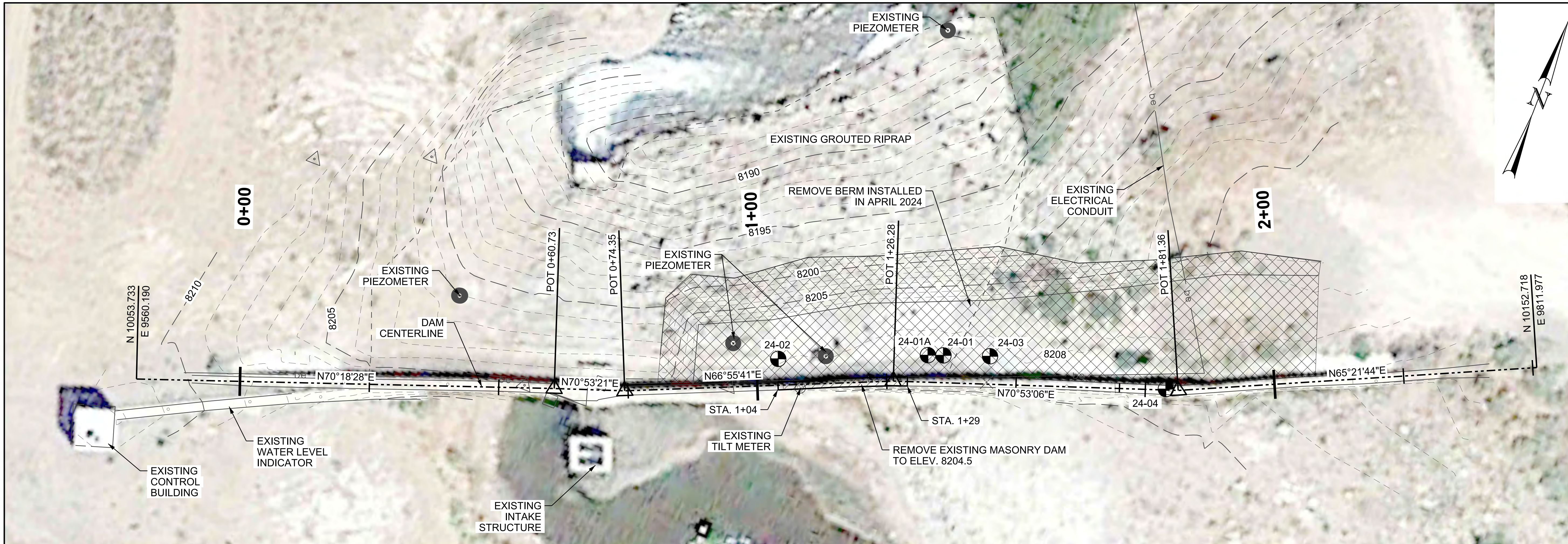


SECTION A-A

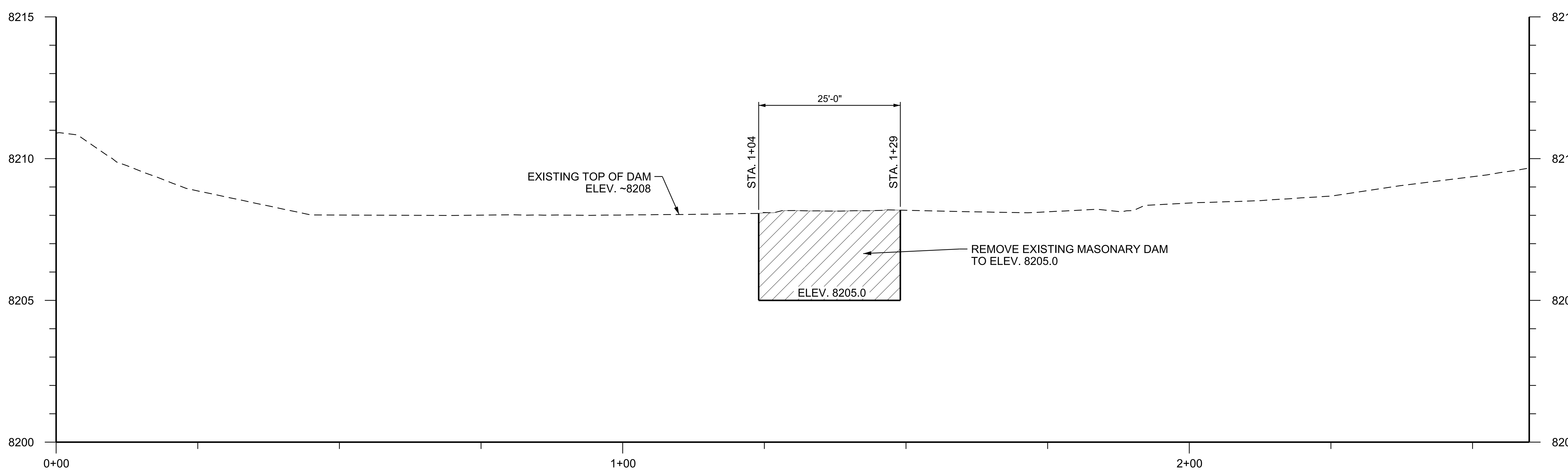
RB&G ENGINEERING, INC.

Panquitch Lake Reservoir

Slide Gate Repair



EXISTING DAM PLAN VIEW



EXISTING DAM PROFILE VIEW

HORZ. SCALE IN FEET 0 10 20 30 40

VERT. SCALE IN FEET 0 2 4 6 8

NO.	REVISION	AUTHORIZED BY	MADE BY	DATE
1				
2				
3				
4				
5				
6				

DESIGNED BY B. HORROCKS
DRAWN BY J. RUSBY
CHECKED BY B. HORROCKS
PROJECT NO. 202404-002
DATE 6-MAY-2024

RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601
801 374-5771 PROVO

PANGUITCH LAKE SPRING RUNOFF REPAIR
GARFIELD COUNTY, UTAH

EXISTING DAM PLAN AND PROFILE

SEAL

DRAWING NO.
S101

SHEET ___ OF X

6-MAY-2024
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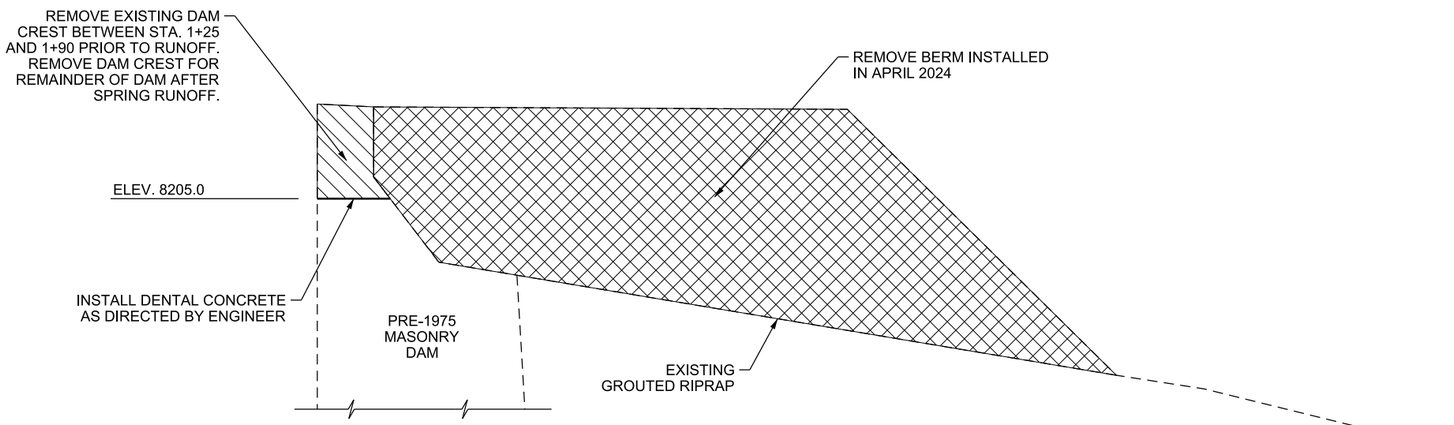

TYPICAL SECTION

NO.	AUTHORIZED BY	REVISION	MADE BY	DATE
1				
2				
3				
4				
5				

DESIGNED BY B. HORROCKS
DRAWN BY J. RUBY
CHECKED BY B. HORROCKS
PROJECT NO. 202404002
DATE 6-MAY-2024

RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601
801 374-5771 PROVO

PANGUITCH LAKE SPRING RUNOFF REPAIR
GARFIELD COUNTY, UTAH

SECTIONS AND DETAILS

SEAL

DRAWING NO.
S102

SHEET ___ OF _X_

6-MAY-2024
DGN File: R:\DMS\Panguitch Lake Reservoir\Dam Crest Repair_202404-002\Cad\Sheet_Files\202404002_s_Runoff_S102.dgn

April 2024 Daily Reports

RB&G ENGINEERING, INC.
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801-374-5771 Provo
801-521-5771 Salt Lake City
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PROJECT REPORT

Project No.	202404-002		
Project	Panguitch Lake Dam		
Day / Date	Tuesday / April 9, 2024	**Weather**	Mild, Temp in 50's
Report By	Brad Price	**Position**	Geotechnical Engineer

Observations / Activities

I received a text from Chad Justice, the Emergency Manager for Garfield County at 8:46 pm last night. He stated that I was listed in the Emergency Action Plan as a point of contact for dam inspection type stuff. He asked if I could call him back. Before seeing the message he called me at around 9 pm. He said that cracks in Panguitch Lake Dam had been observed and that water was flowing through cracks. They felt that the conditions rose to either Level or I Level 2 of the EAP and they were notifying applicable agencies and individuals listed in the EAP flow chart.

I called Brandon Horrocks to discuss RB&G's responsibilities. We decided to conference call Mac Hatch who was the contact for West Panguitch Irrigation Company (Dam Owner) that we have worked with in the past. In 2011 the outlet gate failed and we designed and oversaw installation of a new gate under emergency type conditions. The lead time for a 48 inch cast iron gate was over 6 months. We located a Stainless Steel gate which met the head requirements and was readily available. The work involved lowering the reservoir, designing a cofferdam to allow repair without a complete drawdown and design of a hydraulically operated gate with controls on the left abutment to allow operation of the gate during flooding conditions, The dam serves as the spillway, which limited access to gate operation during flooding with the manually operated gate stem.

Mac told us that he was no longer the WPIC president since his retirement in 2019, but he was on the board. He just returned Sunday from spending the winter 3 months in Yuma Arizona and was asked by the current board president to go up and observe conditions on Monday. He said they were watching it closely. He asked if they should contact the State and we recommended that he contact State Dam Safety and report observations and told him we were available to assist in any way.

Brandon called me at about 3 pm today, stating that Mac Hatch called requesting that we come down to assist them. Mac said that State Dam Safety was on site and had requested that the owner come up with a plan moving forward. Brandon was in Ogden Canyon at the Gateway Canal project and could not get to Panguitch Lake before dark. He asked if I was available. I left at 3:30 pm, arriving on site at 7:30 pm. Brandon and I discussed some options while traveling. The mitigating options appear to be (1) reducing the pressure from the upstream ice loading, (2) stabilizing the wall, and (3) releasing water through the outlet as quickly as feasible. I suggested that Brandon call Mac and recommend that they mobilize a Ditch Witch type trencher to saw cut the ice and discuss ways to buttress from the downstream side. Brandon called Mac who stated that he wasn't sure that it was feasible to use rock to stabilize but that K- rail highway jersey barriers were readily available. He would work on getting them to the site.

I observed conditions upon arrival with Mac Hatch and Matt Call (State Dam Safety Assist. Engineer). Water is flowing through cracks at the contact between the parapet wall and the masonry rock foundation east of the main dam. The parapet wall is about 2 foot wide and appears to be bowed in the center. The concrete wall appears to be about 2 high and sits on a masonry rock foundation. The major flow section appears to be about 25 foot wide where it has cut through

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PROJECT REPORT

Project No.	202404-002		
Project	Panguitch Lake Dam		
Day / Date	Tuesday / April 9, 2024	**Weather**	Mild, Temp in 50's
Report By	Brad Price	**Position**	Geotechnical Engineer

the ~2 foot of snow covering. It is likely that additional flow is occurring beneath the snow cap going to the east or right when looking at the dam from the reservoir side. I estimated the observed flow in the 20 to 25 cfs range. The total flow from the outlet works and seepage combined, as measured at the downstream weir is 160 cfs. They have a tilt meter sitting on the wall. It was reported that a 60 foot section of the wall had tilted 8 degrees downstream on Monday night and had rotated back to a 5 degree tilt during the day on Tuesday. The tilt was visually obvious. Mac said that the trencher on K-rails were scheduled to be on site at 7 am tomorrow morning. A light plant was being set up and the sheriff's department would monitor flow, measure tilt and observe conditions throughout the night. Garfield County had equipment and crews on standby to assist. They said they could begin snow removal from the downstream right abutment tonight if necessary and Mac said he could get the equipment and materials up to the site tonight if needed.

After assessing the existing conditions and history of what has transpired since the leakage was first discovered on Monday, my recommendation was to begin remedial action in the morning at daylight. My major concern was that the freezing night temperatures may cause additional wall tilting. I recommended that the sheriff's department call Mac if the tilt exceeded 8 degrees and that Mac call me so we could get up to the site. We went over our plan with Matt Call and he was in agreement with the planned course of action.

C: Paguitch Lake Dam

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PROJECT REPORT

Project No.	202404-002		
Project	Panguitch Lake Dam		
Day / Date	Wednesday / April 10, 2024	**Weather**	Mild, Temp in 60's
Report By	Brad Price	**Position**	Geotechnical Engineer

Observations / Activities

After considering options during the night and evaluating the irregularities of the parapet wall alignment, the 2 horizontal to 1 vertical slope of the masonry rock section downstream of the wall, with water flowing over it with the risk of equipment sliding down the slope, I did not feel that using K-rails was the best option to buttress the wall. I called Mac Hatch at 6:15 am and recommended that we get riprap size rock, preferably 8" to 36" diameter, to the site and begin placing it on the downstream right abutment adjacent to the parapet wall, working our way across with a ramp, keeping the trackhoe on the rock surface. He said he would make some calls and meet me on site at 7 am.

The wall had remained at the 5 degree tilt through the night. Readings were being taken at about 2 hour intervals with the total flow measuring about 180 cfs. The flow through the wall did not appear to have increased. I requested that they increase the flow through the outlet works at 20 cfs intervals hourly until there was a threat of overtopping and losing access to the site via Highway 143.

The Garfield County crew and equipment (1) Supervisor, (2) Cat 150 Grader with operator, (3) Cat 315 trackhoe w/ operator) began snow removal from the right downstream side. At about 8:30 am Neil Jacobson came to the site. He operates a basalt quarry about 2 miles south of the site. I showed him what we trying to accomplish. He said he could furnish us rock ranging from 8 inches to 48 inches and 8 inch minus crushed rock to cap the surface. He said we could expect the first truck load within an hour. The County said they could mobilize 3 dump trucks to haul rock.

The trencher arrived at about 9 am. Austin Owens (WPIC) dam tender took an ice auger onto the reservoir and drilled 3 holes along a path from the right side to the left side of the reservoir (about 350 feet), about 85 feet upstream of the dam and wall. The ice measured between 14 and 18 inches thick. They stretched a cable to guide the Ditch Witch trencher and trenched a slot across the reservoir. After setup, it took less than ½ hour to cut the first slot. They attempted to cut a second slot midway between the first slot and the wall, but could not get the trencher onto the ice at the reservoir edge on the left side. They moved back to about 15 feet upstream from the first slot and successfully cut another slot across the reservoir. They cut an additional 3 slots across the reservoir by about 2 pm. At noon, the tilt measured 3.5 degrees and by 3 pm the tilt was only 2 degrees.

The first rock truck arrived at about 9:15 am. The crew had removed snow as far out as safety allowed. They exposed another significant flow below the snow over a 20 foot length. I estimated this flow at about 10 cfs.They began placing rock and building the ramp from east to west (right to left). I asked Matt Call if he could paint stations across the wall and identify key features. I did not feel comfortable walking on top of the 2 ft. wide wall from abutment to abutment, but I had no problem in watching the State engineers (younger and agial) go across. A summary of the survey markings follows in the table on the next page.

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PROJECT REPORT

Project No.	202404-002		
Project	Panguitch Lake Dam		
Day / Date	Wednesday / April 10, 2024	**Weather**	Mild, Temp in 60's
Report By	Brad Price	**Position**	Geotechnical Engineer

Station	**Painted Label Station on Top of Wall**	**Description**
0+60	60+00	Piezometer
0+66.8		Air Vent
1+07	107+00	Left most Crack
1+08.5		Tilt meter
1+13.4		2nd Crack
1+21.5		3rd Crack
1+24.5		4th Crack
1+45.1		5th Crack
1+70.5		6th Crack
1+85.5		T-Post (beginning of bow in wall on east side)
2+40	240+00	End of Wall on Right Abutment

It appears that the left most crack at Sta. 1+07 is located where the natural cliff edge is. The first major flow starts at about Sta. 1+07, extending east.

Rock placement continued throughout the day. From 4:30 to 5:30 pm the primary work was stabilizing the entrance road into the site. Five loads of crushed 8 in minus rock was used. By 6 pm the full build out of the rock buttress extended west to about Sta. 1+20, with the initial rock layer extending to Sta. 1+05, with the flow completely within the rock layer.

The reservoir level has dropped 3 inches in the past 24 hours. Flow at the weir measures 253 cfs. There is only 1 degree of tilt in the wall. I was comfortable calling it a day. We should be able to finish the buttress work by noon tomorrow.

I left the site at 7:15 pm.

Photos on next page show cutting slot (9:51 am) and placement of rockfill. Lower left at 10:30 am, lower right at 7:15 pm

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PROJECT REPORT

Project No.	202404-002		
Project	Panguitch Lake Dam		
Day / Date	Wednesday / April 10, 2024	**Weather**	Mild, Temp in 60's
Report By	Brad Price	**Position**	Geotechnical Engineer

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PROJECT REPORT

Project No.	202404-002		
Project	Panguitch Lake Dam		
Day / Date	Thursday / April 11, 2024	**Weather**	Mild, Temp in 60's
Report By	Brad Price	**Position**	Geotechnical Engineer

Observations / Activities

On site at 7 am. Garfield County crews began with rockfill at 7:15. Everett Taylor was on site from ~7:30 until 8:15. We discussed finalizing the emergency repair, agreeing to extend at least 10 feet west of the first major crack which is at Sta. 1+07. He asked Austin to continue opening the gate at about 10 cfs increase intervals today. We also discussed work going forward. Mac asked about draping a liner across the ramp to keep overflow from entering the rock during spring runoff. Our desire is to continue lowering the reservoir to store without overtopping. I like the idea of removing the wall on the right (west) end and creating a spillway around the end. In that light, I asked Mac to have them pothole on the downstream right abutment to verify that it is rock.

By 2 pm the buttress was essentially complete. I asked Mac to have them use the hoe bucket to pound against the downstream slope to help solidify the outer rocks. The flow as at 273 cfs.

I left the site.

Panguitch Lake Dam

Tuesday April 30, 2024

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Project	Panguitch Lake Dam Crest	**Project No.**	202404-002
Report By	B. Horrocks, P.E.	**Position**	Geotechnical Engineer
Weather	Mostly Clear, 50s	**Signature**	

Observations / Activities

I arrived at the dam at about 8:00am and met Mac Hatch. We marked a location between Sta 1+04 and 1+29 for excavation of the dam crest to create a temporary spillway. Garfield County employees arrived at about 9:00am with a Cat 315 excavator and 938 loader to remove the rockfill berm that was installed to stabilize the damaged dam crest. The County brought a dump truck later in the day. They excavated from the left side of the berm (~Sta 0+87) to Sta 1+20 by 12:00pm, then Quick Cut set up a wire saw to remove three feet off the dam between Sta 1+04 and 1+16. The wire saw was set up by coring holes through the dam at Sta 1+04 and 1+16, elevation 8205.0 ft, running a diamond embedded cable through the holes, then running the cable through pulleys positioned to pull the cable along the desired cut. When I left the site at about 3:30pm, Quick Cut had made a 3-foot deep vertical cut at Sta 1+04 and they were setting up the equipment for the horizontal cut between Sta 1+04 and 1+16. I received a message from Mac later in the day reporting that the 12-foot section of the dam crest was removed. Mac reported on May 1st that the dam crest was removed between Sta 1+16 and 1+29. Based on the photos Mac sent, it appears that the masonry within the left half of the temporary spillway is in relativley good condition but he masonry within the right half is in moderate to poor condition. I recommended that non-shrink grout be used to fill the voids in the masonry; however, Mac reported on May 2nd that water began lapping over the spillway before the grout work could be performed.

The reservoir water surface was at 8205.0 feet while I was onsite.

Photos taken during the work performed and photos taken by Mac Hatch after I left the site are attached.

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Rockfill berm being removed

Downstream side of dam between ~Sta 1+04 and 1+20

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Wire saw set up for vertical cut at Sta 1+04

Left side of temporary spillway
(Photo taken by M. Hatch)

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Right side of temporary spillway
(Photo taken by M. Hatch)

Right side of temporary spillway
(Photo taken by M. Hatch)

Panguitch Lake Dam

Monday May 20, 2024

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Project	Panguitch Lake Dam Crest	**Project No.**	202404-002
Report By	B. Horrocks, P.E.	**Position**	Geotechnical Engineer
Weather	Cloudy, 50s	**Signature**	Brandon Horrocks

Observations / Activities

I visited the dam site with Mac Hatch during the afternoon after meeting with the Irrigation Company, Forest Service, and Dam Safety. The reservoir water surface was at elevation 8203.5 feet (55 inches below the dam crest) at the time of the visit. The horizontal crack caused by the ice action damage earlier in the year was visible near the water surface elevation, and there was no visible seepage on the downstream side of the dam. About 150 cfs was being released from the reservoir.

It is our opinion that it is unnecessary to continue to release water in excess of the amount required for downstream use. We recommend that the irrigation company be allowed to reduce reservoir release provided the water surface elevation remains at or below elevation 8203.5 feet. It will be necessary to draw the reservoir down to at least elevation 8201.5 feet for repair of the dam crest.

Photos taken during the site visit are attached.

Upstream dam face, near right abutment

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Downstream side of dam

Ditch Bill Easement

225857
ENTRY NO. ___ RECORDED 8-20, 2001 AT 2:30 PM
AT REQUEST OF U.S. Forest Service
FEE $35.00
RECORDER GARFIELD CO, UT
DEPUTY Cindy Talbot

Authorization ID ____
Contact ID ____
Expiration Date:

FS-2700-9a (9/96)
OMB No. 0596-0082

U.S. DEPARTMENT OF AGRICULTURE
Forest Service
AGRICULTURE IRRIGATION AND LIVESTOCK WATERING SYSTEM EASEMENT
Act of October 21, 1976, Act of October 27, 1986
(Pub. L. 99-545), 36 CFR 251, Subpart B

THIS EASEMENT issued this 30th day of July, 2001, by the **UNITED STATES OF AMERICA**, acting by and through the Forest Service, Department of Agriculture, hereinafter called Grantor, to **West Panguitch Irrigation and Reservoir Company**, a Corporation of the State of Utah, hereinafter called the Holder.

WHEREAS, the Holders have applied for an easement under Section 501 of the Federal Land Policy and Management Act of October 21, 1976, as amended by P. L. 99-545 (90 Stat. 2743; 43 U.S.C. 1761), for agricultural irrigation or livestock watering system facilities located on lands owned by the United States on the Dixie National Forest, in the County of Garfield, State of Utah.

WITNESSETH

WHEREAS, upon acceptance of this easement the Holder relinquishes all right, title, and interest in and to any easement issued for the same lands by the United States by any previous grant or permit.

NOW THEREFORE, the United States does hereby grant, subject to valid existing rights, an easement for occupancy with water conveyance system facilities located on the following described lands:

Principal Meridian, Salt Lake, TOWNSHIP 35 SOUTH, RANGE 7 WEST
Sections 32, 33, and 34
Principal Meridian, Salt Lake, TOWNSHIP 36 SOUTH, RANGE 7 WEST
Sections 3, 4, and 5

Said water conveyance facilities consisting of the West Panguitch Dam and Reservoir is shown on the map contained in **Exhibit A**, attached hereto and incorporated herein, as provided by the Holder and hereby accepted by the Authorized Officer.

This easement is issued subject to the following terms, provisions, and conditions applicable to the Holder, its permittees, contractors, assignees, and successors in interest.

1. AUTHORIZED USE. This easement authorizes only the right-of-way and water conveyance system facilities as constructed and operated on October 21, 1976, as specified herein.

2. EXTENSIONS or ENLARGEMENTS. This easement does not authorize extensions or enlargements of the water conveyance system.

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3. FEES. This easement is issued free of charge.

4. TRANSFERABILITY. This easement is fully transferable provided the water conveyance system facilities are used for agricultural irrigation or livestock watering. Holder shall notify Grantor within sixty (60) days of any address change or change in ownership.

5. TENURE. This easement shall continue for as long as the above described lands and water conveyance system facilities are used, operated, and maintained in accordance with the terms and conditions herein described.

6. OPERATION and MAINTENANCE.

a. Holder agrees to operate and maintain the facilities and use the authorized easement in accordance with applicable Federal, State, and local laws, regulations, and standards.

b. Holder shall notify, consult with, and obtain concurrence of the Grantor for operation and maintenance of the authorized facilities.

c. Holder agrees to install and maintain an operable headgate at each diversion structure. Such headgate shall be capable of controlling the amount of water entering the system.

d. Holder will not use fire or herbicides on the authorized right-of-way except as permitted in writing by the Grantor.

e. Holder agrees to operate and maintain the facilities and use the authorized easement in accordance with the Operation and Maintenance Plan dated April 20, 1994 and the Emergency Action Plan dated April 27, 1994.

f. DAM SAFETY

(1) Definitions. The following definitions apply to this clause:

Qualified Engineer. An engineer authorized to practice engineering in the field of dams in the State where the dam is located, either by professional registration as provided by State law or by reason of employment by the State or Federal government.

Dam Failure. Catastrophic event characterized by the sudden, rapid, and uncontrolled release of impounded water. It is recognized that there are lesser degrees of failure and that any malfunction or abnormality outside the design assumptions and parameters which adversely affect a dam's primary function of impounding water may also be considered a failure.

Rehabilitation or Modification. Repair of major structure deterioration to restore original condition; alteration of structures to meet current design criteria, improve dam stability, enlarge reservoir capacity, or increase spillway and outlet works capacity; replacement of equipment.

Hazard Potential. The classification of a dam based on the potential for loss of life or property damage that could occur if the structure failed (FSM 7500).

Emergency Action Plan. Formal plan of procedures to prevent or reduce loss of life and property that could occur if the structure failed. The plan does not include flood plain management for the controlled release of floodwaters for which the project is designed.

(2) DAM CLASSIFICATION. The dam constructed pursuant to this authorization shall be classified according to its height and storage capacity (water, debris or both) as well as its hazard potential as follows:

Height and Storage Capacity (A, B, C, or D) **B**
Dam Structural Height: **28 feet**
Storage Capacity: **23,730 acre feet**
Hazard Potential (Low, Moderate, High): **High**

Classification criteria are contained in FSM 7511, which the Forest Service may amend from time to time.

The hazard potential of the dam shall be reassessed at least every ten years by a qualified engineer retained by the holder, and this information made available to the authorized officer. The Forest Service may change the hazard potential at any time based on changed conditions or new information.

(3) CONSTRUCTION, INSPECTION, CERTIFICATION, AND PROJECT FILES. For construction, rehabilitation or improvement, the holder shall provide for inspection by a qualified engineer to ensure adequate control of the work being performed. At a minimum, the qualified engineer shall maintain a daily inspection diary, descriptions of design changes, and records of construction material and foundation tests.

Upon completion of construction, rehabilitation, or improvement, the holder shall forward to the Forest Service a statement from the qualified engineer responsible for inspection certifying that the works were built in accordance with the approved plans and specifications, or approved revisions thereto. No water shall be impounded until approval is given by the authorized officer.

All design notes, as-built plans, and the aforementioned diaries and records shall be maintained in a project file by the holder for the duration of this authorization, and shall be available to the Forest Service or other inspection personnel.

(4) DAM OPERATION AND MAINTENANCE PLANS. Prior to the storage of water, the holder shall have an approved plan or plans for the operation and maintenance of the dam and appurtenant structures. The plans will, at a minimum, describe operating requirements and procedures to be followed for the operation of the structure; routine or recurring maintenance required; recordkeeping to be performed for operation and maintenance; and

individuals responsible for implementing the plans. The holder shall ensure the plans are available to the individual responsible for plan implementation and the engineer performing any inspection, are reviewed at least at the time of the operation and maintenance inspection and are amended as conditions or requirements so warrant. No plans or amendments thereto shall be valid until approved by the authorized officer.

(5) DAM EMERGENCY ACTION PLAN. The following provisions are required for certain hazard classifications identified in section 2. The holder shall, during the design phase, prepare an emergency action plan which will include, but not be limited to:

a. Actions to be taken upon discovery of an unsafe condition or impending failure situation to prevent or delay dam failure, and reduce damage or loss of life from subsequent failure.

b. Procedures for notification of law enforcement, civil preparedness, and Forest Service personnel.

c. Procedures for notifying person in immediate danger of losing life or property.

d. Maps delineating the area which would be inundated by water, debris or both in the event of dam failure.

e. The names of those individuals responsible for activating the plan and carrying out the identified actions.

In preparing the emergency action plan, the holder shall consult and cooperate with appropriate law enforcement and civil preparedness personnel, who may be responsible for implementing all or part of the plan. Emergency action plans shall be reviewed and updated annually and tested at intervals not exceeding five years.

(6) INSPECTION AND MAINTENANCE OF DAMS. The holder shall have the dam and appurtenant structures inspected by a qualified engineer to determine the state of operation and maintenance at least **once**[1] every year. An inspection shall also be made following earthquakes, major storms, or overflow of spillways other than the service spillway. Two copies of the inspection report shall be provided to the authorized officer within 30 days of the date of inspection.

Repairs or operational changes recommended by the inspecting engineer shall be made by the holder within a reasonable period of time following the inspection, but in no event later than one year from the inspection (unless a longer period of repairs is authorized in writing, or a shorter period is required when such repairs are deemed by the authorized officer as immediately required for reasons of public safety). Upon request by the authorized officer, the holder shall provide a plan of action outlining planned time and methods for performing said repairs or operational changes, and notify the authorized officer when actions are completed. The authorized officer shall specify a completion date for corrective work. If the corrective action is not taken by the date specified by the authorized officer, the Forest

[1] Refer to schedule for hazard potential in FSM 7511; low + 5 years; moderate = 2 years; high = 1 year.

Service shall have corrective action taken and the holder shall be responsible for all costs including legal and court costs.

(7) FOREST SERVICE INSPECTION OF DAMS. The holder shall allow inspection of the dam and appurtenant structures at any time by the authorized officer. Any condition adversely affecting or which would adversely affect the operation of the facility; safety of the structure or the public, or surrounding lands and resources shall, upon written notice, be corrected or changed by the holder at the holder's expense. The authorized officer shall specify a completion date for corrective work. If the corrective action is not taken by the date specified by the authorized officer, the Forest Service shall have corrective action taken and the holder shall be responsible for all costs including legal and court costs. A copy of the Forest Service inspection report shall be provided to the holder.

An inspection performed by the Forest Service does not relieve the holder of the responsibility of ensuring that inspections are made in accordance with section 6 of this clause.

(8) DAM SAFETY EVALUATIONS. This provision is required for certain hazard classifications identified in section 2.

Beginning in the year 2005 and at 5 year intervals thereafter, the holder shall have a formal dam safety evaluation performed by a qualified engineer to verify the safety and integrity of the dam and appurtenant structures. The evaluation will include, but is not limited to, a detailed field inspection of the dam and appurtenant structures and a review of all pertinent documents, such as investigation, design, construction, instrumentation, operation, maintenance, and inspection records. The evaluation shall be based on current accepted design criteria and practices. The holder shall provide two copies of the evaluation report to the authorized officer and Regional Engineer. Based on this report, the authorized officer may require the holder to perform additional evaluations pursuant to such standards as the officer may define and may require rehabilitation or modification of the structure within a reasonable time.

(9) RIGHT OF ACTION TO ABATE EMERGENCY SITUATIONS. In situations where the authorized officer determines on the available facts that there is danger of a dam failure for any reason, such officer may exercise discretionary authority to enter upon the structure and appurtenances authorized herein and take such actions as are necessary to abate or otherwise prevent a failure. Such actions include, but are not limited to, lowering the level of the impounded waters utilizing existing structures or by artificial breach of the dam. In the event that such actions are taken, the United States shall not indemnify or otherwise be liable to the holder for losses or damages, including losses or damages to the structure or the value of the impounded waters. The failure of the Forest Service to exercise any discretion under this provision shall not be a violation of any duty by the United States, and shall not relieve the holder of any and all liability for damages in the event of a dam failure.

(10) LIABILITY. The activities authorized by this permit shall be deemed a high risk use and occupancy. Sole responsibility for the safety of the dam and associated facilities and any

liability resulting therefrom shall be on the holder and his successors, agents or assigns. Pursuant to 36 CFR 251.56 (d), as such regulation may be amended from time to time, the holder shall be liable for injury, loss or damage resulting from this authorization regardless of the holder's fault or negligence. Maximum strict liability shall not exceed $1,000,000 except as that amount may be changed in the aforementioned regulations.

In addition to all waivers and limitations on liability of the United States under this authorization, the provisions of 33 U.S.C. 702(c) shall apply to any damages from or by floods or flood waters at any place.

g. Pursuant to the requirements of 36 CFR § 251.56(b)(1)(v), the terms and conditions for operation and maintenance set forth in this section, and any operations and maintenance plan incorporated in this Easement pursuant Paragraph (e) of this section, may be revised or modified by the Authorized Officer upon determination that: 1.) modification or revision of such terms and conditions is necessary to meet the requirements of 43 U.S.C. § 1765 or to comply with the requirements of any other applicable Federal law; or 2.) terms and conditions contained herein are no longer needed to protect National Forest System land or resources, or to meet the requirements of 43 U.S.C. § 1765 or any other applicable Federal law.

7. EMERGENCY REPAIRS.

a. Except for emergency repairs required to protect the environment, property of the United States, or public health and safety, the Holder may not use materials on National Forest System lands outside the easement prior to obtaining written authorization and paying for the materials to be used. Holder's use of material within the easement is limited to maintenance of the water conveyance system facility.

b. If the water conveyance system facilities authorized by this Easement are allowed to deteriorate to the point of threatening persons or property, and the Holder, after notification by the Grantor, refuses to perform the repairs and maintenance required to remove the threat to persons or property, Grantor shall have the right to undertake such repair and maintenance and to assess the Holder for the costs of such repair and maintenance, regardless of whether Grantor had required the Holder to furnish a bond or other security.

8. INDEMNIFICATION. Holder shall indemnify the United States against liability for any and all injury, loss, or damage, including fire suppression costs, that the United States may suffer as a result of claims, demands, losses, or judgments caused by the Holder's use or occupancy under this easement.

9. LIABILITY. Holder is liable for and agrees to repair damage to National Forest System lands caused by Holder's negligence, intentional acts, or of failure to comply with the terms and conditions of this easement or of any law or regulation applicable to the National Forests.

10. SITE RESTORATION. Holder shall, upon termination of this easement, stabilize the site as required by the Grantor. If Holder does not stabilize the site, the Holder agrees to pay the costs of such stabilization if undertaken by the Grantor.

11. SPECIAL PROVISIONS. The foregoing notwithstanding, this easement is granted subject to the following reservations by Grantor, for itself, its permittees, contractors, and assigns.

A. NONEXCLUSIVE USE. The Grantor reserves the right to use or permit others to use the easement area, provided such use does not unreasonably interfere with the rights and privileges hereby authorized.

B. TERMINATION. This easement may be terminated with consent of Holder, or if Holder fails to exercise the rights and privileges authorized for any continuous period of five (5) years or more. This easement expires according to its terms if Holder uses the water conveyance system for any purpose other than agricultural irrigation or livestock watering. Grantor may take action to terminate this easement under 7 CFR 1.130 - 1.151, for noncompliance with applicable statutes and regulations, or the terms and conditions of this easement.

C. FOREST SERVICE REPRESENTATIVE. The District Ranger, Cedar City Ranger District, is responsible for administering this easement. The holder should contact the District Ranger regarding any questions concerning the occupancy and use authorized and the provisions of this authorization.

D. WATER RIGHTS/ADJUDICATION. Should, subsequent to the issuance of this easement, an adjudication of the water right or water system authorized by this easement establish the fact that the Holders did not have a valid water right for the use of the water or a water system which meets the requirements of this act, then coincidental with the date of the decree, this easement shall expire on its own terms based upon the failure of the permit holder to meet the requirements of this Act. Upon expiration, all right, title, and interest in and to the subject area shall revert to the United States, or its successors or assigns.

ACCEPTANCE: On this 9 day of July, 2001, I, the undersigned Holder have read, understand, and accept the terms and conditions of this easement.

Allen K Henrie
President

The following certificate shall be executed by the Secretary of the Corporation:

I, J. MERLE PRINCE, certify that I am the Secretary of the Corporation that accepted the above easement; that, ALLEN K. HENRIE, who signed said easement on behalf of said Corporation was then President of said Corporation; that I know his/her signature, and that his/her signature on said easement is genuine; and that said easement was duly signed and attested to for and on behalf of said Corporation by authority of its governing body.

J. Merle Prince
Secretary

ACKNOWLEDGEMENT

STATE OF Utah)
) ss.
COUNTY OF Garfield)

On this 7th day of July, 2001, before me, a Notary Public in and for the State of Utah, personally appeared Allen Henrie and J. Merle Prince, known to be the President and Secretary, respectively, for the Corporation that executed the within instrument, and acknowledged to me that such corporation executed the same.

IN WITNESS WHERREOF, I have hereunto set my hand and affixed my official seal the day and year first above written.

Notary Public
COLLEEN MILLER
55 South Main
Panguitch, Utah 84759
My Commission Expires
October 1, 2001
State of Utah

Colleen Miller
Notary Public for the State of Utah
Residing at Panguitch, Utah
My commission expires 10-01-2001

IN WITNESS WHEREOF, the Secretary of Agriculture by the Regional Forester, Forest Service, has executed this Easement pursuant to delegations of authority specified in 7 CFR 2.60 and 36 CFR 251.52 on the day and year written above.

UNITED STATES OF AMERICA

Jeanne A. Evenden

JACK A. BLACKWELL
Regional Forester
Intermountain Region
Forest Service, Department of Agriculture

ACKNOWLEDGMENT

STATE OF Utah)
)ss
COUNTY OF Weber)

On this 30th day of July, 2001, before me, Lori Blickfeldt, a Notary Public in and for Weber County, personally appeared before me **JEANNE A. EVENDEN**, Director of Lands, Intermountain Region, Forest Service, U.S. Department of Agriculture, the signer of the within instrument, who acknowledged to me that she executed the foregoing instrument acting for and on behalf of **JACK A. BLACKWELL**, Regional Forester, by duly delegated authority.

LORI BLICKFELDT
NOTARY PUBLIC • STATE of UTAH
324 25TH ST
OGDEN, UT 84401
COMM. EXP. 11-30-2003

Lori Blickfeldt

Notary Public for the State of Utah
Residing in South Weber, UT
My commission expires November 30, 2003

According to the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0596-0082.

This information is needed by the Forest Service to evaluate requests to use National Forest System lands and manage those lands to protect natural resources, administer the use, and ensure public health and safety. This information is required to obtain or retain a benefit. The authority for that requirement is provided by the Organic Act of 1897 and the Federal Land Policy and Management Act of 1976, which authorize the Secretary of Agriculture to promulgate rules and regulations for authorizing and managing National Forest System lands. These statutes, along with the Term Permit Act, National Forest Ski Area Permit Act, Granger-Thye Act, Mineral Leasing Act, Alaska Term Permit Act, Act of September 3, 1954, Wilderness Act, National Forest Roads and Trails Act, Act of November 16, 1973, Archeological Resources Protection Act, and Alaska National Interest Lands Conservation Act, authorize the Secretary of Agriculture to issue authorizations for the use and occupancy of National Forest System lands. The Secretary of Agriculture's regulations at 36 CFR Part 251, Subpart B, establish procedures for issuing those authorizations.

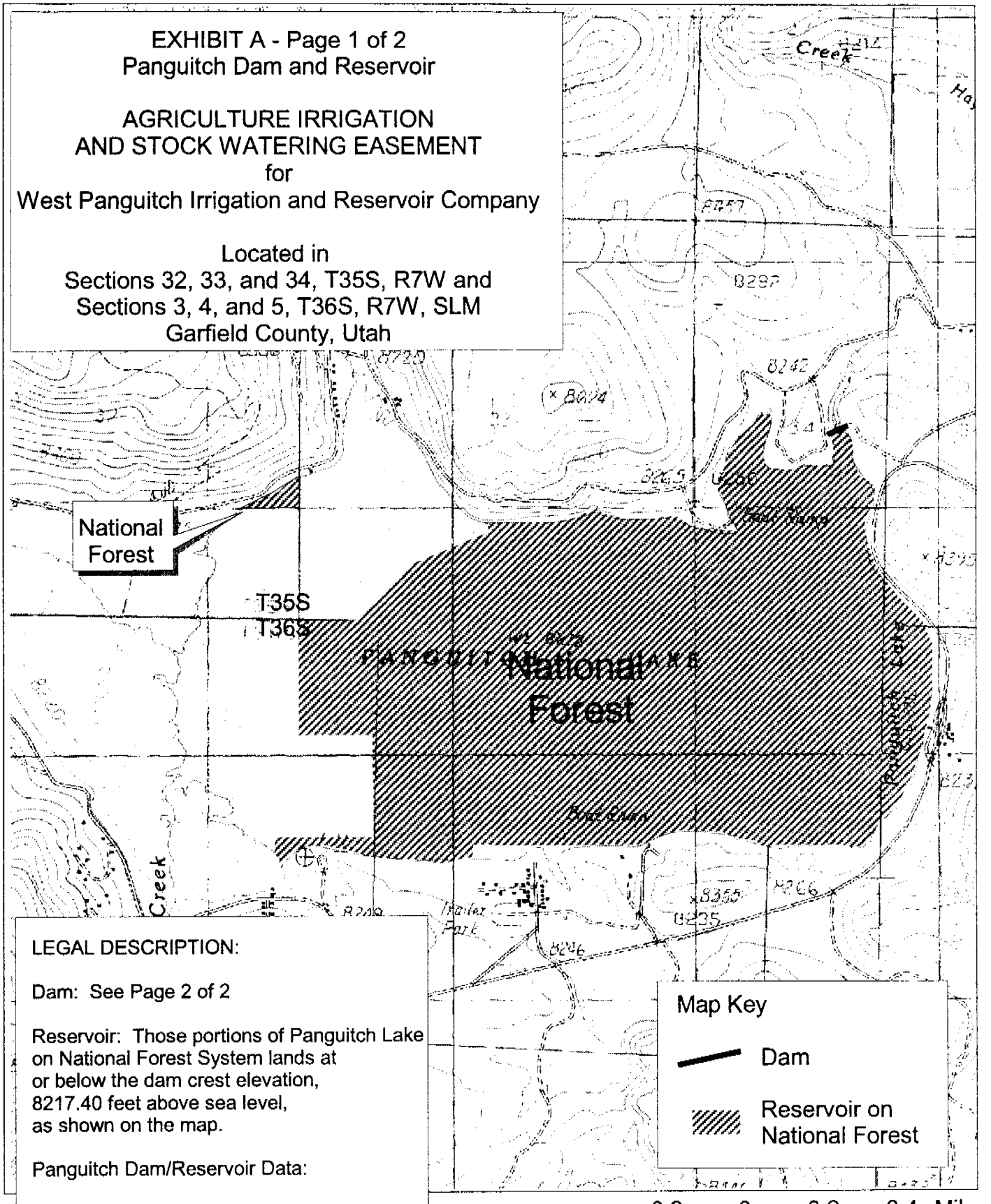
The Privacy Act of 1974 (5 U.S.C. 552a) and the Freedom of Information Act (5 U.S.C. 552) govern the confidentiality to be provided for information received by the Forest Service.

Public reporting burden for this collection of information, if requested, is estimated to average 1 hour per response for annual financial information; average 1 hour per response to prepare or update operation and or maintenance plan; average 1 hour per response for inspection reports; logs, facility and user information, sublease information, and other similar miscellaneous information requests. This includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

EXHIBIT A - Page 1 of 2
Panguitch Dam and Reservoir

AGRICULTURE IRRIGATION
AND STOCK WATERING EASEMENT
for
West Panguitch Irrigation and Reservoir Company

Located in
Sections 32, 33, and 34, T35S, R7W and
Sections 3, 4, and 5, T36S, R7W, SLM
Garfield County, Utah



LEGAL DESCRIPTION:

Dam: See Page 2 of 2

Reservoir: Those portions of Panguitch Lake on National Forest System lands at or below the dam crest elevation, 8217.40 feet above sea level, as shown on the map.

Panguitch Dam/Reservoir Data:

Spillway Elevation - 8217.40 feet
Dam Elevation - 8217.40 feet
Hazard Rating - High
Area - 780 acres more or less

USGS 7.5 Minute Quadrangles
Panguitch Lake and Haycock Mountain
Projection: UTM Zone 12
DATUM: NAD 83

B.Klarich
5-15-2001

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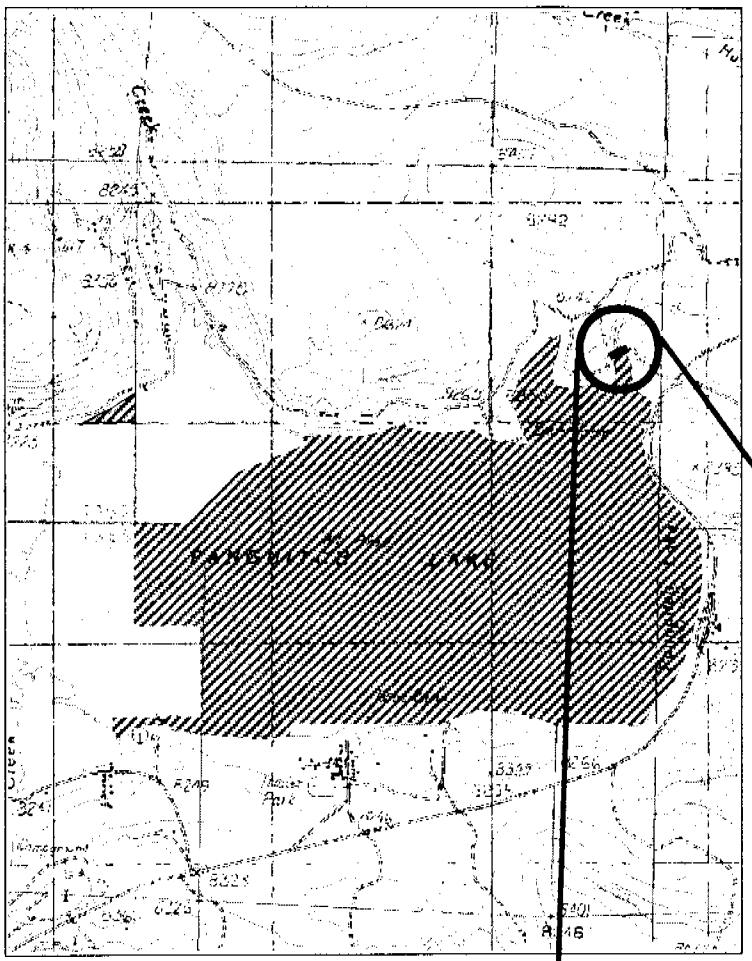
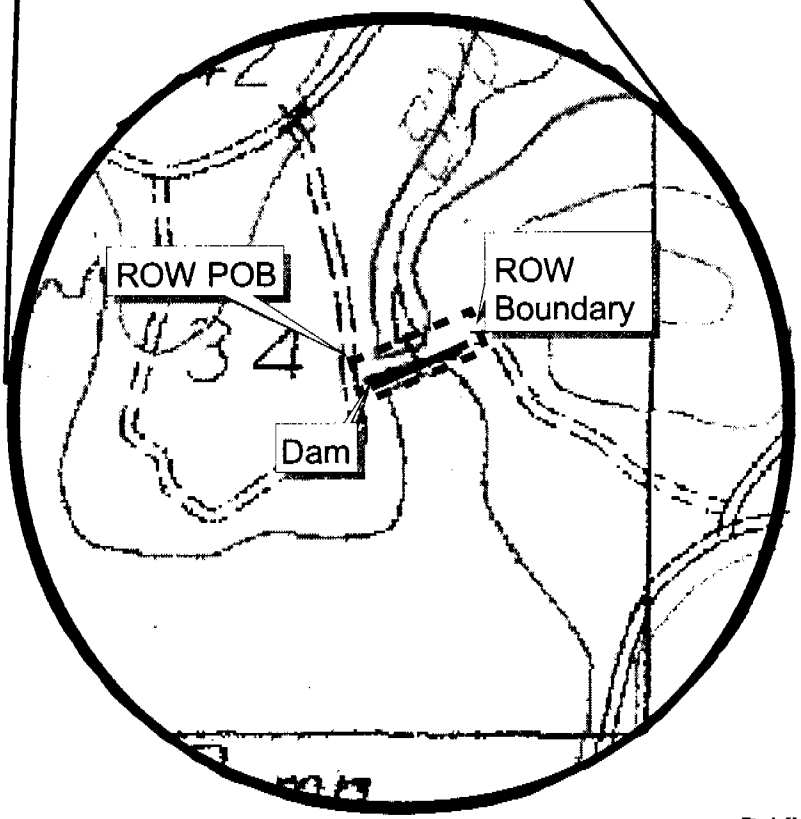
EXHIBIT A - Page 2 of 2
Panguitch Dam and Reservoir

for
West Panguitch Irrigation
and Reservoir Company

Located in
Sections 32, 33, and 34, T35S, R7W and
Sections 3, 4, and 5, T36S, R7W, SLM
Garfield County, Utah





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W E
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LEGAL DESCRIPTION:

Dam: The right-of-way for the dam is located southerly approximately 2830 feet and easterly approximately 1980 feet from the NW corner of Section 34; thence, northeasterly 310 feet; thence, southweasterly 200 feet; thence southwesterly 310 feet; thence, 200 feet northwesterly to the point of beginning.

Panguitch Dam/Reservoir Data:

Spillway Elevation - 8217.40 feet
Dam Elevation - 8217.40 feet
Hazard Rating - High
Area - 780 acres more or less

USGS 7.5 Minute Quadrangles
Panguitch Lake and Haycock Mountain
Projection: UTM Zone 12
DATUM: NAD 83

500 0 500 1000 Feet

B.Klarich
5-15-2001

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APPENDIX 2

Subsurface Investigation

Boring Logs

DRILL HOLE LOG

BORING NO. 24-01

SHEET 1 OF 1

PROJECT: PANGUITCH LAKE DAM CREST REPAIR
CLIENT: WEST PANGUITCH IRRIGATION & RESERVOIR COMPANY
LOCATION: STATION ~1+36, 6.2' DOWNSTREAM
DRILLING METHOD: 08-CME-55 / HWTCA TO 5', HQ3 CORE
DRILLER: T.K., J.H.
DEPTH TO WATER - INITIAL: ▽ 5.7' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 202404-002
DATE STARTED: 4/25/24
DATE COMPLETED: 4/25/24
GROUND ELEVATION:
LOGGED BY: M.N.H., J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
							BASALT COBBLES & BOULDERS (2024 ROCKFILL BERM -NOT SAMPLED)									
	5						MASONRY RUBBLE									
▽				47	Core 87,20	-	lt. gray		149.0	0.9						UC 10,960 psi
	10						ASH-FLOW TUFF fractured	1,000 ft/yr								
				59	Core 98,8	-	lt. gray		149.2	0.8						UC 7,470 psi
							BOTTOM OF HOLE									

DH_LOG_V8-2014-1 PANGUITCH_LAKE_CREST.GPJ US EVAL.GDT 5/22/24

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon
- Split Spoon Sample
- Core
- Thin-Walled Tube Sample
- 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value
- *T 0.45* ← Torvane (tsf)
- *PP 2.0* ← Pocket Penetrometer (tsf)
- Core 95,60 ← With Liners / Percent Recovery, R.Q.D.
- Pushed *T 0.45* ← Torvane (tsf)
- Pushed *PP 2.0* ← Pocket Penetrometer (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride, Soluble Salts
Hyd. = Hydrometer
DC = Dispersive Clay

DRILL HOLE LOG

BORING NO. 24-01A

SHEET 1 OF 1

PROJECT: PANGUITCH LAKE DAM CREST REPAIR

CLIENT: WEST PANGUITCH IRRIGATION & RESERVOIR COMPANY

LOCATION: STATION ~1+33, 6.0' DOWNSTREAM

DRILLING METHOD: 08-CME-55 / HQ3 CORE

DRILLER: T.K., J.H.

DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ 5.6'

PROJECT NUMBER: 202404-002

DATE STARTED: 4/25/24

DATE COMPLETED: 4/25/24

GROUND ELEVATION:

LOGGED BY: M.N.H., J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				31	Core *58,0*	-	lt. gray BASALT COBBLES & BOULDERS (2024 ROCKFILL BERM)								
	5						MASONRY								
				56	Core *94,8*	-	lt. gray ASH-FLOW TUFF								
	10						BOTTOM OF HOLE								

DH_LOG_V8-2014-1 PANGUITCH_LAKE_CREST.GPJ US EVAL.GDT 5/22/24

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon
- Split Spoon Sample
- Core
- Thin-Walled Tube Sample

2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value
T 0.45 ← Torvane (tsf)
PP 2.0 ← Pocket Penetrometer (tsf)
Core 95,60 ← Percent Recovery, R.Q.D.
Pushed *T 0.45* ← Torvane (tsf)
PP 2.0 ← Pocket Penetrometer (tsf)
* With Liners

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride, Soluble Salts
Hyd. = Hydrometer
DC = Dispersive Clay

DRILL HOLE LOG

BORING NO. 24-02

SHEET 1 OF 1

PROJECT: PANGUITCH LAKE DAM CREST REPAIR

CLIENT: WEST PANGUITCH IRRIGATION & RESERVOIR COMPANY

LOCATION: STATION ~1+04, 6.1' DOWNSTREAM

DRILLING METHOD: 08-CME-55 / HWTCA TO 5.5', HQ3 CORE

DRILLER: T.K., J.H.

DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 202404-002

DATE STARTED: 4/24/24

DATE COMPLETED: 4/24/24

GROUND ELEVATION:

LOGGED BY: M.N.H., J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Permeability (ft/yr)	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
	5						BASALT COBBLES & BOULDERS (2024 ROCKFILL BERM -NOT SAMPLED)									
				43	Core 89,29	-			109.3	2.6						UC 1,920 psi
	10						MASONRY RUBBLE		97.9	2.1						UC 1,630 psi
				40	Core 66,16	-		22,000 ft/yr								
	15					-										
				50	Core 84,30	-	lt. gray		142.7	1.1						UC 5,260 psi
	20							740 ft/yr 4,700 ft/yr								
				61	Core 102,79	-	lt. gray		150.7	1.0						UC 11,620 psi
	25						ASH-FLOW TUFF fractured									
				60	Core 100,42	-	lt. gray									
	30							280 ft/yr								
				60	Core 100,44	-	lt. gray									
	35						BOTTOM OF HOLE									

DH_LOG_V8-2014-1 PANGUITCH_LAKE_CREST.GPJ US EVAL.GDT 5/22/24

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon
- Split Spoon Sample
- Core
- Thin-Walled Tube Sample

* 2,3,2,(6) ← Blow Count per 6"
$(N_1)_{60}$ Value
T 0.45 ← Torvane (tsf)
PP 2.0 ← Pocket Penetrometer (tsf)
Core 95,60 ← With Liners, Percent Recovery, R.Q.D.
Pushed *T 0.45* ← Torvane (tsf)
PP 2.0 ← Pocket Penetrometer (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride, Soluble Salts
Hyd. = Hydrometer
DC = Dispersive Clay

DRILL HOLE LOG

BORING NO. 24-03

PROJECT: PANGUITCH LAKE DAM CREST REPAIR

SHEET 1 OF 1

CLIENT: WEST PANGUITCH IRRIGATION & RESERVOIR COMPANY

PROJECT NUMBER: 202404-002

LOCATION: STATION ~1+45, 6.3' DOWNSTREAM

DATE STARTED: 4/26/24

DRILLING METHOD: 08-CME-55 / HQ3 CORE

DATE COMPLETED: 4/26/24

DRILLER: T.K., J.H.

GROUND ELEVATION:

DEPTH TO WATER - INITIAL: ▽ 5.6'

AFTER 24 HOURS: ▼ N.M.

LOGGED BY: M.N.H., J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				29	Core 53,0	-	BASALT COBBLES & BOULDERS (2024 ROCKFILL BERM)								
	5					-									
▽						-	MASONRY RUBBLE								
				60	Core 100,35	-	lt. gray ASH-FLOW TUFF fractured	151.0	2.0						UC 9,430 psi
							BOTTOM OF HOLE								
	10														

DH_LOG_V8-2014-1 PANGUITCH_LAKE_CREST.GPJ US EVAL.GDT 5/22/24

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon
- Split Spoon Sample
- Core
- Thin-Walled Tube Sample

2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value
T 0.45 ← Torvane (tsf)
PP 2.0 ← Pocket Penetrometer (tsf)
Core 95,60 ← With Liners / Percent Recovery, R.Q.D.
Pushed *T 0.45* ← Torvane (tsf)
PP 2.0 ← Pocket Penetrometer (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride, Soluble Salts
Hyd. = Hydrometer
DC = Dispersive Clay

DRILL HOLE LOG

BORING NO. 24-04

PROJECT: PANGUITCH LAKE DAM CREST REPAIR

SHEET 1 OF 1

CLIENT: WEST PANGUITCH IRRIGATION & RESERVOIR COMPANY

PROJECT NUMBER: 202404-002

LOCATION: STATION ~1+79

DATE STARTED: 4/26/24

DRILLING METHOD: 08-CME-55 / HQ3 CORE

DATE COMPLETED: 4/26/24

DRILLER: T.K., J.H.

GROUND ELEVATION:

DEPTH TO WATER - INITIAL: ▽ 4.5' **AFTER 24 HOURS:** ▼ N.M.

LOGGED BY: M.N.H., J.B.

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
			Core	52	Core 88,65		MASONRY (MORTAR, COBBLES & BOULDERS)	118.7	9.8						UC 3,980 psi
	5		Core	59	Core 98,44		ASH-FLOW TUFF fractured								
	10						BOTTOM OF HOLE								

DH_LOG_V8-2014-1 PANGUITCH_LAKE_CREST.GPJ US EVAL.GDT 5/22/24

RB&G ENGINEERING, INC.

LEGEND:

- 2" OD Split Spoon (SPT)
- 2.5" OD Split Spoon
- 3" OD Split Spoon
- Split Spoon Sample
- Core
- Thin-Walled Tube Sample
- 2,3,2,(6) ← Blow Count per 6" ($(N_1)_{60}$ Value)
- *T 0.45* ← Torvane (tsf)
- *PP 2.0* ← Pocket Penetrometer (tsf)
- Core 95,60 ← Percent Recovery, R.Q.D.
- Pushed *T 0.45* ← Torvane (tsf)
- Pushed *PP 2.0* ← Pocket Penetrometer (tsf)
- * With Liners

OTHER TESTS

UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
UU = Unconsolidated, Undrained
CU = Consolidated, Undrained
Chem. = pH, Resistivity, Sulfate, Chloride, Soluble Salts
Hyd. = Hydrometer
DC = Dispersive Clay

Core Photos

RB&G ENGINEERING, INC.

Figure CORE PHOTO SHEET - BORING 24-01

Panguitch Lake Dam Crest Repair

Garfield County, Utah

RB&G ENGINEERING, INC.

Figure CORE PHOTO SHEET - BORING 24-01A

Panguitch Lake Dam Crest Repair

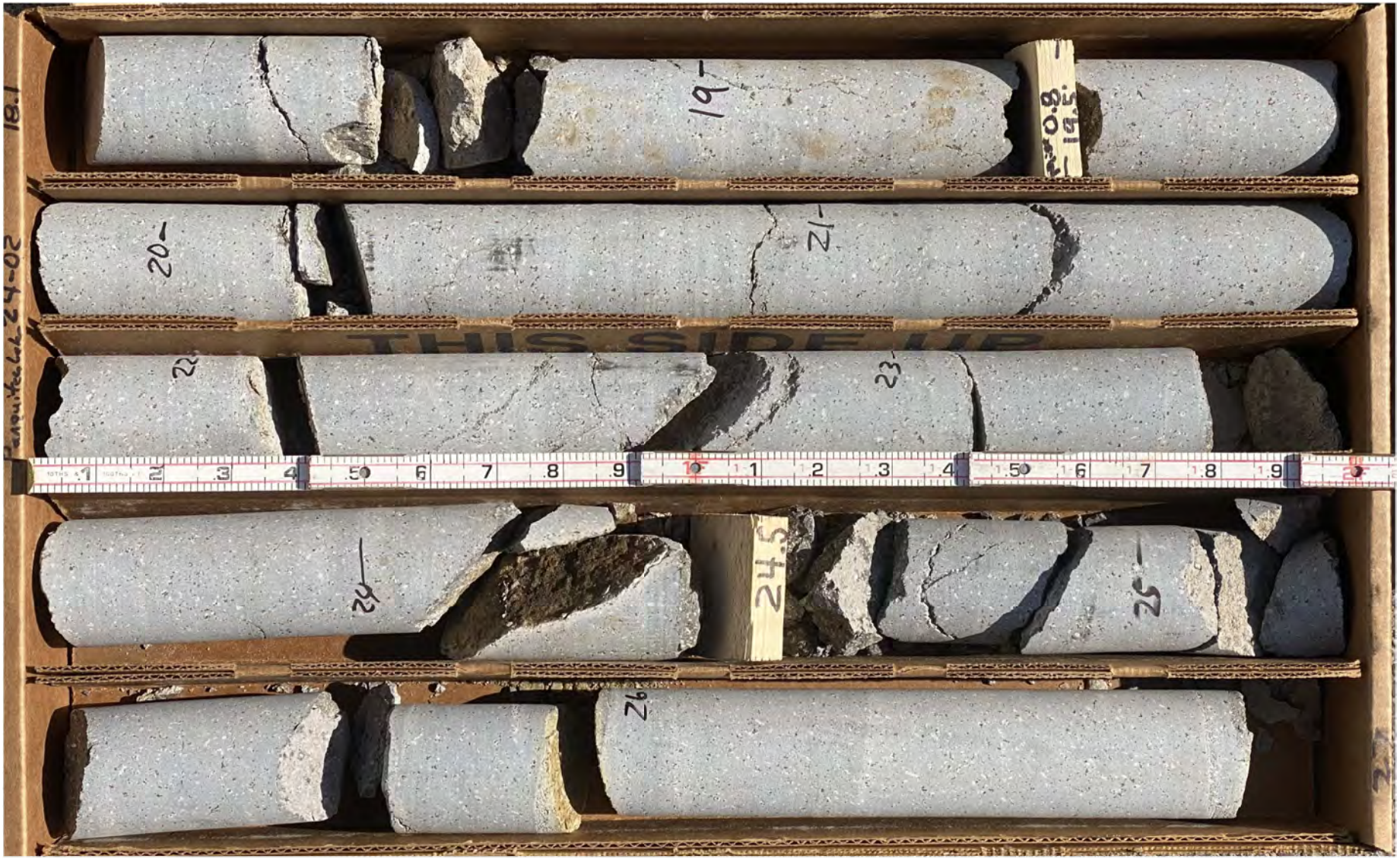
Garfield County, Utah

RB&G ENGINEERING, INC.

Figure CORE PHOTO SHEET - BORING 24-02, SHEET 1 OF 3

Panguitch Lake Dam Crest Repair

Garfield County, Utah

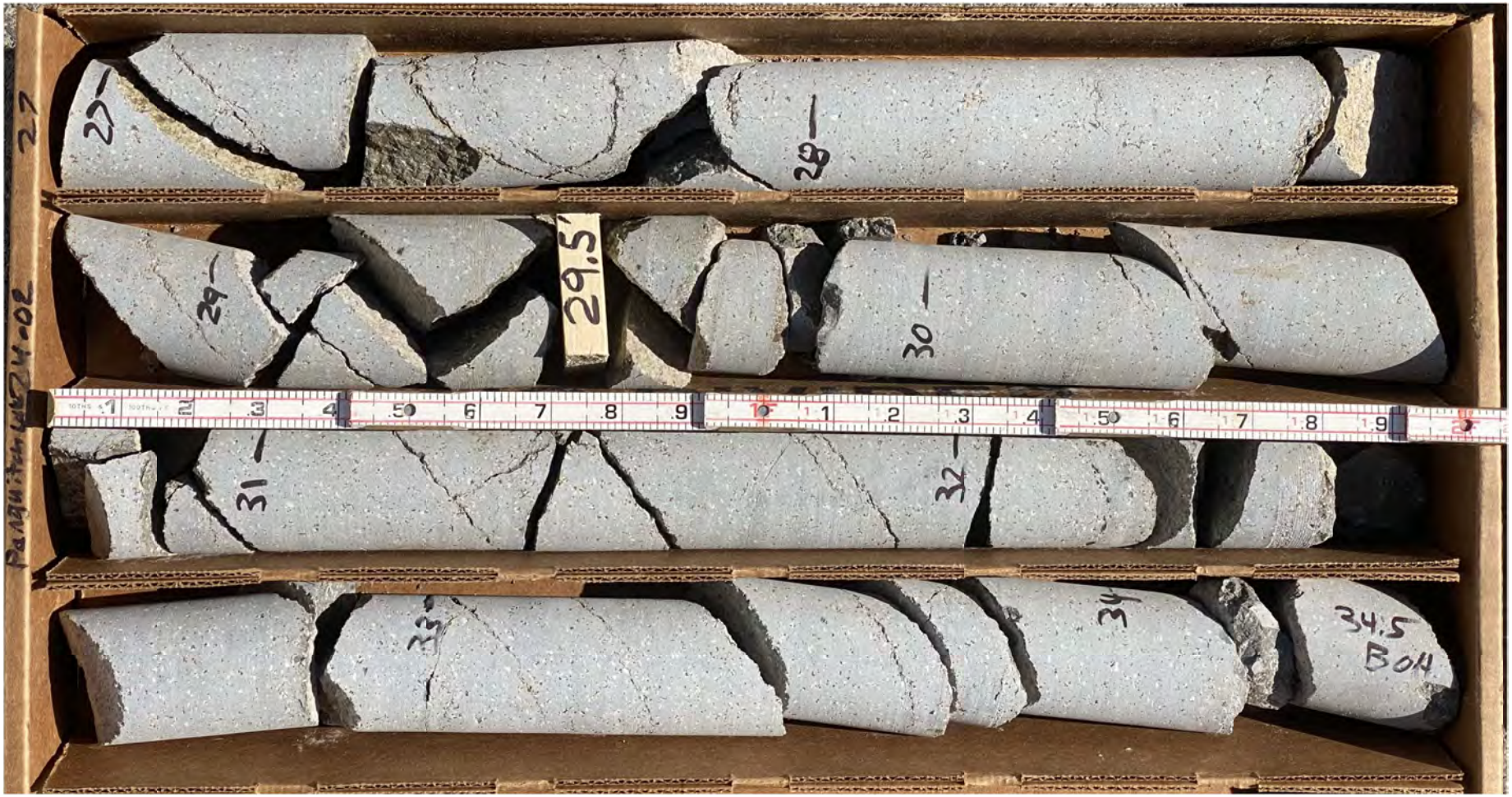


RB&G ENGINEERING, INC.

Figure CORE PHOTO SHEET - BORING 24-02, SHEET 2 OF 3

Panguitch Lake Dam Crest Repair

Garfield County, Utah



RB&G ENGINEERING, INC.

Figure CORE PHOTO SHEET - BORING 24-02, SHEET 3 OF 3

Panguitch Lake Dam Crest Repair

Garfield County, Utah

RB&G ENGINEERING, INC.

Figure CORE PHOTO SHEET - BORING 24-03

Panguitch Lake Dam Crest Repair

Garfield County, Utah

RB&G ENGINEERING, INC.

Figure CORE PHOTO SHEET - BORING 24-04

Panguitch Lake Dam Crest Repair

Garfield County, Utah

Laboratory Testing

RB&G ENGINEERING, INC.

Table 1

SUMMARY OF TEST DATA

PROJECT LOCATION: Panguitch Lake Dam Crest Repair — see site plan

PROJECT NO.: 202404-002

FEATURE: Foundations

HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	IN-PLACE		UNCONFINED OR UU TRIAXIAL COMPRESSIVE STRENGTH (psi)	ATTERBERG LIMITS			MECHANICAL ANALYSIS			PERCENT FINER THAN 0.005 mm	UNIFIED SOIL CLASSIFICATION SYSTEM / (AASHTO CLASSIFICATION)
		DRY UNIT WEIGHT (pcf)	MOISTURE (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY		
24-01	7-7.5	149.0	0.9	10,960								
	11-11.5	149.2	0.8	7,470								
24-02	9-9.5	109.3	2.6	1,920								
	10.5-11	97.9	2.1	1,630								
	17-18	142.7	1.1	5,260								
	21-22	150.7	1.0	11,620								
24-03	6.5-7	151.0	2.0	9,430								
24-04	1.5-2	118.7	9.8	3,980								

NP=Non-Plastic

APPENDIX 3

Conceptual Design

Drawings

APPROXIMATE AREA FOR DAM AS PER DITCH BILL EASEMENT (310 FT x 200 FT)

APPROXIMATE WORK, ACCESS, STOCKPILE AND STAGING AREA

APPROXIMATE FOOTPRINT OF COFFERDAM

APPROXIMATE AREA FOR RESERVOIR AS PER DITCH BILL EASEMENT (DAM CREST ELEVATION)

0 20 40 60 80
SCALE IN FEET

NO	AUTHORIZED BY	REVISION	MADE BY	DATE
6				
5				
4				
3				
2				
1				

DESIGNED BY B. HORROCKS
DRAWN BY B. GOLDING
CHECKED BY B. HORROCKS
PROJECT NO. 202404.002
DATE 3-JUL-2024

R B&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601
801 374-5771 PROVO

PANGUITCH LAKE DAM
GARFIELD COUNTY, UTAH

PROJECT SITE PLAN
OPTIONS 1, 3, AND 4

SEAL

DRAWING NO.
G100a

SHEET ___ OF X

3-JUL-2024
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3-JUL-2024
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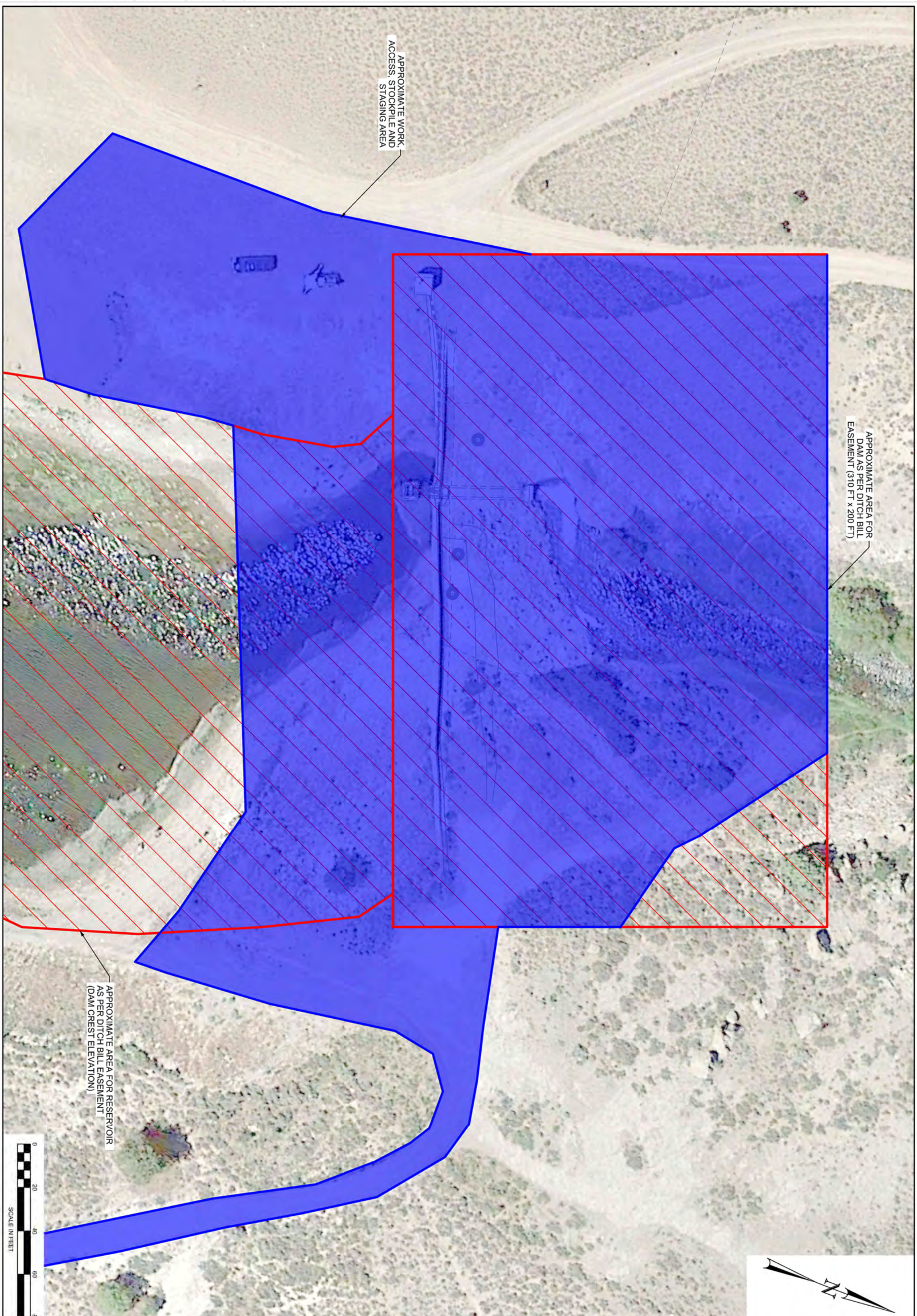


SHEET ___ OF X

DRAWING NO. G100b

SEAL

PANGUITCH LAKE DAM
GARFIELD COUNTY, UTAH

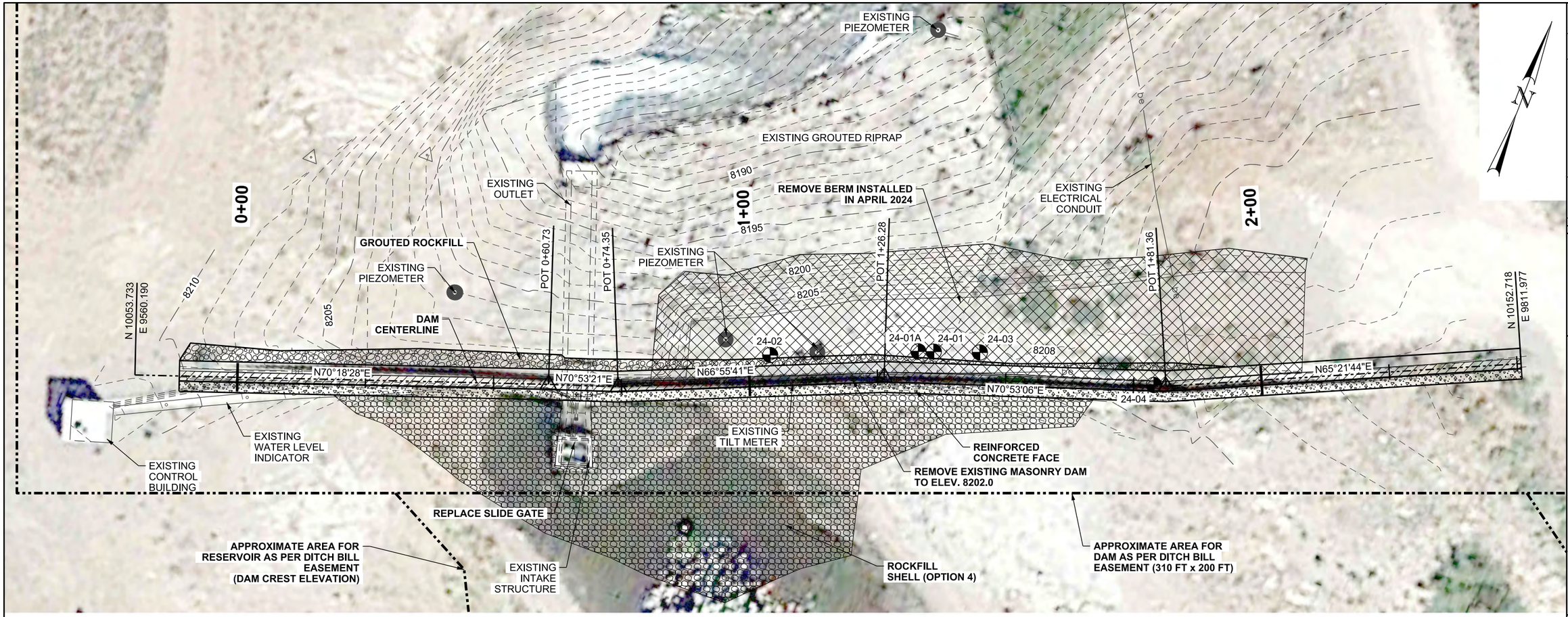
PROJECT SITE PLAN
OPTION 2

RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601
801 374-5771 PROVO

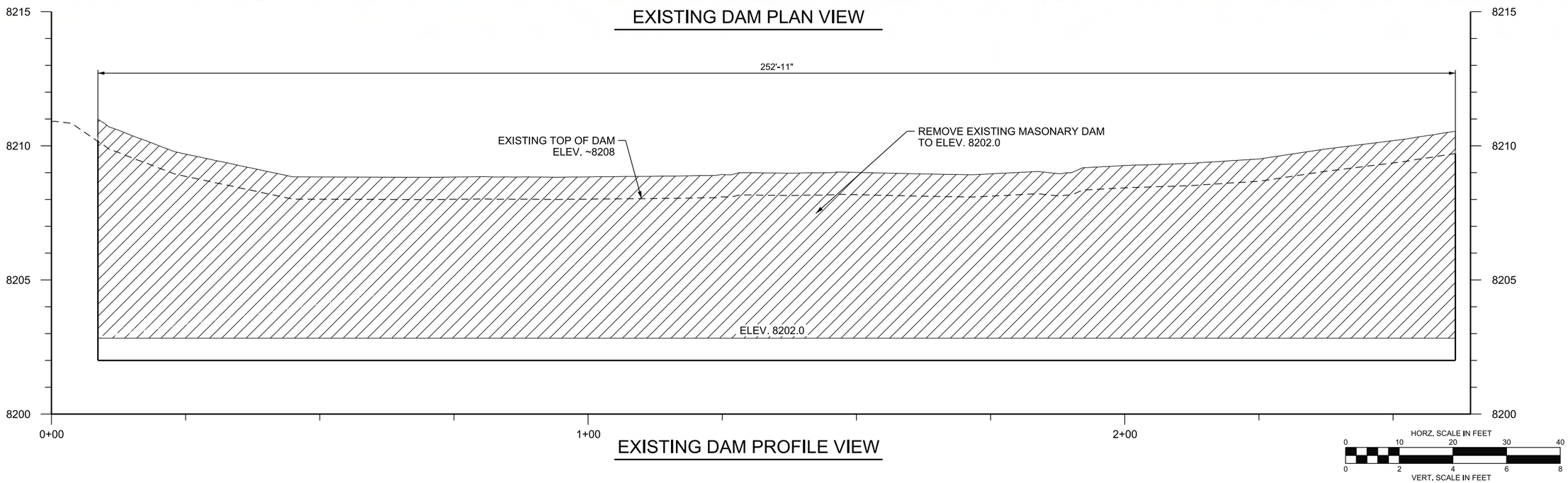
DESIGNED BY	B. HORROCKS
DRAWN BY	[redacted]
CHECKED BY	B. HORROCKS
PROJECT NO.	202404-002
DATE	3-JUL-2024

NO.	AUTHORIZED BY	REVISION	MADE BY	DATE
6				
5				
4				
3				
2				
1				

EXISTING DAM PLAN VIEW



EXISTING DAM PROFILE VIEW



NO.	REVISION	MADE BY	DATE

AUTHORIZED BY

DESIGNED BY B. HORROCKS
DRAWN BY J.S./BBY
CHECKED BY B. HORROCKS
PROJECT NO. 2024254202
DATE 3-JUL-2024

RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601
801 374-5771 PROVO

PANGUITCH LAKE DAM
GARFIELD COUNTY, UTAH

DAM PLAN AND PROFILE OPTION 1, 3 AND 4

SEAL

DRAWING NO. **S101a**

SHEET ___ OF X

3-JUL-2024
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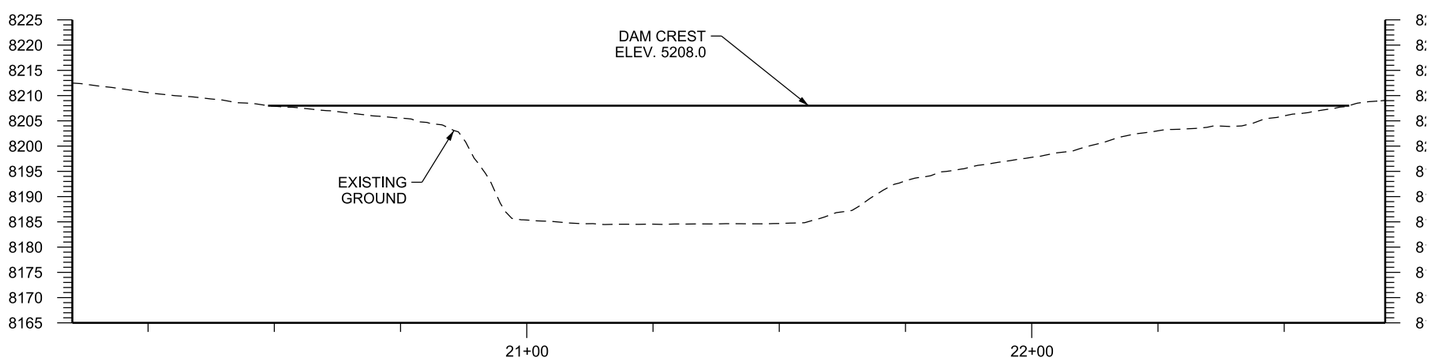
20+00
21+00
22+00
APPROXIMATE AREA FOR DAM AS PER DITCH BILL EASEMENT (310 FT x 200 FT)
N 10128.589
E 9539.479
DAM CENTERLINE
12'-0"
ROLLER COMPACTED CONCRETE
N69°29'31"E
N 10230.619
E 9812.253
REINFORCED CONCRETE
OUTLET WORKS
EXISTING PIEZOMETER
EXISTING OUTLET
8190
EXISTING GROUTED RIPRAP
EXISTING ELECTRICAL CONDUIT
APPROXIMATE AREA FOR DAM AS PER DITCH BILL EASEMENT (310 FT x 200 FT)
EXISTING PIEZOMETER
EXISTING PIEZOMETER
24-02
24-01A
24-01
24-03
8208
24-04
EXISTING CONTROL BUILDING
EXISTING WATER LEVEL INDICATOR
EXISTING TILT METER
EXISTING MASONARY DAM
APPROXIMATE AREA FOR RESERVOIR AS PER DITCH BILL EASEMENT (DAM CREST ELEVATION)
EXISTING INTAKE STRUCTURE

DAM PLAN VIEW



DAM PROFILE VIEW

0 15 30 45 60
SCALE IN FEET

NO.	REVISION	DATE
		MADE BY
		AUTHORIZED BY

DESIGNED BY B. HORROCKS
DRAWN BY J. RUBY
CHECKED BY B. HORROCKS
PROJECT NO. 2024-0402
DATE 3-JUL-2024

RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601
801 374-5771 PROVO

PANGUITCH LAKE DAM
GARFIELD COUNTY, UTAH

DAM PLAN AND PROFILE OPTION 2

SEAL

DRAWING NO.
S101b

SHEET ____ OF X

3-JUL-2024
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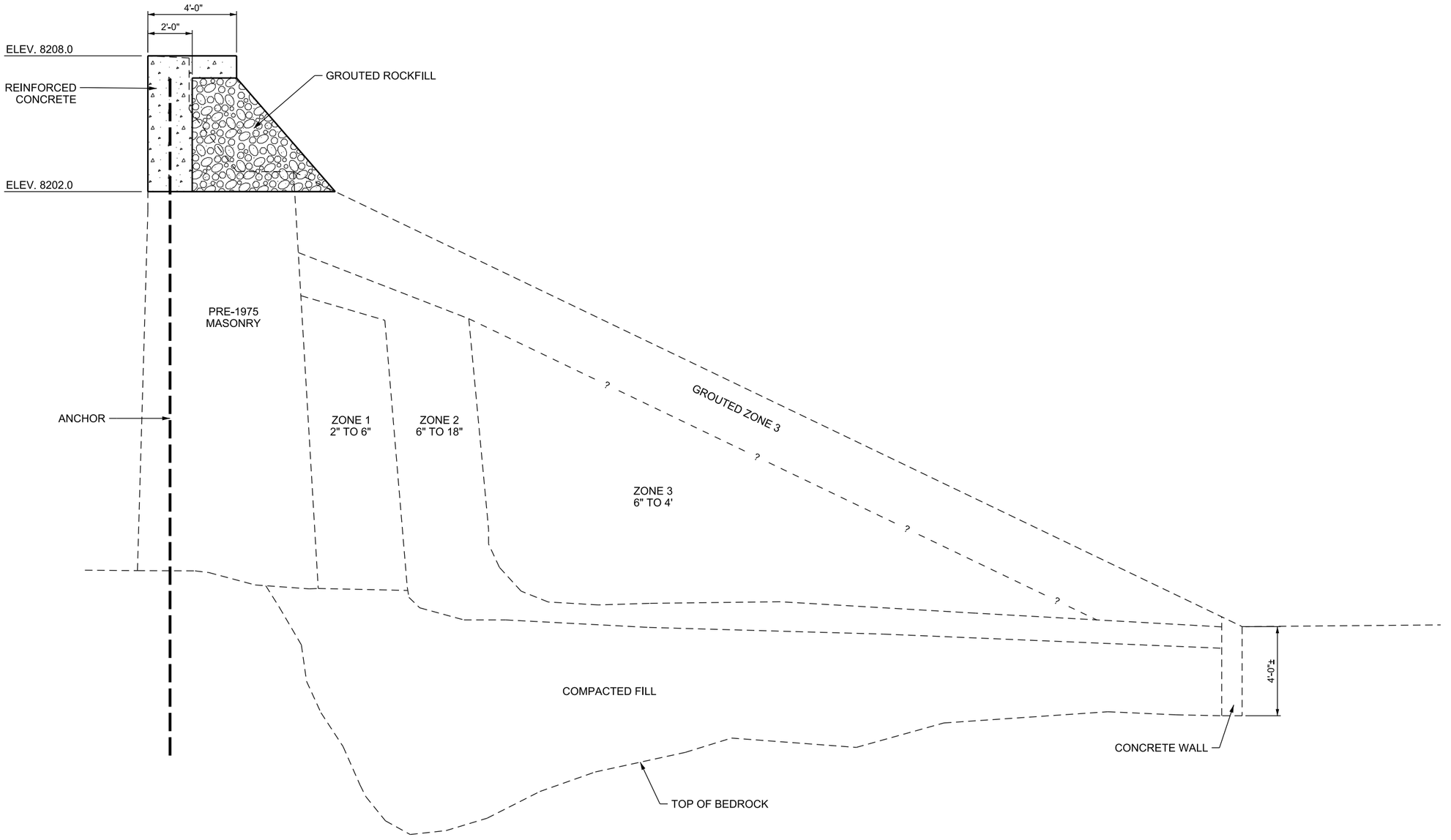

NOTE:
EXISTING CONDITIONS FROM 1975 DRAWINGS.

NO.	AUTHORIZED BY	REVISION	MADE BY	DATE

DESIGNED BY B. HORROCKS
DRAWN BY J. RUBY
CHECKED BY B. HORROCKS
PROJECT NO. 202404002
DATE 3-JUL-2024

RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601
801 374-5771 PROVO

PANGUITCH LAKE DAM
GARFIELD COUNTY, UTAH

DAM REPAIR SECTION
OPTION 1

SEAL

DRAWING NO.
S201a

SHEET ___ OF X

3-JUL-2024
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3-JUL-2024
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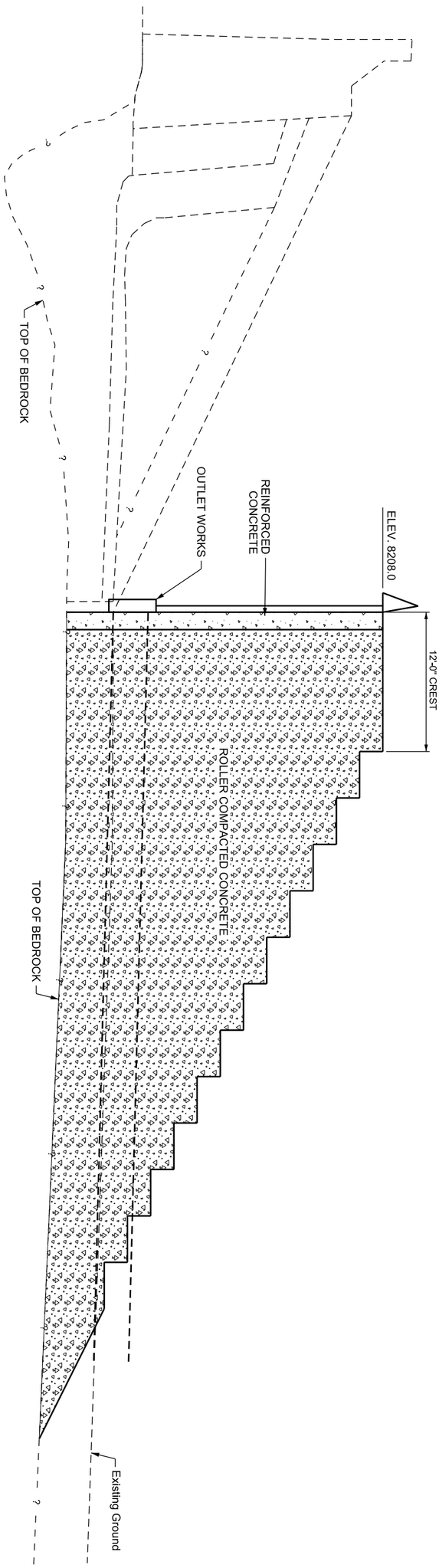

SHEET ___ OF _X_

DRAWING NO. **S201b**

SEAL

PANGUITCH LAKE DAM
GARFIELD COUNTY, UTAH

DAM REPAIR SECTION
OPTION 2

RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601
801 374-5771 PROVO

DESIGNED BY B. HORROCKS
DRAWN BY B. HORROCKS
CHECKED BY B. HORROCKS
PROJECT NO. 202404-002
DATE 3-JUL-2024

NO.	AUTHORIZED BY	REVISION	MADE BY	DATE
1				
2				
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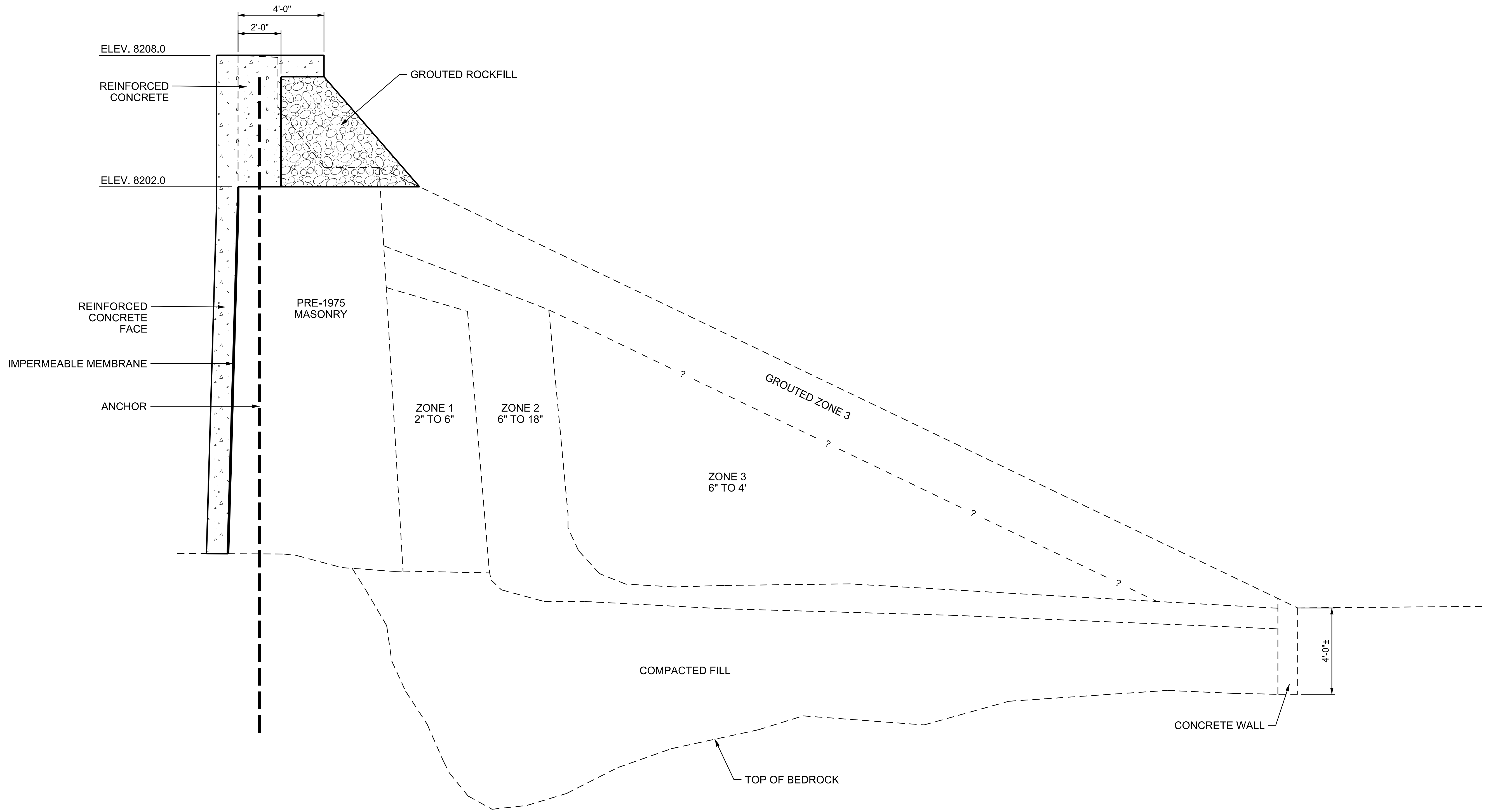
4				
5				



NOTE:
EXISTING CONDITIONS FROM 1975 DRAWINGS.

NO.	AUTHORIZED BY	REVISION	MADE BY	DATE
6				
5				
4				
3				
2				
1				

DESIGNED BY [illegible]
DRAWN BY [illegible]
CHECKED BY B. HORROCKS
PROJECT NO. 202404-002
DATE 3-JUL-2024

RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601
801 374-5771 PROVO

PANGUITCH LAKE DAM
GARFIELD COUNTY, UTAH

DAM REPAIR SECTION
OPTION 3

SEAL

DRAWING NO.
S201c

SHEET ____ OF X

3-JUL-2024
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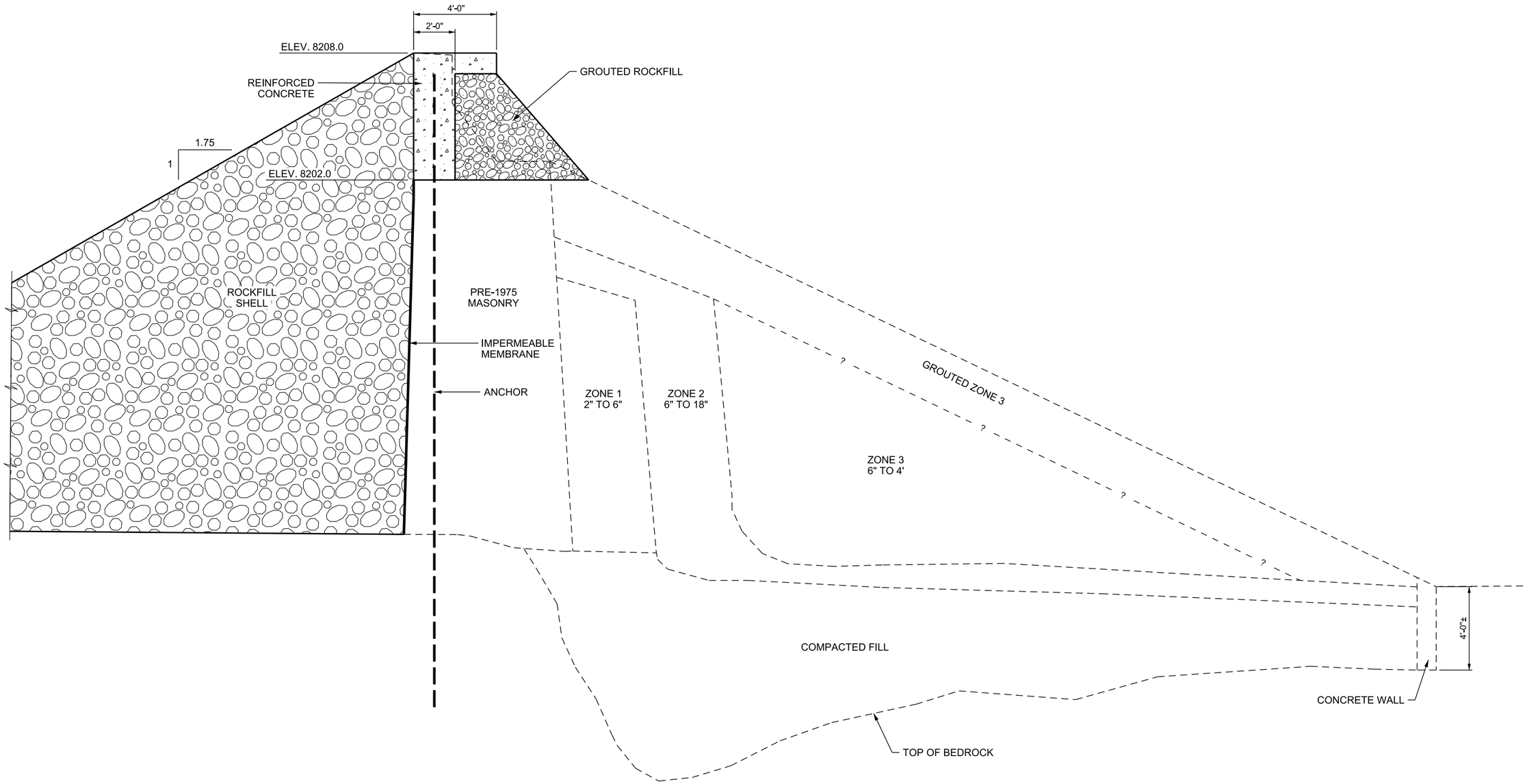

NOTE:
EXISTING CONDITIONS FROM 1975 DRAWINGS.

NO.	AUTHORIZED BY	REVISION	MADE BY	DATE

DESIGNED BY B. HARDCASTLE
DRAWN BY B. HARDCASTLE
CHECKED BY B. HARDCASTLE
PROJECT NO. 202404002
DATE 3-JUL-2024

RB&G ENGINEERING, INC.
1435 WEST 820 NORTH
PROVO, UTAH 84601
801 374-5771 PROVO

PANGUITCH LAKE DAM
GARFIELD COUNTY, UTAH

DAM REPAIR SECTION
OPTION 4

SEAL

DRAWING NO.
S201d

SHEET ___ OF X

3-JUL-2024
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Opinions of Probable Cost

Panguitch Lake Dam

Conceptual Opinions of Probable Cost
6/28/24, BDH

Option 1: 4-ft wide dam crest

Dam Length:	250 ft					
Demolition:	19.5 ft^3/ft	=>	181 yd^3 @	$250	/yd^3 =	$46,000
Reinforced Concrete:	14 ft^3/ft	=>	130 yd^3 @	$1,000	/yd^3 =	$130,000
Grouted Rockfill:	20 ft3/ft	=>	185 yd^3 @	$300	/yd^3 =	$56,000
Anchors (10-ft spacing)			25 anchors @	$2,500	/ea =	$63,000
					subtotal:	$295,000
					mob/demob (~10%):	$30,000
					contigency (~30%):	$98,000
					Est. Total:	**$423,000**

Option 2: Reconstruct Dam

Dam Length:	250 ft					
Assumed Avg. Height:	20 ft					
U/S Reinforced Concrete:	1.5 ft thick	=>	278 yd^3 @	$1,000	/yd^3 =	$278,000
Avg. RCC Width:	32 ft	=>	5926 yd^3 @	$300	/yd^3 =	$1,778,000
Outlet Works				1	lump sum	$500,000
					subtotal:	$2,556,000
					mob/demob (~10%):	$256,000
					contigency (~30%):	$844,000
					design and construction engineering (~15%):	$549,000
					Est. Total:	**$4,205,000**

Option 3: 4-ft wide dam crest and u/s concrete face

Dam Length:	250 ft					
Demolition:	19.5 ft^3/ft	=>	181 yd^3 @	$250	/yd^3 =	$46,000
Reinforced Concrete (Crest):	14 ft^3/ft	=>	130 yd^3 @	$1,000	/yd^3 =	$130,000
Reinforced Concrete (U/S Face):	18 ft^3/ft	=>	167 yd^3 @	$1,500	/yd^3 =	$250,000
Grouted Rockfill:	20 ft3/ft	=>	185 yd^3 @	$300	/yd^3 =	$56,000
Anchors (10-ft spacing)			25 anchors @	$2,500	/ea =	$63,000
New Slide Gate				1	lump sum	$200,000
Install and Remove Cofferdam				1	lump sum	$50,000
					subtotal:	$795,000
					mob/demob (~10%):	$80,000
					contigency (~30%):	$263,000
					design and construction engineering (~15%):	$171,000
					Est. Total:	**$1,309,000**

Option 4: 4-ft wide dam crest and u/s rockfill shell

Dam Length:	250 ft					
Demolition:	19.5 ft^3/ft	=>	181 yd^3 @	$250	/yd^3 =	$46,000
Reinforced Concrete (Crest):	14 ft^3/ft	=>	130 yd^3 @	$1,000	/yd^3 =	$130,000
Upstream Membrane	18 ft^2/ft	=>	4500 ft^2 @	$10	/ft^2 =	$45,000
Rockfill	283.5 ft^3/ft	=>	2625 yd^3 @	$75	/yd^3 =	$197,000
Grouted Rockfill:	20 ft3/ft	=>	185 yd^3 @	$300	/yd^3 =	$56,000
Anchors (10-ft spacing)			25 anchors @	$2,500	/ea =	$63,000
Extend outlet with new gate						$300,000
Install and Remove Cofferdam						$50,000
					subtotal:	$887,000
					mob/demob (~10%):	$89,000
					contigency (~30%):	$293,000
					design and construction engineering (~15%):	$191,000
					Est. Total:	**$1,460,000**