Eklutna Fish & Wildlife Program

Eklutna Dam Spillway Modifications

Design Documentation Report

15% Design
Revision No. 0

April 2024

PLACEHOLDER FOR ENGINEER STAMP
Date:

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Distribution

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Revision Log

Revision No.	Date	Revision Description
0	April 18, 2024	15% Design – Initial Draft
1	April 25, 2024	15% Design – Final Draft

1.0 Introduction

1.1 Purpose

The purpose of this report is to present the design documentation associated with the development of the Spillway Modifications as part of the Eklutna Fish & Wildlife Program (Project). The design documentation report (DDR) summarizes the pertinent data, design criteria, and standards used as the basis for the 15% level of design of the Project. The DDR documents the data, criteria, and standards by engineering discipline, and provides information about the operation of the design components associated with the Project.

The information presented within this DDR will be updated throughout the design development process to reflect refinement of the Project components and facilities, and advancement of the design analysis and details.

1.2 Location

The Project site is located in Southcentral Alaska approximately 30 miles northeast of downtown Anchorage near the Native Village of Eklutna. The Project footprint spans lands owned and managed by the State of Alaska, Eklutna Inc., and the Bureau of Land Management, with the dam and proposed modification to the dam spillway occurring on land owned by the State of Alaska. As proposed, the Project involves modifying the spillway within Eklutna Dam by removing the uncontrolled ogee crest overflow structure and replacing it with a fixed wheel gate and hoist for allowing controlled spills from Eklutna Lake. The location of Eklutna Dam and its vicinity to other features of the overall project is presented in Figure 1-1.

1.3 Background and Objectives

As part of the Eklutna Fish & Wildlife Program, Chugach Electric Association, Matanuska Electric Association, and the Municipality of Anchorage, known collectively as the Owners of the Eklutna Hydroelectric Project (Owners) are studying various means of providing water to the Eklutna River to mitigate damages to, and enhance fish and wildlife impacted by development and continuing operation of the Project. During the consultation process with various stakeholders to the Project, requests were made to replace the existing overflow spillway at the dam with a fixed wheel gate because either (1) climate change may cause inflows to the reservoir to increase significantly, which may increase the likelihood of future spill events, and a fixed wheel gate will allow the Project Owners to better manage those future spill events, or (2) while modeling results show that the default channel maintenance flow regime will maintain spawning gravels in the wetted reach of the Eklutna River, future monitoring may show that a higher magnitude channel maintenance flow that exceeds the combined hydraulic capacity of the existing outlet gate and the Eklutna River Release Facility may be warranted. The purpose of this report is to document the design criteria and analyses performed for the engineering development of the spillway modifications to Eklutna Dam.

1.4 Report Organization

This DDR is a record of the design effort for the Project and specifically describes the details of the design process and work effort for the Dam Outlet Modifications. The DDR consists of a summary of the design elements, criteria, methods and approach, engineering calculations, and pertinent references. The major report sections and intended purpose are presented in Table 1-1.

Table 1-1. Major Report Sections and Purpose.

Section	Description	Purpose
1	Introduction and Background	Presents the Project background, purpose, location, authorization, objectives, feature scope, and the report organization.
2	General Description	Summarizes the basic design criteria that are used as the basis of design.
3	Existing Infrastructure	Summarizes the existing infrastructure related to the Project.
4	Project Infrastructure and Operation	Describes the proposed modifications for the Eklutna Dam spillway.
5	Structural Design	Includes information related to the structural design of the fixed wheel gate, guides, and stability of the dam.
6	Mechanical Design	Includes information related to the mechanical design of the gate hoist.
7	Electrical and Instrumentation / Control Design	Includes information related to the electrical design and instrumentation and controls associated with the spillway modifications.
8	References	Documents the references used in developing the design.

Section	Description	Purpose
Appendices		
A	15% Design Drawings	Presents the 15% design drawings for the Eklutna Dam Spillway Modifications
B	Class 4 OPCC	Presents the Class 4 Opinion of Probable Construction Costs for the Eklutna Dam Spillway Modifications.

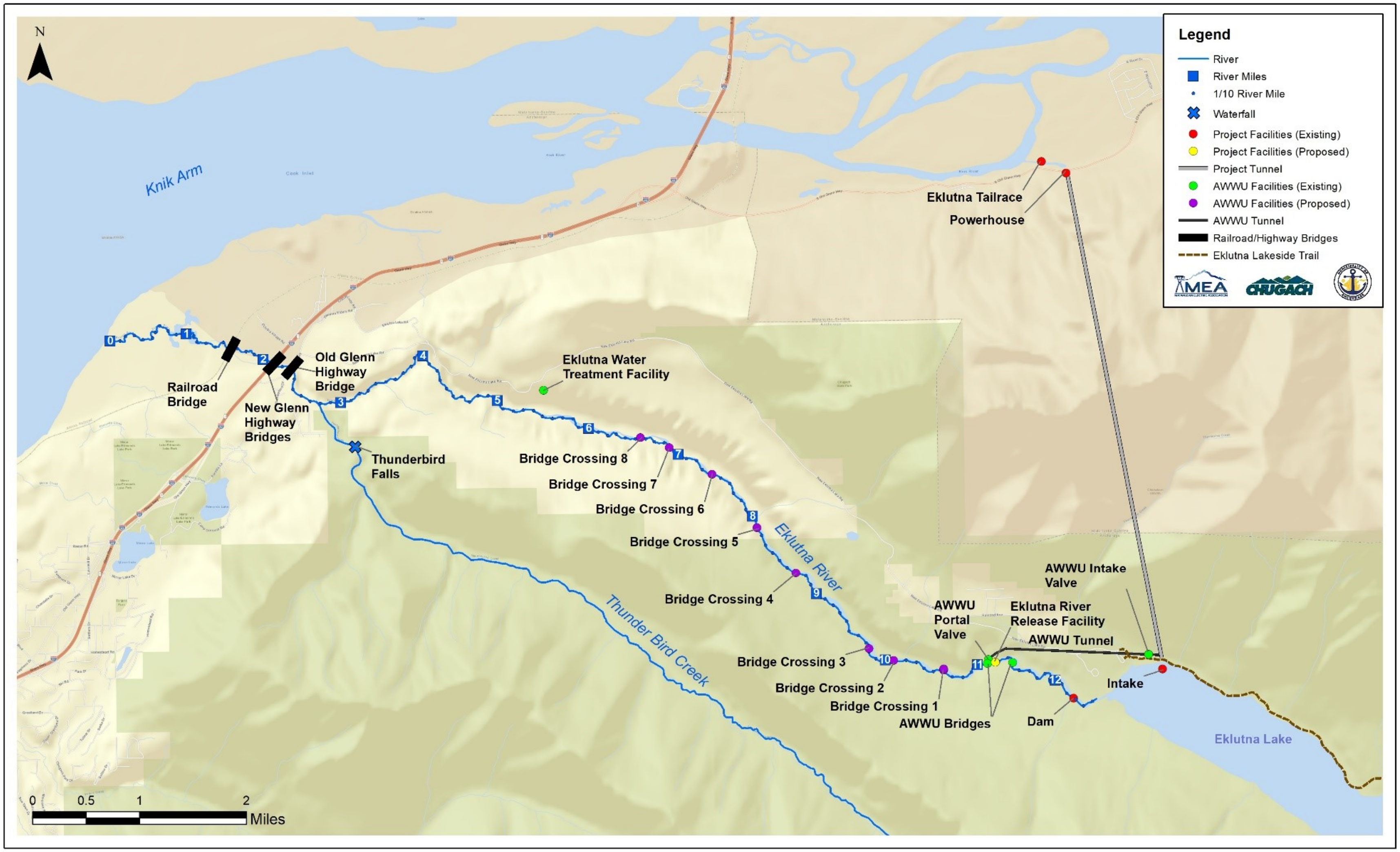

Figure 1-1. Project Overview.

2.0 General Description

2.1 General Design Criteria and Standards

General design criteria and standards for the Project include the abbreviations, survey datum, topographic mapping, references, and design standards as described below.

2.1.1 Standard List of Terms and Abbreviations

AACE	Association for Advancement of Cost Engineering
AC	alternating current
ACI	American Concrete Institute
AF	acre-ft
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASTM	American Society of Testing and Materials
AWWA	American Water Works Association
AWWU	Anchorage Water and Wastewater Utility
BMP	Best Management Practice
CADD	computer aided design and drafting
CEA	Chugach Electric Association
cfm	cubic feet per minute
cfs	cubic feet per second
DC	direct current
DDR	Design Documentation Report
ERRV	Eklutna River Release Valve
El.	elevation
fps	feet per second
ft	feet
HDC	Hydraulic Design Criteria
HEC	Hydrologic Engineering Center
HMI	human-machine interface
HPU	hydraulic power unit

HVAC	heating, ventilation, and air conditioning
Hz	hertz
IESNA	Illuminating Engineering Society of North America
I/O	Input/Output
IBC	International Building Code
IEEE	Institute of Electrical and Electronics Engineers
LED	light-emitting diode
LiDAR	Light Detection and Ranging
MEA	Matanuska Electric Association
MGD	million gallons per day
MOA	Municipality of Anchorage
MSL	Mean Sea Level
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NGVD29	National Geodetic Vertical Datum of 1929
NVE	Native Village of Eklutna
O&M	operation and maintenance
pcf	pounds per cubic foot
PLC	programmable logic controller
psi	pounds per square-inch
RTD	Resistance Temperature Detector
SCADA	Supervisory Control and Data Acquisition
UL	Underwriters Laboratories
UPS	uninterruptible power supply
USGS	U.S. Geological Survey
V	volt

2.2 Survey Datum

Multiple vertical survey datums are reported in and around the main features of the Project. The following datums are identified within the Project area:

1. The MOA conducted LiDAR survey flights over the Project Area between May 12-30, 2015. The vertical datum this data is presented in is NGVD 1929 – M.O.A. 1972 Adjustment (MOA72).

2. McMillen contracted NV5 Geospatial to conduct LiDAR survey flights over the Project Area on May 28, 2020 and on May 18, 2022. The vertical datum this data is presented in is NAVD88, GEOID12B.

3. The As-Built Drawings for the dam and spillway are used for the reservoir modeling and hydraulic analysis. The drawings are titled “Eklutna Project – Alaska; Rehabilitation Pressure Tunnel” dated November 16, 1964 (USBR, Eklutna Project - Alaska. Rehabilitation Pressure Tunnel. As Built Drawings 1964). The vertical datum for these drawings is currently unknown and shall be referred to as “Local Datum” until further information is gathered.

4. The As-Built drawings of the AWWU lake diversion tunnel and pipeline are utilized as part of the design of the proposed facility. The drawings are titled “Eklutna Water Project” dated January 2, 1986 (AWWU 1986). The vertical datum used in these drawings is the GAAB Post-Quake, USC&GS, MSL, 1972. As currently understood this datum is identical to and used interchangeably with MOA72.

5. The USGS gauge station 15278000 Eklutna Lk Nr Palmer AK is reported by USGS to be based on the NGVD29. Discussions with USGS revealed that this is not necessarily the case, rather the gauge is tied to a brass cap set on the Eklutna Dam spillway wall.

The survey datum that will be utilized as the basis of this Project and the basis of all elevations within this report is NAVD88 GEOID 12B in terms of elevation with respect to Mean Sea level (MSL), US Foot. A conversion was determined from each of the unique project datums to correct to NAVD88 for the purposes of this investigation (McMillen 2022). The calculated correction factors between vertical datums used as part of the Eklutna Project is presented in Table 2-1.

Table 2-1. Eklutna Vertical Datum Conversion.

Vertical Datum	Conversion to NAVD88 (ft)	Notes
NAVD88	+0.00	
USGS Gauge	+3.263	Based on Staff Gauge Measurements at Dam
Local Datum	+3.593	Based on 2003 Survey at Dam
MOA72	+6.339	Based on 1987 Survey at Dam
	+6.520	Based on 2015 MOA LiDAR report

3.0 Existing Infrastructure

3.1 Eklutna Dam

The existing dam is located approximately 1,400 feet downstream of the natural outlet of Eklutna Lake. It is an earth and rock fill embankment dam with a crest length of 815 feet, a crest width of 30 feet, and a crest elevation (El.) of 894.6 feet (NAVD88) (USBR 1967). The crest of the dam is finished with crushed rock material to form a stable road surface, as shown in Figure 3-1. The dam allows for storage of water in Eklutna Lake for use throughout the year for power generation and water supply.

Figure 3-1. Dam Crest and Ungated Overflow Spillway, Looking North.

An ungated overflow spillway is incorporated within the middle of the dam. The reinforced concrete spillway consists of an inlet structure 105.54 feet long, a rectangular conduit section 83.80 feet long, a chute 77.66 feet long, and a stilling basin 89.00 feet long. The inlet structure contains a concrete overflow crest with a width of 18-feet and a crest elevation of El. 874.59 ft msl (NAVD88). The floor of the spillway is at El. 855.59 ft msl (NAVD88) for a total crest height of 19 feet. The design discharge capacity of the spillway is 3,315 cfs which corresponds to a reservoir water surface elevation of El. 888.39 ft msl (NAVD88). A cross sectional drawing of the structure is presented in Figure 3-2 with photographs of the spillway provided in Figure 3-3.

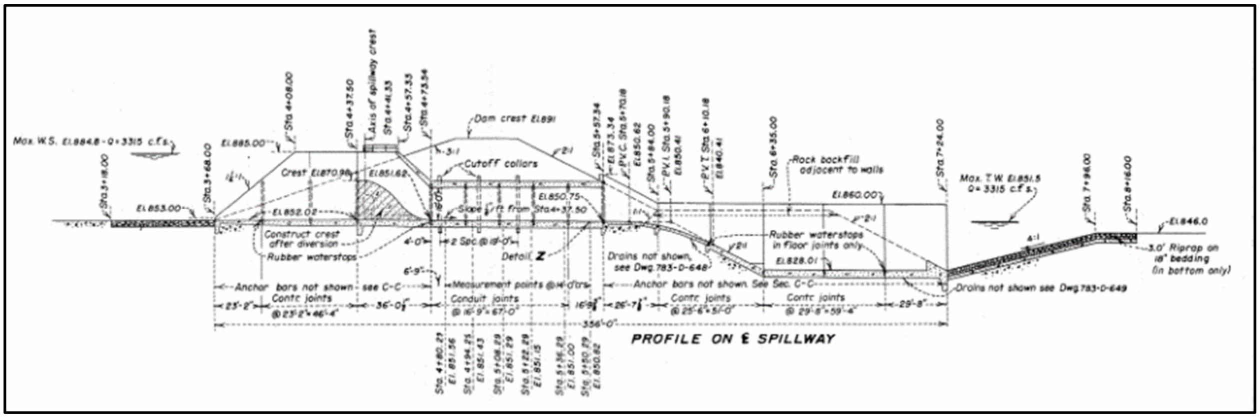

Figure 3-2. Cross Sectional View of Eklutna Dam Spillway.

Figure 3-3. Top View of Spillway (Left). Upstream Face of Spillway (Right).

4.0 Project Infrastructure and Operation

4.1 Spillway Infrastructural Modifications

The proposed modification to the Eklutna Dam Spillway involves the removal of the existing concrete overflow crest, installation of gate guides and sill plate, and installation of a fixed wheel gate, hoist, and hoist support structure. The concrete overflow crest currently provides stability to the concrete training walls; thus, removal of this element will introduce a new loading condition on the walls that must be addressed as part of the proposed scope of work. The modifications to address this new loading condition involve bracing the spillway training walls on the upper deck, which will also serve as the gate hoist platform. During the development of the design, the Alaska Department of Natural Resources Dam Safety division will be closely collaborated with to ensure the dam is protected during construction and operation of the new spillway gate. Details of the structural analysis of the existing spillway training walls under the new loading condition are provided in Appendix C. A section of the proposed infrastructural elements within the spillway is presented in Figure 4-1.

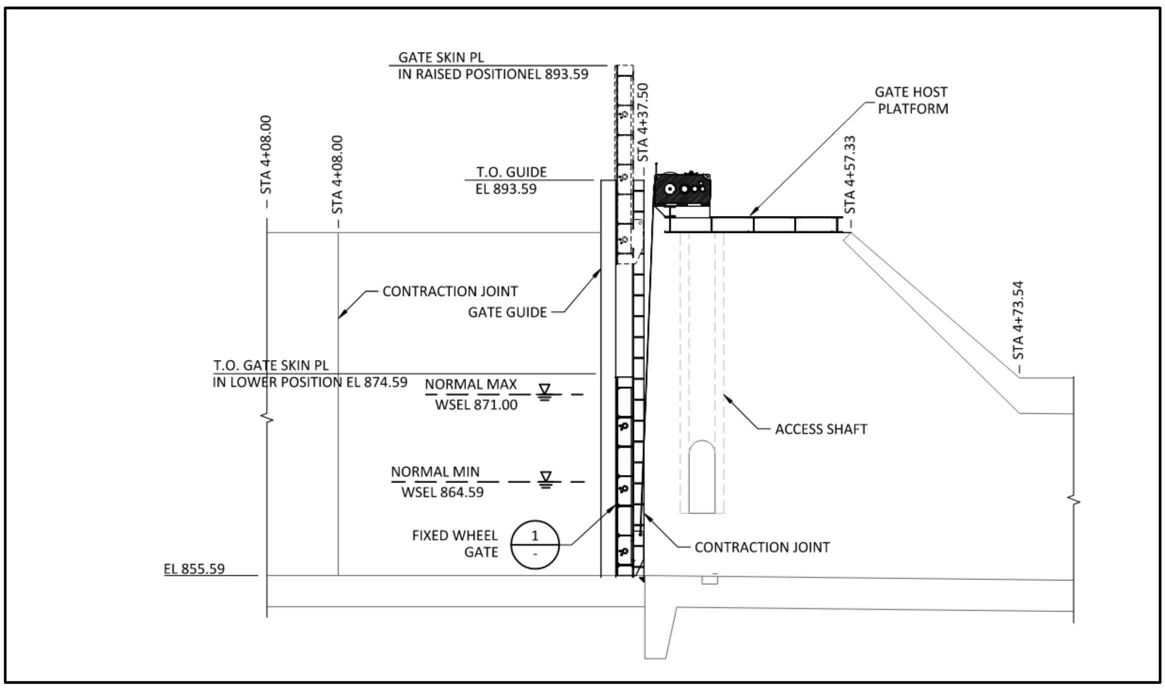

Figure 4-1. Spillway Modifications – Cross Section.

The gate hoist platform will consist of five W18x71 beams anchored across the span of the spillway. This platform will double as the support platform for the hoisting equipment for the gate. A new security fence will be located along the perimeter of the gate hoist platform and spillway upper deck to restrict public access and protect against theft or vandalism.

4.2 Fixed Wheel Gate

To control the flow within the spillway for regulated spill events or for future channel maintenance flow purposes, a fixed wheel gate will be implemented at Eklutna Dam. A fixed wheel gate is a type of vertical lift gate which utilizes wheels located on a fixed axle to transmit loads into the guides and supporting structure. These gates are commonly used in dams and other hydraulic structures due to their reduced friction requiring smaller hoisting mechanism and them being fairly economical to fabricate. A representative photograph of two fixed wheel gates at an existing dam intake is provided in Figure 4-2.

Figure 4-2. Fixed Wheel Gates at Dam Intake.

The fixed wheel gate would be lifted by a wire rope hoisting mechanism located on the proposed hoist platform on top of the spillway. The gate would be actuated locally via push button controls or remotely via the SCADA network. A stage-discharge relationship would be developed for the gate such that the flow rate released into the river may be calculated as a function of the gate opening position and the water surface elevation of the lake.

5.0 Structural Design Criteria

The structural design criteria apply to all design procedures to be implemented during the Project design. Structural design considerations listed in this section include material selection and design requirements that are intended to be incorporated into the Project. Structural Calculations may be found in Appendix A.

5.1 Applicable Codes and Standards

The structural design of the gate and hoist platform will conform to the following reports, criteria, and industry codes and standards. The applicable version of each document is the latest edition in force unless noted otherwise. References to the specific codes and standards will be included in the applicable technical specifications as the final design documents are prepared.

Table 5-1. Structural Codes and Standards.

Number	Description
Building Code	
ASCE 7	ASCE 7/SEI 7-16 Minimum Design Loads for Buildings and Other Structures, 2016
Design Standards and References	
ACI 318	Building Code Requirements for Structural Concrete, 2014
AISC 360	Specification for Structural Steel Buildings, 2016
ASIC SCM	Steel Construction Manual, 14th Edition
AWS D1.1	Structural Steel Welding Code – Steel
USACE EM 1110-2-2107	Design of Hydraulic Steel Structures

5.2 Materials

Materials and standards for concrete, concrete-related materials, structural steel, and miscellaneous metals for the Project are indicated in Table 5-2.

Table 5-2. Structural Materials and Design Standards.

Component	Material and Standard
Concrete and Related	
Existing Concrete	Compressive Strength (static), f'ce = 3000 psi
Adhesive Anchors	Two component epoxy, ASTM C-881 (with SS threaded anchor rod or reinforcing dowels)
Structural Steel	
Wide Flange Shapes	ASTM A992, Grade 50ksi
M, C, L shapes	ASTM A572, Grade 50ksi
Tube (HSS)	ASTM A500, Grade C. (46ksi Round / 50ksi Rect.)
Plates and Bars	ASTM A572, Grade 50ksi
High-Strength Bolts	ASTM F3125, Grade A325
Anchor Rods	ASTM F1554, Grade 50ksi (threaded) A193, Type 316 Stainless Steel
Miscellaneous Metals	
Guardrail and Grating	Galvanized steel

5.3 Design Loads

The general load types considered in the design of the structure are summarized in Table 5-3.

Table 5-3. Structural Design Loads.

Load Type	Description
Dead	Self-weight of all permanent structural elements as well as super-imposed weight of permanent mechanical and electrical equipment and piping.
Live	Temporary loads produced by the use and occupancy of the building or structure (excluding environmental loads). This load type includes those produced by movable objects and loads on guardrails, fixed ladders, and handrail systems by maintenance personnel.
Wind	Wind loads will be applied to all solid surfaces of the access platform and framing.

Seismic	Inertial forces produced by ground motion during a seismic event. The effects of this load type will be approximated based on the provisions of ASCE7.

5.3.1 Design Basis for Hoist Platform

Design of the access platform framing, guardrail, and connections will satisfy Load Factor and Resistance Design (LRFD) methodology by providing the required strength defined by the equation below:

$$U = \sum \gamma_i L_{ni} \leq \phi R_n$$

Where:

- $U =$ required strength
- $\gamma_i =$ load factors per ASCE 7
- $L_{ni} =$ load effects per structural calculations
- $\emptyset =$ resistance factor from ASCE 7
- $R_n =$ nominal resistance from ASCE 7

This methodology will be applied to the design of other material types in accordance with the relevant design standards and references. Refer to the structural calculations for additional information and derivation of these equation variables for specific Project features and components.

5.3.2 Design Basis for Fixed Wheel Gate

The proposed spillway fixed wheel gate will consist of a single steel skin plate welded to a series of WT shapes that are welded to a thick end plate. This design provides strength, stiffness and reliability. The roller wheel system is adjustable so that the wheels can be custom fit to the field conditions.

The gates will be fabricated from ASTM A709 Grade 50 steel and coated with a polyamine cure epoxy paint system. This type of steel is used in modern bridge fabrication because of its high toughness properties which resists sudden fracture. Seal retainer plates and bearing plates will be painted steel to reduce the amount of dissimilar metals in the vicinity which cause corrosion. The seal retainer bolts will be stainless steel. It is noted that some manufacturers choose to provide stainless steel wheels, axles, and embedded parts; however, carbon steel materials are allowed. Carbon steel components will be painted in order to provide corrosion resistance, and these coatings must be maintained by the Owners.

6.0 Mechanical Design Criteria

The mechanical design criteria apply to all design procedures to be implemented during the Project design. Mechanical design considerations listed in this section include detailing of mechanical components, material selection, and design requirements that are intended to be incorporated into the Project. Mechanical design calculations may be found in Appendix B.

6.1 Applicable Codes and Standards

The mechanical design will conform to the following reports, criteria, and industry codes and standards. The applicable version of each document is the latest edition in force unless noted otherwise. References to the specific codes and standards will be included in the applicable technical specifications as the final design documents are prepared.

Table 6-1. Mechanical Codes and Standards.

Codes & Standards	Description
ASTM	American Society of Testing and Material
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASME B16.5	Steel Pipe Flanges
AWS	American Welding Society
CMAA	Crane Manufacturers Association of America
FIST	Facilities Instructions, Standards and Techniques Manuals
MSS	Manufacturers Standardization Society of Valves and Fittings
USACE EM 1110-2-2610	Mechanical and Electrical Design for Lock and Dam Operating Equipment

6.2 Materials

Materials and standards for the mechanical components of the Project are indicated in Table 6-2.

Table 6-2. Mechanical Materials and Design Standards.

Component	Material and Standard
Wire Rope	6x37 Extra Improved Plow Steel – Stainless Steel
Gate Roller Bearings	Fabric Reinforced Composite Self Lubricated Bearing (CIP 151A)
Gate Roller Shafts	17-4 PH Stainless Steel
Cranes and Hoists	Steel with Vendor Coating Systems

6.3 Design Loads

6.3.1 Design Basis for Gate Hoist Components

USACE and ASME standards will be primarily used to guide spillway hoist and gate mechanical components. USACE EM 1110-2-2610 “Mechanical and Electrical Design for Lock and Dam Operating Equipment” and ASME B30.20 “Below the Hook Lifting Devices” are the most applicable. In general, they follow the Allowable Strength Design (ASD) method with the following design criteria:

- Normal operation load cases require that design stresses do not exceed 20% of material ultimate strength.
- Overload load cases require that design stresses do not exceed 75% of material yield strength.
- Overload load cases require that rope loads do not exceed 70% of minimum breaking strength.
- Self-lubricated bushing average bearing loads do not exceed 3,000 psi for normal operating conditions.

Off-the-shelf components will utilize their rated loads as they are assumed to have incorporated appropriate safety factors. In other words, the safety factors listed above will not be applied to off-the-shelf components.

6.3.2 Load Case A – Normal Operation

The normal operation load case (LCA) will be calculated based on the worst-case friction and efficiency values that would be obtained with moderate maintenance performed on the mechanical systems over the 50-year design life. This load case assumes that the hoist and gate are functioning as designed. Per the requirements of USACE EM 1110-2-2610, the hoist system will be designed for a factor of safety of 5 for this load case. Load Case A is comparable to SG, U2 in Table 3-19 of USACE ETL-584. The normal operation loads on the hoist system are a function of the external loads applied to the gate (hydrostatic forces, gravitational forces, friction forces, etc.). To calculate the load required to lift the spillway gate (tension in hoist ropes), a free body diagram has been created. Operating loads were applied to the free body diagram and a summation of forces and moments was performed to solve for the tension in the wire ropes.

6.3.3 Load Case B – Maximum Allowable Motor Torque of Hoist

Load Case B (LCB) will be defined as the maximum torque of the motor applied to the hoist. Per the requirements of EM 1110-2-2610, the hoist system will be designed to not exceed 75% of the yield of the components under this loading except for wire rope, which will be limited to 70% of minimum breaking strength based on the guidance of USACE EM 1110-2-3200. This load case is not directly covered in USACE ETL 584 for the structural design of the gate. However, this load case is most comparable to SG.X3 in Table 3-19. This load case will be calculated based on breakdown torque of motor, which per NEMA MG-1 specifies at 200% of rated motor torque for a NEMA B motor.

6.4 Hoist Performance Criteria

6.4.1 Rated Load

The hoist load will be based on the loads listed below in Table 6-3. This rating is driven by the load required to lift the gate out of the slot under flow. It should be noted that the gate operation will require lifting from the sill at maximum normal water elevation. The contributions to hoist load total are listed in Table 6-3.

Table 6-3. Basic Hoist Loads.

Description	Load
Gate Weight, lbf	23,100
Roller Friction, lbf	20,368
Seal Friction, lbf	515
Ice and Mud, lbf	2,000
Inertial Loading, lbf	48

6.4.2 Gate Travel Speed

Gate travel speed will be one foot per minute, which is typical for dam or spillway gates of this size. The slow operating speed additionally will help regulate the down ramping within the river during spill events to prevent fish stranding.

6.4.3 Motor Sizing

The required power to operate the gates is 2 hp. A 5hp NEMA B motor was selected to be conservative at this time. The calculations to determine the motor capacity are provided in Appendix C.

6.4.4 Hoist Configuration

The hoist configuration will consist of a single 5-hp NEMA B motor with a motor brake driving a parallel shaft reducer with two output shafts, which drives two grooved wire rope drums through an 8-inch-diameter drive shaft supported by two pillow block roller bearings supporting each. The rope will be stainless steel rope and will require no maintenance or lubrication. Each side of the hoist will be two-part rope configuration (Figure 6-1).

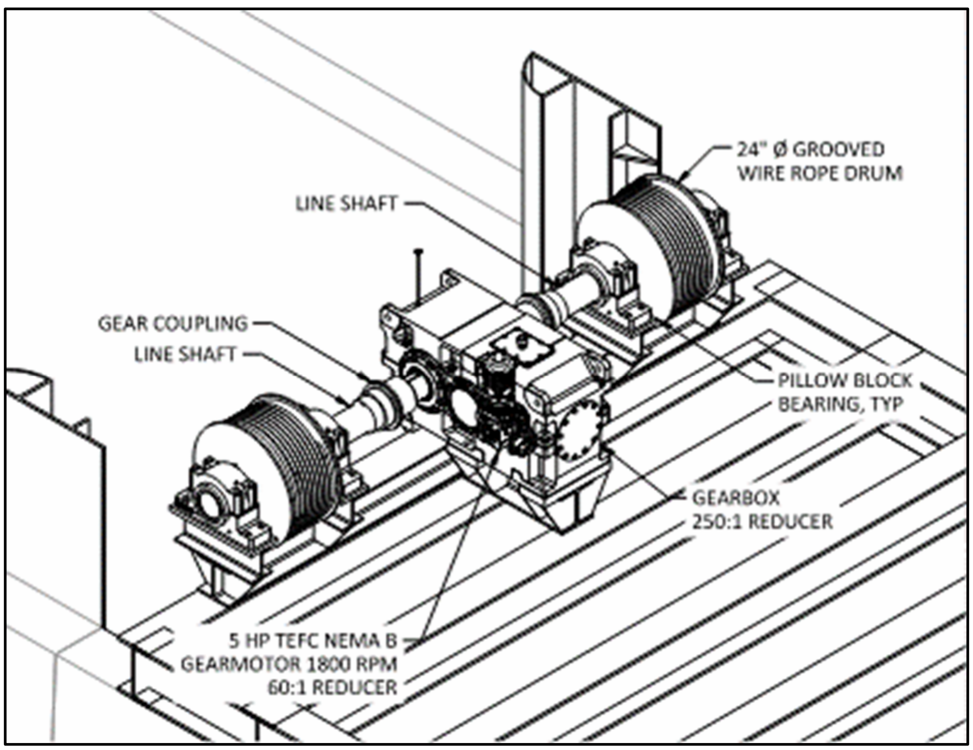

Figure 6-1. Hoist Configuration.

6.4.5 Hoist Wire Rope

The wire rope used will be 1 3/8-inch steel wire rope rated at a minimum 77,700 lbf breaking strength per ASTM A1023 – Standard Specification for Carbon Steel Wire Ropes for General Purposes.

6.4.6 Overload Limit Device

No overload limit device is required as the system will be capable of withstanding breakdown motor torque (load case B) without being damaged.

6.4.7 Hoist Brake

The motor hoist brake will be rated to be at least 250% rated motor torque. This this is a higher rating than USACE EM 1110-2-2610 chapter 2-2b recommends but will ensure that motor cannot overpower the brake if erroneously engaged. A disk type brake will be used for its simplicity, robustness, effectiveness and ease of maintenance.

7.0 Electrical Design

The electrical design criteria apply to all design procedures implemented during the Project design. Electrical design considerations listed in this section include detailing of electrical components, material selection, and design requirements that are intended to be incorporated into the Project.

7.1 Applicable Codes and Standards

Applicable codes and standards are listed in Table 7-1.

Table 7-1. Electrical Codes and Standards

Code	Standard
NFPA 70	National Electrical Code
NFPA 70E	National Electrical Safety Code (NESC)
NFPA 110	Standard for Emergency and Standby Power Systems
IEEE	Institute of Electrical and Electronics Engineers
NEMA	National Electrical Manufacturers Association

NFPA – National Fire Protection Association

7.2 Materials

Materials are summarized in Table 7-2.

Table 7-2. Electrical Materials

Material	Standard
Circuit Breakers	NEMA AB 1, UL 489
Switches	NEMA KS 1, UL 98
Terminal Blocks	UL 1059
Power Conductors/Cable	NEMA WC 70, UL 44, UL 83, UL 854
Instrumentation Cable	NEMA WC 57, UL 13, UL 44
Boxes and Enclosures	NEMA 250

Material	Standard
Raceway	NEMA C80.1, NEMA C80.6, NEMA RN 1, UL 6, UL 360, UL 514B, UL 651, UL 1242
Standby Generators	NEMA MG 1, UL 142, UL 508, UL 1236, UL 2200
Transfer Switches	NEMA ICS 2, UL 1008
Grounding and Bonding Equipment	UL 467

NEMA – National Electrical Manufacturers Association

7.3 Design Loads

7.4 Power Distribution

The gate hoist motor will run on single phase 240 VAC and will be served from a 240V panelboard. A surge protective device will be provided at 240V and 120V to protect the system from transient surges. Power will be provided to the dam via buried 7,200V cable from the nearest transmission line located approximately 2,500 feet north of the site. A 7,200V / 240VAC single phase stepdown transformer will be located at the right abutment of the dam.

7.5 Process Instrumentation and Control

A SCADA system will be implemented to supervise and control the Eklutna Dam spillway gate hoist and to monitor water surface elevation within Eklutna Lake using the level transducer installed as part of the prior dam outlet modification work. The SCADA system will consist of a metal backplane in a local control panel with components mounted to it. This includes PLC and I/O modules, UPS, control power supply and distribution block, control relays, terminal blocks, overcurrent protection, digital communication hardware, and other required appurtenances. It is presumed that datalogging will be performed on the Eklutna Power Plant SCADA system. If autonomous and more continuous datalogging is determined to be required, a datalogging-capable HMI will be specified in addition to the above components.

A fiber optic communication network will be implemented between all systems of the Project via a fiber optic infrastructure. The dam outlet gate and level transducer will connect to a fiber optic communication network between Eklutna Dam, the Eklutna River Release Facility, and the Eklutna Power Plant. Digital communication protocol will be Ethernet/IP over single-mode fiber optic cable (OS2). All new segments of installation will consist of fiber optic cable that will be all-dielectric, loose-tube buffered, with water-repellant gel-fill and jacket rated for direct-bury. For adequate spares to mitigate strand failure, 24-strand cable is proposed. The cable will be installed in HDPE SDR-11 smooth wall conduit. The fiber optic line will be brought to the LCP housed fiber connector housing for termination, then patched to the managed Ethernet switch in a loop configuration. All strands of all fiber optic cables shall be terminated and certified to the OTDR and OLTS tests. The Ethernet switch will connect the PLC to the communication system.

Field instrumentation consists of the following, as provided in Table 7-3.

Table 7-3. Field Instrumentation

Instrument Tag ISA)	Instrument Type	Parameters	Control Loop
LE-100	Pressure Transducer	Water Level Monitoring, 0-30 ft H_20 range	Measure Water Level in Stilling Well within Eklutna Dam Spillway
HOI-100	Electric Motor Hoist	Hoist Position	Measure Status of Encoder and Position of Gate

8.0 References

AWWU. 1986. *Eklutna Water Project.* As Built Drawings.

McMillen. 2022. *Eklutna Vertical Datum Memorandum .*

USBR. 1964. *Eklutna Project - Alaska. Rehabilitation Pressure Tunnel. As Built Drawings .*

—. 1967. *Rehabilitation of Eklutna Project Features following Earthquake of March 1964. A Supplement to Eklutna Dam, Tunnel and Powerplant Technical Record of Design and Construction.*

Appendix A. 15% Design Drawings

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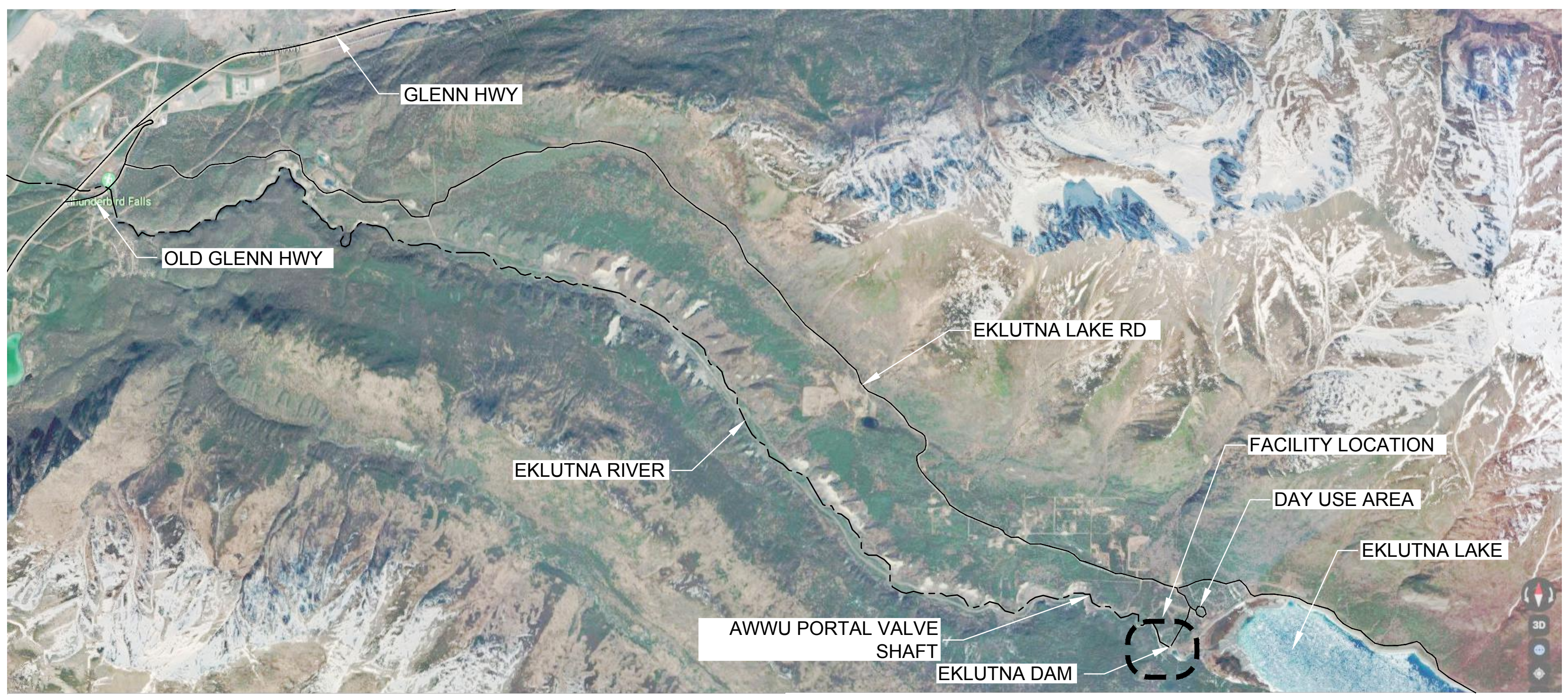
EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS
ANCHORAGE, ALASKA

15% DESIGN
APRIL 2024

EKLUTNA FISH & WILDLIFE PROJECT

EKLUTNA DAM SPILLWAY MODIFICATIONS
15% DESIGN

LOCATION MAP
NTS



VICINITY MAP
NTS

FACILITY MAP
NTS

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
A	04/26/24	SPE	15% DESIGN

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

McMillen

CHUGACH
POWERING ALASKA'S FUTURE

MEA
MATANUSKA ELECTRIC ASSOCIATION

MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS

LOCATION MAP, VICINITY MAP,
AND FACILITY MAP

DESIGNED S. ELLENSON
DRAWN F. HABER
CHECKED J. BOAG
PROJECT DATE 04/26/24

DRAWING
G001

JOB NO: 000000

Path: C:\Vault\Chugach Electric\24-021 Eklutna Spillway Modification\G001.dwg Plot date: Apr 23, 2024 03:42pm, CAD User: WoodRon

DRAWING INDEX

DRAWING NO.	SHEET TITLE
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E100	EKLUTNA DAM SPILLWAY ELECTRICAL PLAN, SECTION, AND DETAILS

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
A	04/26/24	SPE	15% DESIGN

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

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CHUGACH POWERING ALASKA'S FUTURE

MEA MATANUSKA ELECTRIC ASSOCIATION

MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS
DRAWING INDEX

DESIGNED S. ELLENSON
DRAWN F. HABER
CHECKED J. BOAG
PROJECT DATE 04/26/24

DRAWING
G002

JOB NO: 000000

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A/C	AIR CONDITIONING
A/E	ARCHITECT/ENGINEER
A	ARCHITECTURAL (DWG DISCIPLINE), AMP
AB	ANCHOR BOLT
ABC	AGGREGATE BASE COURSE
ABAN	ABANDON
AC	ALTERNATING CURRENT
ACST	ACOUSTIC
AD	ADDENDUM, AREA DRAIN
ADDL	ADDITIONAL
ADH	ADHESIVE
ADJ	ADJUSTABLE, ADJACENT
AF	AMP FRAME, AMP FUSE
AFF	ABOVE FINISH FLOOR
AFG	ABOVE FINISH GRADE
AGGR	AGGREGATE
AIC	AMPS INTERRUPTING CAPACITY
ALIG	ALIGNMENT
ALUM	ALUMINUM
ALT	ALTERNATE, ALTITUDE
AMB	AMBIENT
ANC	ANCHOR
AP	ACCESS PANEL
APRX	APPROXIMATE
APVD	APPROVED
ARCH	ARCHITECTURAL
ASSY	ASSEMBLY
AT	AMP TRIP
ATM	ATMOSPHERE
AUTO	AUTOMATIC
AUX	AUXILIARY
AVE	AVENUE
AVG	AVERAGE
AWG	AMERICAN WIRE GAGE
AWWU	ANCHORE WATER AND WASTEWATER UTILITY
B/B	BACK TO BACK
BAL	BALANCE
BBD	BULLETIN BOARD
BC	BASE CABINET, BOTTOM CHORD, BOLT CENTER, BOLT CIRCLE
BD	BOARD
BE	BOTH ENDS, BELL END
BF	BOTH FACES, BOTTOM FACE, BLIND FLANGE, BOARD FEET
BFV	BUTTERFLY VALVE
BITUM	BITUMINOUS
BKG	BACKING
BL	BASE LINE
BLDG	BUILDING
BLK	BLOCK
BLKG	BLOCKING
BM	BENCHMARK, BEAM
BOC	BACK OF CURB
BOD	BOTTOM OF DUCT
BOG	BOTTOM OF GRILLE
BOL	BOTTOM OF LOUVER
BOP	BOTTOM OF PIPE
BOR	BOTTOM OF REGISTER
BOT	BOTTOM
BOU	BOTTOM OF UNIT
BP	BASE PLATE
BRG	BEARING
BRGP	BEARING PLATE
BRKT	BRACKET
BS	BOTH SIDES
BTU	BRITISH THERMAL UNIT
BTW	BETWEEN
BTWLD	BUTT WELD
BV	BALL VALVE
BW	BOTH WAYS
BYP	BYPASS
C TO C	CENTER TO CENTER
C&G	CURB & GUTTER
C	CHANNEL SHAPE, CENTIGRADE, CONDUIT, CIVIL (DRAWING DISCIPLINE)
CAB	CABINET
CAP	CAPACITY
CAT	CATALOG
CAV	CAVITY
CB	CATCH BASIN
CCB	CONCRETE BLOCK
CCW	COUNTER CLOCKWISE
CF	CUBIC FEET (FOOT)
CHFR	CHAMFER
CHD	CHORD
CHH	COMMUNICATION HANDHOLE
CI	CURB INLET
CIP	CAST-IN-PLACE
CIPB	CONCRETE INTERLOCKING PAVER BALLAST
CIRC	CIRCULATION, CIRCULAR
CJ	CONSTRUCTION JOINT, CONTROL JOINT
CKT	CIRCUIT
CL	CENTERLINE, CLASS, CLOSE
CLR	CLEAR
CMH	COMMUNICATION MANHOLE
CMU	CONCRETE MASONRY UNIT
CO	CLEAN OUT, CONCRETE OPENING
COL	COLUMN
COM	COMMON
COMB	COMBINATION
COMM	COMMUNICATION
COMP	COMPOSITION, COMPRESSIBLE, COMPOSITE
CONC	CONCENTRIC, CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS, CONTINUED
COORD	COORDINATE
CORR	CORROSIVE, CORRUGATED
CP	CHECKER PLATE, CONTROL POINT
CPLG	COUPLING
CSK	COUNTERSINK
CTR	CENTER
CTRL	CONTROL
CU	COPPER, CUBIC
CW	CLOCKWISE
CY	CUBIC YARD
d	PENNY (NAIL MEASURE)
D	DEEP, DIFFUSER
DB	DUCT BANK, DECIBEL, DRY BULB
DBA	DEFORMED BAR ANCHOR
DBL	DOUBLE
DC	DIRECT CURRENT
DEG	DEGREE
DEG C	DEGREE CENTIGRADE
DEG F	DEGREE FAHRENHEIT
DEMO	DEMOLITION
DEP	DEPRESSED
DEPT	DEPARTMENT
DET	DETAIL
DI	DROP INLET, DUCTILE IRON
DIA	DIAMETER
DIAG	DIAGONAL, DIAGRAM
DIFF	DIFFERENTIAL, DIFFERENCE
DIM	DIMENSION
DISCH	DISCHARGE
DIST	DISTANCE, DISTRIBUTION
DIV	DIVISION
DL	DEAD LOAD
DN	DOWN
DP	DEPTH
DS	DOWN SPOUT
DT	DOUBLE TEE, DRIP TRAP ASSEMBLY
DUP	DUPLICATE
DWG	DRAWING
DWL	DOWEL
E	EAST, ELECTRICAL (DWG DISCIPLINE)
EA	EACH, EXHAUST AIR
EC	ELECTRICAL CONTRACTOR
ECC	ECCENTRIC
EDB	ELECTRICAL DUCT BANK
EE	EACH END
EF	EACH FACE
EG	EXISTING GRADE
EGL	ENERGY GRADE LINE
EFF	EFFLUENT, EFFICIENCY
EHH	ELECTRICAL HANDHOLE
EIFS	EXTERIOR INSULATION & FINISH SYSTEM
EJ	EXPANSION JOINT
EL	ELBOW, ELEVATION
ELEC	ELECTRICAL
EMBD	EMBEDDED
EMER	EMERGENCY
EMH	ELECTRICAL MANHOLE
ENCL	ENCLOSURE
ENGR	ENGINEER
ENTR	ENTRANCE
EOP	EDGE OF PAVEMENT
EOW	EDGE OF WATER
EQ	EQUAL
EQUIP	EQUIPMENT
EQUIV	EQUIVALENT
ES	EACH SIDE, EQUAL SPACE, EMERGENCY SHOWER
ESEW	EMERGENCY SHOWER AND EYE WASH
EST	ESTIMATE
EW	EACH WAY, EMERGENCY EYE/FACE WASH
EWC	ELECTRIC WATER COOLER
EWEF	EACH WAY, EACH FACE
EWTB	EACH WAY, TOP AND BOTTOM
EXC	EXCAVATION
EXH	EXHAUST
EXIST	EXISTING
EXP	EXPANSION, EXPOSED
EXT	EXTERIOR, EXTERNAL, EXTENSION
F TO F	FACE TO FACE
FAB	FABRICATE
FBO	FURNISHED BY OWNER
FC	FLUSHING CONNECTION
FCA	FLANGED COUPLING ADAPTER
FCV	FIXED CONE VALVE
FD	FLOOR DRAIN
FDC	FLEXIBLE DUCT CONNECTION
FDR	FEEDER
FE	FLANGED END
FEC	FIRE EXTINGUISHER CABINET
FEXT	FIRE EXTINGUISHER
FF	FAR FACE, FACTORY FINISH, FLAT FACE
FG	FINISHED GRADE
FIG	FIGURE
FH	FIRE HYDRANT
FIN	FINISH
FL	FLOW, FLOW LINE
FLEX	FLEXIBLE
FLG	FLANGE
FLOR	FLUORESCENT
FLR	FLOOR
FLS	FLASHING, FLUSH
FND	FOUNDATION
FNC	FENCE
FO	FINISHED OPENING
FOB	FLAT ON BOTTOM
FOC	FACE OF CONCRETE, FACE OF CURB, FIBER OPTIC CABLE
FOF	FACE OF FINISH
FOM	FACE OF MASONRY
FOS	FACE OF STUDS
FOT	FLAT ON TOP
FPT	FEMALE PIPE THREAD
FR	FRAME
FRP	FIBERGLASS REINFORCED PLASTIC
FS	FLOOR SINK, FAR SIDE
FT	FEET, FOOT
FTG	FOOTING, FITTING FUR FURRED, FURRING
FURN	FURNITURE, FURNISH
FUT	FUTURE
FV	FACE VELOCITY
FW	FIELD WELD, FIRE WALL
FWD	FORWARD
FWE	FURNISHED WITH EQUIPMENT
FXTR	FIXTURE
G	GRILLE, GROUND, GENERAL (DWG DISCIPLINE)
GA	GAGE (METAL THICKNESS)
GAL	GALLON
GALV	GALVANIZED
GB	GRADE BREAK
GD	GUARD
GEN	GENERAL
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GL	GLASS
GP	GUY POLE
GR	GRADE
GRND	GROUND
GRTG	GRATING
GT	GREASE TRAP
GWB	GYPSUM WALLBOARD
GYP	GYPSUM HARDBOARD
H	HIGH
HB	HOSE BIB
HBD	HARDBOARD
HC	HANDICAPPED, HOLLOW CORE, HORIZONTAL CURVE
HC	HORIZONTAL CENTERLINE
HDR	HEADER
HDW	HARDWARE
HEX	HEXAGONAL
HH	HANDHOLE
HM	HOLLOW METAL
HORIZ	HORIZONTAL
HP	HIGH POINT, HORSEPOWER
HPC	HORIZONTAL POINT OF CURVATURE
HPS	HIGH PRESSURE SODIUM
HPT	HORIZONTAL POINT OF TANGENCY
HR	HOUR
HS	HEADED STUD, HIGH STRENGTH
HSS	HOLLOW STRUCTURAL SHAPE
HT	HEIGHT
HV	HIGH VOLTAGE
HVAC	HEATING, VENTILATION & AIR CONDITIONING
HWD	HARDWOOD
HWL	HIGH WATER LEVEL
HYD	HYDRAULIC HZ HERTZ, CYCLES PER SECOND
I	INSTRUMENTATION (DWG DISCIPLINE)
ID	INSIDE DIAMETER, INTERIOR DIMENSION
IE	INVERT ELEVATION
IF	INSIDE FACE
IH	INTAKE HOOD
IMP	IMPACT
IN	INCH
INC	INCLUDE, INCANDESCENT
INF	INFLUENT
INSTR	INSTRUMENTATION
INSUL	INSULATION
INT	INTERIOR, INTERSECTION
INTR	INTERMEDIATE, INTERIOR
INV	INVERT
IPS	IRON PIPE SIZE
IPT	INTERNAL PIPE THREAD
IRR	IRRIGATION
ISO	ISOMETRIC
JB	JUNCTION BOX
JCT	JUNCTION
JF	JOINT FILLER
JT	JOINT
K	KIP
KB	KNEE BRACE
KCMIL	THOUSAND CIRCULAR MILS
KD	KNOCK DOWN
KIUC	KAUAI ISLAND UTILITY COOPERATIVE
KO	KNOCK OUT
KSI	KIPS PER SQUARE INCH
L	ANGLE, LENGTH, LAVATORY
LAM	LAMINATE
LATL	LATERAL
LB	LAG BOLT, POUND
LDR	LEADER
LF	LINEAR FOOT
LG	LONG
LH	LEFT HAND
LIN	LINEAR
LIQ	LIQUID
LL	LIVE LOAD
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LMLU	LIQUID MARKER LECTURE UNIT
LNG	LONGITUDINAL
LOC	LOCATION
LP	LOW POINT
LPS	LOW PRESSURE SODIUM
LR	LONG RADIUS
LT	LEFT
LTD	LIMITED
LTG	LIGHTING
LTL	LINTEL
LTNG	LIGHTNING
LV	LOW VOLTAGE
LVR	LOUVER
LW	LIGHTWEIGHT
LWC	LIGHTWEIGHT CONCRETE
LWL	LOW WATER LEVEL
M	MECHANICAL (DWG DISCIPLINE)
MA	MIXED AIR
MAINT	MAINTENANCE
MAN	MANUAL
MAOP	MAXIMUM ALLOWABLE OPERATING PRESSURE
MATL	MATERIAL
MAX	MAXIMUM
MB	MACHINE BOLT
MBR	MEMBER
MCJ	MASONRY CONTROL JOINT
MECH	MECHANICAL
MED	MEDIUM
MFR	MANUFACTURER
MH	MANHOLE, METAL HALIDE
MIN	MINIMUM
MIR	MIRROR
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
MMB	MEMBRANE
MO	MASONRY OPENING
MOD	MODULAR, MODIFY
MON	MONUMENT
MPT	MALE PIPE THREAD
MSL	MEAN SEA LEVEL
MT	MOUNT
MU	MASONRY UNIT
MULL	MULLION
MV	MEDIUM VOLTAGE
MW	MONITORING WELL
N	NORTH, NEUTRAL
NA	NOT APPLICABLE
NAT	NATURAL
NC	NORMALLY CLOSED
NEG	NEGATIVE
NF	NEAR FACE, NON-FUSED
NG	NATURAL GAS
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN, NUMBER
NOM	NOMINAL
NPS	NOMINAL PIPE SIZE
NPT	NATIONAL PIPE THREAD
NS	NEAR SIDE
NTS	NOT TO SCALE
NWL	NORMAL WATER LEVEL
O TO O	OUT-TO-OUT
OA	OUTSIDE AIR, OVERALL
OC	ON CENTER
OCPD	OVER CURRENT PROTECTION DEVICE
OD	OUTSIDE DIAMETER
OH	OVERHEAD
OPNG	OPENING
OPP	OPPOSITE
OPT	OPTIONAL
ORD	OVERFLOW ROOF DRAIN
ORIG	ORIGINAL
OVFL	OVERFLOW
OVHG	OVERHANG
OZ	OUNCE
P	PAINT, PROCESS (DWG DISCIPLINE)
PAR	PARALLEL, PARAPET
PB	PANIC BAR, PULL BOX
PBD	PARTICLE BOARD
PC	POINT OF CURVE, PIECE, PRECAST
PCC	POINT OF COMPOUND CURVATURE
PCF	POUNDS PER CUBIC FOOT
PCT	PERCENT
PE	PLAIN END
PED	PEDESTAL
PEN	PENETRATION
PERF	PERFORATED
PERM	PERMANENT
PERP	PERPENDICULAR
PF	POWER FACTOR
PH	PHASE
PI	POINT OF INTERSECTION
PKG	PACKAGE
PL	PLATE, PROPERTY LINE
PLBG	PLUMBING
PLF	POUNDS PER LINEAR FOOT
PNEU	PNEUMATIC
POL	POLISH
POS	POSITIVE, POSITION
PP	POLYPROPYLENE, POWER POLE
PRC	POINT OF REVERSE CURVATURE
PREF	PREFINISHED
PREFAB	PREFABRICATED
PRELIM	PRELIMINARY
PREP	PREPARE
PRES	PRESSURE
PROP	PROPERTY
PROT	PROTECTION
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSIG	POUNDS PER SQUARE INCH GAGE
PT	POINT, POINT OF TANGENCY
PTN	PARTITION
PVC	POLYVINYL CHLORIDE
PVMT	PAVEMENT
PWD	PLYWOOD
PZ	PIEZOMETER
Q	RATE OF FLOW
QTR	QUARTER
QTY	QUANTITY
QUAL	QUALITY
R&R	REMOVE AND REPLACE
R&S	REMOVE AND SALVAGE
R	RADIUS, REGISTER, RISER
RA	RETURN AIR
RB	RESILIENT BASE, ROCK BERM
RCPT	RECEPTACLE
RD	ROOF DRAIN
REC	RECESS
RECD	RECEIVED
RECT	RECTANGULAR
RED	REDUCER
REF	REFERENCE
REINF	REINFORCING
REQD	REQUIRED
RESIL	RESILIENT
RET	RETAINING, RETURN
REV	REVISION, REVERSE
RFL	REFLECTED, REFLECTOR
RGS	RIGID GALVANIZED STEEL
RH	RELIEF HOOD, RIGHT HAND, RELATIVE HUMIDITY
RL	REQUIRED LAP
RND	ROUND
RNG	RENEWABLE NATURAL GAS
RO	ROUGH OPENING
ROW	RIGHT-OF-WAY
RPM	REVOLUTIONS PER MINUTE
RR	RAILROAD
RT	RIGHT
S	SOUTH, SINK, STRUCTURAL (DWG DISCIPLINE)
SA	SUPPLY AIR
SAN	SANITARY
SC	SOLID CORE
SCH	SCHEDULE
SCHEM	SCHEMATIC
SCRN	SCREEN
SE	STEEL/ALUMINUM EDGE
SEC	SECONDARY, SECONDS
SECT	SECTION
SEP	SEPARATE
SF	SQUARE FOOT
SH	SHOWER
SHT	SHEET
SHTG	SHEATHING
SIM	SIMILAR
SL	SLOPE
SLTD	SLOTTED
SLV	SLEEVE
SMLS	SEAMLESS
SOG	SLAB ON GRADE
SP	SOUNDPROOF, STANDPIPE
SPC	SPACING
SPEC	SPECIFICATION
SPLY	SUPPLY
SPT	SET POINT
SQ	SQUARE
SR	SHORT RADIUS
SS	SERVICE SINK
SST	STAINLESS STEEL
ST	STREET
STA	STATION
STD	STANDARD
STIF	STIFFENER
STIR	STIRRUP
STL	STEEL
STOR	STORAGE
STR	STRUCTURAL, STRAIGHT
SUB	SUBSTITUTE
SUC	SUCTION
SUSP	SUSPENDED
SY	SQUARE YARD
SYM	SYMBOL
SYMM	SYMMETRICAL
SYN	SYNTHETIC
SYS	SYSTEM
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
T	TILE, TREAD
TA	TEMPERED AIR
TAN	TANGENT
TBM	TEMPORARY BENCHMARK
TEMP	TEMPORARY, TEMPERATURE
THK	THICK
THRD	THREAD
THRU	THROUGH
TOB	TOP OF BOLT, TOP OF BANK, TOP OF BEAM
TOC	TOP OF CURB, TOP OF CONCRETE
TOD	TOP OF DUCT
TOF	TOP OF FOOTING
TOG	TOP OF GRATING
TOL	TOLERANCE, TOP OF LEDGER
TOM	TOP OF MASONRY
TOP	TOP OF PLATE
TOPO	TOPOGRAPHY
TOS	TOP OF SLAB, TOP OF STEEL
TOW	TOP OF WALL
TP	TELEPHONE POLE, TOE PLATE, TRAP PRIMER
TPG	TOPPING
TRANS	TRANSITION
TRD	TRENCH DRAIN
TYP	TYPICAL
U	URINAL
UG	UNDERGROUND
ULT	ULTIMATE
UNFN	UNFINISHED
UNO	UNLESS NOTED OTHERWISE
UTIL	UTILITY
V	VENT, VELOCITY, VOLT
VA	VOLT AMPERE
VAC	VACUUM
VAR	VARNISH, VARIABLE, VOLT AMPERES REACTIVE
VB	VAPOR BARRIER, VINYL BASE, VALVE BOX
VC	VERTICAL CURVE
VCT	VINYL COMPOSITION TILE, VERTICAL CENTERLINE
VEL	VELOCITY
VENT	VENTILATION
VERT	VERTICAL
VS	VERSES, VAPOR SEAL
VOL	VOLUME
VPC	VERTICAL POINT OF CURVATURE
VPI	VERTICAL POINT OF INTERSECTION
VPT	VERTICAL POINT OF TANGENCY
VTR	VENT THROUGH ROOF
VWC	VINYL WALL COVERING
W/	WITH
W/O	WITHOUT
W	WATT, WEST, WIDE, WINDOW, WIRE, WIDE FLANGE BEAM
WC	WATER CLOSET, WATER COLUMN
WD	WIDTH
WF	WIDE FLANGE, WASH FOUNTAIN
WG	WIRE GLASS, WATER GAGE
WH	WALL HYDRANT, WEEP HOLE
WL	WATER LEVEL
WLD	WELDED
WM	WIRE MESH
WP	WATERPROOF, WORKING POINT
WTHP	WEATHERPROOF
WS	WATERSTOP, WATER SURFACE
WSEL	WATER SURFACE ELEVATION
WT	WEIGHT, WATER TIGHT
WWF	WELDED WIRE FABRIC
XS	EXTRA STRONG
XXS	DOUBLE EXTRA STRONG
XSECT	CROSS SECTION
YH	YARD HYDRANT
YS	YIELD STRENGTH

GENERAL NOTES:

1. THESE ABBREVIATIONS APPLY TO THE ENTIRE SET OF CONTRACT DRAWINGS.
2. LISTING OF ABBREVIATIONS DOES NOT IMPLY ALL ABBREVIATIONS ARE USED IN THE CONTRACT DRAWINGS.
3. ABBREVIATIONS SHOWN ON THIS SHEET INCLUDE VARIATIONS OF THE WORD. FOR EXAMPLE, "MOD" MAY MEAN MODIFY OR MODIFICATION; "INC" MAY MEAN INCLUDED OR INCLUDING; "REINF" MAY MEAN EITHER REINFORCE OR REINFORCING.
4. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE-EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH SHEET FOR USAGE.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
A	04/26/24	SPE	15% DESIGN

WARNING
0 1/2 1
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CHUGACH
POWERING ALASKA'S FUTURE

MEA
MATANUSKA ELECTRIC ASSOCIATION

MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS
STANDARD ABBREVIATIONS

DESIGNED S. ELLENSON
DRAWN F. HABER
CHECKED J. BOAG
PROJECT DATE 04/26/24

DRAWING
G003

JOB NO: 000000

Path: C:\Vault\Chugach Electric\24-021 Eklutna Spillway Modification\G003.dwg Plot date: Apr 23, 2024 03:42pm, CAD User: WoodRon

SHEET SYMBOLS

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

N

SECTION IDENTIFICATION

(1) SECTION CUT ON DRAWING C102:

A / C103 — SECTION LETTER; DRAWING WHERE SECTION IS DRAWN

(2) ON DRAWING C103 THIS SECTION IS IDENTIFIED AS:

SECTION LETTER
A / S102 SECTION
SCALE: 1/8"= 1'-0"   0' 8' 16'
DRAWING WHERE SECTION OCCURS*

DETAIL IDENTIFICATION

(1) DETAIL CALL-OUT ON DRAWING C102:

1 / C103 — DETAIL NUMBER; DRAWING WHERE DETAIL IS SHOWN

(2) ON DRAWING C103 THIS SECTION IS IDENTIFIED AS:

DETAIL NUMBER
1 / C102 DETAIL
SCALE: 1"= 2'   0' 2' 4'
DRAWING WHERE DETAIL OCCURS*

*NOTE: IF PLAN AND SECTION (OR DETAIL CALL-OUT AND DETAIL) ARE SHOWN ON SAME DRAWING. DRAWING NUMBER IS REPLACED BY A LINE.

STANDARD DETAIL IDENTIFICATION

(1) DETAIL CALL-OUT ON PLAN OR SECTION:

M101 — STANDARD DETAIL NUMBER

(2) ON DETAIL DRAWINGS, IDENTIFIED AS:

STANDARD DETAIL NUMBER
M101 DETAIL
SCALE: NTS

ELEVATION/IMAGE IDENTIFICATION

1 / D104

SITE PLAN LINE TYPES

- X — X: FENCE LINE
- P — P: OVERHEAD POWER
- 455: MAJOR CONTOUR
- 456: MINOR CONTOUR
- 455: EXIST MAJOR CONTOUR
- 456: EXIST MINOR CONTOUR
- EDGE OF WATERLINE
- TOE: TOE OF SLOPE
- TOB: TOP OF BANK
- SS — SS: SANITARY SEWER
- SD — SD: STORM DRAIN
- EP — EP: EDGE OF PAVEMENT
- EG — EG: EDGE OF GRAVEL
- W: WATTLE
- SF — SF: SILT FENCE
- CF — CF: CONSTRUCTION FENCE
- GAS: GAS LINE
- TC: TURBIDITY CURTAIN
- IRR — IRR: IRRIGATION LINE
- WTR: WATER LINE
- TEL: TELEPHONE LINE
- COM: COMMUNICATION LINE
- OHP: OVERHEAD ELECTRICAL/POWER
- EUG: UNDERGROUND ELECTRICAL
- P/L: PROPERTY LINE
- OHP: EXISTING OVERHEAD POWER LINE
- OHP&T: EXISTING OVERHEAD POWER & TELEPHONE LINE
- T: EXISTING OVERHEAD TELEPHONE LINE
- BT: EXISTING BURIED TELEPHONE LINE EVIDENCED BY PEDESTALS & WARNING PADDLES
- EXISTING FENCE LINE
- PROJECT BOUNDARY
- TREE PROTECTION FENCE
- LIMITS OF DISTURBANCE
- SHORING

SITE PLAN SYMBOLS

- N: ARROW INDICATES DIRECTION OF PLAN NORTH
- CONIFER TREE: FIR, SPRUCE, LARCH OR PINE, 8" DIAMETER OR LARGER.
- DECIDUOUS TREE: COTTONWOOD, HAWTHORN, ASPEN, 8" DIAMETER OR LARGER.
- MH: MANHOLE
- EB: ELECTRIC BOX
- STORM DRAIN MANHOLE
- FH: FIRE HYDRANT
- YH-X: YARD HYDRANT
- SURVEY CONTROL POINT, AS NOTED.
- POLE ANCHOR
- POWER POLE
- LIGHT POLE
- SIGN
- SURVEY HUB
- SECTION CORNER
- BENCH MARK
- EXISTING HEADWALL
- EXISTING MONITORING STATION
- X — X: EXISTING FENCE
- STATE PLANE COORDINATE MARKER
- EXISTING TREE LINE
- EXISTING BUILDING, STRUCTURES
- EXISTING SECTION CORNER MONUMENT FOUND AS DESCRIBED
- EXISTING 5/8" REBAR CONTROL POINT MONUMENT, BORING LOCATION
- W: EXISTING HOSE BIB
- P: EXISTING PORTABLE IRRIGATION WATER PUMP
- WELL: EXISTING 6" WATER WELL
- EXISTING ELECTRICAL OUTLET
- P: EXISTING POWER POLE
- T: EXISTING TELEPHONE PEDESTAL
- CONTROL POINT
- PUMP
- PUMP
- TP: TEST PIT LOCATION

MISCELLANEOUS SYMBOLS

- CHANGE OF PIPE MTL
- OR: END OF PIPE
- ℄: CENTERLINE
- Ø: DIAMETER
- ∠: ANGLE
- ⅊: PLATE
- ±: PLUS/MINUS

GENERAL NOTES:

1. ALL SYMBOLS ARE NOT NECESSARILY USED. THIS IS A STANDARD DRAWING SHOWING COMMON SYMBOLS ON THIS PROJECT.
2. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE-EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH DRAWING FOR USAGE.

HATCH SYMBOLS

- ROCK, TYPE AS NOTED (PLAN/SECTION)
- BED ROCK
- EXISTING GRADE (SECTION)
- NEW SOIL (SECTION)
- CONCRETE EXISTING (SECTION/PLAN)
- CONCRETE 1ST STAGE (SECTION/PLAN)
- CONCRETE 2ND STAGE (SECTION/PLAN)
- SAND, GROUT (PLAN/SECTION)
- STEEL (SECTION)
- GRATING (PLAN)
- MASONRY (PLAN)
- WOOD, SIZE/TYPE AS NOTED (PLAN)
- WOOD, SIZE/TYPE AS NOTED (SECTION)
- RIP RAP (PLAN/SECTION)
- RIGID INSULATION (SECTION)
- ASPHALT CONCRETE PAVEMENT SURFACE (PLAN/SECTION)
- GRASS/VEGETATION (PLAN)
- BATT INSULATION (SECTION)
- NEW CONSTRUCTION
- EXISTING
- EXISTING TO BE REMOVED OR DEMOLISHED
- CLEARING AND GRUBBING
- ASPHALT
- GRASS/VEGETATION
- GRAVEL

PRELIMINARY
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CHUGACH
POWERING ALASKA'S FUTURE

MEA
MATANUSKA ELECTRIC ASSOCIATION

MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS

STANDARD SYMBOLS

DESIGNED S. ELLENSON
DRAWN F. HABER
CHECKED J. BOAG
PROJECT DATE 04/26/24

DRAWING
G004

JOB NO: 000000

INSTRUMENTATION / EQUIPMENT TAGS

EXAMPLE INSTRUMENT CALLOUT

INSTRUMENT IDENTIFICATION — EEE / PLU — CLARIFYING P&ID ABBREVIATIONS (BBB) — DEVICE TAG NUMBER

EXAMPLE EQUIPMENT CALLOUT

EQUIPMENT IDENTIFICATION — (EEE-PLU) — DEVICE TAG NUMBER

EXAMPLE TAG

GGGG - FFF - EEE - P L U

- PROJECT DESIGNATION
- FEATURE DESIGNATION
- INSTRUMENT / EQUIPMENT IDENTIFICATION(1 TO 3 CHARACTERS)
- DEVICE TAG NUMBER (3 DIGIT)
- UNIT NUMBER WITHIN GIVEN LOOP (1 DIGIT)
- LOOP NUMBER WITHIN GIVEN PROCESS (1 DIGIT)
- PROCESS NUMBER (1 DIGIT)

PROCESS NUMBER:

0 MPH COMMON
1 TURBINE/GENERATOR
2 PUMPS/MOTORS
3 TIV
4 HVAC
5 LUBE/WATER COOLING
6 HPU
7 PLUMBING
8 VFD
9 CONTROLS INSTRUMENTATION

NOTE:

PROJECT AND FEATURE DESIGNATION FOR ALL COMPONENTS ON THIS FEATURE SET SHALL BE "EFWP-DOM" FOR "EKLUTNA FISH & WILDLIFE PROJECT - DAM SPILLWAY MODIFICATIONS". THIS HAS BEEN OMITTED ON THE DRAWINGS FOR BREVITY.

GENERAL INSTRUMENT OR FUNCTIONAL SYMBOLS

	FIELD MOUNTED	PRIMARY OR PANEL MOUNTED - ACCESSIBLE (1)	PRIMARY OR PANEL MOUNTED - INACCESSIBLE (2)	SECONDARY OR MCC MOUNTED - ACCESSIBLE (1)	SECONDARY OR MCC MOUNTED - INACCESSIBLE (2)
INSTRUMENT	EEE PLU	EEE PLU	EEE PLU	EEE PLU	EEE PLU
SHARED DISPLAY SHARED CONTROL OR HMI	EEE PLU	EEE PLU	EEE PLU	EEE PLU	EEE PLU
INDICATING LIGHTS	EEE PLU	EEE PLU	N/A	EEE PLU	N/A

(1) NORMALLY ACCESSIBLE TO OPERATOR
(2) NORMALLY INACCESSIBLE TO OPERATOR (BEHIND-THE-PANEL)

SPECIAL CASE INSTRUMENT OR FUNCTIONAL SYMBOLS

- SINGLE INSTRUMENT OR OTHER COMPONENT HAVING MULTIPLE FUNCTIONS
- RELAY INTERLOCK LOGIC - SEE SCHEMATICS OR SPECIFICATIONS FOR MORE INFORMATION
- LSH PLU — LEVEL (FLOAT)
- LE PLU — LEVEL (ULTRASONIC)
- 24 VDC — POWER SUPPLY (SIZE AS NOTED)
- AS — AIR SUPPLY
- PRIMARY ELECTRICAL POWER (120V / 60 HZ UNLESS INDICATED OTHERWISE)
- * — INDICATES VENDOR PACKAGE
- CR — CONTROL RELAY
- LIGHTNING SURGE ARRESTOR
- M — MOTOR

SIGNAL SYSTEM INTERFACES

- AA PLU — ANALOG INPUT
- AA PLU — ANALOG OUTPUT
- AA PLU X — DISCRETE INPUT
- AA PLU X — DISCRETE OUTPUT
- AA PLU YY — DIGITAL DATA SIGNAL

AA = I/O DESIGNATION (MV = MULTIVARIABLE)

YY = DIGITAL PROTOCOL

X: H-MAINTAINED/LATCHING
M = MOMENTARY/FOLLOWER

ANALOG I/O DESIGNATORS

CR	CHLORINE RESIDUAL
DP	DIFFERENTIAL PRESSURE
FL	FLOW
LE	LOWER EXPLOSIVE LIMIT
LV	LEVEL
MO	MANIPULATED OUTPUT
PH	ACIDITY
PO	POSITION
PR	PRESSURE
PV	PROCESS VARIABLE
SP	SPEED
TE	TEMPERATURE
TU	TURBIDITY

DIGITAL PROTOCOL DESIGNATORS

DN	DEVICENET
IP	ETHERNET /IP
MB	MODBUS RTU
PB	PROFIBUS
PL	PARALLEL
SL	SERIAL
TC	MODBUS TCP

DISCRETE I/O DESIGNATORS

AM	AUTO-MANUAL
AU	AUTO
CL	CLOSED
EN	ENABLE
EL	POWER AVAILABLE
FA	FIRE ALARM
FW	FORWARD / REVERSE
HH	HI-HI LEVEL
HI	HI LEVEL
LL	LOW-LOW LEVEL
LO	LOW LEVEL
MN	MANUAL
OO	ON-OFF
OP	OPEN
RB	RUN BOOSTER
RC	RUN CLOSED
RE	REMOTE
RF	RUN FORWARD
RG	RUNNING
RN	RUN-STOP
RO	RUN-OPEN
RR	RUN-REVERSE
RV	REVERSE
YA	FAULT
SU	SUPERVISORY
SW	SELECTION
TR	TROUBLE

INSTRUMENTATION IDENTIFICATION TABLE (ISA)

	FIRST LETTER		SUCCEEDING LETTER(S)		
LETTER	MEASURED INITIATING VARIABLE	VARIABLE MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT OR ACTIVE FUNCTION	FUNCTION MODIFIER
A	ANALYSIS (+)		ALARM		
B	BURNER, COMBUSTION				
C	CONDUCTIVITY			CONTROL	CLOSED
D	DENSITY (S.G.)	DIFFERENTIAL			
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			
G	GAUGE		GLASS, GAUGE, VIEWING DEVICE	GATE	
H	HAND (MANUAL)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOTION	MOMENTARY			MIDDLE, INTERMEDIATE
N	TORQUE		ISOLATE	ISOLATOR	
O	USER CHOICE		ORIFICE, RESTRICTION		OPEN
P	PRESSURE (VACUUM), PNEUMATIC		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION/ RESISTANCE (ELECTRICAL)		RECORD OR PRINT		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTI VARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	INTRUSION	X-AXIS			
Y	EVENT, STATE OR PRESENCE	Y-AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z-AXIS		DRIVER, ACTUATOR, FINAL CONTROL ELEMENT	

EQUIPMENT IDENTIFICATION TABLE

AC	AIR COMPRESSOR	GEN	GENERATOR	PV	PHOTOVOLTAIC
ACC	ACCUMULATOR	GSU	GENERATOR STEP-UP TRANSFORMER	RCT	RECTIFIER
ACT	ACTUATOR	GTC	GENERATOR POWER TERMINAL CABINET	RIO	REMOTE I/O UNIT
AF	AIR FILTER	HB	HOSE BIB	RTD	RESISTANCE TEMPERATURE DETECTOR
AFD	ADJUSTABLE FREQUENCY DRIVE	HMI	HUMAN-MACHINE INTERFACE	RTU	REMOTE TELEMETRY UNIT
AH	AIR HANDLING UNIT	HOI	HOIST/CRANE	SEC	SECURITY CONTROL PANEL
ARC	ARC PLENUM AND EXHAUST DUCT	HPU	HYDRAULIC POWER UNIT	SEP	SEPTIC SYSTEM
ATS	AUTOMATIC TRANSFER SWITCH	HTR	HEATER	SHG	SODIUM HYPOCHLORITE GENERATOR
BAT	BATTERY	INV	INVERTER	SNK	SINK
BC	BATTERY CHARGER	LCP	LOCAL CONTROL PANEL	SPU	SPEED PICKUP SENSOR
BRG	BEARING	LCS	LOCAL CONTROL STATION	STR	STRAINER
BRK	BREAKER	LPU	LUBRICATING OIL PUMP CONTROL UNIT	SVR	SERVER
CAM	CAMERA	MB	METER BASE	SWG	SWITCHGEAR
CSE	COMBINATION SERVICE ENCLOSURE	MC	MECHANICAL COUPLING	TIV	TURBINE INLET VALVE
CV	CHECK VALVE	MCC	MOTOR CONTROL CENTER	TNK	TANK
D	DAMPER	MCP	MAIN CONTROL PANEL	TOI	WATER CLOSET
DCU	DISTRIBUTED CONTROL UNIT	MES	MANAGED ETHERNET SWITCH	TRS	TRAVELING SCREEN
DS	DISCONNECT	MOV	MOTOR OPERATED VALVE	TUR	TURBINE
EAP	ENGINEERING ACCESS POINT	MS	MOTOR STARTER	UPS	UNINTERRUPTABLE POWER SUPPLY
ECP	ENVIRONMENTAL CONTROL PANEL (HVAC)	MTR	MOTOR	UVR	UV REACTOR
EEW	EMERGENCY EYEWASH STATION	MTS	MANUAL TRANSFER SWITCH	V	VALVE
EF	EXHAUST FAN	NET	NETWORK / COMMUNICATIONS RACK	VCP	VENDOR CONTROL PANEL
EXC	EXCITER	OWS	OIL WATER SEPARATOR	VFD	VARIABLE FREQUENCY DRIVE
FAS	FIRE ALARM SYSTEM	P	PUMP	VL	VENTILATION LOUVER
FD	FLOOR DRAIN	PB	PANELBOARD / LOAD CENTER	VSP	VENDOR SUPPLIED PANEL
FIL	FILTER	PCP	PLANT CONTROL PANEL	WS	WATER SOFTENER
FOR	FIBER OPTIC REPEATER	PCU	POWER CONTROL UNIT	XFR	TRANSFORMER
FOT	FIBER OPTIC TRANSCEIVER	PFL	PRE-FILTER	XVR	TRANSCEIVER
FPP	FIBER PATCH PANEL / CONNECTOR HOUSING	PLC	PROGRAMMABLE LOGIC CONTROLLER	YLT	EVENT PILOT LIGHT
G	GATE	PRV	PRESSURE REDUCING VALVE	ZZK	SECURITY GATE INTERFACE
GBK	GENERATOR BRAKE	PS	POWER SUPPLY / ISOLATOR / CONVERTER		

INSTRUMENTATION LINE SYMBOLOGY

- PRIMARY PROCESS (CLOSED CONDUIT, DASHED LINE INDICATES ALTERNATE FLOW STREAM)
- PRIMARY PROCESS (OPEN CHANNEL)
- ANALOG SIGNAL, (4 TO 20 mAdc, ECT)
- DISCRETE SIGNAL, (ON/OFF, ECT)
- PNEUMATIC SIGNAL
- FILLED SYSTEM SIGNAL
- HYDRAULIC SYSTEM SIGNAL
- DIGITAL DATA LINK
- PACKAGE SYSTEM EQUIPMENT
- STRUCTURE/FACILITY BOUNDARY
- CABLE FURNISHED WITH EQUIPMENT
- MECHANICAL POWER/LINKAGE
- ELECTRICAL POWER

PARALLELING LINES

(2) (A) 3 (2) (B)

(A) TOTAL OF 2 SIGNALS

(B) 3 TYPICAL SETS OF 2 SIGNALS EACH. TOTAL OF 6 SIGNALS.

CONNECTING LINES

NON-CONNECTING LINES

SYSTEM CONTINUATION INTERFACES

- GG ISSS — SIGNAL INTERFACE — GG IDDD
- HH ISSS — PROCESS INTERFACE — HH IDDD
- INTERFACE TO OR FROM PROCESS EXTERNAL TO PROJECT
- PROCESS OR SIGNAL LINE ON-SHEET CONTINUATION (N) N=1,2,3,ETC

GG SIGNAL INTERFACE NO.
HH PROCESS INTERFACE NO.
DDD DESTINATION DRAWING NO.
SSS SOURCE DRAWING NO.

P&ID ABBREVIATIONS

AC	ALTERNATING CURRENT
AM	AUTO-MANUAL
COD	CHEMICAL OXYGEN DEMAND
DEV	DEVIATION
DC	DIRECT CURRENT
DCS	DISTRIBUTED CONTROL SYSTEM
ECS	ENVIRONMENTAL CONTROL SYSTEM (HVAC)
EPO	EMERGENCY POWER OFF
FOC	FIBER OPTIC CABLE
FOS	FAST-OFF-SLOW
FOSA	FAST-OFF-SLOW-AUTO
FOSR	FAST-OFF-SLOW-REMOTE
HI	HIGH
HML	HIGH-MID-LOW
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
ISR	INTRINSICALLY SAFE RELAY
LEL	LOWER EXPLOSIVE LIMIT
LO	LOW
LOR	LOCAL-OFF-REMOTE
LOS	LOCKOUT STOP
LR	LOCAL-REMOTE
MC	MODULATE-CLOSE
MOA	MANUAL-OFF-AUTO
MSC	MANUFACTURER SUPPLIED CABLE
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OC	OPEN-CLOSE(D)
OCA	OPEN-CLOSE-AUTO
OCR	OPEN-CLOSE-REMOTE
OI	OPERATOR INTERFACE
OO	ON-OFF
OOA	ON-OFF-AUTO
OOR	ON-OFF-REMOTE
ORP	OXIDATION REDUCTION POTENTIAL
OSC	OPEN-STOP-CLOSE
PC	PERSONAL COMPUTER
PCS	PLANT CONTROL SYSTEM
pH	HYDROGEN ION CONCENTRATION
PID	PROPORTIONAL INTEGRAL DERIVATIVE CONTROL
POT	POTENTIOMETER
RC	RUN CLOSE
RO	RUN OPEN
RL	RAISE-LOWER
RM	REMOTE MULTIPLEXING MODULE
RSL	RAISE-STOP-LOWER
RVSS	REDUCED VOLTAGE SOLID-STATE STARTER
SCADA	SUPERVISORY CONTROL AND DATA ACQUISITION
SEL	SELECT
SET	SET POINT
SF	SLOWER-FASTER
SHC	SODIUM HYPOCHLORITE
SR	START-RESET
SS	START-STOP
SSC	SUPERVISORY SET POINT CONTROL
ST	START
SW	SEAL WATER
TC	THERMOCOUPLE
TCR	TOTAL CHLORINE RESIDUAL
TEMP	TEMPERATURE
TSP	TWISTED SHIELD PAIR
TURB	TURBIDITY
VHC	VOLATILE HYDROCARBONS
VIB	VIBRATION
VSP	VENDOR SUPPLIED PANEL
VTO	VENT TO OUTSIDE
WSEL	WATER SURFACE ELEVATION

NOTES:

1. FOR MECHANICAL ELEMENT SYMBOLS, SEE MECHANICAL LEGEND.
2. FOR ELECTRICAL ELEMENT SYMBOLS, SEE ELECTRICAL LEGEND.

PRELIMINARY
NOT FOR CONSTRUCTION

Path: C:\Vault\Chugach Electric\24-021 Eklutna Spillway Modification\G005.dwg Plot date: Apr 23, 2024 03:42pm, CAD User: WoodRon

REV	DATE	BY	DESCRIPTION
A	04/26/24	SPE	15% DESIGN

WARNING

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

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CHUGACH POWERING ALASKA'S FUTURE

MEA MATANUSKA ELECTRIC ASSOCIATION

MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT

EKLUTNA DAM SPILLWAY MODIFICATIONS

INSTRUMENTATION AND EQUIPMENT LEGEND

DESIGNED S. ELLENSON
DRAWN F. HABER
CHECKED J. BOAG
PROJECT DATE 04/26/24

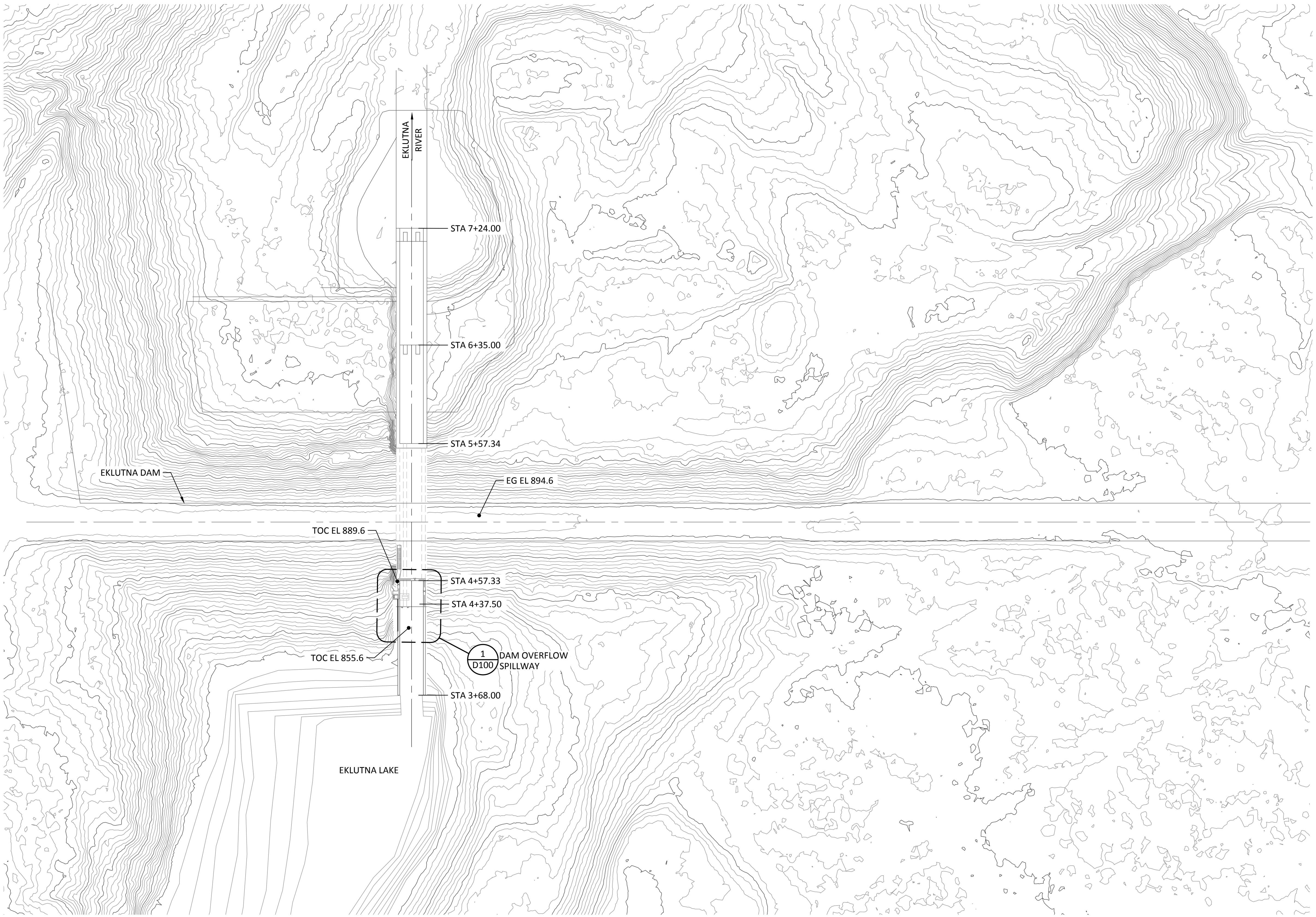
DRAWING

G005

JOB NO: 000000

SHEET NOTES:

1. ELEVATIONS SHOWN ARE IN NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).



DEMOLITION KEY PLAN

SCALE: 1"= 40'

0' 40' 80'

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EKLUTNA FISH & WILDLIFE PROJECT

EKLUTNA DAM SPILLWAY MODIFICATIONS

DEMOLITION KEY PLAN

DESIGNED S. ELLENSON

DRAWN F. HABER

CHECKED J. BOAG

PROJECT DATE 04/26/24

DRAWING

D001

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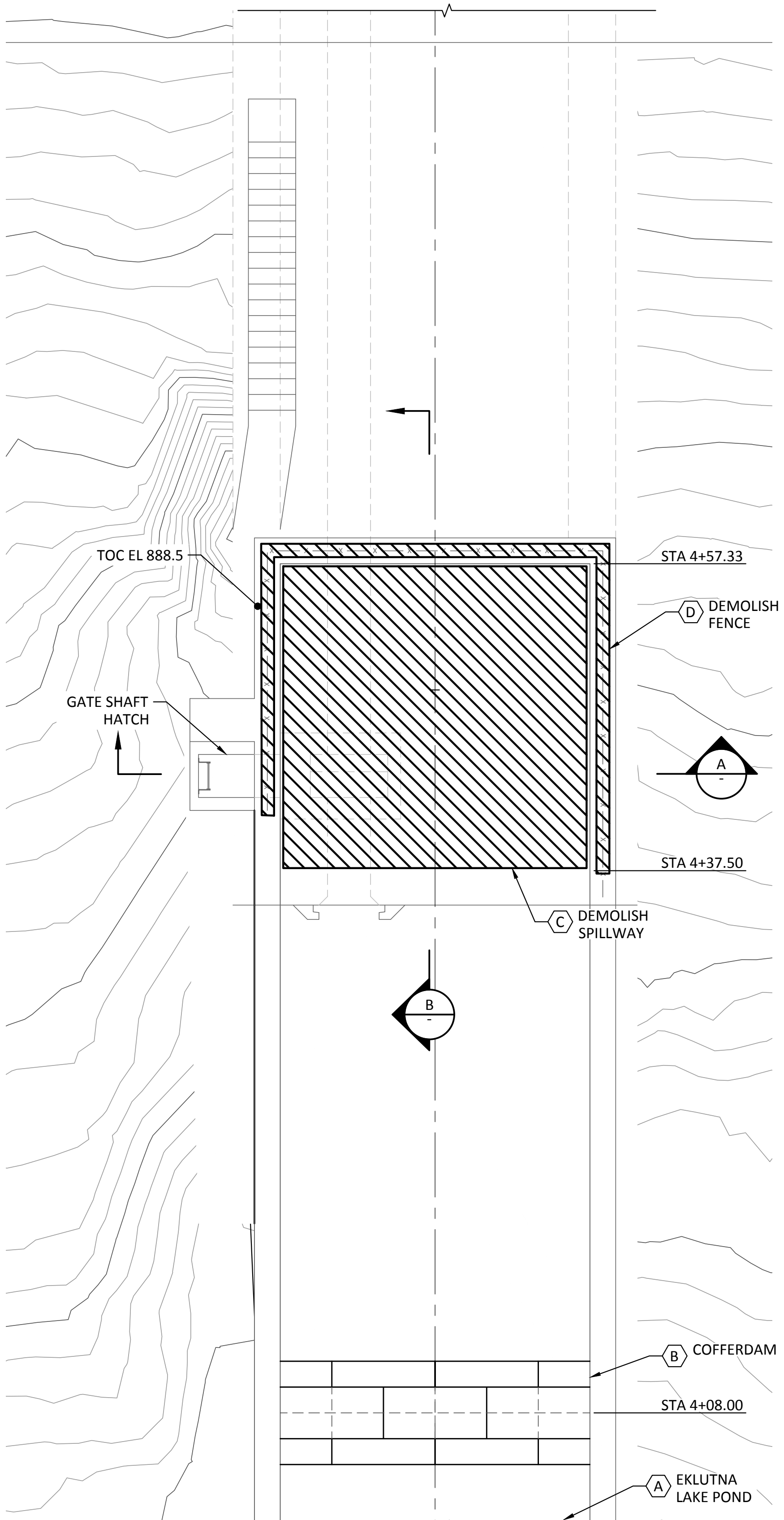
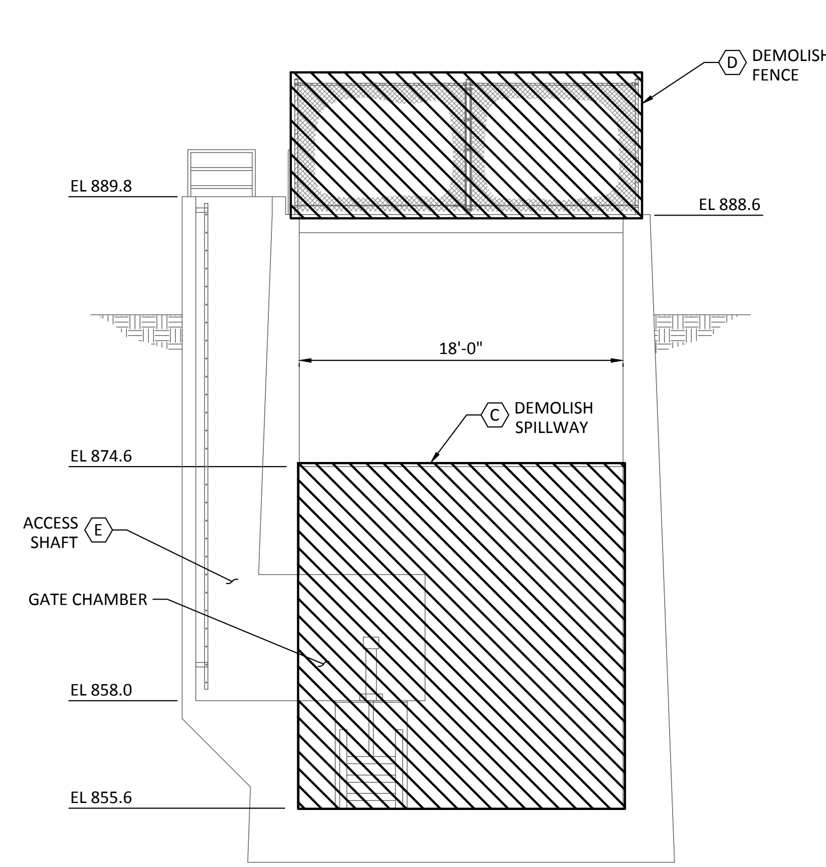
JOB NO: 000000



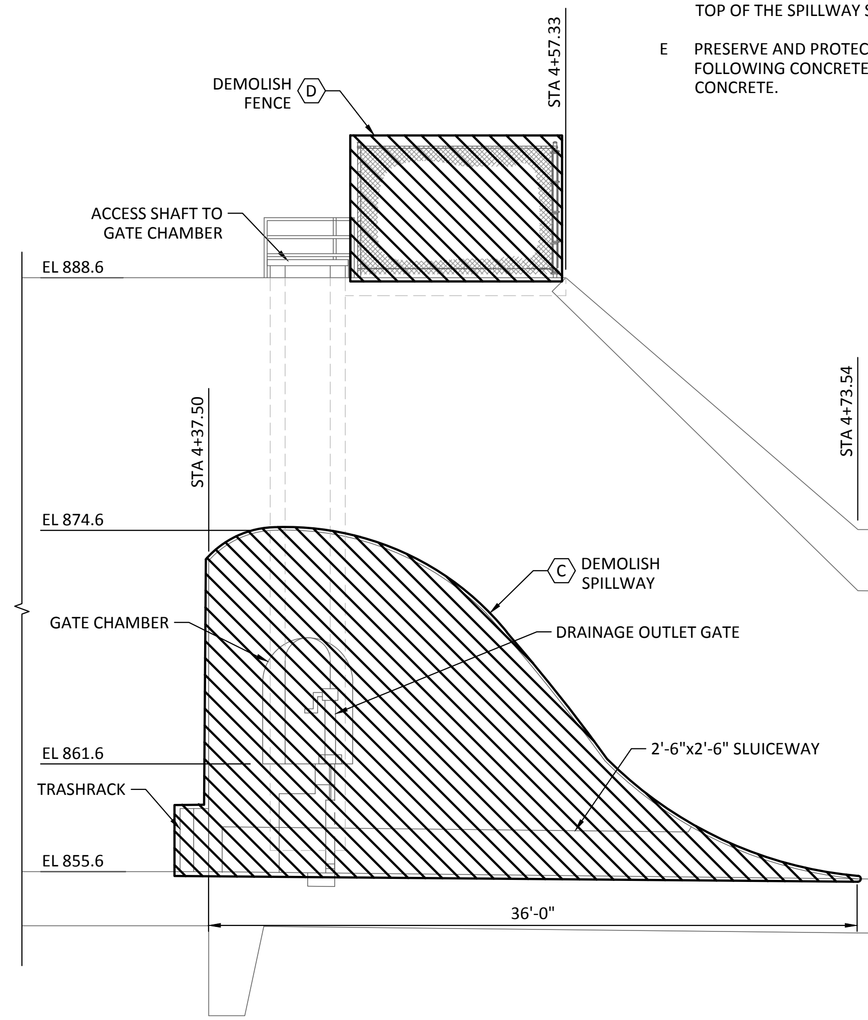
SPILLWAY DETAIL

SCALE: 1"= 5'



A - SPILLWAY SECTION

SCALE: 3/16"= 1'-0"



B - SPILLWAY SECTION

SCALE: 3/16"= 1'-0"

SHEET NOTES:

1. ELEVATIONS SHOWN ARE IN NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

SHEET KEY NOTES:

A PRIOR TO BEGINNING WORK, DRAIN THE EKLUTNA LAKE POND THROUGH THE EXISTING DRAINAGE OUTLET GATE WITHIN THE DAM SPILLWAY. THIS SHALL OCCUR IN THE SPRING WHEN EKLUTNA LAKE IS DISCONNECTED FROM THE DAM.

B A COFFERDAM SHALL BE CONSTRUCTED AT THE INLET TO THE DAM SPILLWAY. DESIGN OF COFFERDAM AND DEWATERING SYSTEM SHALL BE DEVELOPED BY THE CONTRACTOR AND SUBMIT TO THE ENGINEER FOR APPROVAL.

C DEMOLISH AND DISPOSE OF EXISTING OGEE CREST SPILLWAY, APPROXIMATELY 235 CY OF CONCRETE.

D DEMOLISH AND DISPOSE OF CHAIN LINK FENCE LOCATED ON TOP OF THE SPILLWAY STRUCTURE.

E PRESERVE AND PROTECT OPENING TO ACCESS SHAFT FOLLOWING CONCRETE DEMOLITION. REPAIR ANY DAMAGED CONCRETE.

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MEA MATANUSKA ELECTRIC ASSOCIATION

MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT

EKLUTNA DAM SPILLWAY MODIFICATIONS

EKLUTNA DAM SPILLWAY DEMOLITION PLAN, SECTIONS, AND DETAILS

DESIGNED S. ELLENSON
DRAWN F. HABER
CHECKED J. BOAG
PROJECT DATE 04/26/24

DRAWING D100

JOB NO: 000000

Path: C:\Vault\Chugach Electric\24-021 Eklutna Spillway Modification\D100.dwg Plot date: Apr 23, 2024 03:43pm, CAD User: WoodRon

SHEET KEY NOTES:

A DEMOLISH AND DISPOSE OF EXISTING OGEE CREST SPILLWAY, APPROXIMATELY 235 CY OF CONCRETE.

B DEMOLISH AND DISPOSE OF CHAIN LINK FENCE LOCATED ON TOP OF THE SPILLWAY STRUCTURE.

1 D100 PHOTO

1 D100 PHOTO

PRELIMINARY NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
A	04/26/24	SPE	15% DESIGN

WARNING
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MEA MATANUSKA ELECTRIC ASSOCIATION

MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS

EKLUTNA DAM SPILLWAY DEMOLITION PHOTOS

DESIGNED S. ELLENSON
DRAWN F. HABER
CHECKED J. BOAG
PROJECT DATE 04/26/24

DRAWING D101

JOB NO: 000000

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GENERAL STRUCTURAL NOTES:
THE FOLLOWING NOTES ARE GENERAL AND APPLY TO THE ENTIRE PROJECT, UNLESS SPECIFICALLY NOTED OTHERWISE (UNO)

1) GENERAL:

A. CONSTRUCTION DOCUMENTS:
  1. THE CONTRACTOR SHALL REVIEW THE APPROVED CONTRACT DOCUMENTS AND NOTIFY THE ENGINEER OF ANY ERRORS OR DISCREPANCIES PRIOR TO THE START OF CONSTRUCTION.
  2. THE CONTRACTOR SHALL NOTIFY THE OWNER IMMEDIATELY IF ANY UNIDENTIFIED EXISTING UNDERGROUND UTILITIES ARE DISCOVERED.
  3. THE STRUCTURAL CONTRACT DRAWINGS REPRESENT THE FINISHED STRUCTURE. THEY DO NOT INDICATE THE METHOD OF CONSTRUCTION. THE CONTRACTOR SHALL PROVIDE ALL MEASURES NECESSARY TO PROTECT THE STRUCTURE DURING CONSTRUCTION. SUCH MEASURES SHALL INCLUDE, BUT ARE NOT LIMITED TO, BRACING AND/OR SHORING FOR LOADS DUE TO CONSTRUCTION EQUIPMENT, ETC.
  4. UNDER NO CIRCUMSTANCES CAN STRUCTURAL COMPONENTS BE SUBSTITUTED, OMITTED, OR ALTERED FROM THE APPROVED SET OF CONSTRUCTION DOCUMENTS WITHOUT WRITTEN APPROVAL FROM THE ENGINEER.

B. DIMENSIONS AND NOTATIONS:
  1. WRITTEN DIMENSIONS SHALL TAKE PRECEDENCE OVER SCALED DIMENSIONS. DO NOT SCALE DRAWINGS.
  2. ABBREVIATIONS USED ON THE APPROVED CONSTRUCTION DOCUMENTS SHALL BE CONSIDERED TYPICAL ABBREVIATIONS FOR THE INDUSTRY. THE CONTRACTOR SHALL BE RESPONSIBLE TO NOTIFY THE ENGINEER IMMEDIATELY OF ANY ABBREVIATIONS THAT ARE UNKNOWN TO THE CONTRACTOR.

C. TYPICAL NOTES AND DETAILS:
  1. SPECIFIC NOTES AND DETAILS SHALL TAKE PRECEDENCE OVER STANDARD TYPICAL NOTES AND DETAILS.
  2. STANDARD TYPICAL NOTES AND DETAILS ARE TO BE USED WHEN REFERRED TO OR WHEN NO OTHER MORE RESTRICTIVE OR DIFFERENT DETAILS ARE SHOWN ON THE DRAWINGS.
  3. WORK NOT PARTICULARLY SHOWN OR SPECIFIED SHALL BE THE SAME AS SIMILAR PARTS THAT ARE SHOWN OR SPECIFIED.

D. CODE REQUIREMENTS:
  1. ALL WORK SHALL CONFORM TO THE MINIMUM STANDARDS OF REGULATING AGENCIES WHICH MAY HAVE AUTHORITY OVER ANY PORTION OF THE WORK.
  2. SPECIFICATIONS, CODES AND STANDARDS NOTED SHALL BE OF THE LATEST APPROVED ISSUE, INCLUDING SUPPLEMENTS, UNLESS NOTED OTHERWISE.
  3. MINIMUM UNIFORM (BLANKET) ROOF SNOW LOAD, AS DEFINED BY LOCAL BUILDING OFFICIAL OR STATE, SHALL BE DESIGNED FOR, AND IT IS THE RESPONSIBILITY OF THE MBSS ENGINEER TO CONFIRM IF ONE EXISTS BY CONTACTING THE LOCAL BUILDING OFFICIAL.

E. DEFERRED SUBMITTALS:
  1. DEFERRED STRUCTURE SUBMITTAL ITEMS HAVE NOT BEEN PERMITTED UNDER THE BASE BUILDING APPLICATION.
  2. THE CONTRACTOR SHALL SUBMIT COMPONENT SYSTEM DOCUMENTS FOR DEFERRED SUBMITTAL ITEMS, STAMPED BY A PROFESSIONAL ENGINEER LICENSED IN THE JURISDICTION HAVING AUTHORITY, TO THE REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE FOR REVIEW AND FORWARD THE REVIEWED DOCUMENTS TO THE BUILDING OFFICIAL IN COMPLIANCE WITH SECTION 107.3.4.1 OF THE CBC.
  3. DEFERRED SUBMITTAL ITEMS SHALL NOT BE INSTALLED UNTIL THE COMPONENT SYSTEM DOCUMENTS HAVE BEEN APPROVED BY THE BUILDING OFFICIAL.
  4. THE FOLLOWING CONTRACTOR-DESIGNED PROJECT ELEMENTS ARE DEFINED AS DEFERRED STRUCTURAL SUBMITTAL ITEMS:

     PRE-ENGINEERED METAL BUILDINGS

2) CODES, STANDARDS, AND REFERENCES:

A. ASCE 7-16: MINIMUM DESIGN LOADS AND ASSOCIATED CRITERIA FOR BUILDINGS AND OTHER STRUCTURES.
B. ACI 318-14: BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE.
C. ACI 350-06: CODE REQUIREMENTS FOR ENVIRONMENTAL ENGINEERING CONCRETE STRUCTURES.
D. AISC 360-16 SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS.

3) GRATING:

A. UNLESS INDICATED OTHERWISE, ALL GRATING SHALL BE FAS INDICATED IN THE DRAWINGS, OR APPROVED EQUAL.
B. WEIGHT OF GRATING SECTION SHALL NOT EXCEED 80 LBS.
C. PROVIDE A MINIMUM OF 4 CLIPS PER GRATING PANEL, APPROX 4" FROM PANEL CORNERS.
D. WIDTH OF GRATING SECTIONS SHALL NOT EXCEED 3'-0".
E. SHOP DRAWINGS BASED ON FIELD DIMENSIONS SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO FABRICATION.
F. PROVIDE GRATING FASTENERS AS REQUIRED.
G. THE HORIZONTAL CLEARANCE BETWEEN THE GRATING AND GRATING SUPPORTS SHALL NOT BE LESS THAN 1/4" NOR GREATER THAN 1/2"
H. ALL GRATING SECTIONS, WHEN IN PLACE, SHALL ALWAYS BE FIRMLY ANCHORED TO THEIR SUPPORTS.
I. PROVIDE MINIMUM BEARING PER MANUFACTURERS RECOMMENDATIONS FOR ALL GRATING.

4) NON-SHRINK GROUT:

1. ALL GROUT WORK SHALL CONFORM TO THE LATEST EDITION OF ACI 301.
2. FORMWORK: DESIGN, ERECT, SUPPORT, BRACE AND MAINTAIN FORMWORK TO SUPPORT VERTICAL, LATERAL, STATIC AND DYNAMIC LOADS THAT MIGHT BE APPLIED UNTIL STRUCTURE CAN SUPPORT SUCH LOADS.

5) STRUCTURAL AND MISCELLANEOUS STEEL:

A. STRUCTURAL STEEL SHALL CONFORM TO THE FOLLOWING ASTM STANDARDS:
  a) WIDE FLANGE SHAPES — A992, GR 50 GALV
  b) OTHER SHAPES, PLATES, ANGLES AND BARS — A36 GALV
  c) STEEL PIPE — A53, GRADE B GALV
  d) HOLLOW STRUCTURAL SECTIONS — A500, GRADE B GALV
B. WELDS: PROVIDE 70KSI LOW HYDROGEN ELECTRODE OR PROCESS IN ACCORDANCE WITH AWS A5.1.
C. BOLTS, U.N.O.:
  1. STAINLESS STEEL: ASTM A193, GRADE 8, CLASS 2, AISI TYPE 316
D. DRILL AND EPOXY ANCHOR BOLTS:
  1. STAINLESS STEEL ASTM A193, GRADE 8, CLASS 2, AISI TYPE 316 OR EQUAL APPROVED BY ENGINEER
E. EPOXY BOLT OR EXPANSION BOLT SUBSTITUTIONS FOR EMBEDDED BOLTS IS PROHIBITED WITHOUT WRITTEN CONSENT FROM THE ENGINEER.
F. UNLESS NOTED OTHERWISE ON THE DRAWINGS, ALL EPOXY BOLTS SHALL BE AS SPECIFIED.
G. ALL STRUCTURAL STEEL SHALL BE DETAILED, FABRICATED, AND ERECTED IN ACCORDANCE WITH THE AISC CODE OF STANDARD PRACTICE, EXCEPT AS MODIFIED IN THESE NOTES AND THE PROJECT SPECIFICATIONS.
H. ALL STAINLESS STEEL SHALL BE TYPE 316.
I. SPLICING OF STEEL MEMBERS, UNLESS SHOWN ON THE DRAWINGS, IS PROHIBITED WITHOUT WRITTEN APPROVAL OF THE PROJECT ENGINEER.
J. GALVANIC PROTECTION SHALL BE PROVIDED BETWEEN DISSIMILAR METALS.
K. WELDING SHOWN FOR STAINLESS STEEL ELEMENTS SHALL COMPLY WITH AWS D1.6/D1.6M.

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MEA MATANUSKA ELECTRIC ASSOCIATION

MUNICIPALITY OF ANCHORAGE

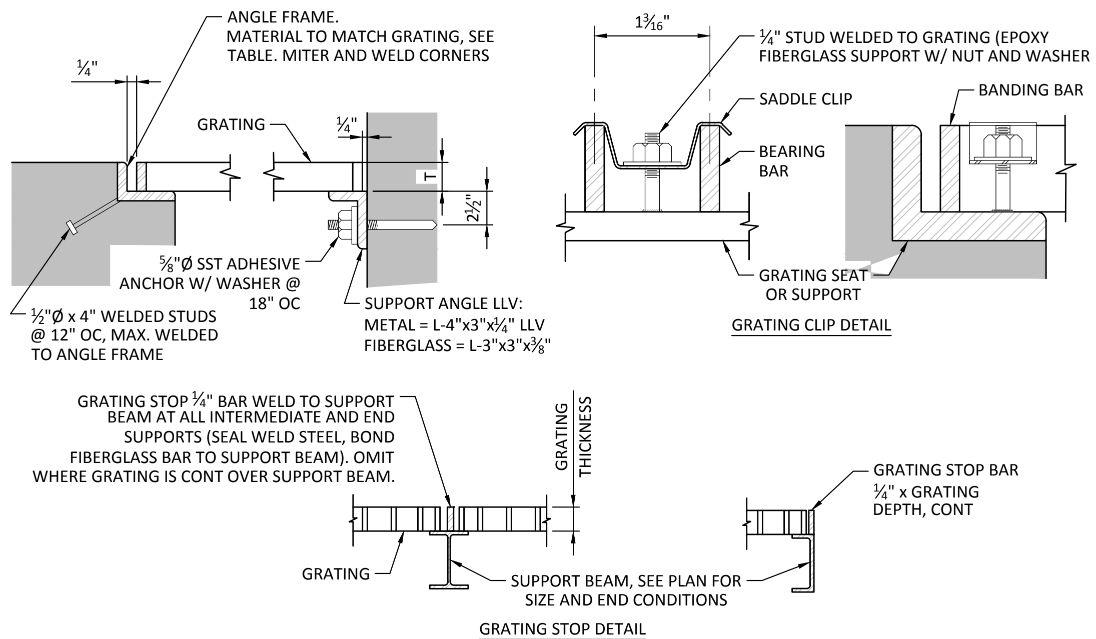
EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS
STRUCTURAL GENERAL NOTES

DESIGNED G. CLARK
DRAWN J. HOLT
CHECKED M. MERKLEIN
PROJECT DATE 04/26/24

DRAWING GS001

JOB NO: 000000

Path: C:\Vault\Chugach Electric\24-021 Eklutna Spillway Modification\GS001.dwg Plot date: Apr 23, 2024 03:43pm, CAD User: WoodRon

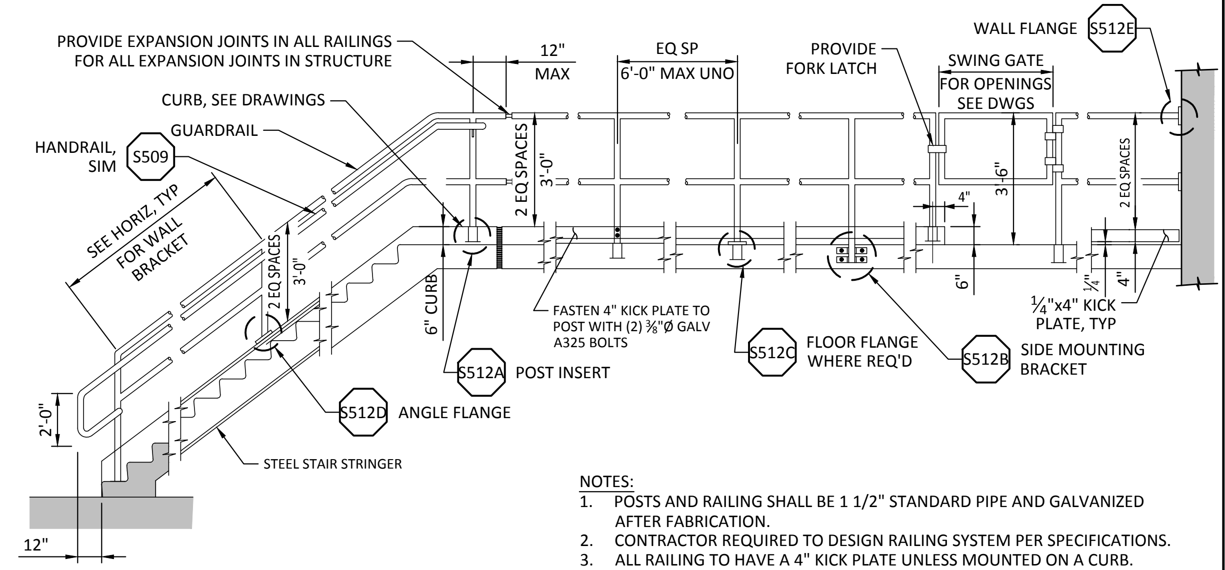


NOTES:
1. UNLESS INDICATED OTHERWISE, ALL GRATING SHALL BE ALUM.
2. GRATING DEPTH TO BE DETERMINED BY MANUFACTURER AND APPROVED BY ENGINEER, UNO.
3. ALL ENDS AND OPENINGS SHALL BE BANDED.
4. WEIGHT OF GRATING SECTION SHALL NOT EXCEED 80 LBS.
5. METAL BEARING BARS SHALL BE DEPTH T x 3/16" @ 1 3/16" OC.. CROSS BARS SHALL BE @ 4" OC.
6. PROVIDE A MINIMUM OF 4 CLIPS PER GRATING PANEL, APPROX 4" FROM PANEL CORNERS. MAXIMUM CLIP SPACING AT 36" OC.
7. MATERIALS:
   A. ALUM GRATING - USE ALUM ANGLE SUPPORTS AND SST BOLTS AND CLIPS. IF SUPPORTED BY STEEL BEAMS, USE STEEL STOP BARS. ALUM IN CONTACT WITH CONC OR STEEL SHALL BE COATED PER THE PROTECTIVE COATING SPECS.
   B. GALV STEEL GRATING - USE STEEL ANGLE SUPPORTS, BOLTS AND CLIPS. GALV AFTER FABRICATION.
   C. SST GRATING - USE SST ANGLE SUPPORTS, BOLTS AND CLIPS
   D. FIBERGLASS GRATING - USE FIBERGLASS FOR ALL COMPONENTS EXCEPT DRILLED ANCHORS; ALL CUT EDGES SHALL BE SEALED WITH RESIN; BONDING: USE EPOXY ADHESIVE BONDING AGENT

GRATING FRAME TABLE SIZED TO MATCH GRATING (FOR FIBERGLASS USE CONTINUOUS PROTRUDED FIBERGLASS SEAT & ANCHOR)			
GRATING DEPTH (T)	STEEL ANGLE (STEEL)	GRATING DEPTH (T)	STEEL ANGLE (STEEL)
1"	1¾ x 1¼ x ¼ (1¼ x 1¼ x ¼)	2"	*2½ x 2½ x ½
1¼"	2 x 1½ x ¼ (1½ x 1½ x ¼)	2¼"	2½ x 2½ x ¼
1½"	1¾ x 1¾ x ¼	2½"	3 x 3 x ½
1¾"	2 x 2 x ¼		

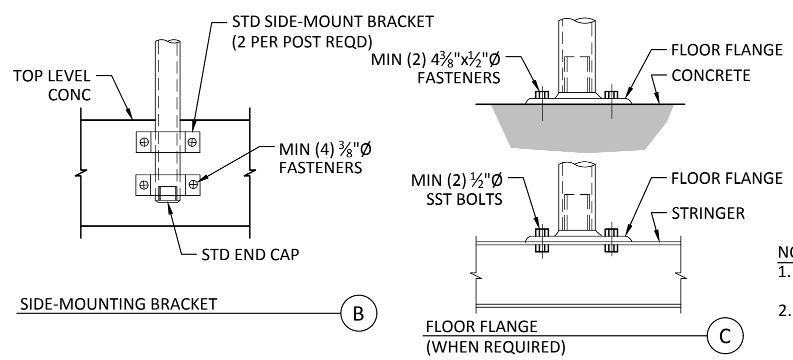
* OR USE 2½"x2½"x¼" W/ ¼" SHIM PLATE WELDED TO BOTTOM

S501 **GRATING**
SCALE: NTS



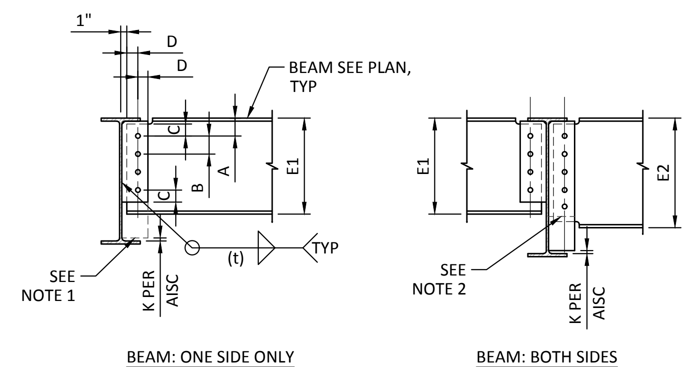
NOTES:
1. POSTS AND RAILING SHALL BE 1 1/2" STANDARD PIPE AND GALVANIZED AFTER FABRICATION.
2. CONTRACTOR REQUIRED TO DESIGN RAILING SYSTEM PER SPECIFICATIONS.
3. ALL RAILING TO HAVE A 4" KICK PLATE UNLESS MOUNTED ON A CURB.

S510 **TWO-RAIL RAILING GUARDRAIL DETAIL**
SCALE: NTS

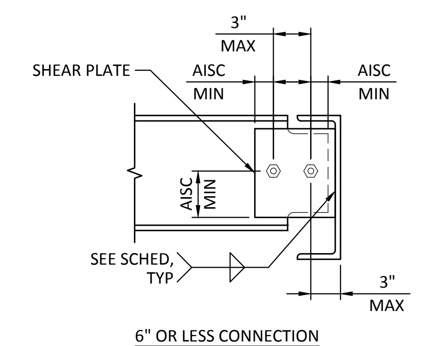


NOTES:
1. IF FASTENING TO CONCRETE, FASTENERS SHALL BE ADHESIVE ANCHORS.
2. CONTRACTOR REQUIRED TO DESIGN RAILING SYSTEM PER SPECIFICATIONS.

S512 **RAILING, GUARDRAIL AND HANDRAIL SUPPORT DETAIL**
SCALE: NTS

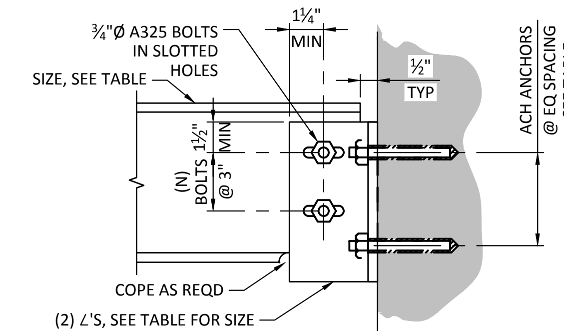


BEAM TO BEAM CONNECTION SCHEDULE								
BEAM SIZE	NO OF A325N BOLTS REQ'D		CONN PLATE THICKNESS (IN)	WELD SIZE (t)	A (IN)	B (IN)	C (IN)	D (IN)
	¾" Ø	1" Ø						
W8	2		5/16	3/16	2½"	2½"	1½"	1½"
W10	2		5/16	3/16	3	3	1½"	1½"



NOTES:
1. EXTEND CONN PLATE WHEN E1 IS GREATER THAN OR EQUAL TO W12 BM.
2. LIMIT OF CONN PLATE WHEN E2-E1 IS LESS THAN OR EQUAL TO 6 INCHES.

S562 **BEAM TO BEAM CONNECTION - PLATE CONNECTION**
SCALE: NTS



BEAM TO CONC CONNECTION SCHEDULE			
BEAM SIZE	DOUBLE ANGLE SIZE	# OF BOLTS (N)	ADHESIVE ANCHORS NUMBER AND SIZE

S563 **BEAM TO CONC CONNECTION**
SCALE: NTS

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MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS
STRUCTURAL STANDARD DETAILS

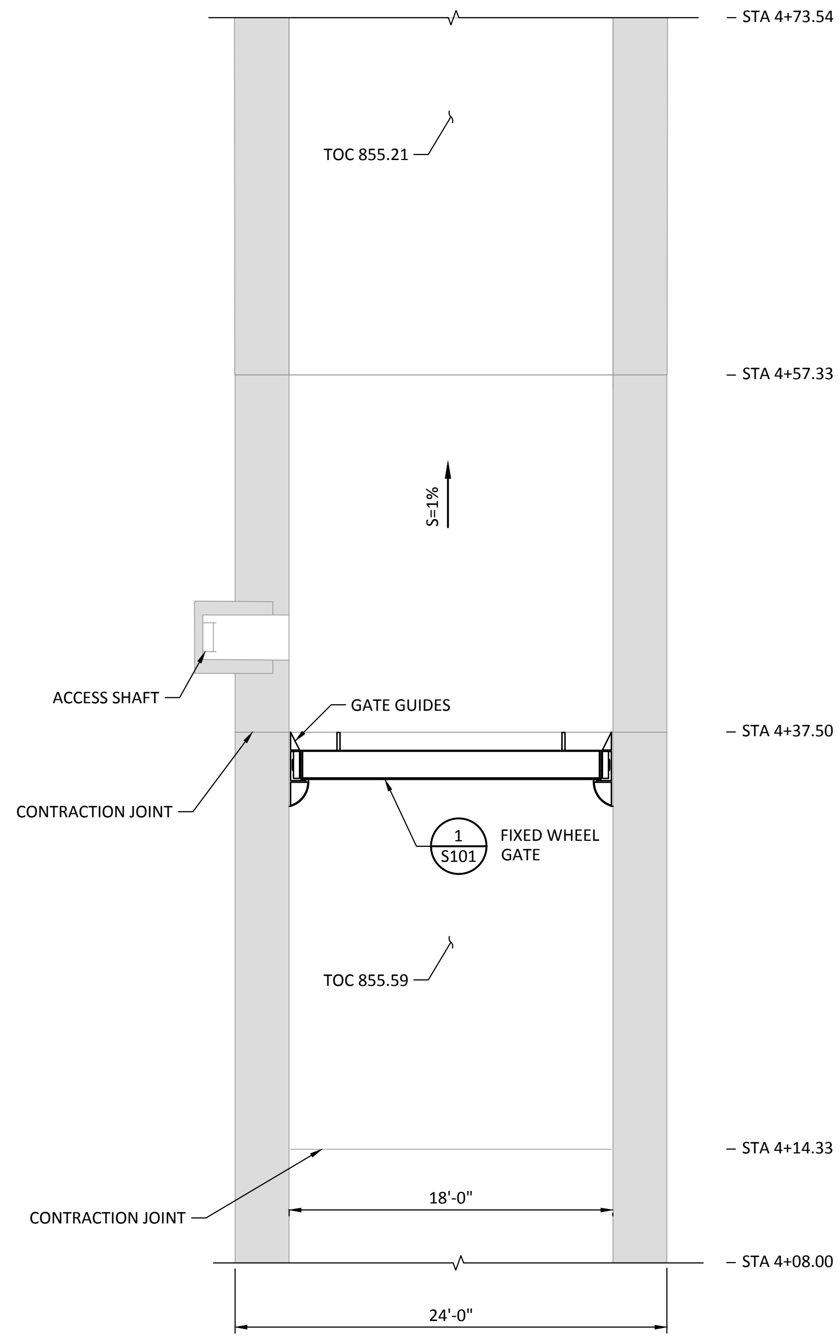
DESIGNED G. CLARK
DRAWN J. HOLT
CHECKED M. MERKLEIN
PROJECT DATE 04/26/24

DRAWING
GS002

JOB NO: 000000

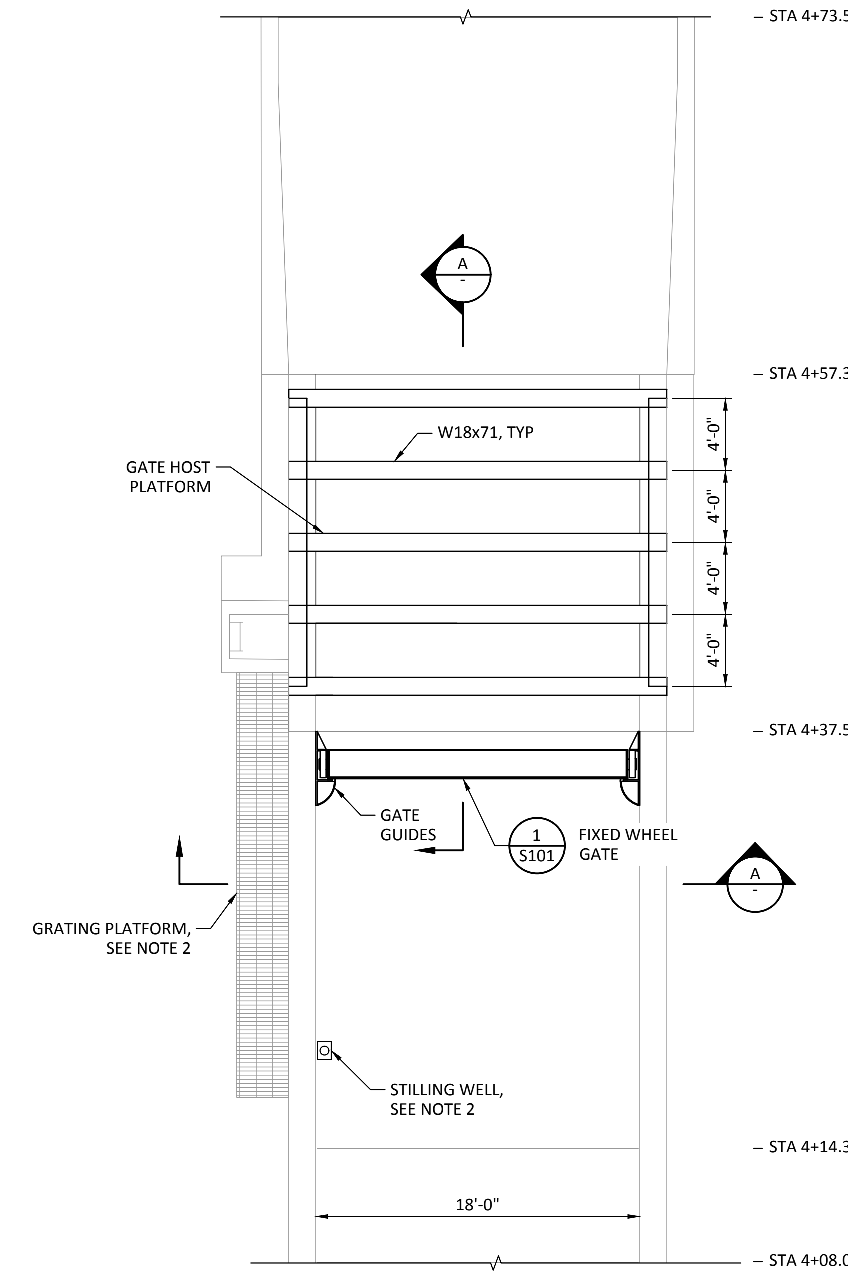
SHEET NOTES:

1. ELEVATIONS SHOWN ARE IN NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
2. GRATING PLATFORM AND STILLING WELL INSTALLED AS PART OF THE DAM OUTLET MODIFICATION WORK PRIOR TO THE SPILLWAY MODIFICATIONS BEING INITIATED. GRATING PLATFORM AND STILLING WELL SHALL BE PRESERVED AND PROTECTED AS PART OF THIS WORK EFFORT.



EKLUNTA DAM SPILLWAY STRUCTURAL PLAN - 862.0

SCALE: 3/16"= 1'-0"



EKLUNTA DAM SP[ILLWAY STRUCTURAL PLAN - EL. 888.6

SCALE: 3/16"= 1'-0"

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EKLUTNA DAM SPILLWAY STRUCTURAL PLANS

DESIGNED G. CLARK
DRAWN J. HOLT
CHECKED M. MERKLEIN
PROJECT DATE 04/26/24

DRAWING
S100

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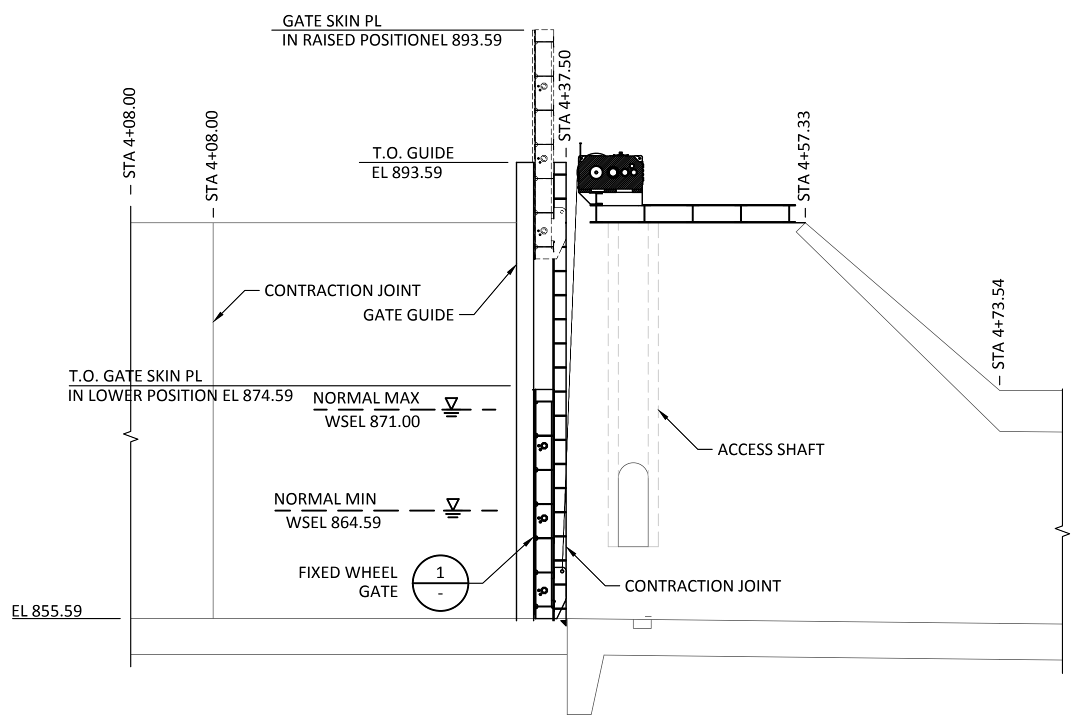
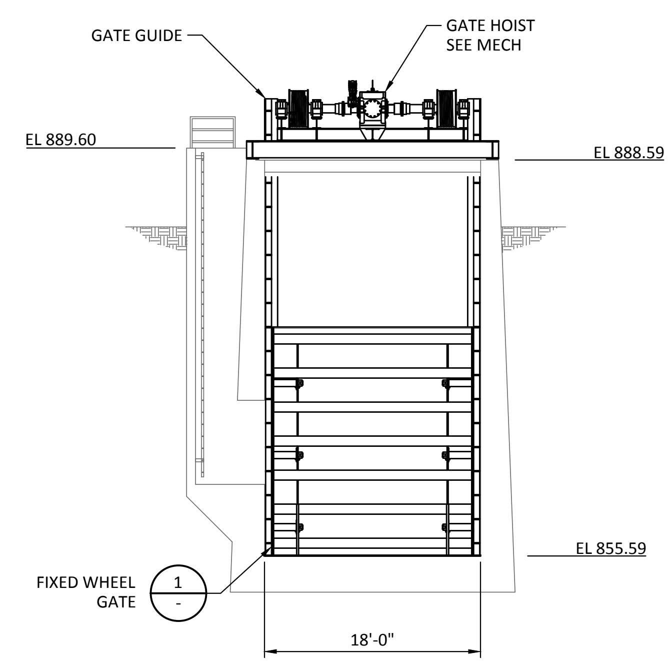
JOB NO: 000000

SHEET NOTE:

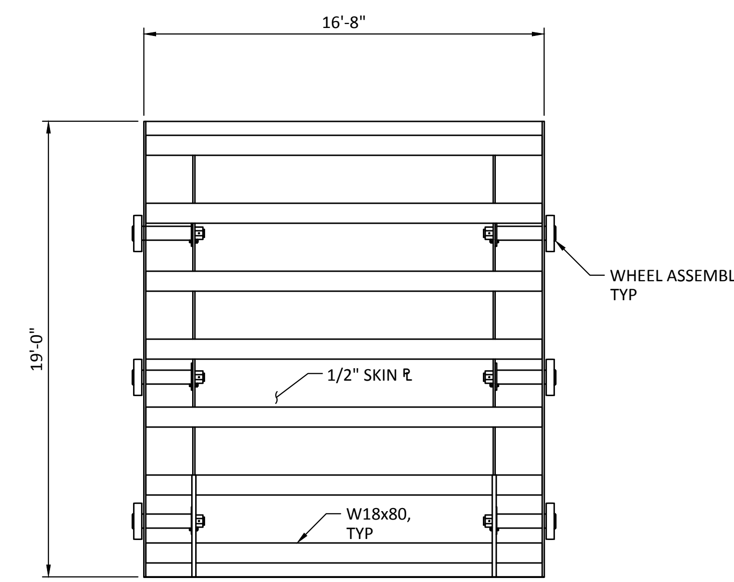
1. ELEVATIONS SHOWN ARE IN NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).



A
S100
SECTION
SCALE: 1/8"= 1'-0"
0' 8' 16'



B
S100
SECTION
SCALE: 1/8"= 1'-0"
0' 8' 16'



1
S100
DETAIL
SCALE: 1/4"= 1'-0"
0' 4' 8'

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EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS
EKLUTNA DAM SPILLWAY STRUCTURAL SECTIONS

DESIGNED G. CLARK
DRAWN J. HOLT
CHECKED M. MERKLEIN
PROJECT DATE 04/26/24

DRAWING
S101

JOB NO: 000000

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DIMENSIONS AND TOLERANCES:

1. UNLESS OTHERWISE NOTED PROVIDE THE FOLLOWING DIMENSIONAL TOLERANCES:

   FRACTIONAL `1/16"
   X `0.06"
   X.X `0.06"
   X.XX `0.010"
   X.XXX `0.002"

2. FEATURES OF PARTS AND ASSEMBLIES THAT ARE IMPLIED AS PARALLEL OR PERPENDICULAR MUST BE PARALLEL OR PERPENDICULAR WITHIN ANGULAR TOLERANCE.
3. INFORMATION, TOLERANCES, AND NOTES ON THIS SHEET APPLY TO ALL MECH. DRAWINGS, UNLESS NOTED OTHERWISE.
4. DIMENSIONS AND TOLERANCE ARE PER ASME Y14.5 UNLESS INDICATED OTHERWISE.
5. CYLINDRICAL LIMITS AND FITS ARE PER ASME B4.1 UNLESS INDICATED OTHERWISE.
6. THREAD CALLOUTS ARE PER ASME Y14.6 UNLESS INDICATED OTHERWISE.
7. SURFACE TEXTURE IS PER ASME B46.1.
8. PROVIDE A MAXIMUM OF 125 MICROINCH SURFACE TEXTURE ON ALL MACHINED SURFACES, UNLESS SHOWN OTHERWISE.
9. LINEAR UNITS ARE FEET AND INCHES OR INCHES AND ALL ANGULAR UNITS ARE DEGREES, UNLESS SHOWN OTHERWISE.
10. BREAK CORNERS AND EDGES, UNLESS SHOWN OTHERWISE.

FABRICATION AND INSTALLATION:

1. FABRICATION OF EQUIPMENT SHALL BE IN GENERAL CONFORMANCE WITH THE LATEST REVISION OF AISC STEEL CONSTRUCTION MANUAL.
2. SURFACE FINISH, WHERE GIVEN, IS ACCORDING TO ANSI B46.1. SURFACES NOT MARKED SHALL HAVE A FINISH OF 250 MICRO-INCHES OR BETTER, EXCEPT FOR SURFACES IN CONTACT WITH GASKETED BEARING SURFACES SHALL BE 125 MICRO-INCHES OR BETTER. NO MACHINING IS REQUIRED IF OTHERWISE FINISHED (ROLLED, CAST, ETC) SURFACE IS BETTER THAN THE INDICATED REQUIREMENTS, EXCEPT IF INDICATED OTHERWISE. SURFACES TO BE MACHINED SHALL INCLUDE ALL SURFACES REQUIRED TO BE PRECISELY ALIGNED INCLUDING BEARING AND SURFACES, BUSHINGS, PINS AND OTHER CRITICAL BEARING SURFACES. SURFACE FINISH IN EACH CASE SHALL BE AS SHOWN ON THE SHOP DRAWINGS. IF NOT SHOWN, THE FINISH SHALL BE SUBJECT TO APPROVAL BY THE DISTRICT.
3. TOLERANCED MACHINE FINISHES TO BE FINAL, AS INSTALLED VALUES, TOLERANCES NOT BE TAKEN PRIOR TO WELDING OR PAINTING.
4. LOCTITE NICKEL ANTI-SEIZE LUBRICANT FORMULA 771 (OR APPROVED EQUAL) SHALL BE APPLIED TO THE THREADS OF ALL FASTENERS PRIOR TO ASSEMBLY TO PREVENT GALLING. TORQUE VALUES USED TO BASED ON LUBRICATED VALUES.
5. DIMENSIONS SHALL BE MEASURED CALIBRATED MEASURING DEVICES SUITABLE FOR DIMENSIONS TAKEN. CALIBRATED TAPE MEASUREMENTS SUITABLE FOR FRACTIONAL DIMENSIONS ONLY. MICROMETERS OR CALIPERS WITH RESOLUTION TO SUITABLE FOR THE TOLERANCE OF THE PART TO BE USED. MAKE CALIBRATION RECORDS AVAILABLE AS REQUESTED BY ENGINEER.
6. LIKE PARTS SHALL BE INTERCHANGEABLE.
7. ROUNDING OF EDGES WHERE SHOWN SHALL BE FULL RADIUS.
8. PROVIDE STAINLESS STEEL SHIMS MEETING ASTM A240 TYPE 304 FOR ALIGNMENT OF MACHINERY. DEBURR ALL SHIMS PRIOR TO INSTALLATION.

FASTENERS:

1. UNLESS NOTED OTHERWISE, MAKE MECHANICAL CONNECTIONS WITH ASTM A449 HEAVY HEX BOLTS, ASTM A563 NUTS, AND ASTM F436 WASHERS. HOT DIP GALVANIZE CARBON STEEL BOLTS, NUTS, AND WASHERS UNLESS OTHERWISE NOTED.
2. USE FASTENERS THAT ARE IN ACCORDANCE WITH THE FOLLOWING DIMENSIONAL STANDARDS:
   A. HEAVY HEX BOLTS PER ASME B18.2.6.
   B. HEX NUTS PER ASME B18.2.6.
   C. PLAIN WASHERS PER ASTM F436.
3. TENSION FASTENERS IN ACCORDANCE WITH THE RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RCSC) METHOD FOR TURN-OF-NUT PRETENSIONING. ROTATE NUT AFTER ACHIEVING A SNUG TIGHT CONDITION IN ACCORDANCE WITH RCSC TABLE 8.1
4. HOT DIP GALVANIZE FASTENERS PER ASTM A153. OVERSIZE NUT THREADS PER ASTM A563.

KEYWAYS:

1. MACHINE KEYS AND KEYWAYS PER ANSI B17.1 1967 (R 2017) INCLUDING THE RECOMMENDED CHAMFERS AND FILLETS PROVIDED IN THE STANDARD. SUPPLY KEYS FOR ALL ASSEMBLIES WHERE DIRECTLY INDICATED OR WHERE KEYWAYS ARE SHOWN FOR ONE OR BOTH MATING COMPONENTS.

WELDING:

1. PERFORM WELDING IN ACCORDANCE WITH AWS D1.1. WELDERS AND WELDING PROCEDURES SHALL BE IN ACCORDANCE WITH AWS D1.1. WELDING ELECTRODES SHALL CONFORM TO THE APPROPRIATE AWS SPECIFICATION FOR THE BASE METAL AND WELDING PROCESS USED.
2. PROVIDE WELD ACCESS HOLES TO AVOID INTERSECTING WELDSPER AISC STEEL CONSTRUCTION MANUAL 15TH ED. FIGURE C-J1..2 ALTERNATIVE 1 AND GRIND SMOOTH.
3. GRIND, BLEND, AND DRESS WELDS WITH SURFACE IRREGULARITIES AND SHARP CORNERS TO AVOID STRESS RISERS AND FOR PROPER ADHESION OF THE COATING BEFORE PROCEEDING WITH THE OVERALL SURFACE PREPARATION FOR COATING. REMOVE WELD SPATTER TO ENSURE PROPER ADHESION OF THE COATING. AREAS OF HIGH STRESS AND MACHINED SURFACES SHALL BE PROTECTED FROM WELD SPATTER.
4. CLEAN AND CAREFULLY EXAMINE COMPLETED WELDS FOR INSUFFICIENT THROAT OR LEG SIZES, CRACKS, UNDERCUTTING, OVERLAP, EXCESSIVE CONVEXITY OR REINFORCEMENT AND OTHER SURFACE DEFECTS TO ENSURE COMPLIANCE WITH THE REQUIREMENTS OF AWS D1.1. PERFORM NON-DESTRUCTIVE EXAMINATION BY ULTRASONIC METHOD FOR BUTT WELDS. EXAMINE OTHER WELDS BY DYE PENETRANT (PT) METHOD; MAGNETIC PARTICLE (MT); OR ULTRASONIC TESTING (UT).
5. PERFORM RANDOM SPOT CHECK EXAMINATION OF WELDS AS REQUESTED BY THE ENGINEER AS PART OF THE EQUIPMENT EXAMINATION.
6. PREHEAT THE BASE METAL AS NECESSARY TO MINIMIZE DISTORTION BEFORE WELDING. USE WELD PROCEDURES THAT CONTROL HEAT TO AVOID ADVERSELY AFFECT THE MECHANICALPROPERTIES OF THE BASE METAL. AFTER WELDING IS COMPLETE, STRESS RELIEVE WELDMENTS BY HEAT TREATMENT IN ACCORDANCE WITH AWS D1.1. USE PROPER RESTRAINT AND SUPPORT DURING HEAT TREATMENT TO MINIMIZE DISTORTION.

COMPONENT NAMING:

1. HOIST COMPONENT NAMING HAS BEEN PROVIDED WITH THE FOLLOWING NAMING CONVENTION:

   [GATE]-[MECH COMPONENT ABBR]-[COMPONENT NUMBER]

MECHANICAL COMPONENT ABBREVIATIONS	
ABBR	COMPONENT TYPE
B	BRAKE
D	DRUM
EN	ENCODER
GC	GATE CONNECTION
LP	LOAD PIN
LS	LIMIT SWITCH
M	MOTOR
MC	MACHINERY COVER
MS	MACINERY SKID
R	REDUCER
S	SHAFT
SB	SHAFT BEARING
SC	SHAFT COUPLING
SH	SHEAVE
W	WIRE ROPE

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EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS

MECHANICAL GENERAL NOTES

DESIGNED A. DESANTIS
DRAWN J. HOLT
CHECKED S. ELLENSON
PROJECT DATE 04/26/24

DRAWING
GM001

JOB NO: 000000

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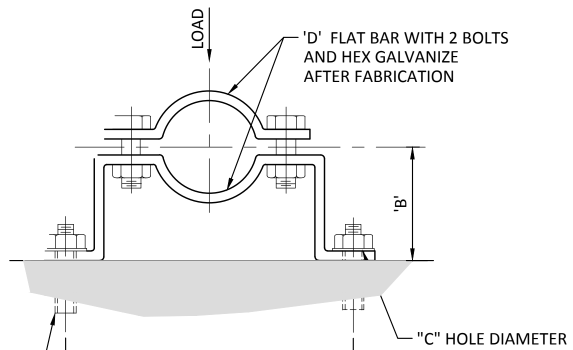


DIMENSIONS IN INCHES					LOAD RATING LBS
PIPE DIAMETER	"A"	"B" SEE NOTE 3 BELOW	"C" HOLE DIAMETER	"D" FLAT BAR SIZE	
¾	5 15/16	2½	7/16	3/16 x 1¼	190
1	6¼	2⅝	7/16	3/16 x 1¼	190
1¼	6 11/16	2¾	7/16	3/16 x 1¼	190
1½	6 15/16	3	7/16	3/16 x 1¼	190
2	8 5/16	3 3/16	7/16	¼ x 1¼	420
2½	8⅞	3 7/16	7/16	¼ x 1¼	420
3	9⅛	3¾	7/16	¼ x 1¼	420
3½	10 1/16	4	7/16	¼ x 1¼	420
4	10 9/16	4¼	9/16	¼ x 1½	610
5	11¾	4¾	9/16	¼ x 1½	610
6	14⅜	5 5/16	9/16	⅜ x 1½	870
8	16⅝	6 5/16	9/16	⅜ x 1½	870

NOTE:
1. WHERE SUBMERGED, PIPE CLAMP, ANCHORS, SHIELD, NUTS AND LOCKWASHER TO BE TYPE 316 STAINLESS STEEL.
2. WHEN USED WITH PVC OR FIBERGLASS PIPE, PROVIDE STEEL SHIELD WITH LOOSE FIT AROUND PIPE AT CLAMP. WRAP COPPER TUBING WITH 2" WIDE STRIP OF RUBBER AT CLAMP.
3. FOR FLANGED PIPING, INCREASE 'B' DIMENSION AS REQUIRED.
4. FOR PIPES SMALLER THAN ¾" SEE STANDARD DETAIL M142.

M117 PIPE CLAMP FOR INDIVIDUAL PIPES
SCALE: NTS

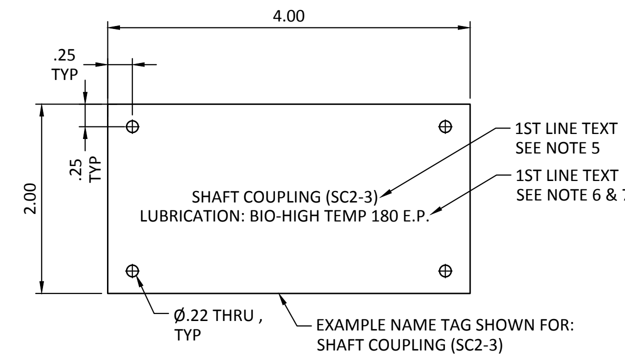
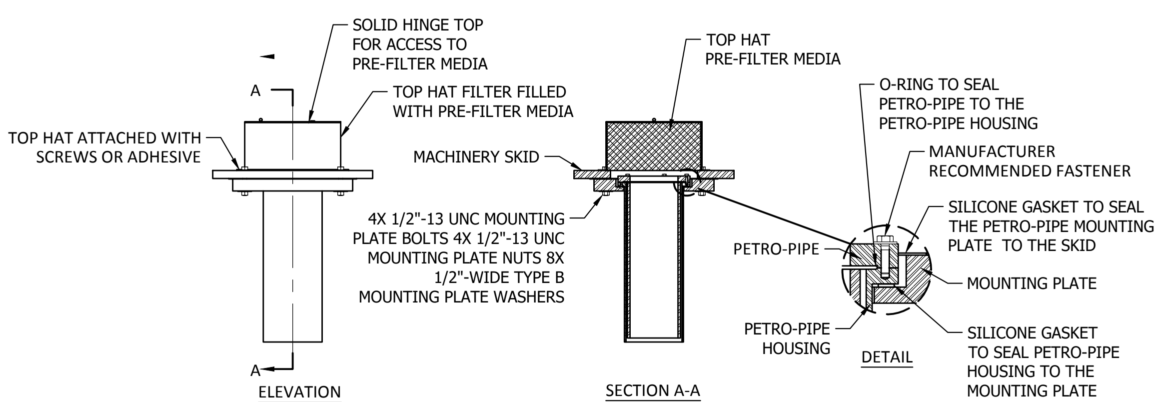


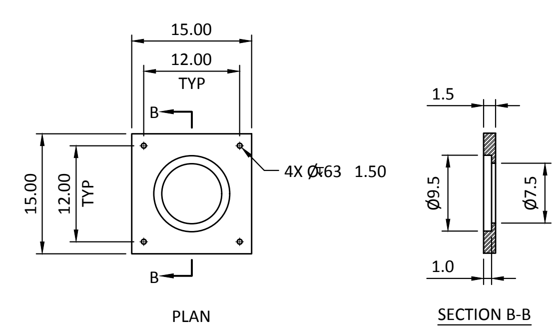
TABLE 1 -- NAMEPLATE INFO			
COMPONENT NAME	PART. NO.	LUBRICATION	TOP PLY COLOR
MOTOR	M	NA	BLACK
BRAKE	B1, B2	NA	BLACK
DRUM	D1, D2	NA	BLACK
REDUCER	R1, R2, R3	PANOLINE MARGEAR GEAR OIL	BLUE
SHAFT	S1	NA	BLACK
SHAFT BEARING	SB1-1, SB1-2, SB1-3, SB1-4, SB1-5, SB1-6, SB1-7, SB1-8, SB2-1, SB2-2	BOI-HIGH TEMP 180 EP	GREEN
SHAFT COUPLING	SC1, SC2-1, SC2-2, SC2-3, SC2-4, SC3-1, SC3-2	BOI-HIGH TEMP 180 EP	GREEN
LIMIT SWITCH	LS1, LS2, LS3	NA	BLACK
ENCODER	EN	NA	BLACK
MACHINERY SKID	MS1, MS2-1, MS2-2, MS3, MS4	NA	BLACK

NOTES:
1. PROVIDE POLYMER NAMEPLATES FOR EQUIPMENT AS INDICATED
2. MFABRICATE NAMEPLATES FROM IMPACT RESISTANT, UV STABILIZIED, 2-PLY, ACRYLIC LAMACOID RATED FOR OUTDOOR USE.
3. THE TOP LAMACOID PLY SHALL BE THE COLOR INDICATED. THE BOTTOM LAMACOID PLY COLOR SHALL BE WHITE.
4. ENGRAVE LETTERING THROUGH THE TOP LAMACOID PLY
5. 1ST LINE TEXT SHALL BE: COMPONENT NAME PER TABLE 1 (PART NO. PER TABLE 1).
6. 2ND LINE TEXT SHALL BE: "LUBRICATION:" (LUBRICATION PER TABLE 1).
7. IF COMPONENT IS NOT LUBRICATED (NA IN TABLE 1) THERE IS NO 2ND LINE TEXT.
8. PROVIDE NAMEPLATES WITH MOUNTING HOLES IN CORNERS FOR SOLID RIVETS OR SCREWS.

M605 MACHINERY NAMEPLATE
SCALE: NTS



PETRO-PIPE ASSEMBLY



NOTES:
1. MOUNTING PLATE BOLT LENGTHS WILL DEPEND ON THE THICKNESS OF THE SKID BASE PLATE.
2. MATCH DRILL MOUNTING PLATE BOLT HOLES IN MACHINERY SKID BASE PLATE.

PETRO-PIPE MOUNTING PLATE

M750 PETRO-PIPE
SCALE: NTS

PRELIMINARY NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
A	04/26/24	SPE	15% DESIGN

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

McMillen
CHUGACH POWERING ALASKA'S FUTURE
MEA MATANUSKA ELECTRIC ASSOCIATION
MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS
MECHANICAL STANDARD DETAILS

DESIGNED A. DESANTIS
DRAWN J. HOLT
CHECKED S. ELLENSON
PROJECT DATE 04/26/24

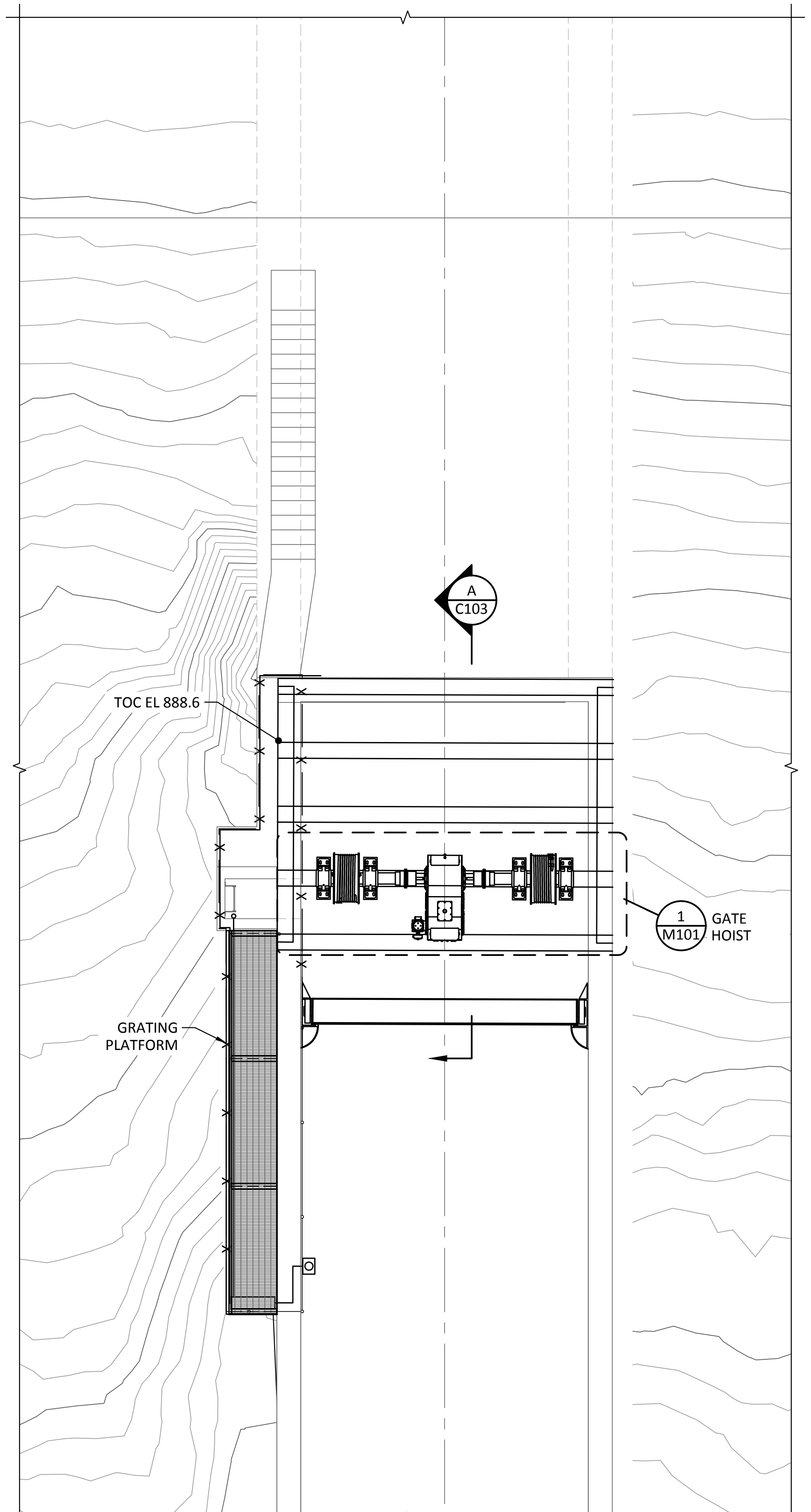
DRAWING GM002

JOB NO: 000000

Path: C:\Vault\Chugach Electric\24-021 Eklutna Spillway Modification\GM002.dwg Plot date: Apr 23, 2024 03:44pm, CAD User: WoodRon

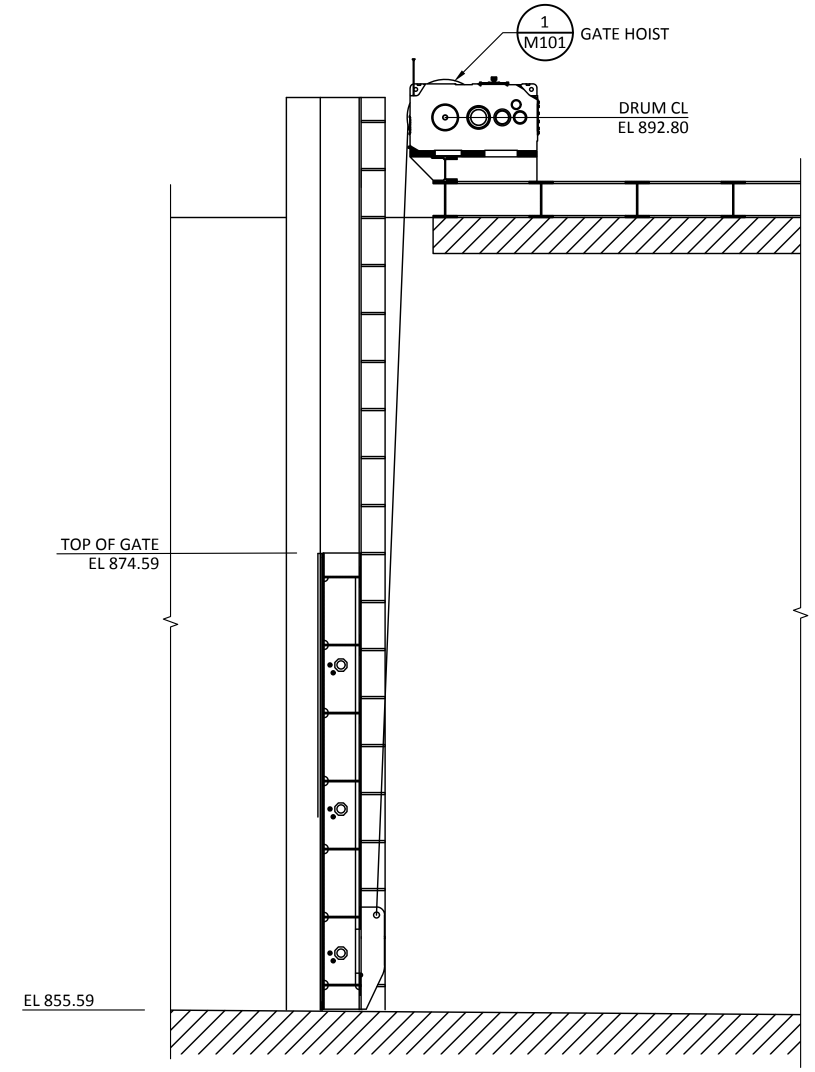
SHEET NOTES:

1. ELEVATIONS SHOWN ARE IN NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).



EKLUNTA DAM SPILLWAY MECHANICAL PLAN - EL 888.6

SCALE: 3/16"= 1'-0"



A
-
SECTION

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

0' 4' 8'

PRELIMINARY
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A	04/26/24	SPE	15% DESIGN

WARNING

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EKLUTNA FISH & WILDLIFE PROJECT

EKLUTNA DAM SPILLWAY MODIFICATIONS

EKLUTNA DAM SPILWAY MECHANICAL PLAN AND SECTIONS

DESIGNED A. DESANTIS

DRAWN J. HOLT

CHECKED S. ELLENSON

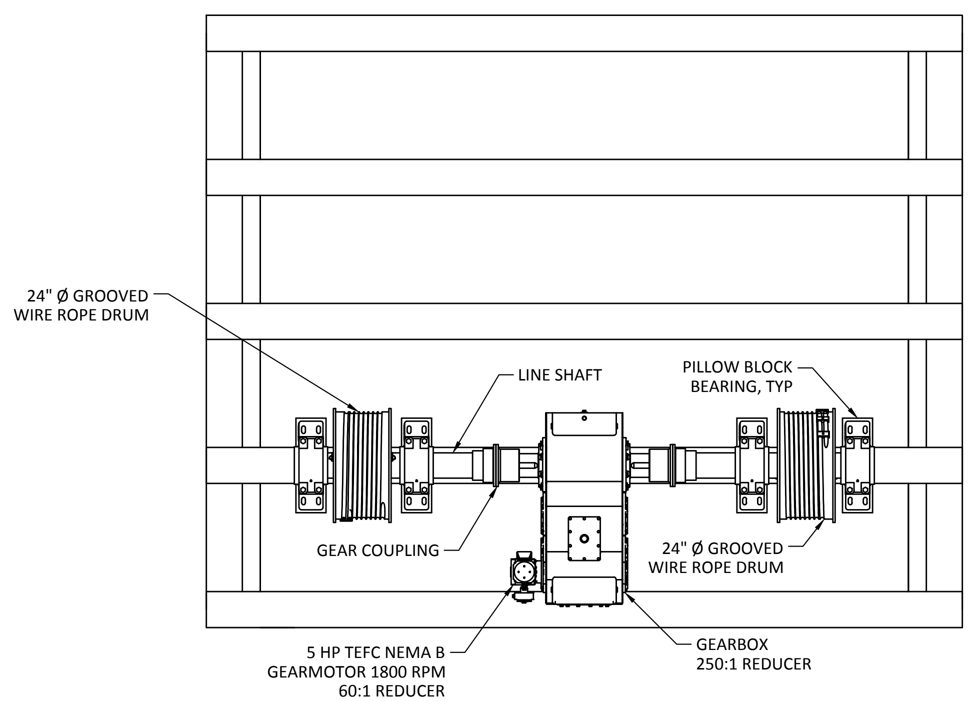
PROJECT DATE 04/26/24

DRAWING

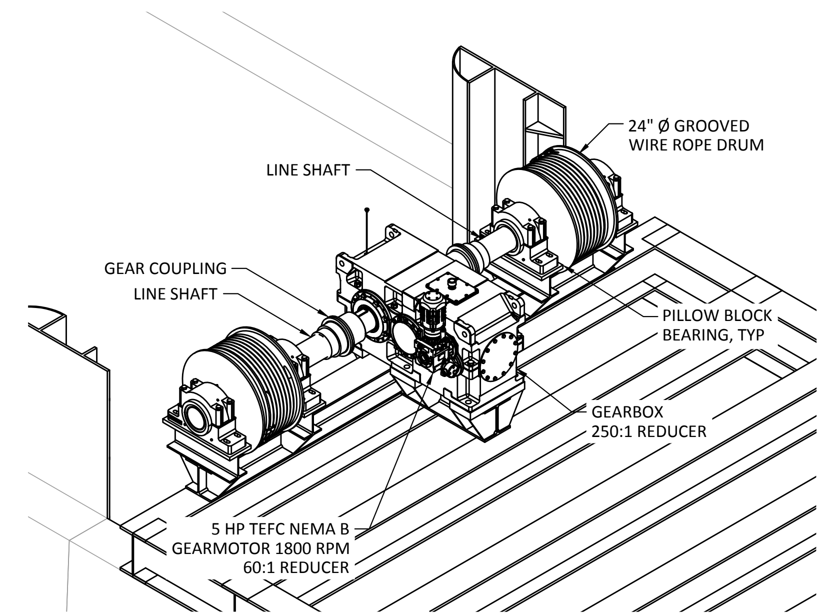
M100

JOB NO: 000000

Path: C:\Vault\Chugach Electric\24-021 Eklutna Spillway Modification\M100.dwg Plot date: Apr 23, 2024 03:44pm, CAD User: WoodRon



1 / M100 DETAIL
SCALE: 3/8"= 1'-0"



FIXED WHEEL GATE HOIST ISOMETRIC VIEW
SCALE: NTS

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
A	04/26/24	SPE	15% DESIGN

WARNING
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McMillen

CHUGACH
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MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS

EKLUTNA DAM SPILLWAY MECHANICAL DETAILS

DESIGNED A. DESANTIS
DRAWN J. HOLT
CHECKED S. ELLENSON
PROJECT DATE 04/26/24

DRAWING
M101

JOB NO: 000000

Path: C:\Vault\Chugach Electric\24-021 Eklutna Spillway Modification\M101.dwg Plot date: Apr 23, 2024 03:44pm, CAD User: WoodRon

IEEE STANDARD CONTROL AND PROTECTION DEVICES FUNCTION NUMBERS

01	MASTER ELEMENT	51	AC INVERSE TIME OVERCURRENT RELAY
02	TIME-DELAY STARTING OR CLOSING RELAY (TDPU)	52	AC CIRCUIT BREAKER
03	CHECKING OR INTERLOCKING RELAY	53	EXCITER OR DC GENERATOR RELAY
04	MASTER CONTACTOR	54	TURNING GEAR ENGAGING DEVICE
05	STOPPING DEVICE	55	POWER FACTOR RELAY
06	STARTING CIRCUIT BREAKER	56	FIELD APPLICATION RELAY
07	RATE-OF-CHANGE RELAY	57	SHORT-CIRCUITING OR GROUNDING DEVICE
08	CONTROL POWER DISCONNECTING DEVICE	58	RECTIFICATION FAILURE RELAY
09	REVERSING DEVICE	59	OVERVOLTAGE RELAY
10	UNIT SEQUENCE SWITCH	60	VOLTAGE OR CURRENT BALANCE RELAY
11	MULTIFUNCTION DEVICE	61	DENSITY SWITCH OR SENSOR
12	OVER-SPEED DEVICE	62	TIME-DELAY STOPPING OR OPENING RELAY (TDDO)
13	SYNCHRONOUS-SPEED DEVICE	63	PRESSURE SWITCH
14	UNDER-SPEED DEVICE	64	GROUND DETECTOR RELAY
15	SPEED OR FREQUENCY MATCHING DEVICE	65	GOVERNOR
16	DATA COMMUNICATIONS DEVICE	66	NOTCHING OR JOGGING DEVICE
17	SHUNTING OR DISCHARGE SWITCH	67	AC DIRECTIONAL OVERCURRENT RELAY
18	ACCELERATING OR DECELERATING DEVICE	68	BLOCKING RELAY
19	STARTING-TO-RUNNING TRANSITION CONTACTOR	69	PERMISSIVE CONTROL DEVICE
20	ELECTRONICALLY OPERATED VALVE	70	RHEOSTAT
21	DISTANCE RELAY	71	LEVEL SWITCH
22	EQUALIZER CIRCUIT BREAKER	72	DC CIRCUIT BREAKER
23	TEMPERATURE CONTROL DEVICE	73	LOAD-RESISTOR CONTACTOR
24	VOLTS PER HERTZ RELAY	74	ALARM RELAY
25	SYNCHRONIZING OR SYNCHRONISM - CHECK DEVICE	75	POSITION CHANGING MECHANISM
26	APPARATUS THERMAL DEVICE	76	DC OVERCURRENT RELAY
27	UNDERVOLTAGE RELAY	77	PULSE TRANSMITTER
28	FLAME DETECTOR	78	PHASE-ANGLE MEASURING OR OUT-OF-STEP PROTECTIVE RELAY
29	ISOLATING CONTACTOR	79	AC RECLOSING RELAY
30	ANNUNCIATOR RELAY	80	FLOW SWITCH
31	SEPARATE EXCITATION DEVICE	81	FREQUENCY RELAY
32	DIRECTIONAL POWER RELAY	82	DC RECLOSING RELAY
33	POSITION SWITCH	83	AUTOMATIC SELECTIVE CONTROL OR TRANSFER RELAY
34	MASTER SEQUENCE DEVICE	84	OPERATING MECHANISM
35	BRUSH-OPERATING OF SLIP-RING SHORT-CIRCUITING DEVICE	85	CARRIER OR PILOT-WIRE RECEIVER RELAY
36	POLARITY OR POLARIZING VOLTAGE DEVICE	86	LOCKOUT RELAY
37	UNDERCURRENT OR UNDERPOWER RELAY	87	DIFFERENTIAL PROTECTIVE RELAY
38	BEARING PROTECTIVE DEVICE	88	AUXILIARY MOTOR OR MOTOR GENERATOR
39	MECHANICAL CONDITION MONITOR	89	LINE SWITCH
40	FIELD (OVER/UNDER EXCITATION) RELAY	90	REGULATING DEVICE
41	FIELD CIRCUIT BREAKER	91	VOLTAGE DIRECTIONAL RELAY
42	RUNNING CIRCUIT BREAKER	92	VOLTAGE AND POWER DIRECTIONAL RELAY
43	MANUAL TRANSFER OR SELECTOR DEVICE	93	FIELD-CHANGING CONTACTOR
44	UNIT SEQUENCE STARTING RELAY	94	TRIPPING OR TRIP-FREE RELAY
45	ATMOSPHERIC CONDITION MONITOR	95	RESERVED FOR FUTURE APPLICATION
46	REVERSE-PHASE OR PHASE-BALANCE CURRENT RELAY	96	RESERVED FOR FUTURE APPLICATION
47	PHASE-SEQUENCE OR PHASE-BALANCE VOLTAGE RELAY	97	RESERVED FOR FUTURE APPLICATION
48	INCOMPLETE SEQUENCE RELAY	98	CREEP DETECTOR DEVICE
49	MACHINE OR TRANSFORMER THERMAL RELAY	99	RESERVED FOR FUTURE APPLICATION
50	INSTANTANEOUS OVERCURRENT OR RATE-OF-RISE RELAY		

METERING SYSTEMS AND DEVICES INDEX

A	AMMETER	PB	PUSHBUTTON
AH	AMPERE HOUR METER	PF	POWER FACTOR METER
AS	AMMETER SELECTOR SWITCH	PH	PHASE METER
C	COUNTER	PI	POSITION INDICATOR
CMA	CONTACT MAKING AMMETER	REC	RECORDER
CMC	CONTACT MAKING CLOCK	RF	REACTIVE FACTOR METER
CMV	CONTACT MAKING VOLTMETER	RPM	SPEED INDICATOR
CS	CONTROL STATION	SW	TRANSFER SWITCH
DM	DEMAND METER	SY	SYNCHROSCOPE
ETM	ELAPSE TIME METER	T	TEMPERATURE METER
F	FREQUENCY METER	TLM	TELEMETER
G	GALVANOMETER	TOC	TRUCK-OPERATED CONTACT
GD	GROUND FAULT DETECTOR	TS	TIME SWITCH
KV	KILO-VOLTMETER	V	VOLTMETER
KW	KILO-WATTMETER	VAR	VARMETER
KWH	KILO-WATT HOUR METER	VH	VAR HOUR METER
mA	MILLI-AMMETER (TRANSDUCER)	VS	VOLTMETER SELECTOR SWITCH
MOC	MECHANISM-OPERATED CONTACT	W	WATTMETER
OHM	OHMMETER	WH	WATT HOUR METER
OSC	OSCILLOGRAPH	WHDM	WATT HOUR DEMAND METER

NOTE: "R" IN FRONT OF LETTERS INDICATES A RECORDING TYPE METER.

PILOT - INDICATOR LIGHT INDEX

A	AMBER
B	BLUE
C	CLEAR
G	GREEN
NE	NEON
O	ORANGE
OP	OPALESCENT
P	PURPLE
R	RED
W	WHITE
Y	YELLOW

FIRST LETTER SUFFIX OF IEEE DEVICE DESIGNATION

A	GOVERNOR SYSTEM (OR ACTUATOR SYSTEMS - GATES)
B	BATTERY CHARGING AND MONITORING SYSTEM OR BUS
C	HIGH-VOLTAGE CABLE SYSTEM OR CLOSING RELAY/CONTACTOR
D	DATA ACQUISITION SYSTEM
E	EXCITATION SYSTEM INCLUDING TRANSFORMER AND REGULATOR BUT NOT MAIN FIELD
F	FIRE AND CO2 SYSTEM
G	MAIN GENERATOR INCLUDING AUXILIARY SYSTEMS OR GROUND
G/M	GENERATOR MOTOR INCLUDING AUXILIARY SYSTEMS IN PUMPED STORAGE APPLICATIONS
H	TURBINE OR MAIN PUMP INCLUDING AUXILIARY SYSTEMS
I	ISOLATED AND OTHER POWER BUS SYSTEMS (NOT HIGH VOLTAGE CABLE)
J	POWER CIRCUIT BREAKER INCLUDING AUXILIARY SYSTEMS
K	POWER TRANSFORMER INCLUDING AUXILIARY SYSTEMS
L	ANNUNCIATOR SYSTEM, SECURITY SYSTEM, LINE, OR LOWERING RELAY/CONTACTOR
M	MAIN PUMP MOTOR INCLUDING AUXILIARY SYSTEMS AND VARIABLE SPEED DRIVE
N	AIR (PNEUMATIC) SYSTEM OR NEUTRAL
O	OPENING RELAY/CONTACTOR
P	PENSTOCK OR DISCHARGE LINE SYSTEM
Q	OIL STORAGE, HANDLING, PURIFICATION SYSTEM
R	FIELD FLASHING SYSTEM, PHASE REVERSAL SWITCH INCLUDING AUXILIARY SYSTEM, OR RAISING RELAY/CONTACTOR
S	STATION SERVICE SUBSTATION SYSTEM INCLUDING ENGINE/GENERATOR SYSTEM
T	TONE AND TRANSFER TRIP SYSTEM OR TRANSFORMER
U	UNIT CONTROL CIRCUIT SYSTEM OR UNINTERRUPTIBLE POWER SUPPLY SYSTEM
V	INTAKE AND/OR DISCHARGE VALVE SYSTEM
W	WATER SYSTEMS INCLUDING INTAKE/OUTLET WORKS AND PLANT WATER AND SUMP SYSTEMS
X	DEFINED FOR SYSTEMS UNIQUE TO A FACILITY
Y	DEFINED FOR SYSTEMS UNIQUE TO A FACILITY
Z	DEFINED FOR SYSTEMS UNIQUE TO A FACILITY

SECOND AND SUBSEQUENT LETTER SUFFIXES OF THE IEEE DEVICE DESIGNATION

A	ABNORMAL, A.C., ACCELERATION, ADMISSION, ALARM, AMPERES, AUTOMATIC, AUXILIARIES, PHASE A, ECT.
B	BACKUP, BEARING, BLOCK, BLOWER, BOOSTER, BRAKES, BUS, BUTTON, BYPASS, PHASE B, ETC.
C	CABLE, CARRIER, CHARGER, CHECK, CHLORINATION, CLOSE, COLLECTOR, COMMON, COMPENSATOR, COMPRESSOR, CONTROL, COOLING, CURRENT, CYCLE, CYLINDER, PHASE C, CONVEYOR, ECT.
D	D.C, DECELERATION, DELAY, DEPRESS, DETECTOR, DIELECTRIC, DIFFERENTIAL, DISCHARGE, DISCONNECT, DISCORDANCE, DOMESTIC, DOWN, DOWNSTREAM, DRAFT TUBE, DRAIN, ETC.
E	EJECTOR, ELEVATOR, EMERGENCY, EXPLOSIVE, ETC.
F	FAILURE, FAN, FAULT, FEEDER, FIELD, FILTER, FIRE, FLAME, FLOW, FOLLOWER, FORWARD, FREQUENCY, FULL, FUMES, FUSE, ETC.
G	GAS, GATE, GATING (SCR), GENERATE, GROUND, GUIDE BEARING, ETC.
H	HALON, HAND, HEAT, HEATER, HIGH, HOIST, HORN, HOT, HOUSING, HYDROPNEUMATIC TANK, ETC.
I	INDICATION, INITIAL, INLET, INOUT, INSTANTANEOUS, INTAKE, INTERFACE, INTERLOCK, INTERRUPT, INVERTER, IONIZATION, ETC.
J	JACKING, JET, ETC.
K	KEY, TRANSFORMER
L	LAMPS, LEFT, LEVEL, LIGHTS, LIMITS, LINE, LIQUID, LOCAL, LOGIC, LOSS, LOUVERS, LOW, LOWER, LUBRICATION, ETC.
M	MAIN, MALFUNCTION, MANUAL, METER, METERING, MOTOR, ETC.
N	NEGATIVE, NETWORK, NEUTRAL, NORMAL, ETC.
O	OPEN, OUTLET, OUTPUT, ETC.
P	PACKING BOX, PARALLEL, PARAMETER, PENSTOCK, PHASE, PHASEBACK, PILOT, PIT, POSITION, POTENTIAL, POTHEAD, POWER, PRESSURE, PRIMARY, PROTECTION, PULSE, PUMP, PURIFICATION, PUSH, ETC.
Q	OIL, ETC.
R	RAISE, REACTOR, RECLOSE, RECORD, RECTIFIER, REED, REFRIGERATION, REGULATE, RELAY, RELEASE, RELIEF, REMOTE, RESERVOIR, RESET, RESISTOR, RIGHT, ROTATION, ROTOR, RUNNER, ETC.
S	SEALS, SECONDARY, SELECTOR, SEWAGE, SHORTING, SHUTDOWN, SIGNAL, SKIMMER, SLUDGE, SMOKE, SOLENOID, SPEED, SPIRAL OR SCROLL CASE, SPLICE, STABILIZER, STANDBY, STARTING, STATOR, STEPPING, STORAGE, STRAINER, SUCTION, SUMP, SUPPLY, SWITCH, SYNCHRONIZING, ETC.
T	TANK, TEMPERATURE, TEST, THERMAL, THRUST BEARING, THYRATRON, TIE, TIME, TRANSDUCER, TRANSER, TRANSMITTER, TRIP, TROUBLE, TRASHRAKE, ETC.
U	UNIT, UNLOADER, UNWATERING, UP, UPPER, UPSTREAM, ETC.
V	VALVE, VARS, VIBRATION. VOLTAGE, ETC.
W	WATER, WATTS, WINDINGS, ETC.
X	AUXILIARY DEVICE, ETC.
Y	AUXILIARY TO DEVICE X, ANTIPUMP RELAY, ETC.
Z	AUXILIARY TO DEVICE Y

ABBREVIATIONS

A, AMP	AMP, AMPERE
AAAC	ALL ALUMINUM ALLOY CONDUCTOR
AC	ALTERNATING CURRENT
AF	AMPERE FRAME SIZE
AFD	ADJUSTABLE FREQUENCY DRIVE
AFF	ABOVE FINISHED FLOOR
AH	AMPERE HOURS
AHJ	AUTHORITY HAVING JURISDICTION
AHU	AIR HANDLING UNIT
AL	ALUMINUM
A/R	AS REQUIRED
AT	AMPERE TRIP
ATS	AUTOMATIC TRANSFER SWITCH
AVR	AUTOMATIC VOLTAGE REGULATOR
BAT	BATTERY
C	CONDUIT
CB	CIRCUIT BREAKER
CKT	CIRCUIT
CLF	CURRENT LIMITING FUSE
CO	CONDUIT ONLY
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
CR	CONTROL RELAY
CS	CONTROL SWITCH
CT	CURRENT TRANSFORMER
DC	DIRECT CURRENT
DCS	DISTRIBUTED CONTROL SYSTEM
DISC	DISCONNECT
DP	DISTRIBUTION PANEL
DPDT	DOUBLE-POLE, DOUBLE-THROW
DPST	DOUBLE-POLE, SINGLE-THROW
EDH	ELECTRIC DUCT HEATER
EG	ENGINE GENERATOR
EPT	EXCITATION POWER TRANSFORMER
EUH	ELECTRIC UNIT HEATER
EV	ELECTRICAL VAULT
F, FU	FUSE
FA	FIRE ALARM
FACP	FIRE ALARM CONTROL PANEL
FAS	FIRE ALARM SYSTEM
FREQ	FREQUENCY
FS	FLOAT SWITCH
FT	FLOW TRANSMITTER
FVNR	FULL VOLTAGE NON-REVERSING
FVR	FULL VOLTAGE REVERSING
GEN	GENERATOR
GFI	GROUND-FAULT INTERRUPTION
GFP	GROUND-FAULT PROTECTION
GND	GROUND
GPR	GENERATOR PROTECTION RELAY
GSU	GENERATOR STEP-UP TRANSFORMER
HMI	HUMAN-MACHINE INTERFACE
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
HPU	HYDRAULIC POWER UNIT
HTR	HEATER
HZ	HERTZ (CYCLES PER SECOND)
IC	INTERRUPTING CAPACITY
I & C	INSTRUMENTATION AND CONTROL
I/O	INPUT/OUTPUT
INST	INSTANTANEOUS
INTLK	INTERLOCK
IP	INTERNET PROTOCOL
K	KEY INTERLOCK
kV	KILOVOLTS
kVA	KILOVOLT AMPERES (APPARENT POWER)
kVAR	KILOVARS (REACTIVE POWER)
kW	KILOWATTS (REAL POWER)
kWH	KILOWATT HOUR
LC	LIGHTING CONTROLLER
LCP	LOCAL CONTROL PANEL
LE	LEVEL ELEMENT
LIT	LEVEL INDICATING TRANSMITTER
LOR	LOCAL-OFF-REMOTE
LP	LIGHTING PANEL
LS	LEVEL SWITCH
LT	LEVEL TRANSMITTER
mA	MILLIAMPERES
M	MOTOR, MAN, MANUAL
MAG	MAGNETIC
MCC	MOTOR CONTROL CENTER
MDP	MAIN DISTRIBUTION PANEL
MFM	MULTIFUNCTIONAL METER
MPR	MOTOR PROTECTION RELAY
MTS	MANUAL TRANSFER SWITCH
mV	MILLIVOLTS
MVA	MEGAVOLT AMPERES (APPARENT POWER)
MVAR	MEGAVARS (REACTIVE POWER)
MW	MEGAWATTS (REAL POWER)
MWH	MEGAWATT HOUR
NEUT	NEUTRAL
NGR	NEUTRAL GROUNDING RESISTOR
OHM	OHMMETER
OL	OVERLOAD
OPER	OPERATOR, OPERATED
PB	PANELBOARD, PULLBOX, PUSH BUTTON
PC	PHOTOCELL
PCB	POWER CIRCUIT BREAKER
PCC	POINT OF COMMON CONNECTION
PF	POWER FACTOR
PH, Ø	PHASE
PMP	PUMP
PNL	PANEL
PLC	PROGRAMMABLE LOGIC CONTROLLER
POI	POINT OF INTER-CONNECTION
PS	PRESSURE SWITCH
PTT	PUSH-TO-TEST
PWR	POWER
R	RELAY, REVERSE, RUN
RCP	RECEPTACLE
RIO	REMOTE I/O
RTD	RESISTANCE TEMPERATURE DETECTOR
RVNR	REDUCED VOLTAGE NON-REVERSING
RVR	REDUCED VOLTAGE REVERSING
S	SYNC SCOPE
SA	SURGE ARRESTER
SC	SURGE CAPACITOR
SDP	STANDBY DISTRIBUTION PANEL
SEL	SELECTOR, SCHWEITZER ENGINEERING LABORATORIES
SPD	SURGE PROTECTION DEVICE
SPDT	SINGLE-POLE, DOUBLE-THROW
SPST	SINGLE-POLE, SINGLE-THROW
S/S	STATION SERVICE
SV	SOLENOID VALVE
SW	SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
T	THERMOSTAT
TB	TERMINAL BLOCK, TERMINAL BOX
TD	TEMPERATURE DETECTOR, TIME DELAY
TEL	TELEPHONE
TS	THERMOSTAT
TSP	TWISTED SHIELDED PAIR
TST	TWISTED SHIELDED TRIAD
TX	TRANSMITTER
UH	UNIT HEATER
UP	UTILITY POWER
UPS	UNINTERRUPTIBLE POWER SUPPLY
V	VOLTS
VAC	VOLTS ALTERNATING CURRENT
VC	VIDEO CAMERA
VCB	VACUUM CIRCUIT BREAKER
VDC	VOLTS DIRECT CURRENT
VFD	VARIABLE FREQUENCY DRIVE
W	WIRE, WATTS
WP	WEATHER PROOF
XD	TRANSDUCER
XFMR	TRANSFORMER
XLP	CROSS LINKED POLYETHYLENE
XP	EXPLOSION PROOF

PRELIMINARY
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REV	DATE	BY	DESCRIPTION
A	04/26/24	SPE	15% DESIGN

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MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT

EKLUTNA DAM SPILLWAY MODIFICATIONS

ELECTRICAL ABBREVIATIONS AND DEVICE INDEXES

DESIGNED C. CURTIS
DRAWN F. HABER
CHECKED J. BAKKEN
PROJECT DATE 04/26/24

DRAWING
GE001

JOB NO: 000000

DIAGRAMS

HIGH - MEDIUM VOLTAGE SWITCHING

- POWER CIRCUIT BRK, DRAWOUT
- POWER CIRCUIT BRK, NON-DRAWOUT
- HV ISOLATING SW MOTOR OPERATED
- HV INTERRUPTER SW FUSED
- CENTER-BREAK SW MOTOR OPERATED
- DUAL-BREAK SW MOTOR OPERATED
- LOAD-BREAK SW MOTOR OPERATED
- HORN GAP SW

TRANSFORMERS:

- POWER XFMR
- MAG CORE XFMR
- LOAD TAP CHANGING XFMR
- SPLIT SECONDARY XFMR
- AUTO-XFMR

INSTRUMENT TRANSFORMERS:

- POTENTIAL XFMR
- POTENTIAL XFMR DUAL SECONDARY
- (3) 800:5 — CURRENT XFMR, QTY & RATIO AS INDICATED
- (1) 50:5 — CORE BALANCE CURRENT XFMR RATIO AS INDICATED
- (3) 800:5 — BUSHING CURRENT XFMR, QTY & RATIO AS INDICATED
- kWH — KILOWATT-HOUR METER

MACHINES:

- M, XXHP — MOTOR-DC
- M, XXHP — MOTOR-AC
- G, XXKW XXPF — AC GENERATOR

TRANSFORMERS WINDING CONNECTIONS:

- DELTA 3PH3W
- DELTA CENTER TAP GND 3PH4W
- DELTA CORNER GRD 3PH3W
- BROKEN DELTA 3PH2W
- OPEN DELTA 2PH2W
- WYE 3PH3W
- WYE GRD 3PH4W
- ZIG-ZAG 3PH3W
- ZIG-ZAG GRD 3PH4W

HIGH - MEDIUM VOLTAGE DEVICES

- L/A OR — LIGHTNING ARRESTER
- WT — WAVE TRAP
- M, 57 — GROUND SW MOTOR OPER
- MV CABLE TERMINATION
- CABLE POTHEAD OIL-FILLED

MISC DEVICES & CONNECTIONS:

- IN/OUT LINE
- 01 02 — PROTECTIVE DEVICE ELEMENT, SEE DEVICE FUNCTION INDEX
- TEST SWITCH
- TEST SWITCH, CURRENT SHORTING
- BATTERY
- GROUND
- DISCONNECTING DEVICE
- NEUTRAL CONNECTION
- ISOL PH BUS FLEX CONN
- ISOL PH BUS REMOVEABLE LINK

MISC DEVICES & CONNECTIONS:

- DEVICE TERMINAL POINT
- TERMINAL BLOCK
- EXTERNAL EQUIPMENT INTERCONNECTION
- XX XX — RELAY, SOLENOID, OR CONTACTOR COIL
- TD XX — TRANSDUCER
- I XX — INDICATING METER
- TLM XX — TELEMETRY
- X — PUSH-TO-TEST LIGHT
- X — PILOT/INDIC LIGHT
- XA — FUSE, SIZE AS INDICATED
- FUSE DUMMY
- XA — DISC SW FUSED
- FUSIBLE LINK
- CAPACITOR
- 3% — REACTOR
- RES — RESISTOR
- RES — RESISTOR VARIABLE
- OR — HEATER ELEMENT
- RECTIFIER SOLID STATE
- AC, DC+, DC-, AC — RECTIFIER FULLWAVE
- DC BRAKE
- GROUND
- CHASSIS GROUND
- CURRENT SHUNT

LOW VOLTAGE SWITCHING:

- DISCONNECTING SWITCH, MANUALLY GANG-OPERATED
- MOLDED CASE OR AIR CIRCUIT BREAKER
- CONTACTOR WITH THERMAL OL TRIP
- CONTACTOR WITH MAGNETIC OL TRIP
- CONTACTOR WITH THERMAL AND MAGNETIC OL TRIP
- E — CIR BKR DRAWOUT ELEC OPER
- E — CIR BKR THERMO O/L DRAWOUT ELEC OPER
- E — CIR BKR MAG O/L DRAWOUT ELEC OPER
- E — CIR BKR THERMO/MAG O/L DRAWOUT ELEC OPER

SELECTOR:

TWO-POSITION X-CONTACT CLOSED (J, K; A1, A2)

	J	K
A1	X	
A2		X

THREE-POSITION X-CONTACT CLOSED (J, K, L; A1, A2)

	J	K	L
A1	X		
A2			X

TWO-POSITION SELECTOR PUSHBUTTON X-CONTACT CLOSED (A, B; 1, 2, 3, 4)

CONTACTS	SELECTOR POSITION			
	A		B	
	BUTTON		BUTTON	
	FREE	CONTACTS	FREE	CONTACTS
1-2	X			
3-4		X	X	X

CONTROL SWITCHING:

- XX — PB SWITCH NORM OPEN
- XX — PB SWITCH NORM CLOSED
- XX OFF, MAN, AUTO — SELECTOR SWITCH
- XX — LIMIT SW NORM OPEN
- XX — LIMIT SW NORM CLOSED
- XX — LIMIT SW NORM OPEN HELD CLOSED
- XX — LIMIT SW NORM CLOSED HELD OPEN
- SOLENOID
- XX — CONTACT NORM OPEN
- XX — CONTACT NORM CLOSED
- XX — FLOW OPER NORM OPEN
- XX — FLOW OPER NORM CLOSED
- XX — LEVEL OPER NORM OPEN
- XX — LEVEL OPER NORM CLOSED
- XX — SWITCH NORM OPEN
- XX — SWITCH NORM CLOSED
- XX — TEMP ACT SW NORM OPEN
- XX — TEMP ACT SW NORM CLOSED
- XX — FOOT OPER NORM OPEN
- XX — FOOT OPER NORM CLOSED
- XX — PRESS OPER NORM OPEN
- XX — PRESS OPER NORM CLOSED

PRELIMINARY
NOT FOR CONSTRUCTION

MOMENTARY CONTACTS:

- NO, NC — SINGLE CIRCUIT
- NO & NC — DOUBLE CIRCUIT

MAINTAINED CONTACTS:

- TWO SINGLE CIRCUIT
- ONE DOUBLE CIRCUIT
- ESS — E-STOP, 2NC

INSTANT OPERATION CONTACTS WITH BLOWOUT

- XA — NO
- XA — NC

INSTANT OPERATION CONTACTS WITHOUT BLOWOUT

- XA — NO
- XA — NC

TIMED CONTACTS - CONTACT ACTION DELAYED AFTER COIL IS ENERGIZED

- XX SEC — NOTC
- XX SEC — NCTC

TIMED CONTACTS - CONTACT ACTION DELAYED AFTER COIL IS DE-ENERGIZED

- XX SEC — NOTC
- XX SEC — NCTC

SUPPLEMENTARY CONTACTS SYMBOLS:

- SPST, NO SINGLE-BREAK
- SPST, NO DOUBLE-BREAK
- SPST, NC SINGLE-BREAK
- SPST, NC DOUBLE-BREAK
- SPDT, SINGLE-BREAK
- SPDT, DOUBLE-BREAK
- DPST, NO, SINGLE-BREAK
- DPST, NO, DOUBLE-BREAK
- DPST, NC, SINGLE-BREAK
- DPST, NC, DOUBLE-BREAK
- DPDT, SINGLE-BREAK
- DPDT, DOUBLE-BREAK

NOTE:

1. "X" OR "XX" SHOWN ON SYMBOLS WILL BE SUBSTITUTED WITH DEVICE FUNCTION NUMBERS, LETTER SUFFIXES, PILOT LIGHT COLORS, OR OTHER DESCRIPTIVE TEXT, WHICH ARE DEFINED ELSEWHERE IN THESE LEGEND DRAWINGS.

Path: C:\Vault\Chugach Electric\24-021 Eklutna Spillway Modification\GE002.dwg Plot date: Apr 23, 2024 03:44pm, CAD User: WoodRon

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CHUGACH POWERING ALASKA'S FUTURE
MEA MATANUSKA ELECTRIC ASSOCIATION
MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT
EKLUTNA DAM SPILLWAY MODIFICATIONS
ELECTRICAL STANDARD SYMBOLS 1

DESIGNED C. CURTIS
DRAWN F. HABER
CHECKED J. BAKKEN
PROJECT DATE 04/26/24

DRAWING
GE002

JOB NO: 000000

PRIVATE TELEPHONE SYSTEM

- SB — SWITCHBOARD
- TC — TERMINAL CABINET
- D — DESK PHONE
- W — WALL PHONE

PRIVATE ETHERNET NETWORK SYSTEM

- DATA JACK
- VOICE/DATA JACK

PAGE/SOUND SYSTEM

- A — AMPLIFIER
- S — SPEAKER, WALL MTD
- S — SPEAKER, CEIL MTD
- H — HORN, WALL MTD
- H — HORN, CEIL MTD
- MIC — MICROPHONE
- P — HANDSET

INTRUSION ALARM/ACCESS SYSTEM

S A — SECURITY ALARM
- A POINT OF CONTACT
- C SECURITY PROXIMITY CARD READER (+48" AFF)
- E SECURITY ELEVATOR LOCKOUT CONTROL
- K SECURITY KEYPAD
- P SECURITY PANIC BUTTON (MOUNT UNDER CABINET)

SC D — SECURITY DOOR CONTACT
- D INTEGRAL TO DOOR HARDWARE OR HINGE. SEE ARCHITECTURAL DOOR HARDWARE SCHEDULE
- S SURFACE MOUNTED CONTACT/MAGNET COMBO WITH TAMPER RESISTANT METAL-CLAD PIGTAIL.
- M FULLY RECESSED CONTACT/MAGNET COMBO INSTALLED IN DOOR FRAME HEADER/TOP OF DOOR.

SL D — SECURITY DOOR LOCK CONNECTION (LOCK BY OTHERS)
- D INTEGRAL TO DOOR HARDWARE OR HINGE. SEE ARCHITECTURAL DOOR HARDWARE SCHEDULE
- S ELECTRICAL STRIKE IN DOOR FRAME LATCH.
- M MAGNETIC LOCK ON DOOR FRAME HEADER.

S M — SECURITY MOTION SENSOR - ARROW INDICATES DIRECTION OF SENSING; 360° INDICATES SENSING IN ALL DIRECTIONS

SM — SECURITY MONITOR AND MULTIPLEXOR/DVM

REX D — REQUEST TO EXIT SIGNAL DEVICE
- D INTEGRAL TO DOOR HARDWARE OR HINGE. SEE ARCHITECTURAL DOOR HARDWARE SCHEDULE
- P PASSIVE INFRARED DETECTOR MOUNTED ABOVE DOOR FRAME. PROVIDE J-BOX TYPE 'B' HORIZONTALLY MOUNTED 6" ABOVE DOOR.

P — POWERED DOOR OPERATOR ACTUATOR

CCTV SYSTEM

- CCTV — CAMERA FIXED POSITION
- CCTV — CAMERA, PAN-TILT-ZOOM
- CCTV — CCTV MONITOR
- CCTV — CCTV MONITOR

LOW VOLTAGE ELECTRICAL MATERIALS

- CB — CIRCUIT BREAKER SWITCH
- UF — UNFUSED DISCONNECT SWITCH
- F — FUSED DISCONNECT SWITCH
- MOTOR STARTER MANUAL
- MOTOR STARTER MAGNETIC
- CB — MOTOR STARTER MAG. COMBINATION C.B. SW.
- F — MOTOR STARTER MAG. COMBINATION FUSED D.S.
- VFD — VARIABLE FREQUENCY DRIVE
- PUSHBUTTON SW. EMERG. STOP
- PUSHBUTTON SW. STOP/START
- PUSHBUTTON STATION
- SELECTOR SWITCH
- CS — CONTROL STATION
- FS — FLOAT SWITCH
- LI — LEVEL SWITCH
- BI — BIN LEVEL SWITCH
- LS — LIMIT SWITCH
- PS — PRESSURE SWITCH
- PE — ELECTRICAL/PNEUMATIC SWITCH
- PT — PRESSURE TRANSMITTER
- SV — SOLENOID VALVE
- T — THERMOSTAT
- TS — TEMPERATURE SWITCH
- 2 — MOTOR
- POINT OF CONNECTION
- J — JUNCTION BOX OR CONDUIT FITTING

$ — WALL SWITCH
- (1a) NUMBER & LETTER IN PARENTHESES INDICATES PANELBOARD CIRCUIT & SWITCHING ZONE
- 3 THREE WAY
- 4 FOUR WAY
- D DIMMER
- OS OCC SENSOR
- T TIMER
- XP EXPLOSIVE PROOF
- WP WATERPROOF

$ M — MOTOR SWITCH
- M MOTOR RATED TOGGLE SWITCH WITHOUT OVERLOADS
- MS MANUAL MOTOR STARTER WITH OVERLOADS

- DS — DAYLIGHT SENSOR
- OS — WALL MOUNTED OCCUPANCY SENSOR
- OS — CEILING MOUNTED OCCUPANCY SENSOR
- PC — PHOTOCELL, SUBSCRIPT INDICATES CIRCUIT

CONVENIENCE RECEPTACLE - DUPLEX
- C CLOCK
- CR CORROSION RESISTANT
- GFI GROUND FAULT INTERRUPTER
- TL TWIST LOCK, NEMA CONFIGURATION AS INDICATED
- U UPS FED
- WP WEATHERPROOF

SUBSCRIPT NUMBER AT RECEPTACLE INDICATES CIRCUIT

- QUADRUPLEX RECEPTACLE
- SINGLE RECEPTACLE
- FLOOR RECEPTACLE
- SPECIAL PURPOSE RECEPTACLE, NEMA CONFIGURATION AS INDICATED

SITE ELECTRICAL

- POLE CONCRETE
- POLE WOOD
- POLE MOUNTED TRANSFORMER
- DOWN GUY
- SIDEWALK GUY
- M — MANHOLE
- H — HANDHOLE
- V — VAULT
- S — PAD MOUNTED SWITCH
- T — TRANSFORMER VAULT
- PAD MOUNTED TRANSFORMER

GROUNDING

- GROUND ROD
- GROUND ROD WITH ACCESS BOX
- GROUND CONNECTION EXOTHERMIC
- GROUND CONNECTION MECHANICAL BOLTED
- GROUND CONNECTION COMPRESSION
- GROUND COIL (PIGTAIL) 5'0" (1.5M)
- GROUND GRADIENT MAT (SAFETY MAT) 4'X 4'
- GROUND GRADIENT MAT (SAFETY MAT) 4'X 6'

ELECTRICAL LIGHTING FIXTURES

- SURFACE/PENDANT LINEAR FIXTURE
- SURFACE/PENDANT LINEAR FIXTURE WITH BATTERY BACKUP
- RECESSED LINEAR FIXTURE
- RECESSED LINEAR FIXTURE WITH BATTERY BACKUP
- DOWNLIGHT FIXTURE SURFACE/PENDANT CEILING MOUNT
- DOWNLIGHT OR SCONCE FIXTURE SURFACE WALL MOUNT
- R — DOWNLIGHT FIXTURE RECESSED CEILING MOUNT
- R — DOWNLIGHT OR SCONCE FIXTURE RECESSED WALL MOUNT
- H — HAZARDOUS AREA LIGHT FIXTURE CEILING MOUNT
- EXIT SIGN, ARROW INDICATES DIRECTION SURFACE/PENDANT CEILING MOUNT, FILLED QUARTER INDICATES NON-INDICATING FACE
- EXIT SIGN, ARROW INDICATES DIRECTION SURFACE WALL MOUNT, FILLED QUARTER INDICATES NON-INDICATING FACE
- R — EXIT SIGN, ARROW INDICATES DIRECTION RECESSED WALL MOUNT, FILLED QUARTER INDICATES NON-INDICATING FACE
- EMERGENCY DOWNLIGHT FIXTURE SURFACE/PENDANT CEILING MOUNT
- EMERGENCY DOWNLIGHT OR SCONCE FIXTURE SURFACE WALL MOUNT
- R — EMERGENCY DOWNLIGHT FIXTURE RECESSED CEILING MOUNT
- R — EMERGENCY DOWNLIGHT OR SCONCE FIXTURE RECESSED WALL MOUNT
- EMERGENCY LIGHTING UNIT, 1 HEAD
- EMERGENCY LIGHTING UNIT, 2 HEAD
- EMERGENCY LIGHTING UNIT, 3 HEAD
- SURFACE MTD. DISTR. PANELBOARD
- FLUSH MTD. DISTR. PANELBOARD
- LF-1 LF-1 — POLE-MOUNTED AREA LIGHT, NUMBER OF FIXTURES AND CONFIGURATION AS SHOWN AND PER SCHEDULE
- A (2a) — LETTER NEXT TO LUMINAIRE INDICATES TYPE PER SCHEDULE. NUMBER AND LOWER CASE LETTER IN PARENTHESES INDICATES CIRCUIT AND SWITCHING ZONE IN PANELBOARD.

PLAN LINETYPES AND CONVENTIONS

- EXPOSED CONDUCTOR/CONDUIT
- CONCEALED/EMBEDDED CONDUCTOR/CONDUIT
- CONDUCTOR/CONDUIT DOWN
- CONDUCTOR/CONDUIT UP
- G — GROUNDING ELECTRODE CONDUCTOR, BARE COPPER
- G — GROUND CONNECTION, EXOTHERMIC OR WELDED
- G — GROUND CONNECTION, BOLTED
- EOH — OH POWER
- EUG — UG POWER
- [3/4"C, 3#12, 1#12G] — CIRCUIT CALLOUT, CONDUIT AND CONDUCTOR SIZES AS INDICATED; "n-" IN FRONT OF CALLOUT INDICATES "n" PARALLEL SETS
- RXX — RACEWAY CALLOUT, INDEX NUMBER AS INDICATED IN RACEWAY SCHEDULE

DIAGRAM LINETYPES AND CONVENTIONS

- ENCLOSURE
- CONDUCTOR, CABLE, CIRCUIT, OR BUS
- INTERCONNECTION WITH EXTERNAL EQUIPMENT
- GANG OPERATED INTERLOCK
- OR — CONDUCTOR, CROSSING OF PATHS OR CONDUCTORS NOT CONNECTED
- CONDUCTOR, JUNCTION OF CONNECTED PATHS, CONDUCTORS OR WIRES

PRELIMINARY
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REV	DATE	BY	DESCRIPTION
A	04/26/24	SPE	15% DESIGN

WARNING

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CHUGACH POWERING ALASKA'S FUTURE

MEA MATANUSKA ELECTRIC ASSOCIATION

MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT

EKLUTNA DAM SPILLWAY MODIFICATIONS

ELECTRICAL STANDARD SYMBOLS 2

DESIGNED C. CURTIS

DRAWN F. HABER

CHECKED J. BAKKEN

PROJECT DATE 04/26/24

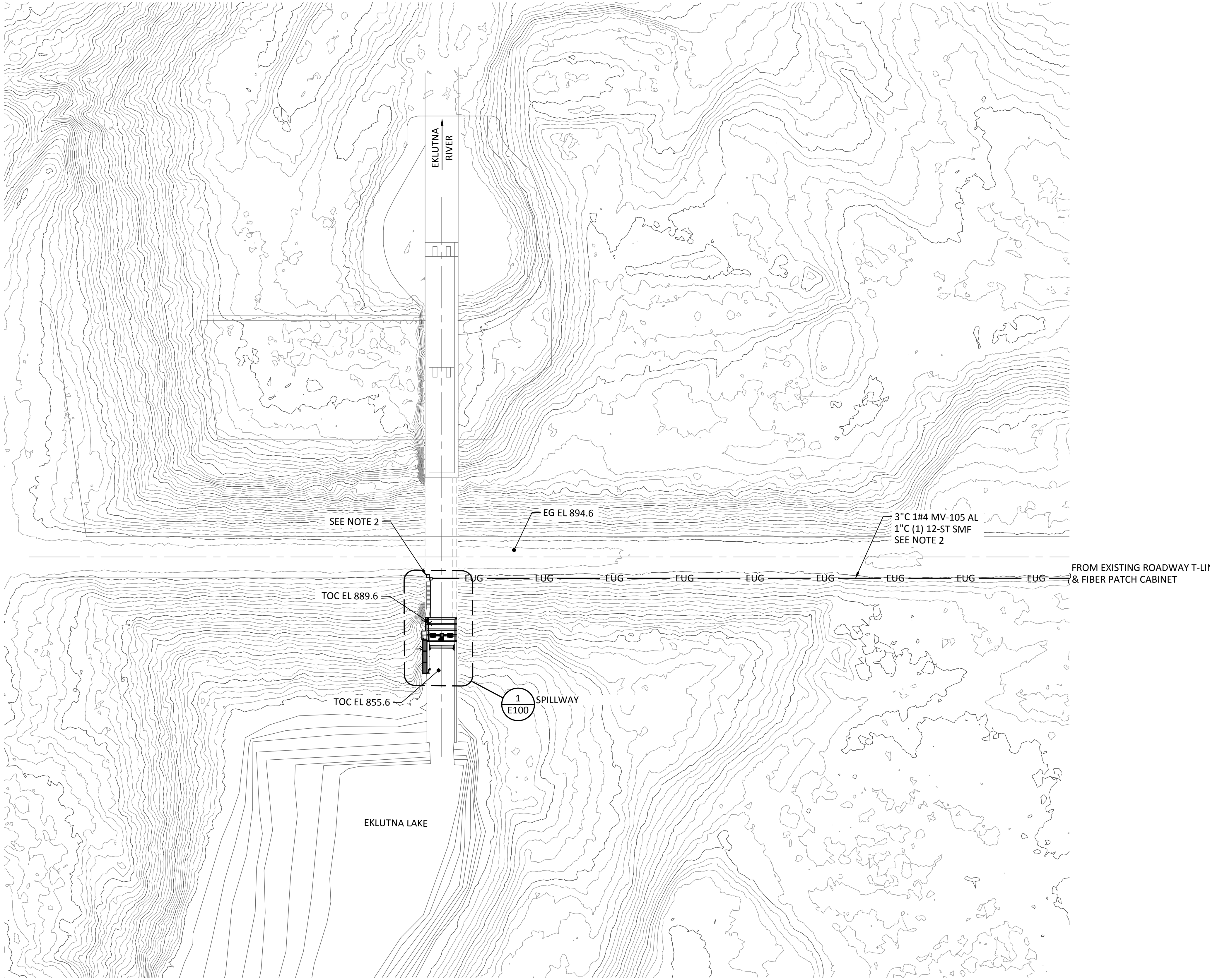
DRAWING GE003

JOB NO: 000000

Path: C:\Vault\Chugach Electric\24-021 Eklutna Spillway Modification\GE003.dwg Plot date: Apr 23, 2024 03:44pm, CAD User: WoodRon

SHEET NOTES:

1. ELEVATIONS SHOWN ARE IN NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
2. BURIED POWER LINE, FIBER OPTIC COMMUNICATION LINES, AND CONCRETE HANHOLES INSTALLED PREVIOUSLY DURING DAM OUTLET GATE MODIFICATION WORK.



INSTALLATION KEY PLAN

SCALE: 1"= 40'

0' 40' 80'

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
A	04/26/24	SPE	15% DESIGN

WARNING

0 1/2 1

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MEA MATANUSKA ELECTRIC ASSOCIATION

MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT

EKLUTNA DAM SPILLWAY MODIFICATIONS

ELECTRICAL TRANSMISSION & COMMUNICATIONS UPGRADES PLAN

DESIGNED S. ELLENSON

DRAWN J. HOLT

CHECKED J. BAKKEN

PROJECT DATE 04/26/24

DRAWING

E001

JOB NO: 000000

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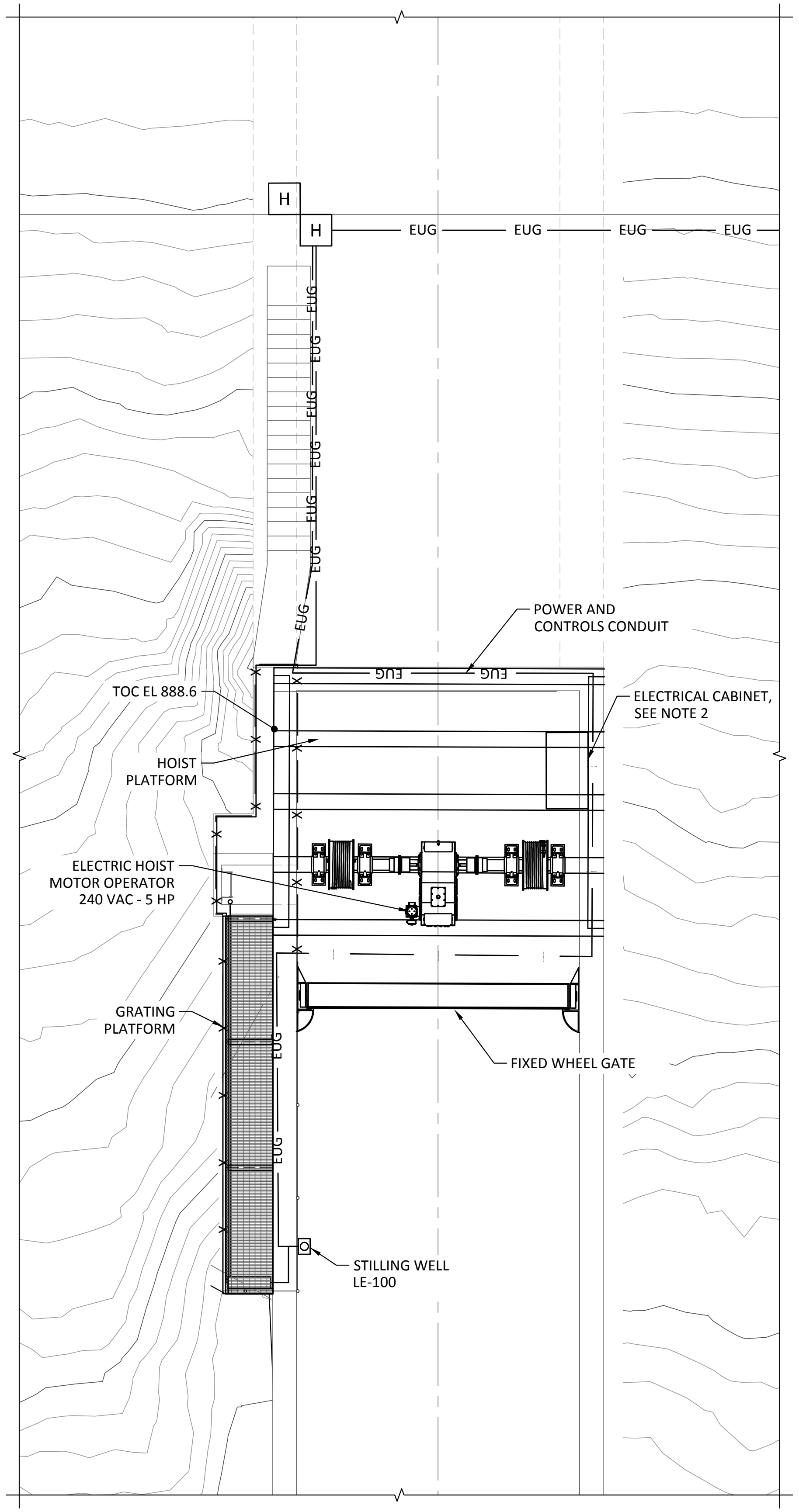

SPILLWAY DETAIL

SCALE: 3/16"= 1'-0"

SHEET NOTES:

1. ELEVATIONS SHOWN ARE IN NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
2. INSTALL NEW NEMA 250 TYPE 4X SS CABINET ON HANDRAIL OR FRAMING CHANNEL RACK. CABINET SHALL INCLUDE 240VAC SINGLE-PHASE LOADCENTER, FIBER OPTIC CLOSET CONNECTOR HOUSING, AND REMOTE I/O RACK. PROVIDE CABINET COMPLETE AND OPERABLE WITH TERMINAL BLOCKS, SURGE SUPPRESSORS, AND POWER SUPPLIES. INCLUDE LOCKABLE SERVICE ENTRANCE RATED DISCONNECT SWITCH ON EXTERIOR OF CABINET.
3. MOUNT ALL CONDUITS ALONG LOWER PORTION OF HANDRAIL.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION
A	04/26/24	SPE	15% DESIGN

WARNING

0 1/2 1

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

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CHUGACH POWERING ALASKA'S FUTURE

MEA MATANUSKA ELECTRIC ASSOCIATION

MUNICIPALITY OF ANCHORAGE

EKLUTNA FISH & WILDLIFE PROJECT

EKLUTNA DAM SPILLWAY MODIFICATIONS

EKLUTNA DAM SPILLWAY ELECTRICAL PLAN, SECTION, AND DETAILS

DESIGNED S. ELLENSON

DRAWN J. HOLT

CHECKED J. BAKKEN

PROJECT DATE 04/26/24

DRAWING

E100

JOB NO: 000000

Path: C:\Vault\Chugach Electric\24-021 Eklutna Spillway Modification\E100.dwg Plot date: Apr 23, 2024 03:44pm, CAD User: WoodRon

Appendix B. Class 4 Opinion of Probable Construction Costs

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Phase 2 Engineering
Eklutna Dam Spillway Modifications

Line Item	Item	Quantity	Unit	Unit Cost	Total Cost	Total
01	**DIVISION 01 INDIRECTS**					**$460,000**
	Mobilization and Establishment of Site Infrastructure	8	%	0.08	$184,000	
	Contractor General Requirements (Percentage of Direct Cost)	12	%	0.12	$276,000	
02	**SITE CONSTRUCTION AND ACCESS ROADS**					**$80,000**
	Site Access - Construct Laydown Areas, Turnarounds and Crane Pads	0.5	ACRE	$160,000	$80,000	
03	**SPILLWAY MODIFICATIONS**					**$698,100**
	Cofferdam	1	LS	$30,000	$30,000	
	Dewatering	3	MO	$35,000	$105,000	
	Demo, Misc	1	LS	$15,000	$15,000	
	Concrete Demolition, Spillway Concrete	250	CY	$2,000	$500,000	
	Hoist Structure and Platfoms	16,500	LBS	$7.50	$123,800	
	Security Gate Installation	130	LF	$110	$14,300	
	Spillway Apron Surface Concrete Repair	40	CY	$1,500	$60,000	
04	**MECHANICAL EQUIPMENT**					**$1,275,000**
	Gate Guides and Embeds	1	LS	$155,000	$155,000	
	Fixed Wheel Gate Fabrication; 16-ft x 20-ft	25,000	lb	$20	$500,000	
	Gate Guides & Fixed Wheel Gate Installation	1	LS	$90,000	$90,000	
	Hoist and Gearbox Procurement	1	EA	$430,000	$430,000	
	Superstructure, Hoist and Gearbox Installation	1	LS	$100,000	$100,000	
05	**ELECTRICAL AND TRANSMISSION**					**$245,000**
	Distribution Panel, Conduit, & Cable	1	LS	$20,000	$20,000	
	Instrumentation, Flow Meters, & Gate Controls	1	LS	$150,000	$150,000	
	Electrical Install	1	LS	$40,000	$40,000	
	Startup & Commissioning	1	LS	$35,000	$35,000	
	Project Subtotal (without Division 01)					**$2,298,100**
	Project Subtotal					**$2,758,100**

AACE International CLASS 4 Cost Estimate - Class 4 estimates are generally prepared based on limited information, and subsequently have fairly wide accuracy ranges. Typically, engineering is 1% to 15% complete. They are typically prepared for detailed strategic planning, business case development, projection screening, alternative scheme analysis, confirmation of economic and technical feasibility, selection of a feasible alternative and preliminary budget approval to proceed to the next stage of the project. Virtually all Class 4 estimates use stochastic estimating methods such as cost/capacity curves and factors, historical data and other parametric and modeling techiques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and other risks. Ranges could exceed those shown in unusual circumstances.

Project: Eklutna Dam Fixed Wheel Gate
Location: Anchorage, AK
Date: 18-Apr-24

Class 4 Engineer's Estimate -- 15% Design

Item	Direction Construction Cost		Amount
01	DIVISION 01 INDIRECTS		$460,000
02	SITE CONSTRUCTION AND ACCESS ROADS		$80,000
03	SPILLWAY MODIFICATIONS		$698,100
04	MECHANICAL EQUIPMENT		$1,275,000
05	ELECTRICAL AND TRANSMISSION		$245,000
	Total Construction Cost		**$2,758,100**
	Overhead		
	GC Overhead and Profit	15.00%	$414,000
	Construction Bonds	1.25%	$40,000
	Total - Overhead		**$454,000**
	Direct Cost Contingency		
	*Overall Project Contingency:	25.00%	$803,000
	Escalation:	0.00%	$0
	Total - Contingency		**$803,000**
	Taxes		
	AK Sales Tax	0.00%	$0
	Total - Taxes		**$0**
	Median Construction Price - Direct and Indirect		**$4,015,100**
	Total Construction Price Range (-30% to +50%)		**$2,810,000 to $6,020,000**

Notes:
All costs based on 2024 Construction Dollars
Does not include: interest during construction, legal, financing, or administration costs.
Costs assume a crane can be located on the dam crest for support of work in spillway.
* Overall Project Contingency is set at 25% due to the current level of project definition and it may be reduced at later stages of design.

Appendix C. Structural Calculations

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Calculation Cover Sheet

Project: Eklutna Fixed Wheel Gate

Client: Eklutna Fish & Wildlife **Proj. No.:** 24-021

Title: Channel Wall Stability

Prepared By, Name: J.Cirafici

Prepared By, Signature: ______________ **Date:** 2/12/2024

Peer Reviewed By, Name: G. Clark

Peer Reviewed, Signature: ______________ **Date:** 2/12/2024

Purpose

The purpose of this calculation is to determine whether the existing reinforcement in the channel was is adequate to resist lateral earth pressures after the ogee is removed. The ogee provides lateral bracing of the channel walls along their bottom halves. When the ogee is removed, the walls are no longer laterally braced and serve essentially as cantilevered retaining walls. The following analysis will determine if they can do adequately.

References

- *ACI 318-19: Building Code Requirements for Structural Concrete*
- *ACI 350-20: Code Requirements for Environmental Engineering Concrete Structures*
- *ASCE 7-22: Minimum Design Loads for Buildings and Other Structures*

General Information

Material Unit Weights

γ_w =	**62.4**	pcf	*Water*
γ_c =	**150**	pcf	*Concrete*
γ_s =	**490**	pcf	*Steel*
γ_{soil} =	**130**	pcf	*Soil (Saturated)*

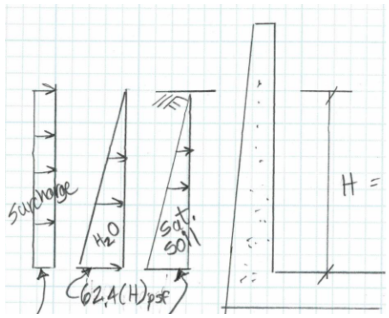
Channel Wall Geometry

T.O Wall =	**885**	ft	*Top of Wall Elevation*
T.O. Slab =	**852**	ft	*Top of Slab Elevation*
B.O. Slab =	**849**	ft	*Bottom of Slab Elevation*
T.O. Soil =	**879.6667**	ft	
H_{wall} =	**36**	ft	*Height of Wall*
H_{soil} =	**27.667**	ft	*Height of Retained Soil*
t_{wtop} =	**18**	in	*Wall Thickness @ Top*
t_{wbott} =	**36**	in	*Wall Thickness @ Bottom*

**Note: Soil Elevation Varies along length of wall. The channel wall is braced laterally by a top slab starting @ Sta. 4+57.33 and by a vertical shaft @ approx. Sta. 4+45.17. The center point between these two bracing points will be considered for design for the closest approximation of pure cantilever action.*

Soil Properties (Assumed)

ϕ =	**30**	deg	*Friction Angle*
K_0 =	**0.500**		*At-Rest Pressure Coeff*
K_a =	**0.333**		*Active Pressure Coeff (Rankine)*
K_p =	**3.000**		*Passive Pressure Coeff (Rankine)*



Lateral Earth Pressure

*Wall is assumed to be designed as non-yielding, therefore at-rest pressures will be considered

σ_0 =	935.133	psf	*At-rest Lat. Earth Pressure @ Base*
σ_w =	1726.400	psf	*Lat. Water Pressure @ Base*
σ_{sur} =	100.0	psf	*Assumed Surchage Pressure for Construction/Maintenance*
LRFD Factor =	1.6		*ACI350 9.2*

Wall Strength Check - Cantilever Action

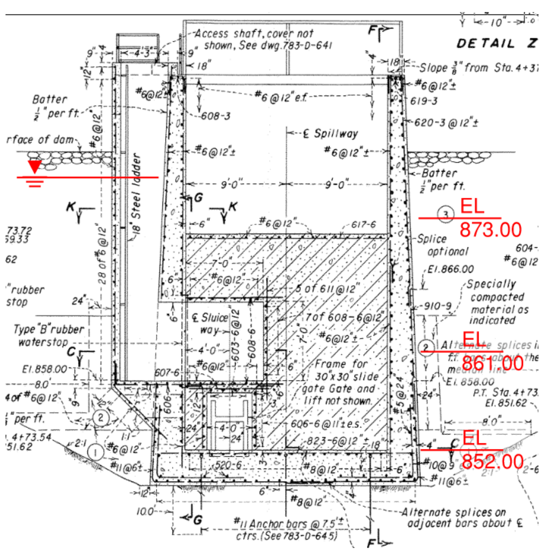
Assumed Concrete Properties:

f'_c =	4000	psi	*Concrete Compressive Strength*
f_y =	60000	psi	*Reinforcement Yield Strength*

**Since wall is battered, effective depth of reinforcement. Wall bending capacity will be checked at multiple points along height of wall. The wall will be analyzed in representative 1-ft segment idealized as a singly-reinforced rectangular section.*

Cover =	2	in	*Minimum concrete cover*
β_1 =	0.85		*ACI350 Section 10.2.7.3*
β =	EQ 10-6		*ACI350 Strain gradient amplification factor per 10.6.4.4*
Exposure:	Normal		*ACI350 Section 10.6.4.5*
Exposure Factor =	320		
Element action:	One-way		
Stress Limit =	20000	psi	

Typical Wall Section:



Wall		South Wall			North Wall		
Elevation		852.00	861.00	873.00	852.00	861.00	873.00
Wall Thickness	in	34.5	30	24	34.5	30	24
bar size		#11	#9	#6	#11	#9	#6
spacing	in	6	6	12	6	6	12
A_s/ft	in^2/ft	3.12	2.00	0.44	3.12	2.00	0.44
d_{bar}	in	1.375	1.125	0.750	1.375	1.125	0.750
d	in	31.8125	27.4375	21.625	31.8125	27.4375	21.625
a	in	4.59	2.94	0.65	4.59	2.94	0.65
c	in	5.40	3.46	0.76	5.40	3.46	0.76
β		1.10	1.11	1.11	1.10	1.11	1.11
ε_t		0.015	0.021	0.082	0.015	0.021	0.082
Check		OK	OK	OK	OK	OK	OK
Min Reinf Ratio		0.005	0.005	0.005	0.005	0.005	0.005
Min Reinf Req'd		1.035	0.900	0.720	1.035	0.900	0.720
Min Steel Check		OK	OK	OK	OK	OK	OK

$$a = {A_s f_y}/{0.85 f'_c b}$$

$$c = a/\beta_1$$

*Shrinkage and Temp steel can be considered to be split between both faces of wall

		ACI 350					
M_{earth}	kip-ft/ft	119.3	36.6	1.7	119.3	36.6	1.7
M_{hydro}	kip-ft/ft	220.2	67.6	3.1	220.2	67.6	3.1
$M_{surcharge}$	kip-ft/ft	38.27	17.42	2.22	38.27	17.42	2.22
$M_{u\_factored}$	kip-ft/ft	604.50	194.73	11.16	604.50	194.73	11.16
$M_{u\_service}$	kip-ft/ft	377.81	121.71	6.97	377.81	121.71	6.97
Max f_s	psi	36,000	36,000	22,261	36,000	36,000	22,261
γ		1.600	1.600	1.600	1.600	1.600	1.600
φ (bending)		0.9	0.9	0.9	0.9	0.9	0.9
S_d		1.00	1.00	1.52	1.00	1.00	1.52
$S_d M_{factor}$	kip-ft/ft	604.50	194.73	16.91	604.50	194.73	16.91
φ *M_n	kip-ft/ft	414.44	233.70	42.18	414.44	233.70	42.18
Utilization	%	146%	83%	40%	146%	83%	40%
d - a/2	in	29.52	25.97	21.30	29.52	25.97	21.30
Actual f_s	psi	49,228	28,122	8,927	49,228	28,122	8,927
s Check ($f_{sactual}$ < f_{smas})		No Good	OK	OK	No Good	OK	OK

At El. 852.00, there are multiple layers of vertical bars that can be considered ot resist bending moments. The capacity is rechecked more thoroughly below:

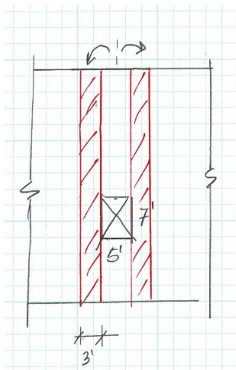
Outer Layer -->	#11	@	6	in O.C.
	d_{bar} =	1.375	in	
	A_s/ft =	3.12	in^2/ft	
	d_{outer} =	31.8125	in	
Inner Layer -->	#10	@	9	in O.C.
	d_{bar} =	1.250	in	
	A_s/ft =	1.69	in^2/ft	
	d_{inner} =	27.8125	in	
Combined -->	A_s/ft =	4.81	in^2/ft	
	d_{comb} =	30.405	in	

Bending Strength -->	a =	7.08	in
	c =	8.33	in
	β =	1.19	
	ε_t =	0.008	
	Check	OK	
	Max f_s =	33,510	psi
	γ	1.600	
	φ (bending)	0.9	
	S_d	1.01	
	$S_d M_{factor}$	608.84	
	φ *M_n	581.92	
	Utilization	105%	
	d - a/2	31.81	
	Actual f_s	29,609	
	Tensile Reinf. Stress Check ($f_{sactual}$ < f_{smas})	OK	

Even when considering all layers of reinforcement, the bending moments encountered at the base of the wal still exceed its capacity. As such, struts are recommended at the top of the wall so that the wall functions in simple support bending as opposed to cantilevered action.

Wall at Chamber Opening:

**There is an opening in the south side wall that allows access into the ogee. For the purpose of analysis, load imparted onto the wall above and below the openings are assumed to be resisted by 3-ft segments of the wall directly adjacent to the opening on both sides. A factor of 1.83 has been applied to the loads to account for the 5-ft opening width distributed to the adjacent segments.*



$$\text{Ratio} = \frac{3' + 5/2}{3'} = 1.83'$$

Wall		South Wall			
Elevation		852.00	858.00	861.00	873.00
Wall Thickness	in	34.5	31.5	30	24
bar size		#11	#9	#9	#6
spacing	in	6	6	6	12
A_s/ft	in^2/ft	3.12	2.00	2.00	0.44
d_{bar}	in	1.375	1.125	1.125	0.750
d	in	31.8125	28.9375	27.4375	21.625
a	in	4.59	2.94	2.94	0.65
c	in	5.40	3.46	3.46	0.76
β		1.10	1.04	0.86	1.62
ε_t		0.015	0.022	0.021	0.082
Check		OK	OK	OK	OK
Min Reinf Ratio		0.005	0.005	0.005	0.005
Min Reinf Req'd		1.035	0.945	0.900	0.720
Min Steel Check		OK	OK	OK	OK

$$a = {A_s f_y}/{0.85 f'_c b}$$

$$c = a/\beta_1$$

*Shrinkage and Temp steel can be considered to be split between both faces of wall

		ACI 350			
M_{earth}	kip-ft/ft	218.3	104.9	67.1	3.1
M_{hydro}	kip-ft/ft	403.0	193.6	123.8	5.6
$M_{surcharge}$	kip-ft/ft	70.04	42.95	31.88	4.07
$M_{u\_factored}$	kip-ft/ft	1106.24	546.22	356.36	20.42
$M_{u\_service}$	kip-ft/ft	691.40	341.39	222.73	12.76
Max f_s	psi	36,000	36,000	36,000	20,000
γ		1.600	1.600	1.600	1.600
φ (bending)		0.9	0.9	0.9	0.9
S_d		1.00	1.00	1.00	1.69
$S_d M_{factor}$	kip-ft/ft	1106.24	546.22	356.36	34.45
φ *M_n	kip-ft/ft	414.44	247.20	233.70	42.18
Utilization	%	267%	221%	152%	82%
d - a/2	in	29.52	27.47	25.97	21.30
Actual f_s	psi	90,087	74,575	51,464	16,337
s Check ($f_{sactual} < f_{smas}$)		No Good	No Good	No Good	OK

Due to the increased loading from the opening, the segments of the wall adjacent to the opening are inadequate for the applied bending moments.

Wall Strength Check - Fixed-Pin Condition

*Recheck wall capacity for condition where lateral bracing is provided @ top of wall. The wall can now be considered fixed-pinned.

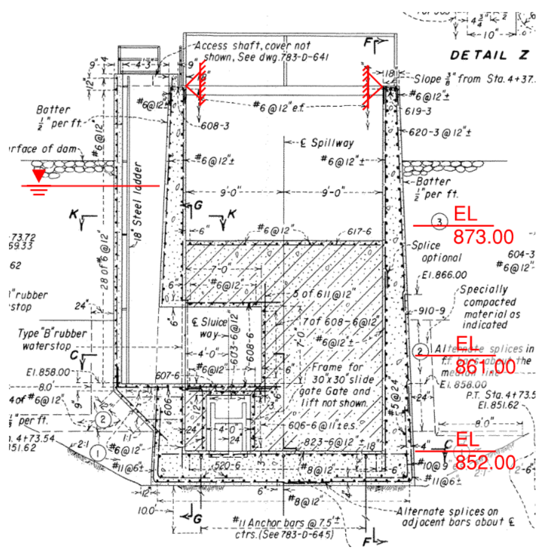
Assumed Concrete Properties:

f'_c =	4000	psi	*Concrete Compressive Strength*
f_y =	60000	psi	*Reinforcement Yield Strength*

**Since wall is battered, effective depth of reinforcement. Wall bending capacity will be checked at multiple points along height of wall. The wall will be analyzed in representative 1-ft segment idealized as a singly-reinforced rectangular section.*

Cover =	2	in	*Minimum concrete cover*
β_1 =	0.85		*ACI350 Section 10.2.7.3*
β =	EQ 10-6		*ACI350 Strain gradient amplification factor per 10.6.4.4*
Exposure:	Normal		*ACI350 Section 10.6.4.5*
Exposure Factor =	320		
Element action:	One-way		
Stress Limit =	20000	psi	

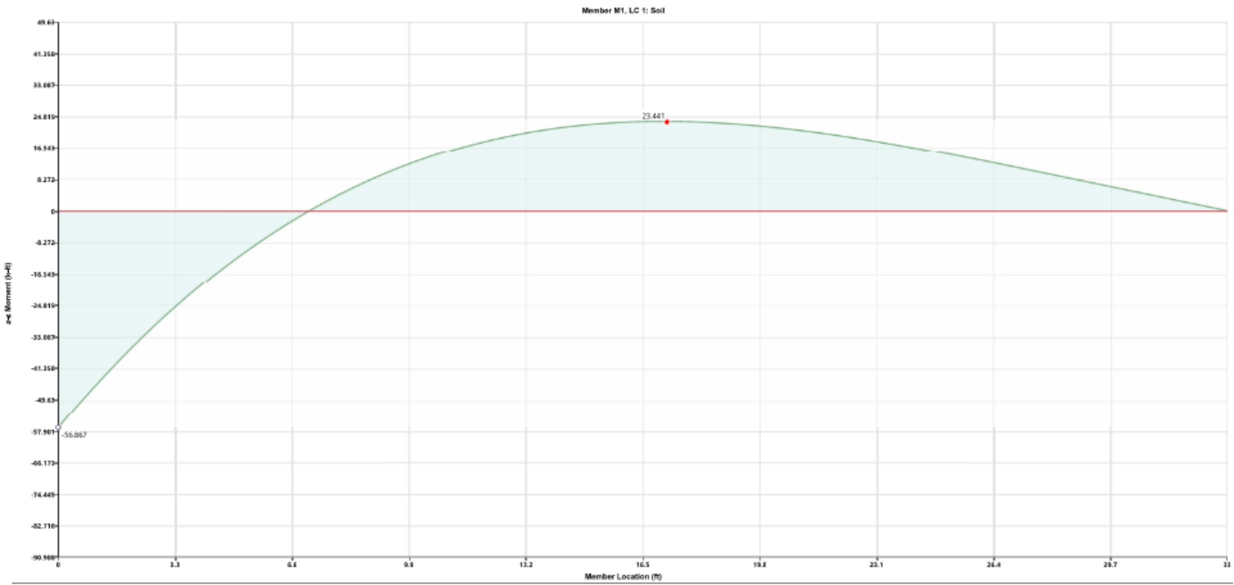
Typical Wall Section:

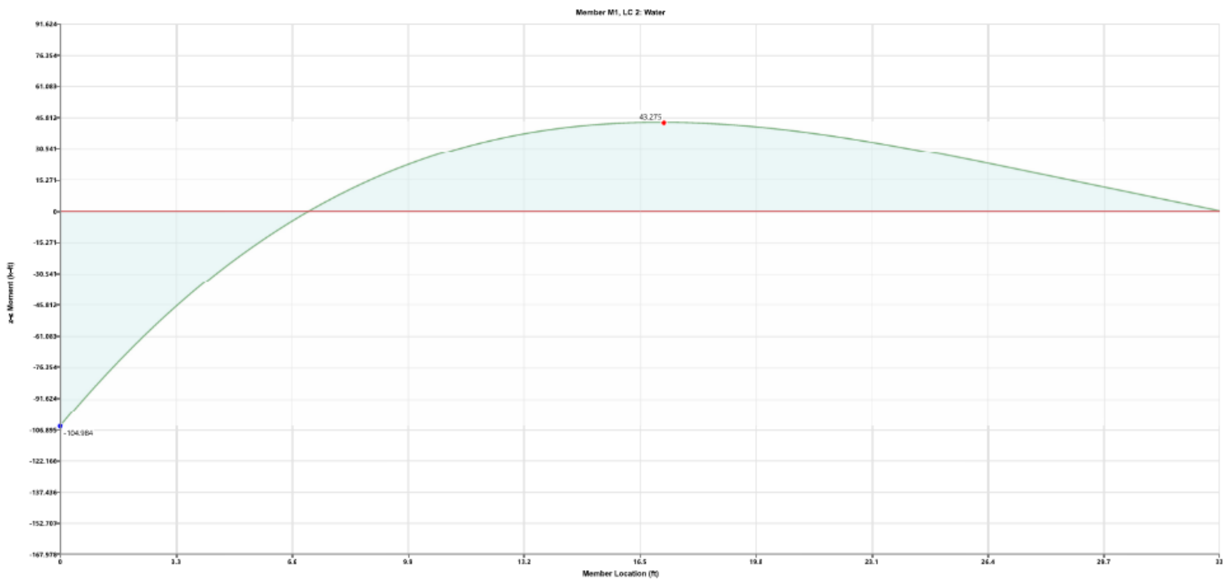


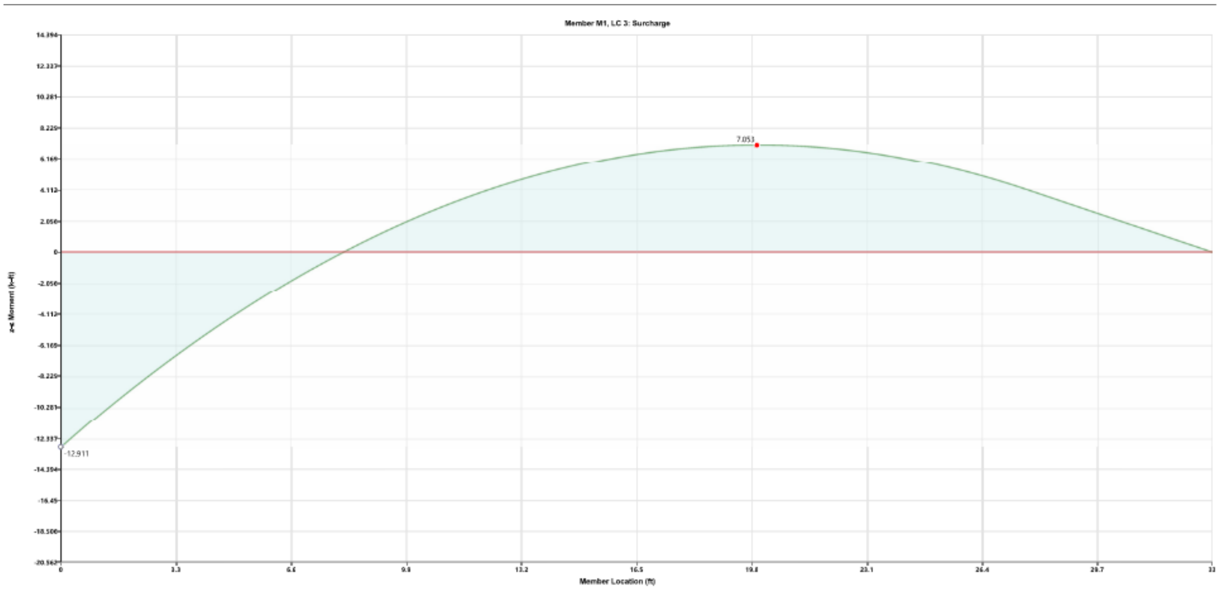
		South Wall			North Wall		
Wall Elevation		852.00	861.00	873.00	852.00	861.00	873.00
Wall Thickness	in	34.5	30	24	34.5	30	24
bar size		#11	#6	#6	#11	#6	#6
spacing	in	6	12	12	6	12	12
A_s/ft	in^2/ft	3.12	0.44	0.44	3.12	0.44	0.44
d_{bar}	in	1.375	0.750	0.750	1.375	0.750	0.750
d	in	31.8125	27.625	21.625	31.8125	27.625	21.625
a	in	4.59	0.65	0.65	4.59	0.65	0.65
c	in	5.40	0.76	0.76	5.40	0.76	0.76
β		1.10	1.09	1.11	1.10	1.09	1.11
ε_t		0.015	0.106	0.082	0.015	0.106	0.082
Check		OK	OK	OK	OK	OK	OK
Min Reinf Ratio		0.005	0.005	0.005	0.005	0.005	0.005

$$a = A_s f_y / 0.85 f'_c b$$

$$c = a/\beta_1$$


Member M1, LC 1: Soil
z-z Moment (k-ft)
Member Location (ft)
23.441
-56.867


Member M1, LC 2: Water
z-z Moment (k-ft)
Member Location (ft)
43.275
-104.984


Member M1, LC 3: Surcharge
z-z Moment (k-ft)
Member Location (ft)
7.053
-12.911

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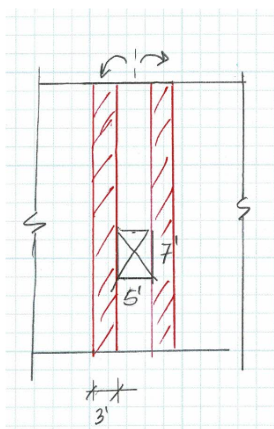
		ACI 350					
M_{earth}	kip-ft/ft	56.9	9.9	21.1	56.9	9.9	21.1
M_{hydro}	kip-ft/ft	105.0	18.2	38.9	105.0	18.2	38.9
$M_{surcharge}$	kip-ft/ft	12.91	1.33	7.00	12.91	1.33	7.00
$M_{u\_factored}$	kip-ft/ft	279.62	47.07	107.18	279.62	47.07	107.18
$M_{u\_service}$	kip-ft/ft	174.76	29.42	66.99	174.76	29.42	66.99
Max f_s	psi	36,000	22,781	22,261	36,000	22,781	22,261
γ		1.600	1.600	1.600	1.600	1.600	1.600
φ (bending)		0.9	0.9	0.9	0.9	0.9	0.9
S_d		1.00	1.48	1.52	1.00	1.48	1.52
S_dM_{factor}	kip-ft/ft	279.62	69.73	162.50	279.62	69.73	162.50
φ *M_n	kip-ft/ft	414.44	54.06	42.18	414.44	54.06	42.18
Utilization	%	67%	129%	385%	67%	129%	385%
d - a/2	in	29.52	27.30	21.30	29.52	27.30	21.30
Actual f_s	psi	22,771	29,385	85,767	22,771	29,385	85,767
s Check ($f_{sactual}$ < f_{smas})		OK	No Good	No Good	OK	No Good	No Good

While the base of the wall is now adequate when the wall is considered fixed-pinned, the new moment distribution means the inside face reinforcement is the primary tension reinforcement along the top 2/3 of the wall. This inside face is less heavily reinforced than the outside face, thus limiting the bending capacity.

Wall at Chamber Opening:

**There is an opening in the south side wall that allows access into the ogee. For the purpose of analysis, load imparted onto the wall above and below the openings are assumed to be resisted by 3-ft segments of the wall directly adjacent to the opening on both sides. A factor of 1.83 has been applied to the loads to account for the 5-ft opening width distributed to the adjacent segments.*



$$Ratio = \frac{3' + 5'/2}{3'} = 1.83'$$

Wall		South Wall			
Elevation		852.00	858.00	861.00	873.00
Wall Thickness	in	34.5	31.5	30	24
bar size		#11	#6	#6	#6
spacing	in	6	12	12	12
A_s/ft	in^2/ft	3.12	0.44	0.44	0.44
d_{bar}	in	1.375	0.750	0.750	0.750
d	in	31.8125	29.125	27.625	21.625
a	in	4.59	0.65	0.65	0.65
c	in	5.40	0.76	0.76	0.76
β		1.10	1.03	0.87	1.62
ε_t		0.015	0.112	0.106	0.082
Check		OK	OK	OK	OK
Min Reinf Ratio		0.005	0.005	0.005	0.005

$$a = A_s f_y / 0.85 f'_c b$$

$$c = a/\beta_1$$

		ACI 350			
M_{earth}	kip-ft/ft	104.1	13.1	18.1	38.6
M_{hydro}	kip-ft/ft	192.1	24.2	33.3	71.2
$M_{surcharge}$	kip-ft/ft	23.6	5.38	2.4	12.8
$M_{u\_factored}$	kip-ft/ft	511.70	68.34	86.13	196.14
$M_{u\_service}$	kip-ft/ft	319.81	42.71	53.83	122.59
Max f_s	psi	36,000	24,053	28,663	20,000
γ		1.600	1.600	1.600	1.600
φ (bending)		0.9	0.9	0.9	0.9
S_d		1.00	1.40	1.18	1.69
$S_d M_{factor}$	kip-ft/ft	511.70	95.89	101.42	330.99
φ $*M_n$	kip-ft/ft	414.44	57.03	54.06	42.18
Utilization	%	123%	168%	188%	785%
d - a/2	in	29.52	28.80	27.30	21.30
Actual f_s	psi	41,671	40,445	53,775	156,954
s Check ($f_{sactual}$ < f_{smas})		No Good	No Good	No Good	No Good

Due to the increased loading from the opening, the segments of the wall adjacent to the opening are inadequate for the applied bending moments.

Appendix D. Hydraulic Calculations

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Calculation Cover Sheet

Project: Eklutna Spillway Modifications

Client: Chugach Electric Association **Proj. No.:** 24-021

Title: Hydraulic Calculations

Prepared By, Name: Sean Ellenson, P.E.

Prepared By, Signature: ______________ **Date:** ______________

Peer Reviewed By, Name: ______________

Peer Reviewed, Signature: ______________ **Date:** ______________

McMillen

SUBJECT:	Chugach Electric Association	**BY:** S Ellenson	**CHK'D BY:**
	Eklutna Spillway Modifications	**DATE:** 4/19/2024	
	Hydraulic Calculations	**PROJECT NO.:** 21-024	

Table of Content

SUBJECT: Chugach Electric Association
Eklutna Spillway Modifications
Gate Rating Curve

BY: S Ellenson **CHK'D BY:**
DATE: 4/19/2024
PROJECT NO.: 21-024

Purpose

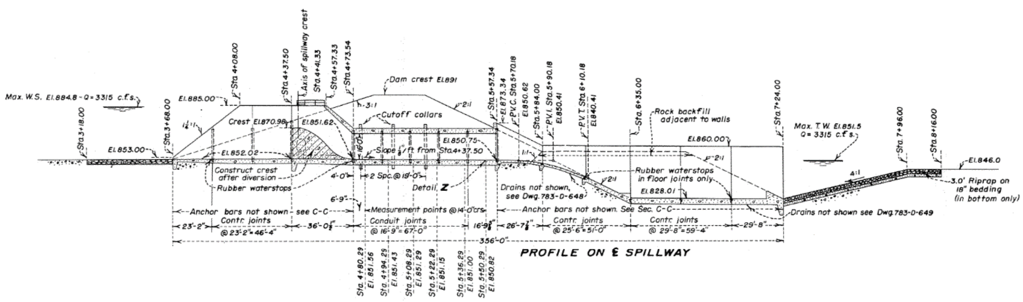
The purpose of this calculation sheet is to develop a preliminary gate rating curve for the proposed fixed wheel gate within the Eklutna Dam Spillway.

References

- *Tullis, J. Paul. (1989). Hydraulics of Pipelines, Pumps, Valves, Cavitation, Transients. New York: John Wiley & Sons.*
- *Miller, D.S. (1990). Internal Flow Systems, Design and Performance Prediction. Houston: Gulf Publishing Company.*

Information - Input

Dimensions and elevations of the spillway are obtained from the As-Built Drawings. Eklutna Project - Alaska. Replacement of Eklutna Dam and Spilway. January, 1965.



Calculation

Full Open

Calculations were performed to determine the stage-discharge relationship of the spoillway with the existing ogee crest removed and the gate in the fully open position. The spillway was treated as a concrete culvert utilzing open channel flow equations with a tailwater elevation assumed constant at a crest elevation of 855.09 ft msl (NAVD88)The spillway was treated as a concrete culvert utilzing open channel flow equations with a tailwater elevation assumed constant at a crest elevation of 855.09 ft msl (NAVD88).

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	855.6100	0.00	0.0	0-NF	0.00	0.00	0.75	23.49	0.00	0.00
321.50	321.50	859.2700	3.66	0.88	1-S2n	1.35	2.15	1.49	23.49	11.96	0.00
643.00	643.00	861.4200	5.80	2.17	1-S2n	2.14	3.41	2.47	23.49	14.48	0.00
964.50	964.50	863.2200	7.61	3.26	1-S2n	2.80	4.47	3.33	23.49	16.11	0.00
1200.00	1200.00	864.4100	8.80	4.00	1-S2n	3.25	5.17	3.91	23.49	17.05	0.00
1607.50	1607.50	866.3100	10.69	5.19	1-S2n	3.96	6.28	4.86	23.49	18.39	0.00
1929.00	1929.00	867.6900	12.07	6.08	1-S2n	4.50	7.09	5.56	23.49	19.28	0.00
2250.50	2250.50	868.9900	13.38	6.94	1-S2n	5.01	7.86	6.23	23.49	20.06	0.00
2572.00	2572.00	870.2400	14.63	7.78	1-S2n	5.50	8.59	6.88	23.49	20.77	0.00
2893.50	2893.50	871.4300	15.82	8.60	1-S2n	5.99	9.29	7.50	23.49	21.42	0.00
3215.00	3215.00	872.5800	16.96	9.41	1-S2n	6.45	9.97	8.11	23.49	22.02	0.00

Orifice Control

Calculations were performed to determine the stage discharge relationship at various gate openings with the gate controlling the flow. The flow rate is based on the orifice equation with a discharge coefficient of 0.70.

Gate Opening =		1	ft	Gate Opening =		2	ft	Gate Opening =		3	ft
Opening Elevation =		856.6	ft	Opening Elevation =		857.6	ft	Opening Elevation =		858.6	ft
Open Area =		18.0	ft2	Open Area =		36.0	ft2	Open Area =		54.0	ft2
Headwater Elevation (ft)	**Water Depth(ft)**	**Control**	**Flow Rate (cfs)**	**Headwater Elevation (ft)**	**Water Depth(ft)**	**Control**	**Flow Rate (cfs)**	**Headwater Elevation (ft)**	**Water Depth(ft)**	**Control**	**Flow Rate (cfs)**
855.6	0.0	Uncontrolled	0.0	855.6	0.0	Uncontrolled	0.0	855.6	0.0	Uncontrolled	0.0
856.0	0.4	Uncontrolled	34.3	856.0	0.4	Uncontrolled	34.3	856.0	0.4	Uncontrolled	34.3
857.0	1.4	Orifice Control	82.5	857.0	1.4	Uncontrolled	122.1	857.0	1.4	Uncontrolled	122.1
858.0	2.4	Orifice Control	119.7	858.0	2.4	Orifice Control	205.6	858.0	2.4	Uncontrolled	209.9
859.0	3.4	Orifice Control	147.8	859.0	3.4	Orifice Control	268.9	859.0	3.4	Orifice Control	297.8
860.0	4.4	Orifice Control	171.3	860.0	4.4	Orifice Control	320.0	860.0	4.4	Orifice Control	430.7
861.0	5.4	Orifice Control	192.0	861.0	5.4	Orifice Control	363.9	861.0	5.4	Orifice Control	513.9
862.0	6.4	Orifice Control	210.6	862.0	6.4	Orifice Control	403.1	862.0	6.4	Orifice Control	576.0
863.0	7.4	Orifice Control	227.8	863.0	7.4	Orifice Control	438.8	863.0	7.4	Orifice Control	631.9
864.0	8.4	Orifice Control	243.7	864.0	8.4	Orifice Control	471.8	864.0	8.4	Orifice Control	683.3
865.0	9.4	Orifice Control	258.7	865.0	9.4	Orifice Control	502.6	865.0	9.4	Orifice Control	731.1
866.0	10.4	Orifice Control	272.8	866.0	10.4	Orifice Control	531.6	866.0	10.4	Orifice Control	776.0
867.0	11.4	Orifice Control	286.2	867.0	11.4	Orifice Control	559.2	867.0	11.4	Orifice Control	818.4
868.0	12.4	Orifice Control	299.1	868.0	12.4	Orifice Control	585.4	868.0	12.4	Orifice Control	858.7
869.0	13.4	Orifice Control	311.4	869.0	13.4	Orifice Control	610.6	869.0	13.4	Orifice Control	897.2
870.0	14.4	Orifice Control	323.2	870.0	14.4	Orifice Control	634.7	870.0	14.4	Orifice Control	934.1
871.0	15.4	Orifice Control	334.6	871.0	15.4	Orifice Control	657.9	871.0	15.4	Orifice Control	969.6
872.0	16.4	Orifice Control	345.7	872.0	16.4	Orifice Control	680.4	872.0	16.4	Orifice Control	1003.9
873.0	17.4	Orifice Control	356.4	873.0	17.4	Orifice Control	702.1	873.0	17.4	Orifice Control	1037.0
874.0	18.4	Orifice Control	366.8	874.0	18.4	Orifice Control	723.2	874.0	18.4	Orifice Control	1069.1
875.0	19.4	Orifice Control	376.9	875.0	19.4	Orifice Control	743.7	875.0	19.4	Orifice Control	1100.3

Gate Opening =		4	ft	Gate Opening =		5	ft	Gate Opening =		6	ft
Opening Elevation =		859.6	ft	Opening Elevation =		860.6	ft	Opening Elevation =		861.6	ft
Open Area =		72.0	ft2	Open Area =		90.0	ft2	Open Area =		108.0	ft2
Headwater Elevation (ft)	**Water Depth(ft)**	**Control**	**Flow Rate (cfs)**	**Headwater Elevation (ft)**	**Water Depth(ft)**	**Control**	**Flow Rate (cfs)**	**Headwater Elevation (ft)**	**Water Depth(ft)**	**Control**	**Flow Rate (cfs)**
855.6	0.0	Uncontrolled	0.0	855.6	0.0	Uncontrolled	0.0	855.6	0.0	Uncontrolled	0.0
856.0	0.4	Uncontrolled	34.3	856.0	0.4	Uncontrolled	34.3	856.0	0.4	Uncontrolled	34.3
857.0	1.4	Uncontrolled	122.1	857.0	1.4	Uncontrolled	122.1	857.0	1.4	Uncontrolled	122.1
858.0	2.4	Uncontrolled	209.9	858.0	2.4	Uncontrolled	209.9	858.0	2.4	Uncontrolled	209.9
859.0	3.4	Uncontrolled	297.8	859.0	3.4	Uncontrolled	297.8	859.0	3.4	Uncontrolled	297.8
860.0	4.4	Orifice Control	430.7	860.0	4.4	Uncontrolled	430.7	860.0	4.4	Uncontrolled	430.7
861.0	5.4	Orifice Control	580.2	861.0	5.4	Orifice Control	580.2	861.0	5.4	Uncontrolled	580.2
862.0	6.4	Orifice Control	727.8	862.0	6.4	Orifice Control	746.6	862.0	6.4	Orifice Control	746.6
863.0	7.4	Orifice Control	806.1	863.0	7.4	Orifice Control	925.2	863.0	7.4	Orifice Control	925.2
864.0	8.4	Orifice Control	877.5	864.0	8.4	Orifice Control	1053.2	864.0	8.4	Orifice Control	1118.9
865.0	9.4	Orifice Control	943.5	865.0	9.4	Orifice Control	1138.9	865.0	9.4	Orifice Control	1316.3
866.0	10.4	Orifice Control	1005.2	866.0	10.4	Orifice Control	1218.5	866.0	10.4	Orifice Control	1415.3
867.0	11.4	Orifice Control	1063.3	867.0	11.4	Orifice Control	1293.3	867.0	11.4	Orifice Control	1507.8
868.0	12.4	Orifice Control	1118.4	868.0	12.4	Orifice Control	1364.0	868.0	12.4	Orifice Control	1594.9
869.0	13.4	Orifice Control	1170.9	869.0	13.4	Orifice Control	1431.2	869.0	13.4	Orifice Control	1677.6
870.0	14.4	Orifice Control	1221.1	870.0	14.4	Orifice Control	1495.3	870.0	14.4	Orifice Control	1756.3
871.0	15.4	Orifice Control	1269.4	871.0	15.4	Orifice Control	1556.9	871.0	15.4	Orifice Control	1831.7
872.0	16.4	Orifice Control	1315.9	872.0	16.4	Orifice Control	1616.0	872.0	16.4	Orifice Control	1904.1
873.0	17.4	Orifice Control	1360.8	873.0	17.4	Orifice Control	1673.1	873.0	17.4	Orifice Control	1973.8
874.0	18.4	Orifice Control	1404.2	874.0	18.4	Orifice Control	1728.3	874.0	18.4	Orifice Control	2041.2
875.0	19.4	Orifice Control	1446.4	875.0	19.4	Orifice Control	1781.8	875.0	19.4	Orifice Control	2106.4

Gate Opening = 7 ft
Opening Elevation = 862.6 ft
Open Area = 126.0 ft2

Headwater Elevation (ft)	Water Depth(ft)	Control	Flow Rate (cfs)
855.6	0.0	Uncontrolled	0.0
856.0	0.4	Uncontrolled	34.3
857.0	1.4	Uncontrolled	122.1
858.0	2.4	Uncontrolled	209.9
859.0	3.4	Uncontrolled	297.8
860.0	4.4	Uncontrolled	430.7
861.0	5.4	Uncontrolled	580.2
862.0	6.4	Uncontrolled	746.6
863.0	7.4	Orifice Control	925.2
864.0	8.4	Orifice Control	1118.9
865.0	9.4	Orifice Control	1326.5
866.0	10.4	Orifice Control	1541.0
867.0	11.4	Orifice Control	1706.0
868.0	12.4	Orifice Control	1810.6
869.0	13.4	Orifice Control	1909.6
870.0	14.4	Orifice Control	2003.6
871.0	15.4	Orifice Control	2093.5
872.0	16.4	Orifice Control	2179.6
873.0	17.4	Orifice Control	2262.5
874.0	18.4	Orifice Control	2342.4
875.0	19.4	Orifice Control	2419.7

Gate Opening = 8 ft
Opening Elevation = 863.6 ft
Open Area = 144.0 ft2

Headwater Elevation (ft)	Water Depth(ft)	Control	Flow Rate (cfs)
855.6	0.0	Uncontrolled	0.0
856.0	0.4	Uncontrolled	34.3
857.0	1.4	Uncontrolled	122.1
858.0	2.4	Uncontrolled	209.9
859.0	3.4	Uncontrolled	297.8
860.0	4.4	Uncontrolled	430.7
861.0	5.4	Uncontrolled	580.2
862.0	6.4	Uncontrolled	746.6
863.0	7.4	Uncontrolled	925.2
864.0	8.4	Orifice Control	1118.9
865.0	9.4	Orifice Control	1326.5
866.0	10.4	Orifice Control	1541.0
867.0	11.4	Orifice Control	1768.3
868.0	12.4	Orifice Control	2005.7
869.0	13.4	Orifice Control	2126.6
870.0	14.4	Orifice Control	2236.8
871.0	15.4	Orifice Control	2341.8
872.0	16.4	Orifice Control	2442.2
873.0	17.4	Orifice Control	2538.8
874.0	18.4	Orifice Control	2631.7
875.0	19.4	Orifice Control	2721.5

Gate Opening = 9 ft
Opening Elevation = 864.6 ft
Open Area = 162.0 ft2

Headwater Elevation (ft)	Water Depth(ft)	Control	Flow Rate (cfs)
855.6	0.0	Uncontrolled	0.0
856.0	0.4	Uncontrolled	34.3
857.0	1.4	Uncontrolled	122.1
858.0	2.4	Uncontrolled	209.9
859.0	3.4	Uncontrolled	297.8
860.0	4.4	Uncontrolled	430.7
861.0	5.4	Uncontrolled	580.2
862.0	6.4	Uncontrolled	746.6
863.0	7.4	Uncontrolled	925.2
864.0	8.4	Uncontrolled	1118.9
865.0	9.4	Orifice Control	1326.5
866.0	10.4	Orifice Control	1541.0
867.0	11.4	Orifice Control	1768.3
868.0	12.4	Orifice Control	2005.7
869.0	13.4	Orifice Control	2253.1
870.0	14.4	Orifice Control	2455.2
871.0	15.4	Orifice Control	2576.1
872.0	16.4	Orifice Control	2691.6
873.0	17.4	Orifice Control	2802.3
874.0	18.4	Orifice Control	2908.9
875.0	19.4	Orifice Control	3011.6

Gate Opening = 10 ft
Opening Elevation = 865.6 ft
Open Area = 180.0 ft2

Headwater Elevation (ft)	Water Depth(ft)	Control	Flow Rate (cfs)
855.6	0.0	Uncontrolled	0.0
856.0	0.4	Uncontrolled	34.3
857.0	1.4	Uncontrolled	122.1
858.0	2.4	Uncontrolled	209.9
859.0	3.4	Uncontrolled	297.8
860.0	4.4	Uncontrolled	430.7
861.0	5.4	Uncontrolled	580.2
862.0	6.4	Uncontrolled	746.6
863.0	7.4	D/S Control	925.2
864.0	8.4	D/S Control	1118.9
865.0	9.4	D/S Control	1326.5
866.0	10.4	D/S Control	1541.0
867.0	11.4	D/S Control	1768.3
868.0	12.4	D/S Control	2005.7
869.0	13.4	D/S Control	2253.1
870.0	14.4	D/S Control	2510.3
871.0	15.4	D/S Control	2777.3
872.0	16.4	D/S Control	2927.2
872.6	17.0	D/S Control	3003.2

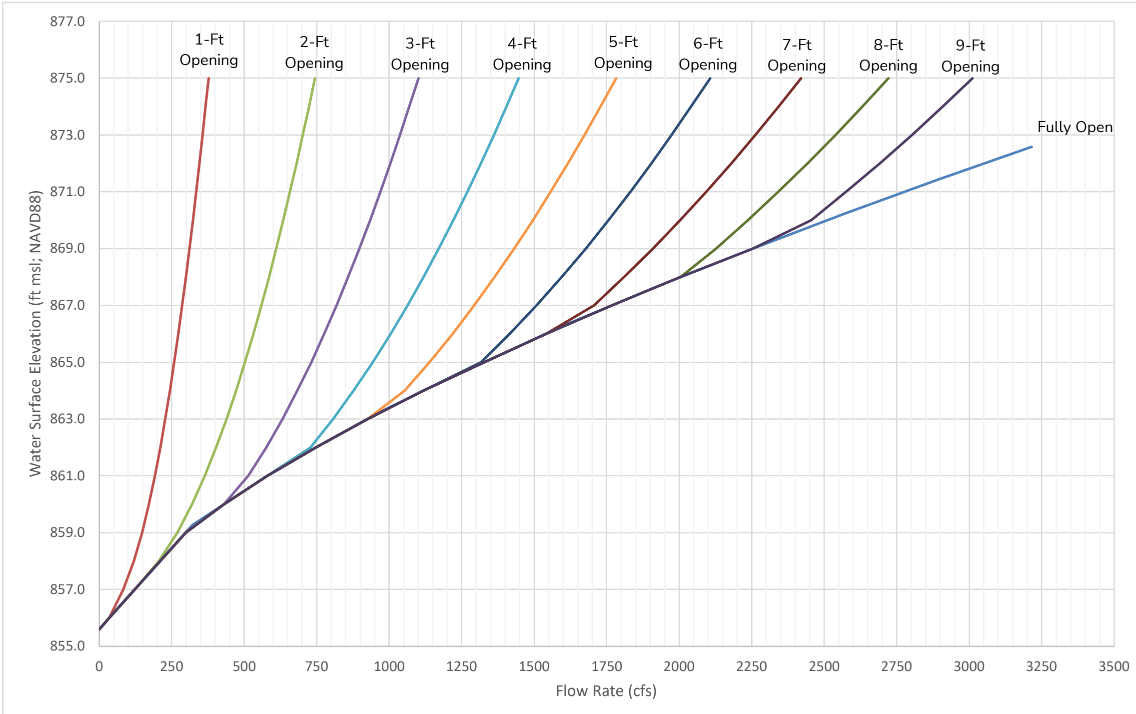
Gate Opening = 11 ft
Opening Elevation = 866.6 ft
Open Area = 198.0 ft2

Headwater Elevation (ft)	Water Depth(ft)	Control	Flow Rate (cfs)
855.6	0.0	Uncontrolled	0.0
856.0	0.4	Uncontrolled	34.3
857.0	1.4	Uncontrolled	122.1
858.0	2.4	Uncontrolled	209.9
859.0	3.4	Uncontrolled	297.8
860.0	4.4	Uncontrolled	430.7
861.0	5.4	Uncontrolled	580.2
862.0	6.4	Uncontrolled	746.6
863.0	7.4	Uncontrolled	925.2
864.0	8.4	D/S Control	1118.9
865.0	9.4	D/S Control	1326.5
866.0	10.4	D/S Control	1541.0
867.0	11.4	D/S Control	1768.3
868.0	12.4	D/S Control	2005.7
869.0	13.4	D/S Control	2253.1
870.0	14.4	D/S Control	2510.3
871.0	15.4	D/S Control	2777.3
872.0	16.4	D/S Control	3052.9
872.6	17.0	D/S Control	3215.0

Gate Opening = 12 ft
Opening Elevation = 867.6 ft
Open Area = 216.0 ft2

Headwater Elevation (ft)	Water Depth(ft)	Control	Flow Rate (cfs)
855.6	0.0	Uncontrolled	0.0
856.0	0.4	Uncontrolled	34.3
857.0	1.4	Uncontrolled	122.1
858.0	2.4	Uncontrolled	209.9
859.0	3.4	Uncontrolled	297.8
860.0	4.4	Uncontrolled	430.7
861.0	5.4	Uncontrolled	580.2
862.0	6.4	Uncontrolled	746.6
863.0	7.4	Uncontrolled	925.2
864.0	8.4	Uncontrolled	1118.9
865.0	9.4	D/S Control	1326.5
866.0	10.4	D/S Control	1541.0
867.0	11.4	D/S Control	1768.3
868.0	12.4	D/S Control	2005.7
869.0	13.4	D/S Control	2253.1
870.0	14.4	D/S Control	2510.3
871.0	15.4	D/S Control	2777.3
872.0	16.4	D/S Control	3052.9
872.6	17.0	D/S Control	3215.0

Results



1-Ft Opening
2-Ft Opening
3-Ft Opening
4-Ft Opening
5-Ft Opening
6-Ft Opening
7-Ft Opening
8-Ft Opening
9-Ft Opening
Fully Open
Water Surface Elevation (ft msl; NAVD88)
877.0
875.0
873.0
871.0
869.0
867.0
865.0
863.0
861.0
859.0
857.0
855.0
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
2750
3000
3250
3500
Flow Rate (cfs)

Appendix E. Mechanical Calculations

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REVISION:

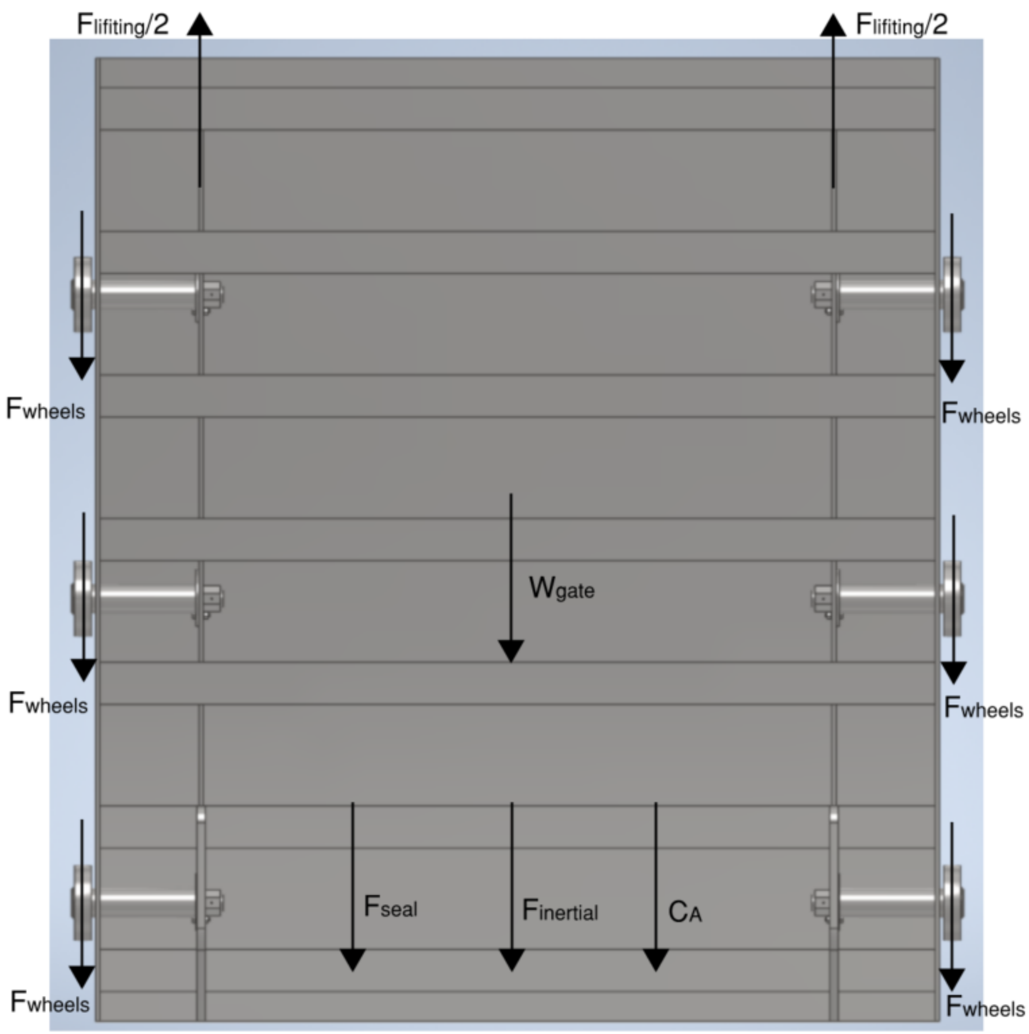
Rev: 0 | **Date**: April 17, 2024 | **Description**: Hydrostatic Gate Loading Calcs

Created By: Anthony DeSantis, EIT Reviewed By:

Gate, Hoist Loading

A) Discussion

This calculation sheet will determine the spillway gate loads imparted to the hoist.



B) Basic Gate Info

Gate width, width of gate subject to hydrostatic pressure, skin width per DWG C-004 — $W_{gate} := 16\ ft + 8\ in$

Gate weight with a 10% uncertainty factor — $P_{gate} := 21000\ lbf \cdot 1.10 = 23100\ lbf$

Ice and mud load — $C_A := 1.0\ (2\ kip) = 2\ kip$

For structural load cases, the atmospheric ice load (C) comes from guidance in USACE EM 1110-2-2107 and ASCE 7. These sources typically find the most extreme loading which does not match the "normal operation" scenario intended for load case A. Because the extreme (max) ice loading is used, the ice and mud load will have an uncertainty factor of 1.0.

C) Hydrostatic Loading

Density of Water — $\gamma_w := 62.4 \cdot \frac{lbf}{ft^3}$

Sill Elevation — $EL_{sill} := 855.6 \cdot ft$

Top of Skin PL (max normal water level) — $EL_{pool} := 874.6 \cdot ft$

Head on gate — $h_{eff} := EL_{pool} - EL_{sill} = 19\ ft$

Average Effective pressure on Gate — $p_{eff1} := \gamma_w \cdot \frac{h_{eff}}{2} = 4.117\ psi$

Submerged area of gate — $A_1 := W_{gate} \cdot h_{eff} = 316.667\ ft^2$

Force acting on gate — $F_{hyd} := p_{eff1} \cdot A_1 = 187720\ lbf$

D) Roller Friction Forces

Roller Diameter — $Diam_{roller} := 18 \cdot in$

Bearing Bore Diameter — $Diam_{bearing} := 6.51\ in$

Coef of Friction for Self Lube bushings — $\mu_b := .3$

Frictional Force@ bushing — $F_{friction\_axle} := \mu_b \cdot F_{hyd}$

Frictional Force Seen by gate & hoist at full pool

$$F_{friction\_wheels} := F_{friction\_axle} \cdot \frac{Diam_{bearing}}{Diam_{roller}}$$

$$F_{friction\_wheels} = 20368\ lbf$$

Effective COF

$$\frac{F_{friction\_wheels}}{F_{hyd}} = 0.109$$

D) Seal Friction

Pressure at the bottom seal

$$P_{seal\_bottom} := \gamma_w \cdot h_{eff}$$

Coefficient of friction for the side seals (EM 2701, Section 10.2.9.1.1).

$$\mu_{seals} := 0.5$$

Seal dimensions are assumed for now

Side Seal Thickness

$$t_{seal} := \frac{1}{2} \cdot in$$

Preset Seal Distance (Not available in but this is common value among various projects)

$$\delta_s := \frac{1}{8} \cdot in$$

Typical J-bulb seal are 60-70 on the Shore A durometer scale

$$H_A := 60$$

Distance from inside of skin plate to centerline of J-bulb side seal

$$D_b := 1.23 \cdot in$$

E. Calculate Frictional Force From the Bulb Seals

See LP-212-78 for seal details. The force from side seal friction is defined in EM 2702, 3-4 as:

$$F_{SEALS} = \mu_{SEALS} \cdot S \cdot l + \mu_{SEALS} \cdot \gamma_W \cdot \frac{d}{2}\left(l_1 \cdot \frac{h}{2} + h \cdot l_2\right)$$

where:

$$S = \frac{3\delta EI}{d^3}$$

Total Length of Both Side Seals:

$$L_{ss} := h_{eff} \cdot 2 = 38\ ft$$

Width of Side Seal exposed to Hydrostatic Pressure [(width of side seal)-(width of backing bar)] (Width of side seal & backing bar

$$d_{ss} := 1.91 \cdot in$$

Modulus of Elasticity for seals. (From Engineering with Rubber, Gent & Campion)

$$E_{seals} := \left(\frac{15.75 + 2.15 \cdot H_A}{100 - H_A}\right) \cdot 1 \cdot MPa$$

Seal Second Moment of Inertia

$$I_{ss} := \frac{L_{ss} \cdot (t_{seal})^3}{12}$$

Force Induced by Pre-setting Side Seal

$$S_{preset\_ss} := \frac{3 \cdot (\delta_s) \cdot E_{seals} \cdot (I_{ss})}{d_{ss}^{\ 3}} = 134.17\ \mathbf{lbf}$$

Side Seal Friction Force (both sides combined)

$$F_{ss} := (\mu_{seals} \cdot (S_{preset\_ss})) + \left(\mu_{seals} \cdot (\gamma_w) \cdot 0.5 \cdot (d_{ss}) \cdot L_{ss} \cdot (0.5) \cdot \frac{h_{eff}}{2}\right) = 515\ \mathbf{lbf}$$

Conclusion: Assumed bulb seal values show that side seals do not contribute greatly to overall lifting forces.

F. Gate Inertial Loads:

This section will calculate the inertial loads required to accelerate the gate to full speed.

LCA rope velocity. This values is an estimate. The actual gate speed is calculated at the end of this calculation sheet

$$V_g := 2.0\ \frac{\mathbf{ft}}{min}$$

Time for gate to reach full velocity (estimated)

$$t_g := 0.5\ \mathbf{s}$$

Acceleration of the gate from a stop to full speed.

$$A_g := \frac{V_g}{t_g} = 0.067\ \frac{\mathbf{ft}}{\mathbf{s}^2}$$

Inertial force to accelerate the gate.

$$F_i := \frac{P_{gate}}{\mathbf{g}} \cdot A_g = 48\ \mathbf{lbf}$$

G. Combined Lifting Forces - Normal Lifting @ Unusual Water Elevation

$$F_{lifting} := P_{gate} + F_{friction\_wheels} + F_{ss} + C_A + F_i = 46031\ \mathbf{lbf}$$

H. Hoist Load Evaluation:

This section evaluates the percent that each load contributes to the total hoist load

Percent that each force contributes to the hoist load

Weight of Gate	Ice and Mud:	Seal Friction	Roller Friction	Inertial Load
$P_{gate} = 23.1\ kip$	$C_A = 2.0\ kip$	$F_{ss} = 0.52\ kip$	$F_{friction\_wheels} = 20.37\ kip$	$F_i = 47.86\ lbf$
$\frac{P_{gate}}{F_{lifting}} = 50.2\%$	$\frac{C_A}{F_{lifting}} = 4.3\%$	$\frac{F_{ss}}{F_{lifting}} = 1.1\%$	$\frac{F_{friction\_wheels}}{F_{lifting}} = 44.2\%$	$\frac{F_i}{F_{lifting}} = 0.1\%$

Find the difference between gate gravity loads (D) and friction loads (F_{SS} + F_{RF}):. To lower under the influence of gravity the gate gravity loads will need to be larger than the friction loads. The ice and mud load will not be included here because for most operations it will not be applied to the gate. A positive value means the gate will lower under it's own weight.

$$P_{gate} - \left(F_{ss} + F_{friction\_wheels}\right) = 2.2\ kip$$

REVISION:

Rev: 0 | **Date**: April 17, 2024 | **Description**: Load Case A Calc

Created By: Anthony DeSantis, EIT Reviewed By:

Load Case A (Normal Lifting) Calculation

A) Discussion

The loads required to lift a spillway gate are a function of the external loads applied to the gate (hydrostatic forces, gravitational forces, friction forces, etc). To calculate the loads at Load Case A, (Normal Operating Condition, NOC, split 50/50 across both hoists) to hoist the Eklutna hoist gate, a free body diagram will be created per Part 1. Operating loads will be applied and the tension in the hoist ropes will be solved. The hoist tension in the wire ropes should experience the largest load at the instant the gate is being lifted from the closed position with a full pool. The assumption with this approach is that a discrete instant of time is utilized in order to account for the inclusion of dynamic forces (side seal and bearing friction). While this is not a true dynamic analysis, performing the calculation at the worse case scenario at its particular instant will yield the most conservative result. This approach has been validated by the inertia calc in Part 1 which indicates that the increase in tension required to bring the gate to full speed is negligible. With the hoist tension known, the torque and speed of the hoisting equipment can be solved for. These torque and speed values will be used to appropriately size equipment for the hoist system.

B) Reference Info

Part 1 - Spillway Gate Loading

C) Hoist Configuration

Lifting Load From Part 1 $F_{lifting} := 46031\ lbf$

Drum Diameter (live wrap) & radius $D_{drum} := 26 \cdot 1.375\ in = 35.75\ in$ $r_{drum} := \frac{D_{drum}}{2} = 17.875\ in$

Reducer Ratios: 250:1 Sumitomo Paramax 9105 $red_{paramax} := 250$

60:1 BBB4 Gearmotor $red_{BBB} := 60$

$red_{total} := red_{paramax} \cdot red_{BBB} = 15000$

Rope Diameter $D_{rope} := 1.375 \cdot in$

Number of rope parts $n_{parts} := 1$

D) Define Efficiency Losses

Define the mechanical efficiencies of various hoist machinery components

Hoist drum roller bearing efficiency (EM 1110-2-2610-2.1.d):

$\eta_{Hoist\_Bearing} := 0.98$

Quadruple reduction parallel shaft reducer efficiency and BBB4 reducer efficiency (see cutsheets):

$\eta_{paramax} := 0.90$ $\eta_{BBB} := 0.90$

System Efficiency $\eta_{system} := \eta_{paramax} \cdot \eta_{BBB} \cdot \eta_{Hoist\_Bearing}{}^{2} = 0.778$

Wire Rope Sizing: Per EM 1110-2-3200

Rope Min Breaking Strength for 1-3/8in 6x37 carbon steel wire rope per ASTM-A1023 is 77.7 ton $MBS_{Rope\_.75in} := 77.7\ \mathbf{tonf}$

Number of total ropes $n_{ropes} := 2$

EM3200 requires a SF>=5 on rope breaking strength for normal lifting $Q_{Rope\_Single\_LCA\_Allow} := 0.2 \cdot \left(MBS_{Rope\_.75in}\right) = 31080\ \mathbf{lbf}$

Rope Tension (each side) $Q_{Rope\_LCA} := \dfrac{F_{lifting}}{n_{ropes} \cdot n_{parts}} = 23016\ \mathbf{lbf}$

Factor of Safey Ropes (over 1 is req'd) $FS_{rope\_LCA} := \dfrac{Q_{Rope\_Single\_LCA\_Allow}}{Q_{Rope\_LCA}} = 1.35$

E) Find speed at different locations

Motor RPM $\omega_{motor} := 1760 \cdot \mathbf{rpm}$

BBB4 Output Shaft Speed $\omega_{BBB} := \dfrac{\omega_{motor}}{red_{BBB}} = 29.333\ \mathbf{rpm}$

Paramax Output Shaft Speed $\omega_{paramax} := \dfrac{\omega_{BBB}}{red_{paramax}} = 0.117\ rpm$

Drum Rotational Speed $\omega_{drum} := \omega_{paramax} = 0.117\ rpm$

Gate Travel Speed $V_{gate} := r_{drum} \cdot \dfrac{\omega_{drum}}{n_{parts}} = 1.098\ \dfrac{\mathbf{ft}}{\mathbf{min}}$

Gate Travel Per Rev $D_{rope\_drum} := \dfrac{\pi \cdot D_{drum}}{n_{parts}} = 9.359\ \mathbf{ft}$

Gate Travel Per Degree $D_{rope\_drum\_deg} := \dfrac{D_{rope\_drum}}{360} = 0.312\ in$

F) Find torque at different locations

Torque on Drum (each side)

$$T_{drum\_LCA} := Q_{Rope\_LCA} \cdot r_{drum} = 34.3\ kip \cdot ft$$

Torque Output of PARAMAX Red 9105, 250 ratio

$$T_{paramax.out\_LCA} := \frac{2 \cdot T_{drum\_LCA}}{\eta_{Hoist\_Bearing}^{2}} = 71.394\ kip \cdot ft$$

Torque Input of PARAMAX Red

$$T_{paramax.in\_LCA} := \frac{T_{paramax.out\_LCA}}{red_{paramax} \cdot \eta_{paramax}} = 317.308\ lbf \cdot ft$$

Torque Output of BBB4 Red 3hp, 60 ratio

$$T_{BBB\_LCA} := T_{paramax.in\_LCA} = 317.3\ lbf \cdot ft$$

Torque Output of Motor

$$T_{motor\_LCA} := \frac{T_{BBB\_LCA}}{red_{BBB} \cdot \eta_{BBB}} = 5.876\ ft \cdot lbf$$

G) Find power at different locations

Motor Power Output

$$P_{motor} := \omega_{motor} \cdot T_{motor\_LCA} = 1.969\ hp$$

BBB4 Red Power Output

$$P_{cyclo} := \omega_{BBB} \cdot T_{BBB\_LCA} = 1.772\ hp$$

Paramax Red Power Output

$$P_{paramax} := \omega_{paramax} \cdot T_{paramax.out\_LCA} = 1.595\ hp$$

Drum Power Output

$$P_{drum} := \omega_{drum} \cdot T_{drum\_LCA} = 0.766\ hp$$

Select Motor HP:

$$Power_{motor} := 5 \cdot hp$$

H) Additional component checks

Torque Output after first reducer, motor rated at 250% of rated motor torque

$$T_{brake} := 2.5 \cdot T_{motor\_LCA} = 14.69\ ft \cdot lbf$$

Torque requirement of coupling

$$T_{coupling} := \frac{T_{paramax.out\_LCA}}{2} = 428365\ in \cdot lbf$$

Brake Motor Torque (250% rated torque)

$$T_{brake} := 2.5 \cdot \frac{Power_{motor}}{\omega_{motor}} = 37.302\ ft \cdot lbf$$

I) Conclusions

1) Wire rope selection of 1-3/8" has 35% remaining capacity than required for normal operation
2) 5hp motor selection is the basis of design
3) 60:1 Primary reducer is the basis of design
4) 150:1 Secondary reducer is the basis of design

REVISION:

Rev: 0 | **Date**: April 17, 2024 | **Description**: Load Case B Calc

Created By: Anthony DeSantis, EIT Reviewed By:

Load Case B (Jammed Gate) Calculation

A) Discussion

The second load case, Load Case B (LCB), represents a gate jammed situation. LCB is comparable to Case 6 as defined in EM 1110-2-2107 Section 13.5.6 Load Combinations. For this load case, it is assumed that the gate has become jammed during operation and the maximum hoisting loads have been applied to the system.

Per the requirements of USACE EM 1110-2-2610 Section 2.1.b.(1), hoist systems will be designed to not exceed 75% of the yield strength of the components under this loading and 70% of breaking strength for the wire rope per Section 2.2.l. In addition, LCB assumes that the hoist load is imbalanced between the sides of the gate with a 70/30 split. The imbalanced loading assumptions are taken from USACE EM 1110-2-2610 Section 9-2.m.(5) that discusses the 70/30 imbalanced loading assumptions.

Electric motors can typically generate 275% to 325% of rated load torque when experiencing a locked rotor condition. Given the gear reduction typically associated with wire rope hoists, even a small motor can apply very large loads to the gate and supporting structure in a locked rotor condition. The maximum allowable overload applied to the gate will be calculated, and load-limiting devices will be incorporated to de-energize the motor at the corresponding output torque. Load limiting devices would consist of a motor control relay that would measure the loads in the drivetrain, with a 150% LCA motor torque cut-out applying to the LCB design limit.

B) Reference Info

Part 1 - Spillway Gate Loading

Part 2 - Hoist LCA

C) Hoist Torque and Power

Hoist motor Power $Torque_{motor.LCA} := 5.876 \ (ft \cdot lbf)$

NEMA B motor locked rotor torque for a 3hp motor as a % of full load torque
https://www.engineeringtoolbox.com/iec-nema-standards-torques-d_741.html

Motor torque limited to 150% of LCA motor torque $T_{bd} := 150\%$

Motor RPM $\omega_{motor} := 1760 \ rpm$

Motor Limited Torque $T_{motor} := T_{bd} \cdot Torque_{motor.LCA} = 8.814\ ft \cdot lbf$

Drum Pitch Diameter and radius $D_{drum} := 35.75\ in$ $r_{drum} := \frac{D_{drum}}{2} = 17.875\ in$

Reducer Ratios: 250:1 Sumitomo Paramax 9105 $red_{paramax} := 250$

60:1 BBB4 Reducer $red_{BBB} := 60$

BBB4 Red Output Torque (each side) $T_{BBB\_LCB} := T_{motor} \cdot red_{BBB} = 0.53\ ft \cdot kip$

Max Reducer Output Torque
PARAMAX 9105 is rated to $T := 144\ kN \cdot m$
$T = 106.209\ ft \cdot kip$

$T_{paramax\_LCB} := T_{BBB\_LCB} \cdot red_{paramax} = 132.21\ ft \cdot kip$

Max Rope Force (each side)

$$T_{Rope\_LCB.70} := \frac{70\% \cdot \left(T_{paramax\_LCB}\right)}{r_{drum}} = 62.13\ kip$$

$$T_{Rope\_LCB.30} := \frac{30\% \cdot \left(T_{paramax\_LCB}\right)}{r_{drum}} = 26.63\ kip$$

Wire Rope Sizing: Per EM 3200

Load Case B allowable tension (EM 1110-2-3200 section 4-5):

Rope Min Breaking Strength for 1-3/8" wire rope $MBS_{Rope\_.75in} := 77.7\ tonf$

Number of total ropes $n_{ropes} := 2$

EM3200 requires 70% or less for breaking on overload cases $T_{Rope\_Single\_LCB\_Allow} := .7 \cdot \left(MBS_{Rope\_.75in}\right) = 108780\ lbf$

Factor of Safety Ropes (over 1 is req'd)

$$FS_{rope\_LCB} := \frac{T_{Rope\_Single\_LCB\_Allow}}{T_{Rope\_LCB.70}} = 1.751$$

Conclusion: 1-3/8" carbon steel IRWC wire rope is adequate for this application.

REVISION:

Rev: 2 | **Date**: April 17, 2024 | **Description**: 15% Design

Created By: Anthony DeSantis, E.I.T. Reviewed By:

Extreme Ice Loading Calculation

A. DISCUSSION:
This calculation sheet will find the deep bay hoist system loads under extreme ice loading. Ice loading is found using the method in ASCE 7-22

B. REFERENCES:

- *ASCE* - ASCE 7-22 Minimum Design Loads and Associated Criteria for Buildings and Other Structures

C. EXTREME ICE LOADING:

1. Height above ground. This is taken as the distance from top of the gate in the closed position to the sill elevation assuming there is no tailrace. The tailrace is assumed to be a factor(ASCE - Section 10.4.3):

$$z := 874.6\ ft - 855.6\ ft = 19.00\ ft$$

2. Height factor (ASCE - Eqn. 10.4-4):

$$f_z := \left(\frac{z}{33\ ft}\right)^{0.10} = 0.95$$

3. Ice thickness (Figure 1 & ASCE - Figure 10.4-4D):

$$t := 0.75\ in$$

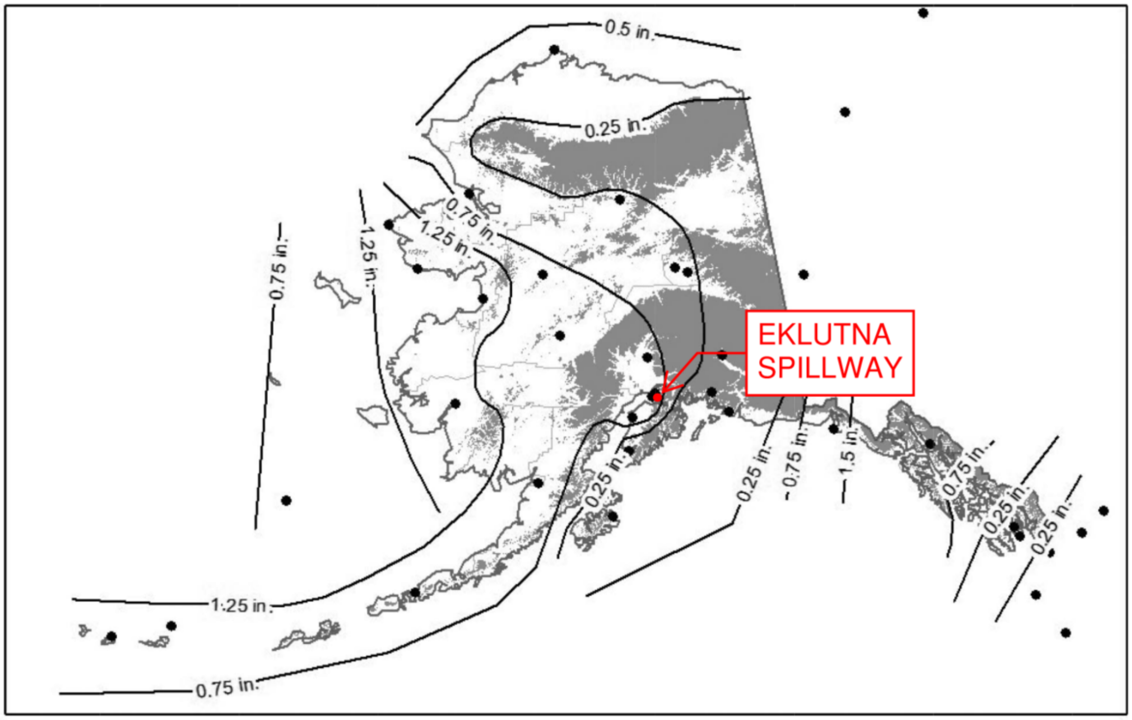


Figure 10.4-3D. Nominal ice thicknesses caused by freezing rain for Alaska for Risk Category IV (1,400-year mean recurrence interval) structures.

Figure 1 - ASCE Ice Thickness for Risk Category IV Structures
(Figure 10.4-3D)

4. Width of gate (from Inventor model):

$$B := 200\ in$$

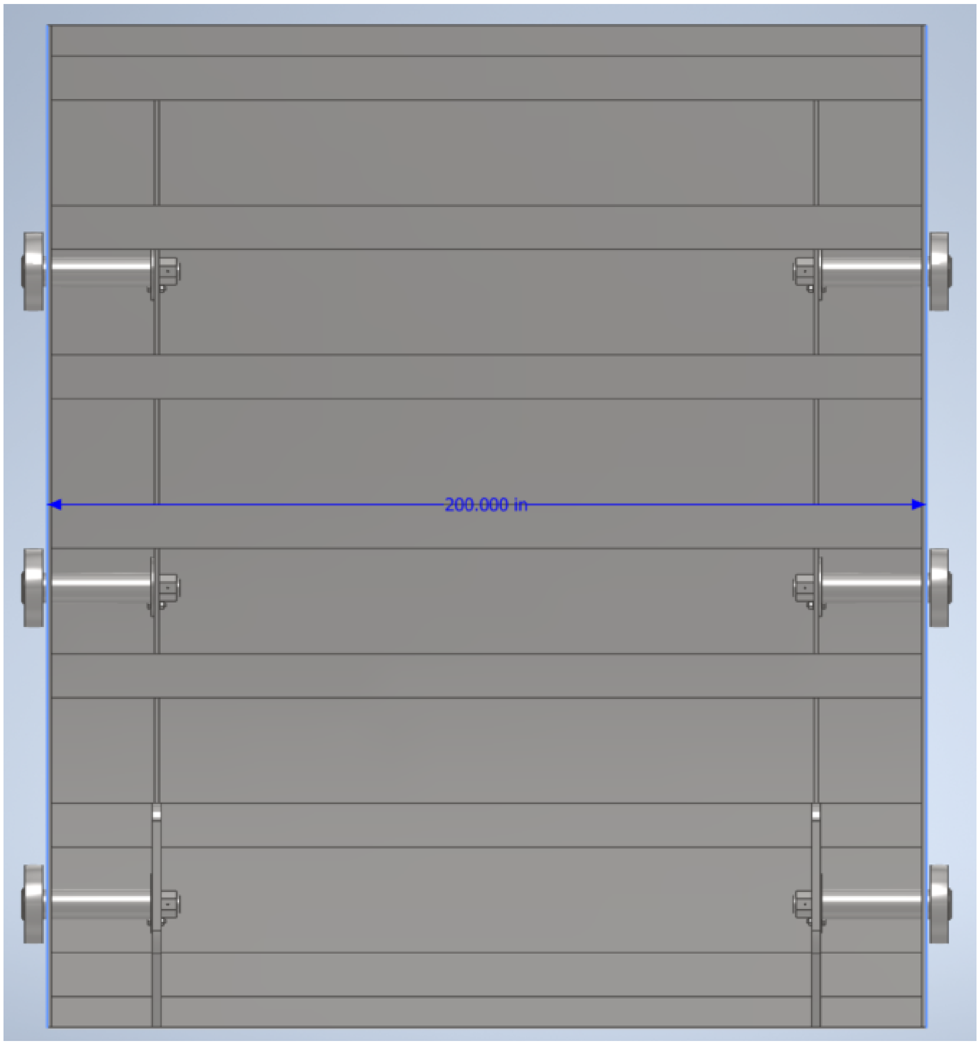


Figure 2 - New Gate Plan and Elevation View Showing Width
(DWG. S111)

5. Design Ice thickness for freezing rain. Deep bay gates do not meet the dimensional conditions of an escarpment. Topographic factor is taken as 1.0 (ASCE - Section 10.4.4 and 26.8.2):

$$K_{zt} := 1.0$$

6. Design Ice thickness for freezing rain (ASCE - Eqn. 10.4.5):

$$t_d := t \cdot f_z \cdot \left(K_{zt}\right)^{0.35} = 0.71\ in$$

7. Deep bay gate characteristic length (Figure 3 & ASCE - Section 10.4-1):

$D_c := 228.77\ in$

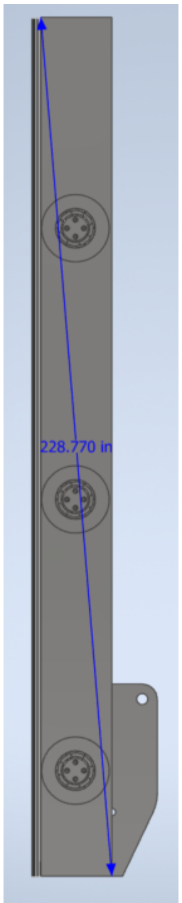


Figure 3 - Gate Characteristic Length

8. Volume of freezing rain buildup on deep bay gate:

$$V_I := B \cdot (D_c) \cdot t_d = 18.8\ ft^3$$

9. Ice density (ASCE - Section 10.4.1):

$$\rho_I := 56\ \frac{lbf}{ft^3}$$

10. Extreme ice load:

$$C_A := V_I \cdot (\rho_I) = 1.1\ kip$$