GREENFIELDS IRRIGATION DISTRICT

GID's HYDRO DEVELOPMENT

GREENFIELDS IRRIGATION DISTRICT

Who we are – Background

- District comprising +132,760 acres, 207 sq. miles
- Cascade, Teton and Lewis & Clark Counties
- Part of the USBR's Sun River Project along with Fort Shaw Irrigation District
- GID shares its water right with Reclamation
- Head-quartered in Fairfield
- First water delivery was in 1920
- Greenfields Irrigation District was formed in 1925

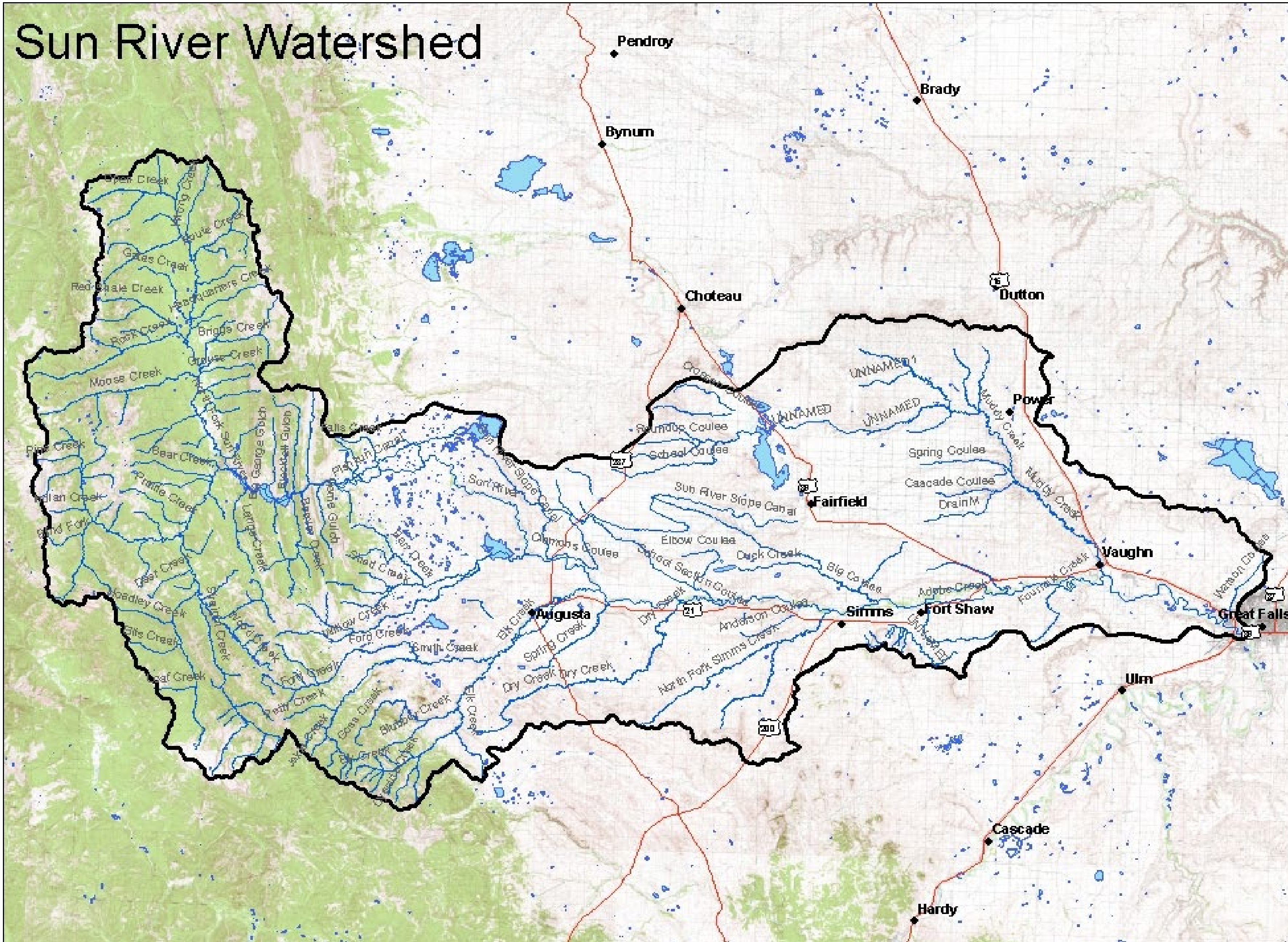
What we do – Operations

- Deliver irrigation water between April 1st and Oct 31st
- Water Rights allow for 83,231.72 acres of irrigation
- There are over 1550 individual Farm Units
- 550 individual landowners and 450 AG producers
- Administer over 24,000 acres of Grazing Land
- A staff of 18 FTEs
- 4-6 additional seasonal workers
- Full compliment of heavy equipment
- Pre-cast concrete facilities

What we do – Maintenance

As a Transferred Works Project, GID is 100%, fully responsible for operation, maintenance, and replacement of infrastructure including

- Gibson Dam & Reservoir
- Willow Creek Dam & Reservoir
- Pishkun Dikes & Reservoir
- Diversion Dam
- Major structures such as bridges, tunnels, siphons, canal headworks, drops, check structures & etc.
- Over 50 miles of major supply canals
- Over 400 of miles of submains, laterals, & drains


Sun River Watershed
Pendroy
Brady
Bynum
Choteau
Dutton
Power
Fairfield
Vaughn
Augusta
Simms
Fort Shaw
Great Falls
Ulm
Cascade
Hardy
Sun River Slope Canal
Moose Creek
Elk Creek
Smith Creek
Ford Creek
Spring Coulee
Cascade Coulee
Big Coulee
Adobe Creek
North Fork Simms Creek
Anderson Coulee
Dry Creek
Spring Creek

GREENFIELDS IRRIGATION DISTRICT

OUR BIGGEST ISSUES

- **1st**, Aging Infrastructure, +100-years-old,
  Well Beyond its Design Life
- Built Rapidly & All at Once, We Fear It Will Fail Rapidly & All at Once
- Fear of Mid-Season, Catastrophic Failures Taking More Than 1 Season to Fix
- Besides Time, Costs to Fix Unplanned Failures
  24-7, Round the Clock, Crisis/Emergency Mode
- **2nd**, Modernization and Overhaul of District Operations

GREENFIELDS IRRIGATION DISTRICT

OUR BIGGEST ISSUES

$$$

GREENFIELDS IRRIGATION DISTRICT

FINANCING & FUNDING

- Replacing Aging Infrastructure and District Modernization/Overhaul is Estimated to Cost Between $65-$75 Million and Take 30 Years
- Absolutely, Positively Cannot be Done on the Backs of the Producers,
- State-Based Grant & Loan Programs,
- Federal-Based Grant & Loan Programs,
- Many Grant Programs Require a 100% Match Requirement
- Find Some Other Revenue Generating Strategies to Help Leverage Long-Term Loans

GREENFIELDS IRRIGATION DISTRICT

WE HAVE AN EXAMPLE

- Turnbull Hydro Project
- Situated at 2 Sequential, Open Chute Drops & Stilling Basins
- Combined 14MW, 1st On-Line in 2011
- A Private Development Venture
- GID has 10% Ownership
- GID Parlayed Construction Services into Ownership, i.e. “Sweat Equity”
- Averages 22,910 MWh per Year
- GID’s Cut is About $180,000 after Annual O&M Costs


DANGER
TURBULENT
WATER


CAUTION
AUTHORIZED
PERSONNEL
ONLY
DANGER
HIGH VOLTAGE
4160 VOLTS

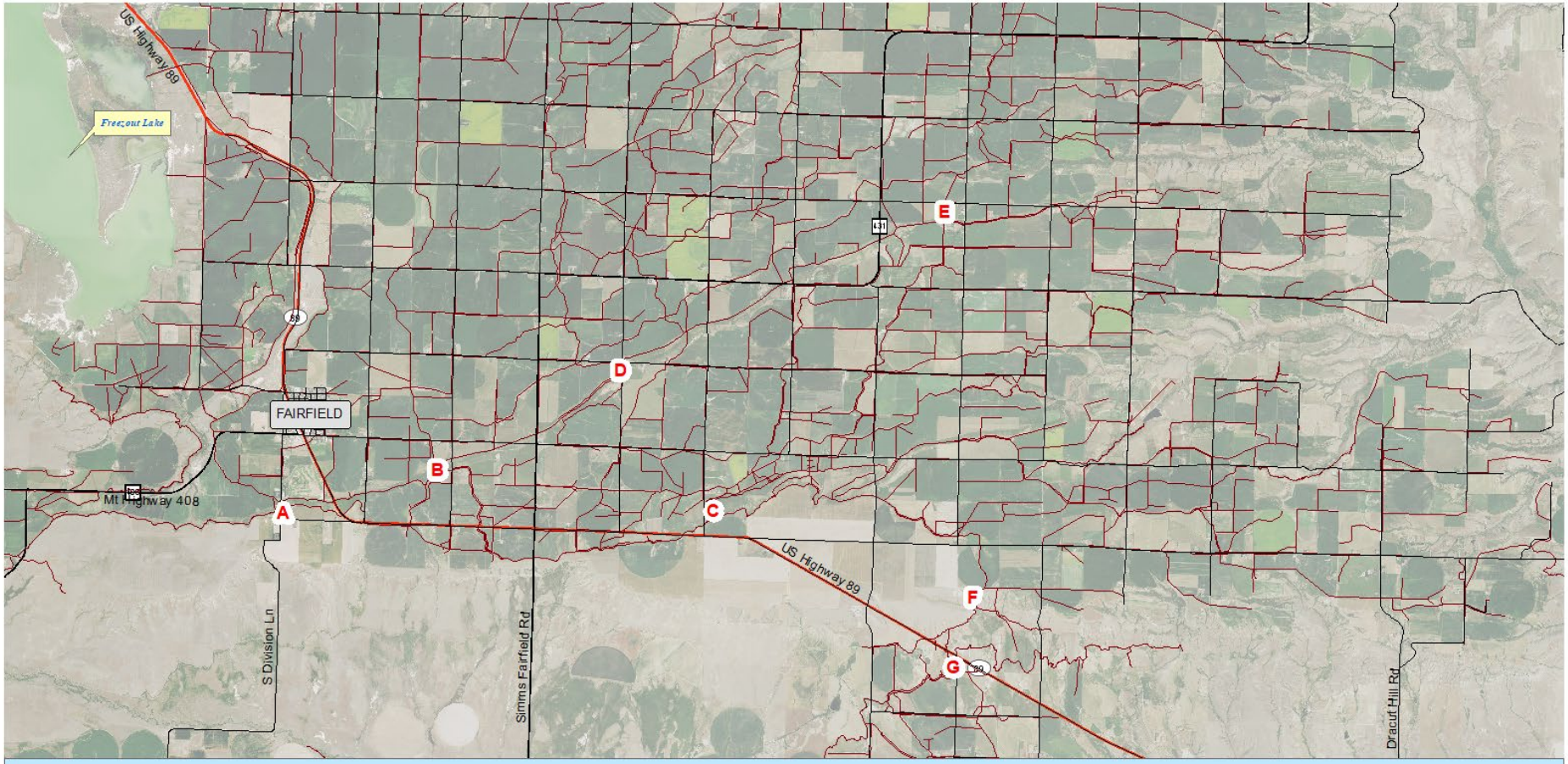
GREENFIELDS IRRIGATION DISTRICT

HYDROPOWER DEVELOPMENT FOR GREENFIELDS IRRIGATION DISTRICT

A Summary of Potential Hydropower Sites, Economic Feasibility Analyses, & a Strategy for Implementation

WHAT DETERMINES FEASIBLITY?

- Net Turbine Head & Water Discharge = Site Capacity
- Length of Generation, Year-Round vs Seasonal
- Other Turbine Dynamics – Varying Head & Flow
- Price of Energy and Cost of Delivery, Wheeling Fees, BA Transfer Charges, & Line Losses
- Site Location and Complexity
- Construction Costs, Equipment, Materials, & Labor
- Length of the Extension Cord, i.e. Transmission
- Cost of Financing, ROI, ROR
- Annual O&M Costs
- Basically – Revenue Must be >> Expenses Over an Acceptable Time Frame



SITE	POTENTIAL POWER		SITE	POTENTIAL POWER	
A	A-Drop	2,200 kW (1)	F	Mill Coulee Drop (upper) . .	1,000 kW
B	Mary Taylor Drop	1,200 kW	G	Mill Coulee Drop (lower) . .	200 kW
C	Johnson Drop	850 kW (1)			
D	Woods Chute	1,100 kW	(1) Under Development		
E	Knights Chute	800 kW			

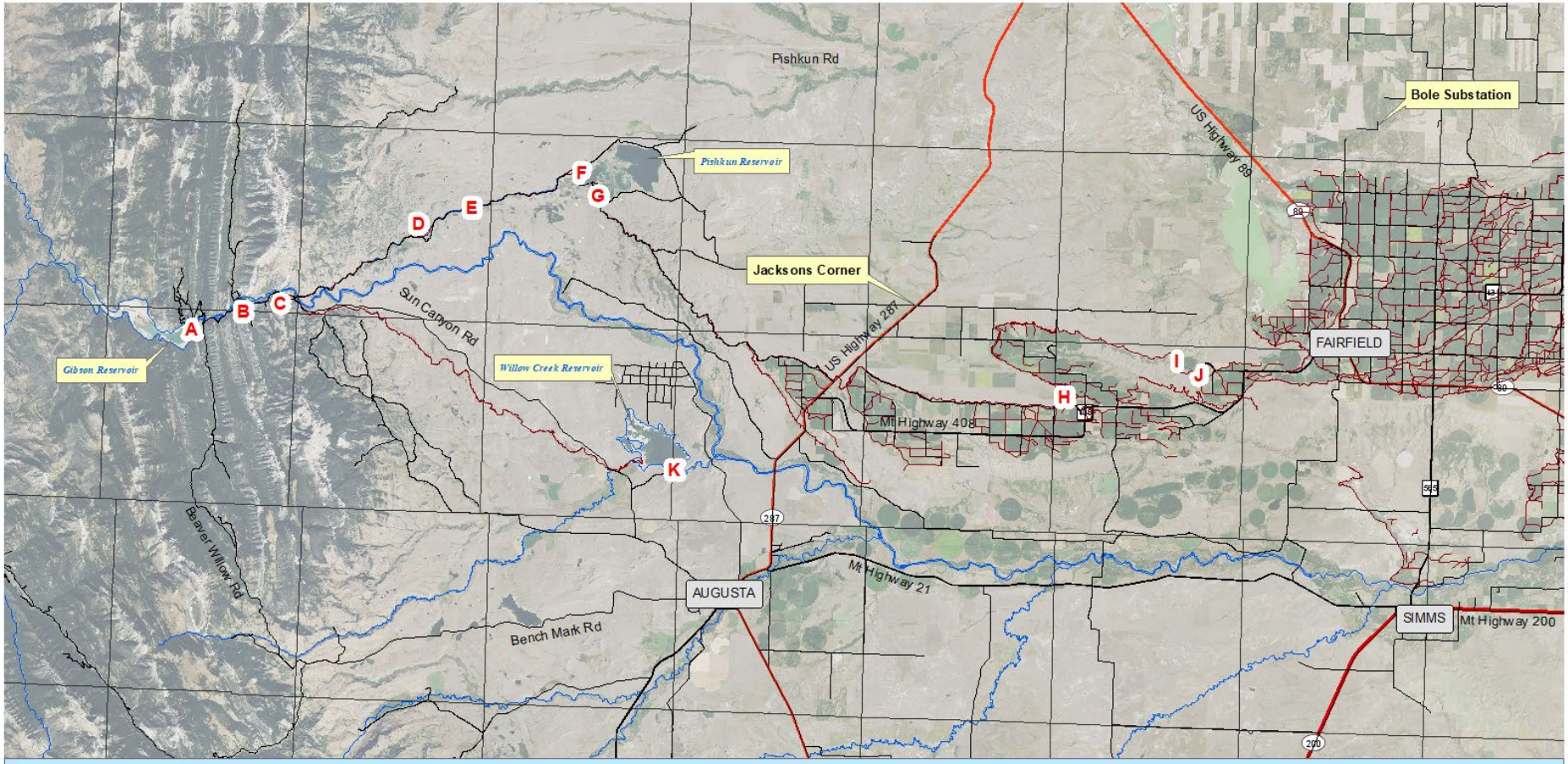
HYDRO POWER DEVELOPMENT
EAST OF FAIRFIELD, MONTANA

0 1 2 4 Miles

N

Greenfields IRRIGATION DISTRICT

X:\GIS\Maps\Hydro Power Development East



SITE	POTENTIAL POWER	
A	Gibson Dam	25,000 kW (4)
B	Diversion Dam	4,600 kW
C	PSC Tunnel No.1	500 kW
D	PSC Tunnel No.3	750 kW
E	Arnold Coulee	3,000 kW (2)
F	Pishkun Inlet	3,000 kW (3)
G	Pishkun Outlet	1,800 kW

SITE	POTENTIAL POWER	
H	Spring Valley Drop	750 kW
I	Turnbull (Comb.)	14,000 kW (1)
J	11-Ft Drop	750 kW
K	Willow Creek Dam	2,200 kW

(1) Existing
(2) Under Construction
(3) Under Development
(4) Planning Stages

HYDRO POWER DEVELOPMENT
WEST OF FAIRFIELD, MONTANA

0 2.5 5 10 Miles

N

Greenfields IRRIGATION DISTRICT

X:\GIS\Maps\Hydro Power Development West

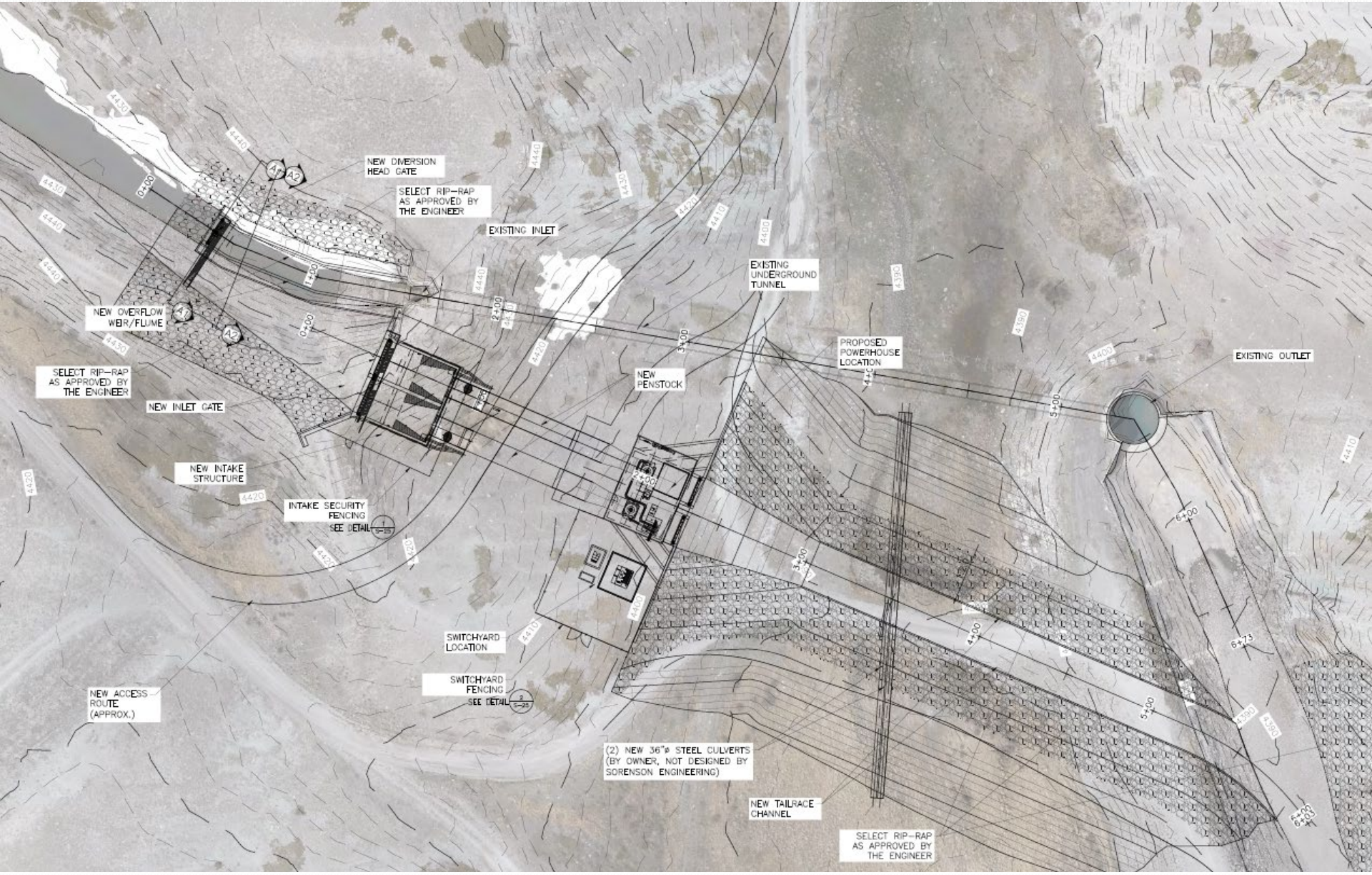
GID's OVERALL HYDRO STRATEGY

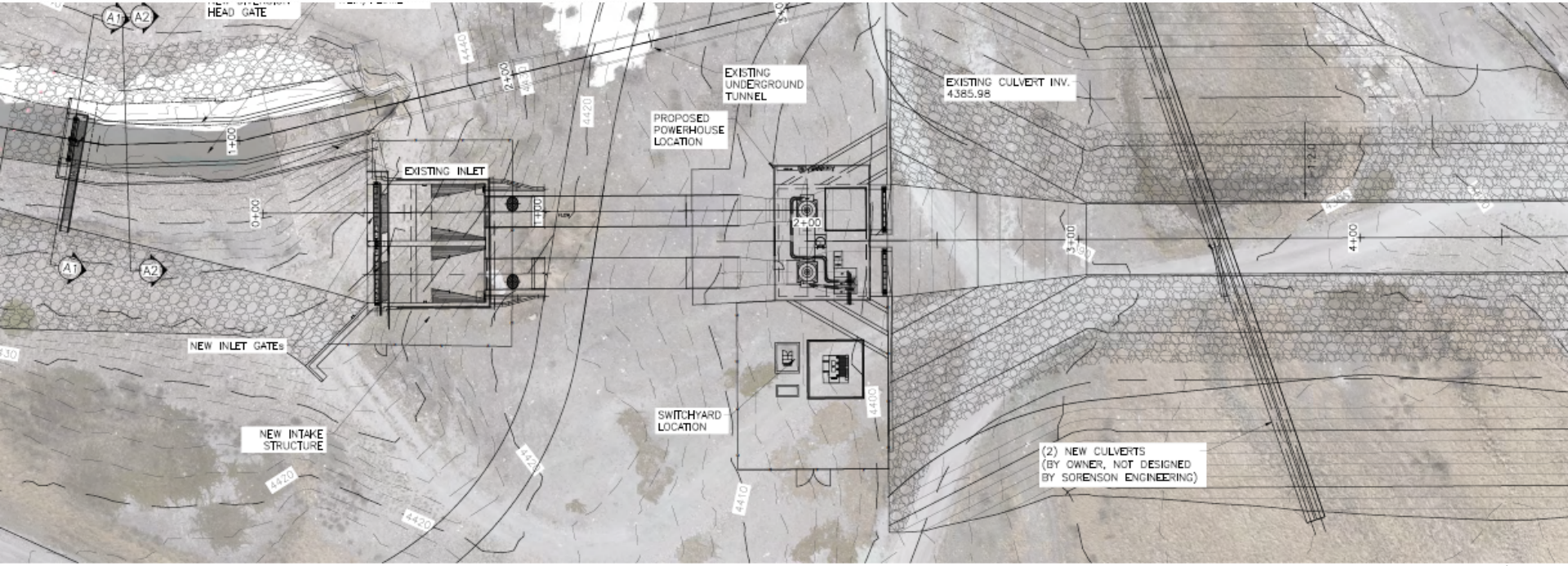
- Low Hanging Fruit, Generate a Revenue Stream Which Fuels Further Development
- Eye on Gibson Reservoir, the Mother Lode @+25MW
- Procure Grants & Loans, Use GID Crews & Equip.
- Arnold Coulee Drop – 3MW
- Pishkun Inlet Drop – 3MW
- Pishkun Outlet – 2.4MW
- Johnson Drop – 850kW
- A-Drop – 2.2MW
- Mary Taylor – 1.1MW

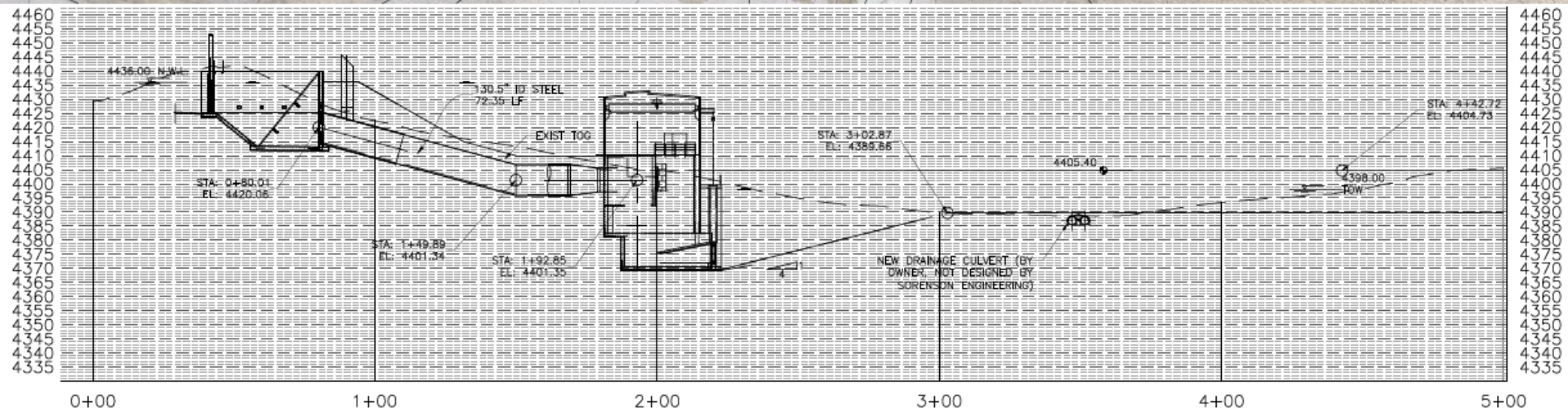
ARNOLD COULEE DROP HYDRO

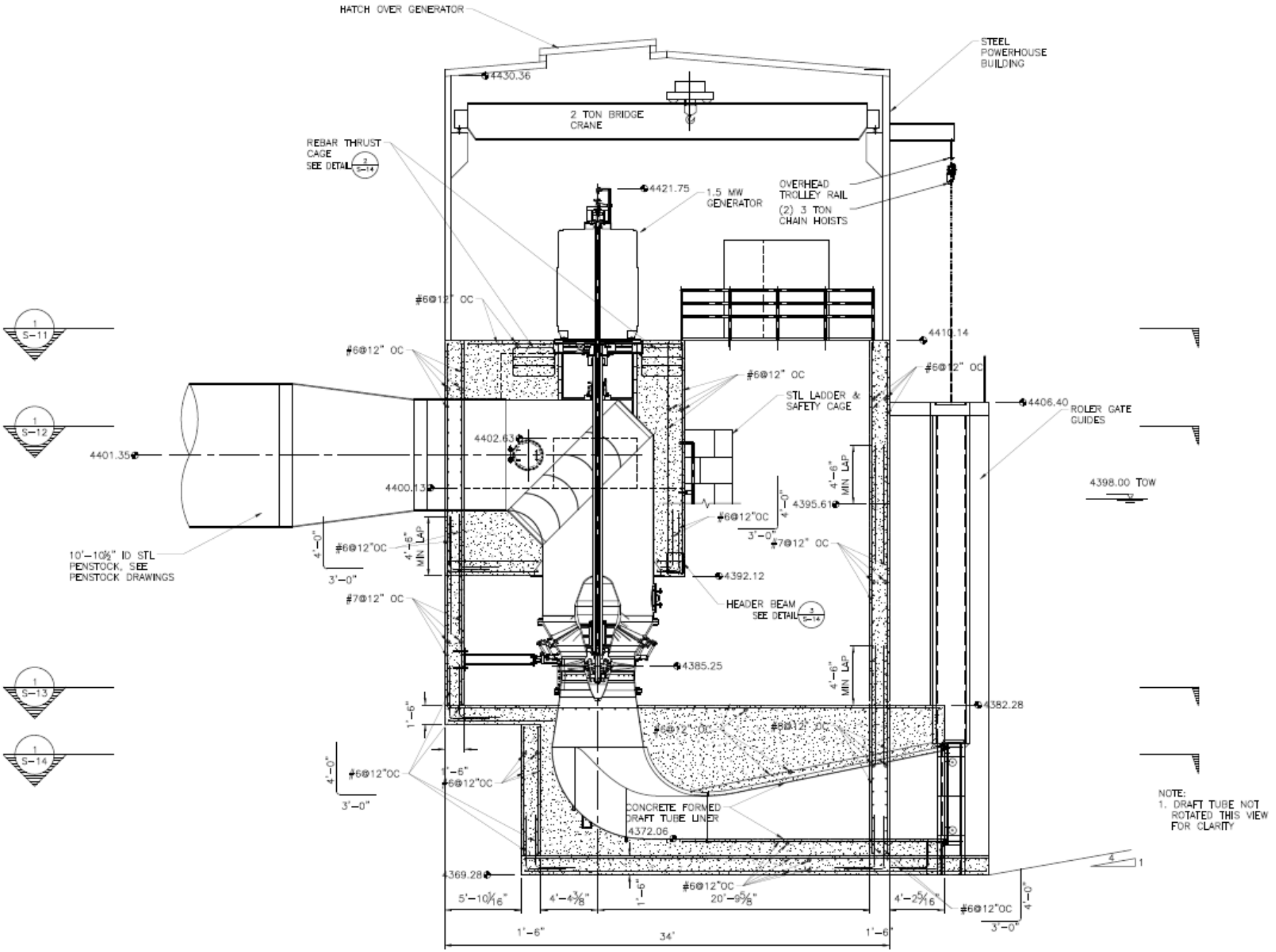
- Located on the Pishkun Supply Canal
- Q= 1,400 cfs, 38-ft Drop
- Seasonal Operation, Late April to Early Sept.
- Historically, 110 days = Theoretical 7,920 MWhs
- Keep Old Drop for Emergency By-Pass
- Steady-State, Constant Generation
- Dual, 1.5MW Vertical Kaplan Turbines


Arnold Coulee Drop
Pishkun Rd
Image © 2025 Airbus


NEW DIVERSION HEAD GATE
SELECT RIP-RAP AS APPROVED BY THE ENGINEER
EXISTING INLET
EXISTING UNDERGROUND TUNNEL
NEW OVERFLOW WEIR/FLUME
SELECT RIP-RAP AS APPROVED BY THE ENGINEER
NEW INLET GATE
NEW INTAKE STRUCTURE
INTAKE SECURITY FENCING SEE DETAIL 1/S-25
NEW PENSTOCK
PROPOSED POWERHOUSE LOCATION
EXISTING OUTLET
SWITCHYARD LOCATION
SWITCHYARD FENCING SEE DETAIL 2/S-25
NEW ACCESS ROUTE (APPROX.)
(2) NEW 36"ø STEEL CULVERTS (BY OWNER, NOT DESIGNED BY SORENSON ENGINEERING)
NEW TAILRACE CHANNEL
SELECT RIP-RAP AS APPROVED BY THE ENGINEER


A1
A2
HEAD GATE
EXISTING INLET
NEW INLET GATEs
NEW INTAKE STRUCTURE
EXISTING UNDERGROUND TUNNEL
PROPOSED POWERHOUSE LOCATION
SWITCHYARD LOCATION
EXISTING CULVERT INV. 4385.98
(2) NEW CULVERTS (BY OWNER, NOT DESIGNED BY SORENSON ENGINEERING)
0+00
1+00
2+00
3+00
4+00


4436.00 N.W.L.
30.5" ID STEEL
72.35 LF
EXIST TOE
STA: 0+80.01
EL: 4420.06
STA: 1+49.89
EL: 4401.34
STA: 1+92.85
EL: 4401.35
STA: 3+02.87
EL: 4389.86
4405.40
4398.00
TOW
STA: 4+42.72
EL: 4404.73
NEW DRAINAGE CULVERT (BY OWNER, NOT DESIGNED BY SORENSON ENGINEERING)
4460
4455
4450
4445
4440
4435
4430
4425
4420
4415
4410
4405
4400
4395
4390
4385
4380
4375
4370
4365
4360
4355
4350
4345
4340
4335
0+00
1+00
2+00
3+00
4+00
5+00


HATCH OVER GENERATOR
STEEL POWERHOUSE BUILDING
4430.36
2 TON BRIDGE CRANE
REBAR THRUST CAGE SEE DETAIL 2/S-14
4421.75
1.5 MW GENERATOR
OVERHEAD TROLLEY RAIL
(2) 3 TON CHAIN HOISTS
#6@12" OC
4410.14
#6@12" OC
#6@12" OC
#6@12" OC
STL LADDER & SAFETY CAGE
4406.40
ROLER GATE GUIDES
4402.63
4401.35
4400.13
4398.00 TOW
4395.61
4'-6" MIN LAP
4'-0"
3'-0"
#6@12"OC
#7@12" OC
10'-10½" ID STL PENSTOCK, SEE PENSTOCK DRAWINGS
4392.12
HEADER BEAM SEE DETAIL 3/S-14
#7@12" OC
4385.25
4382.28
1'-6"
#6@12" OC
#6@12" OC
4'-0"
#6@12"OC
1'-6"
#6@12"OC
3'-0"
CONCRETE FORMED DRAFT TUBE LINER
4372.06
4369.28
#6@12"OC
5'-10 1/16"
4'-4 3/8"
20'-9 5/8"
4'-2 5/16"
#6@12"OC
4'-0"
3'-0"
1'-6"
34'
1'-6"
4
1
NOTE:
1. DRAFT TUBE NOT ROTATED THIS VIEW FOR CLARITY
1 S-11
1 S-12
1 S-13
1 S-14

GREENFIELDS IRRIGATION DISTRICT

Sources of Funding - Arnold Coulee

- $2 Million GID Reserves and General Funds
- $2 Million Bureau of Reclamation WaterSMART - WEEG Grant
- $2.6 Million Montana Dept. Of Commerce – Board Of Investments INTERCAP Loan
- $125k MT DNRC RRG Grant

GREENFIELDS IRRIGATION DISTRICT

CARPE DIEM

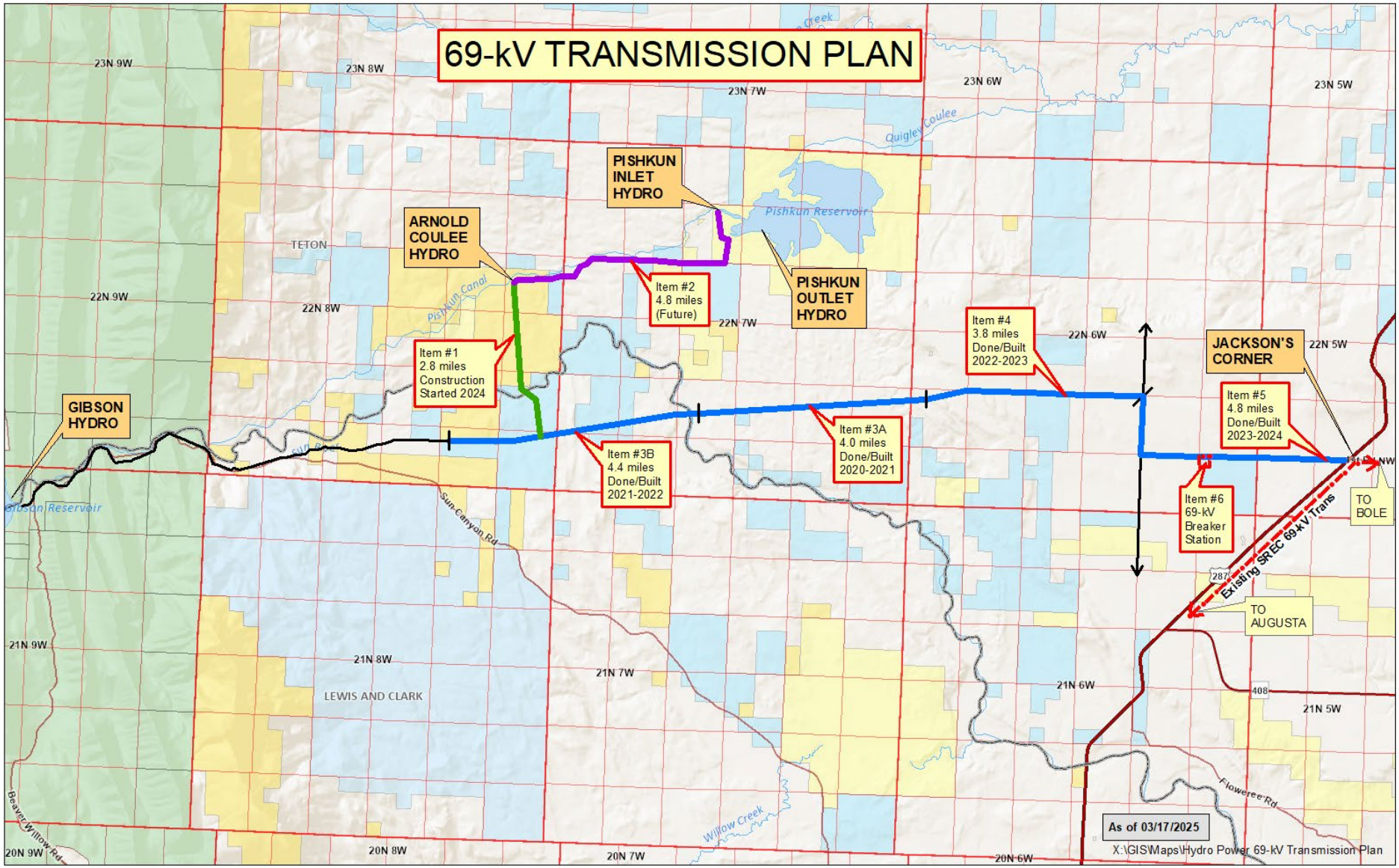
- Keystone XL Pipeline, NE Montana
- Project included Pipeline Booster Stations Proposed to be Supplied by 115-kV Transmission Lines
- Off, On, Off, 2021 Canadians said they were done
- GID Swooped in like a Vulture
  - Bought 360 poles from Big Flat Electric Co-Op for $1,000/pole
  - Bought 36 Reels of Conductor (360,000 LF) from NorVal Electric Co-Op for $1/LF
  - 15 Laminate Poles for $1,000/structrue
  - Stand-off, 115-kV Insulators, $75 each


RAZORBACK
RAZORBACK

GREENFIELDS IRRIGATION DISTRICT
CARPE DIEM - Part Deux

- Surplus Pipe from a Screwed-up, Water Project
- 11-ft OD, 0.75-inch thick steel, coated, $625/LF
- New Price $2,250/LF

- Needed a Crane
- Found one in Four Corners
- 1966 Link Belt lattice boom, 82-ton capacity
- Friction over Hydraulics
- $25,000
- A bit of money pit.


69-kV TRANSMISSION PLAN
PISHKUN INLET HYDRO
ARNOLD COULEE HYDRO
PISHKUN OUTLET HYDRO
GIBSON HYDRO
Item #1 2.8 miles Construction Started 2024
Item #2 4.8 miles (Future)
Item #3A 4.0 miles Done/Built 2020-2021
Item #3B 4.4 miles Done/Built 2021-2022
Item #4 3.8 miles Done/Built 2022-2023
Item #5 4.8 miles Done/Built 2023-2024
Item #6 69-kV Breaker Station
JACKSON'S CORNER
TO BOLE
TO AUGUSTA
Existing SREC 69-kV Trans
Pishkun Reservoir
Gibson Reservoir
Pishkun Canal
Sun Canyon Rd
Willow Creek
Floweree Rd
Beaver Willow Rd
TETON
LEWIS AND CLARK
23N 9W
23N 8W
23N 7W
23N 6W
23N 5W
22N 9W
22N 8W
22N 7W
22N 6W
22N 5W
21N 9W
21N 8W
21N 7W
21N 6W
21N 5W
20N 9W
20N 8W
20N 7W
20N 6W
As of 03/17/2025
X:\GIS\Maps\Hydro Power 69-kV Transmission Plan

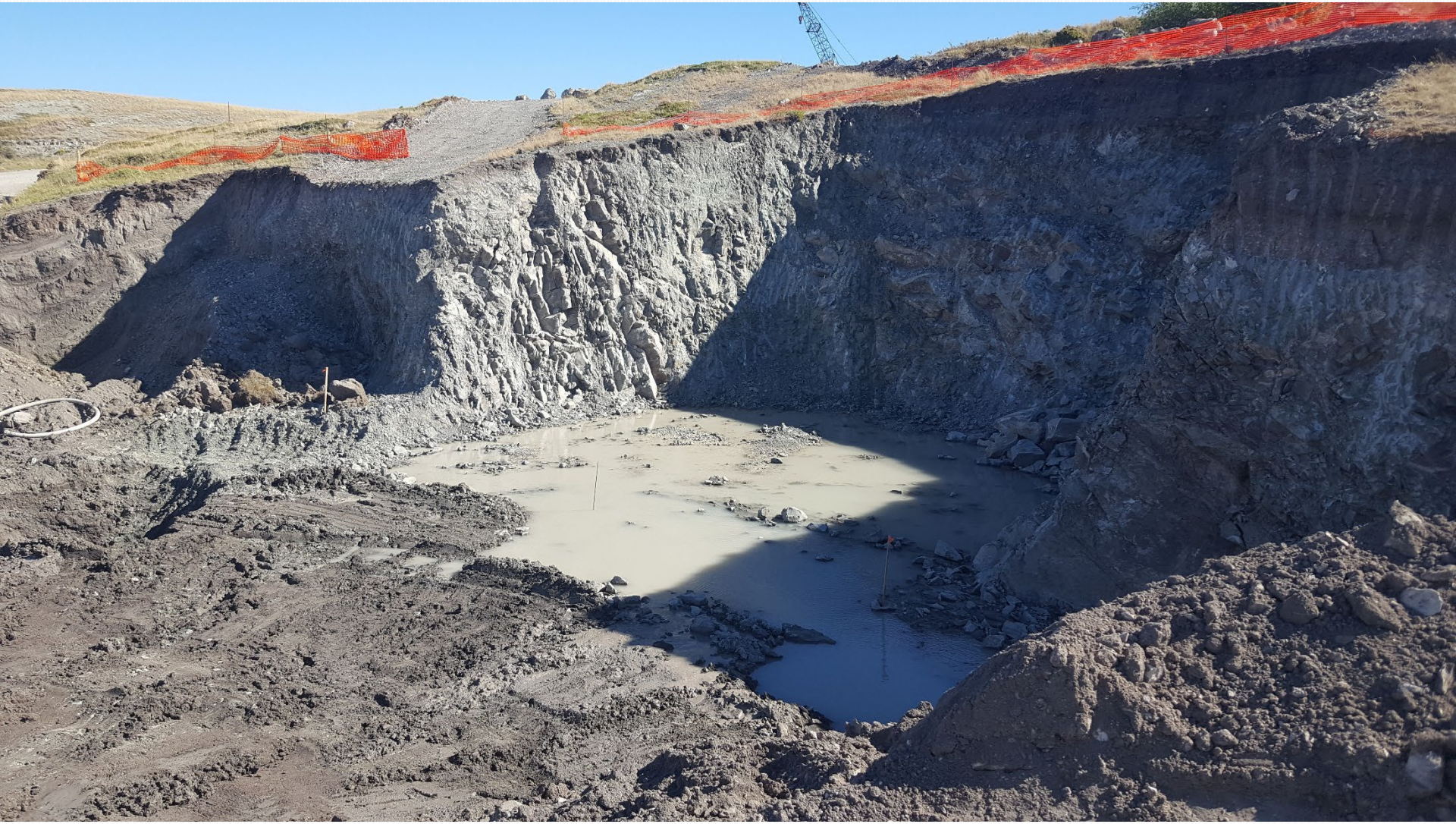
Long-Crested By-Pass Weir, 2022-2023


DEWALT

Under Drain & Foundation Block Excavation, Started August 2024


VOLVO
CAT

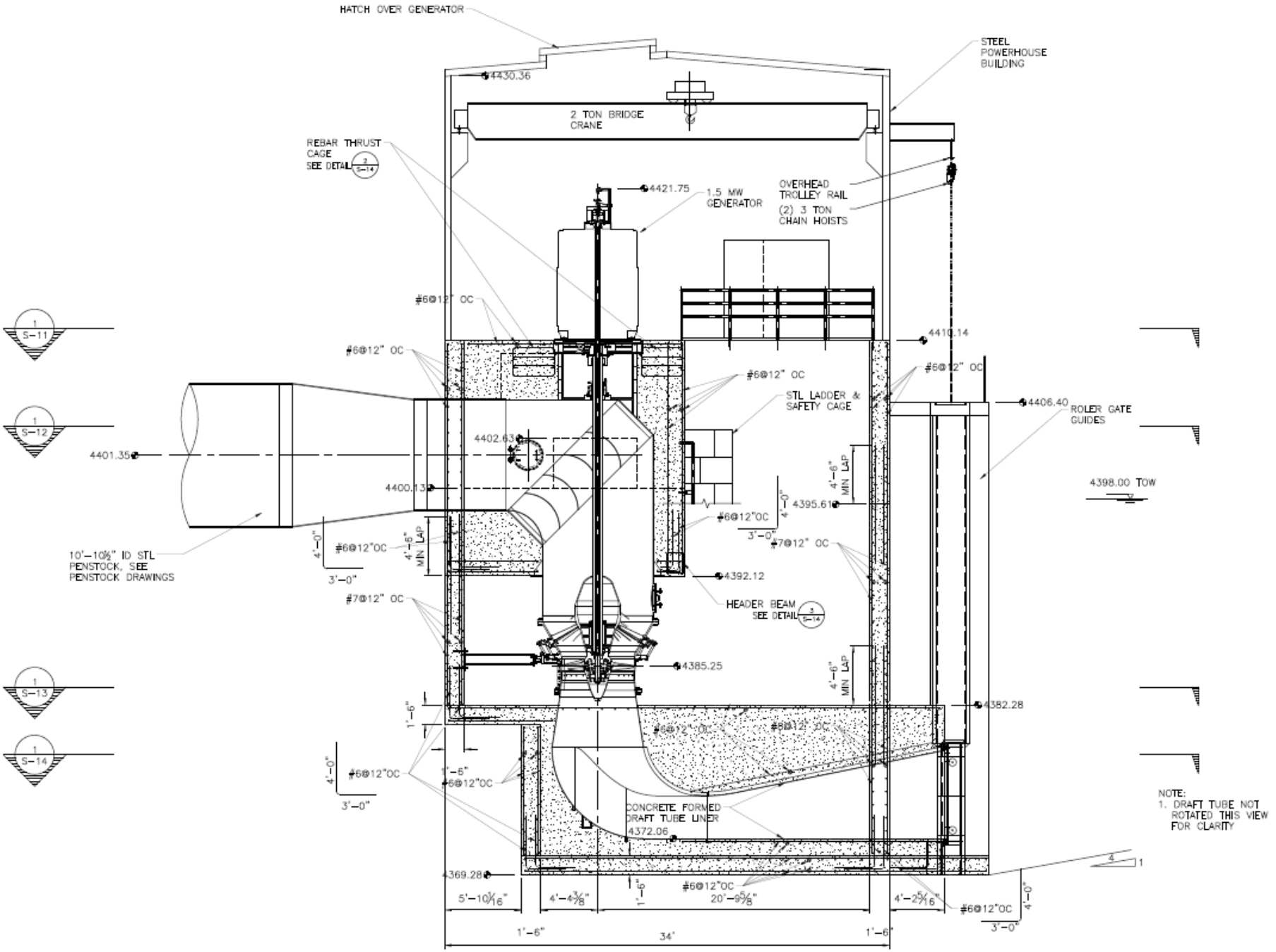

EC250EL
ACTIVE CONTROL
VOLVO




VOLVO
VOLVO


CAT
VOLVO
VOLVO
CAT
320E


AFFCO
CATALYS
FASTENAL


HATCH OVER GENERATOR
STEEL POWERHOUSE BUILDING
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2 TON BRIDGE CRANE
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1.5 MW GENERATOR
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4410.14
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STL LADDER & SAFETY CAGE
4406.40
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4402.63
4401.35
4400.13
4398.00 TOW
4395.61
4'-6" MIN LAP
4'-0"
3'-0"
#6@12"OC
#7@12" OC
10'-10½" ID STL PENSTOCK, SEE PENSTOCK DRAWINGS
4392.12
HEADER BEAM SEE DETAIL 3/S-14
#7@12" OC
4385.25
4382.28
1'-6"
#6@12" OC
#6@12" OC
4'-0"
#6@12"OC
1'-6"
#6@12"OC
3'-0"
CONCRETE FORMED DRAFT TUBE LINER
4372.06
4369.28
#6@12"OC
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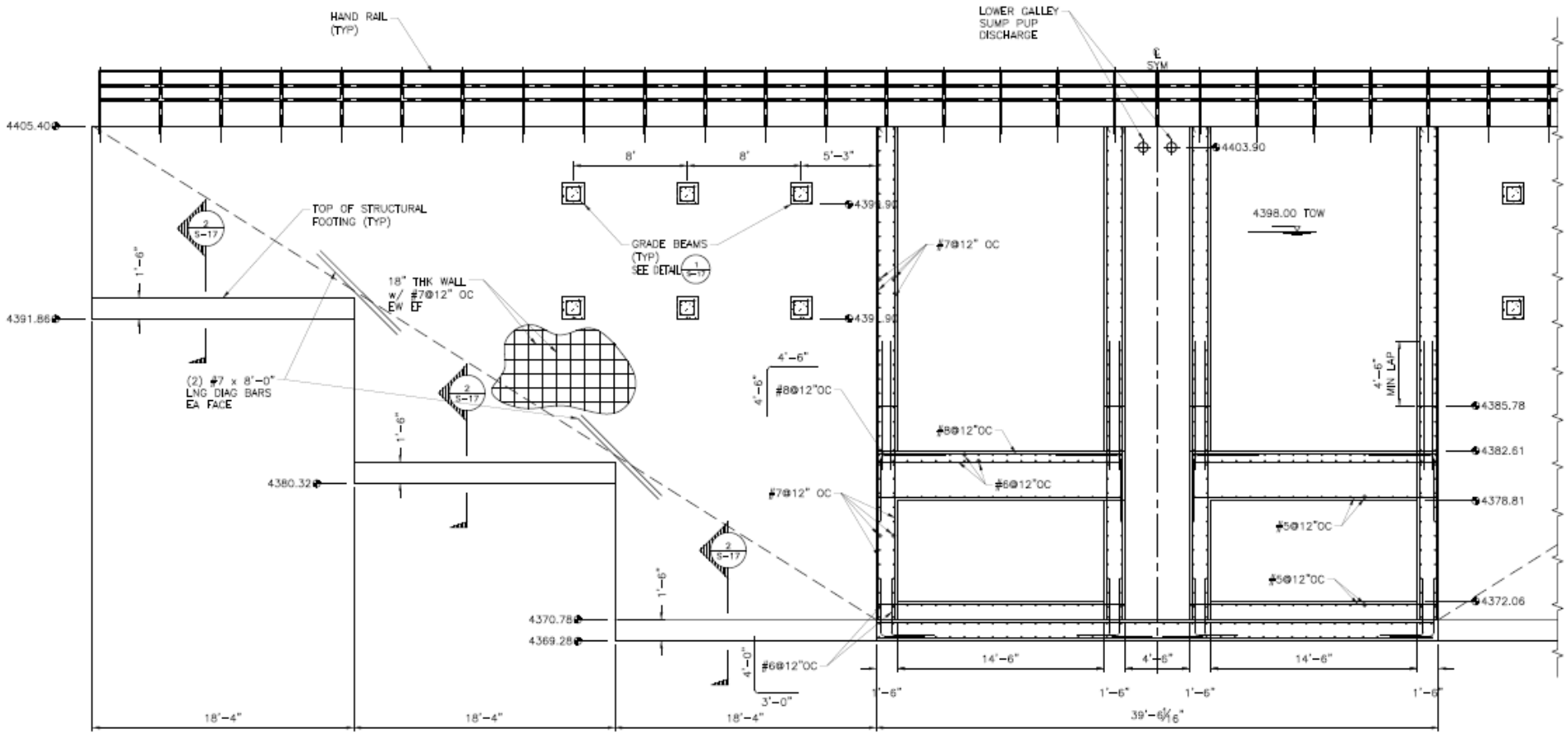
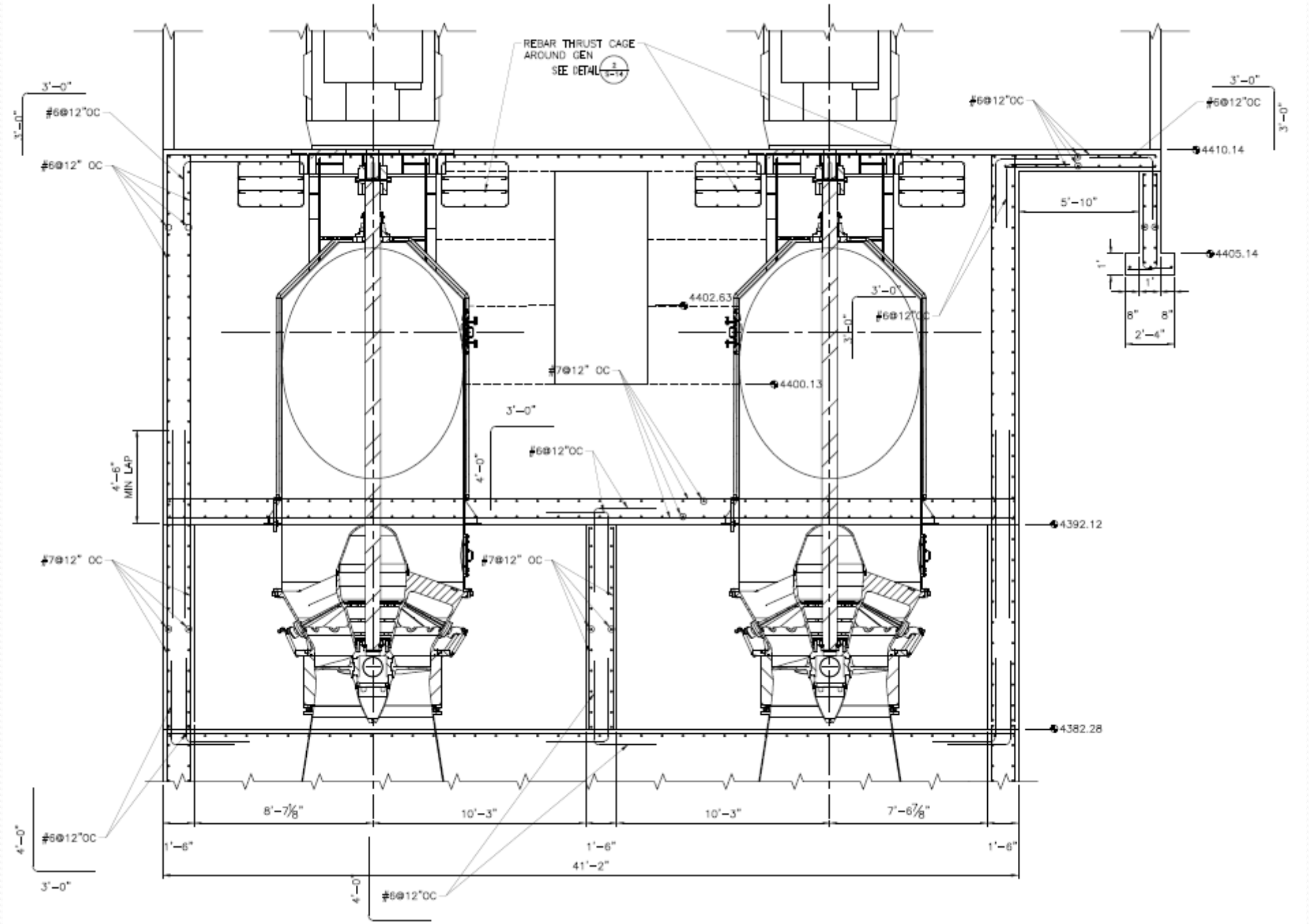
4'-4 3/8"
20'-9 5/8"
4'-2 5/16"
#6@12"OC
4'-0"
3'-0"
1'-6"
34'
1'-6"
4
1
NOTE:
1. DRAFT TUBE NOT ROTATED THIS VIEW FOR CLARITY
1 S-11
1 S-12
1 S-13
1 S-14

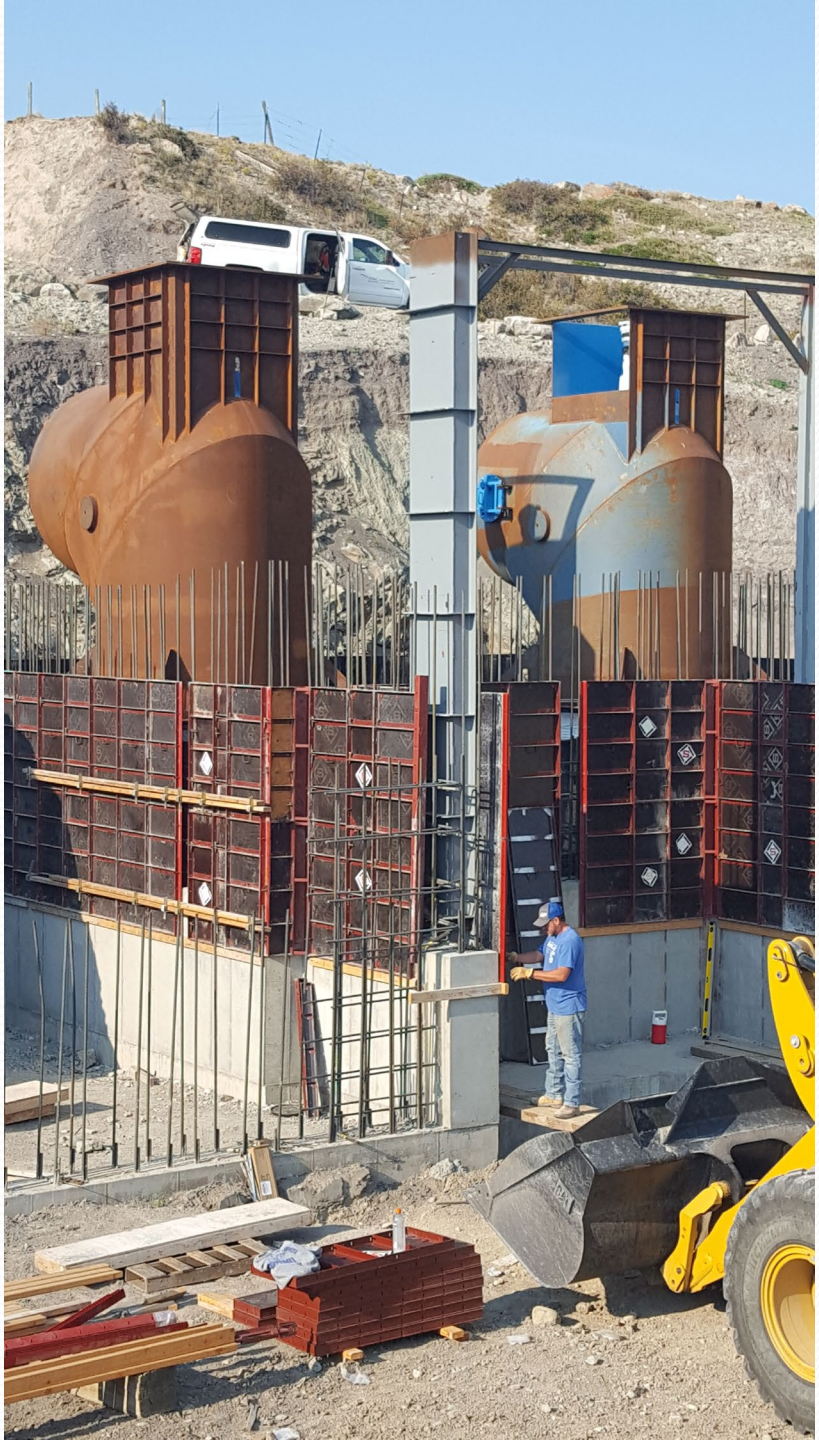

HAND RAIL (TYP)
LOWER GALLEY SUMP PUP DISCHARGE
℄ SYM
4405.40
4403.90
8'
8'
5'-3"
4398.00 TOW
TOP OF STRUCTURAL FOOTING (TYP)
GRADE BEAMS (TYP) SEE DETAIL 1/S-17
18" THK WALL w/ #7@12" OC EW EF
#7@12" OC
4391.88
4391.90
4389.90
(2) #7 x 8'-0" LNG DIAG BARS EA FACE
4'-6"
#8@12"OC
4'-6" MIN LAP
4385.78
#8@12"OC
4382.61
#6@12"OC
4380.32
#7@12" OC
#5@12"OC
4378.81
#5@12"OC
4372.06
4370.78
4369.28
#6@12"OC
4'-0"
3'-0"
14'-6"
4'-6"
14'-6"
1'-6"
1'-6"
1'-6"
1'-6"
1'-6"
18'-4"
18'-4"
18'-4"
39'-8 1/16"


REBAR THRUST CAGE
AROUND GEN
SEE DETAIL 2/S-14
3'-0"
#6@12"OC
#6@12" OC
#7@12" OC
4410.14
5'-10"
4405.14
1'
1'
8"
8"
2'-4"
4402.63
4400.13
4392.12
4382.28
4'-6"
MIN LAP
4'-0"
8'-7⅞"
10'-3"
10'-3"
7'-6⅞"
1'-6"
1'-6"
1'-6"
41'-2"

Exciting Day – Turbines Arrive, April 2025, Just Ahead of Tariffs


CAT
LINK-BELT

Resumed Construction – August 2025
Powerhouse Above Basement Floor

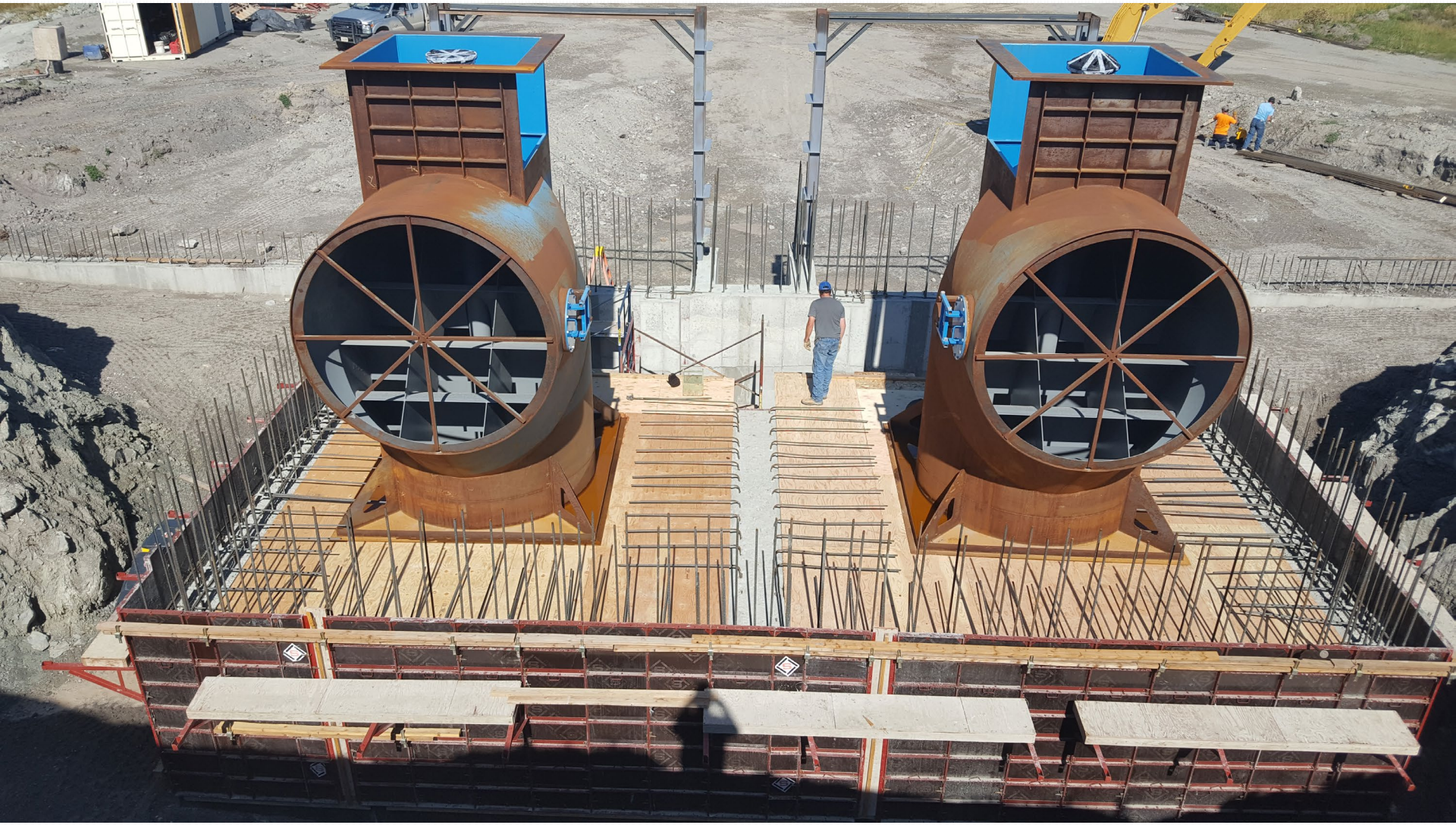



VOLVO
CAT

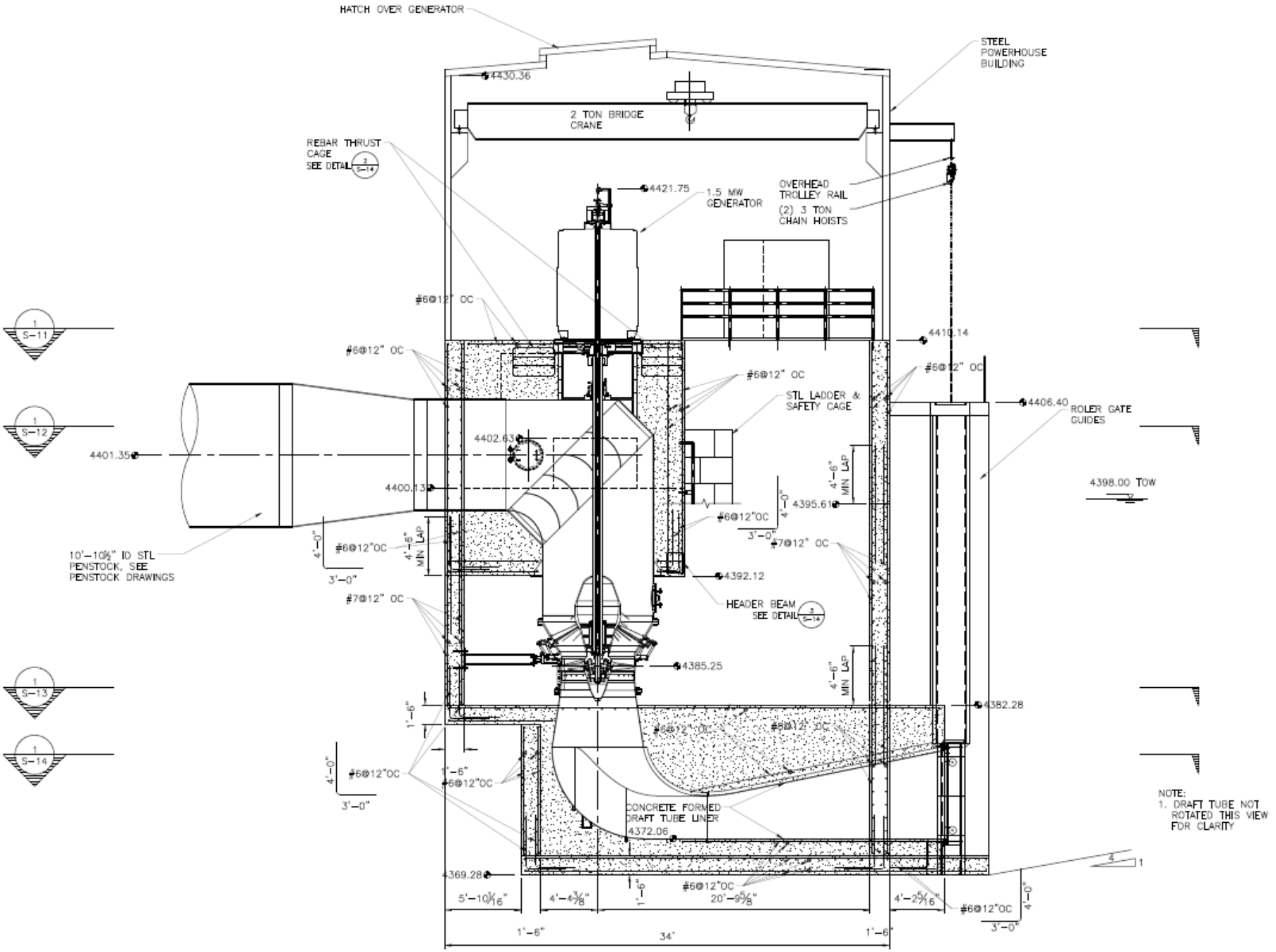

HT. B69268 4"SQ. .375 USA 06/03/25


E8
Westinghouse


Tyvek




CAT
CAT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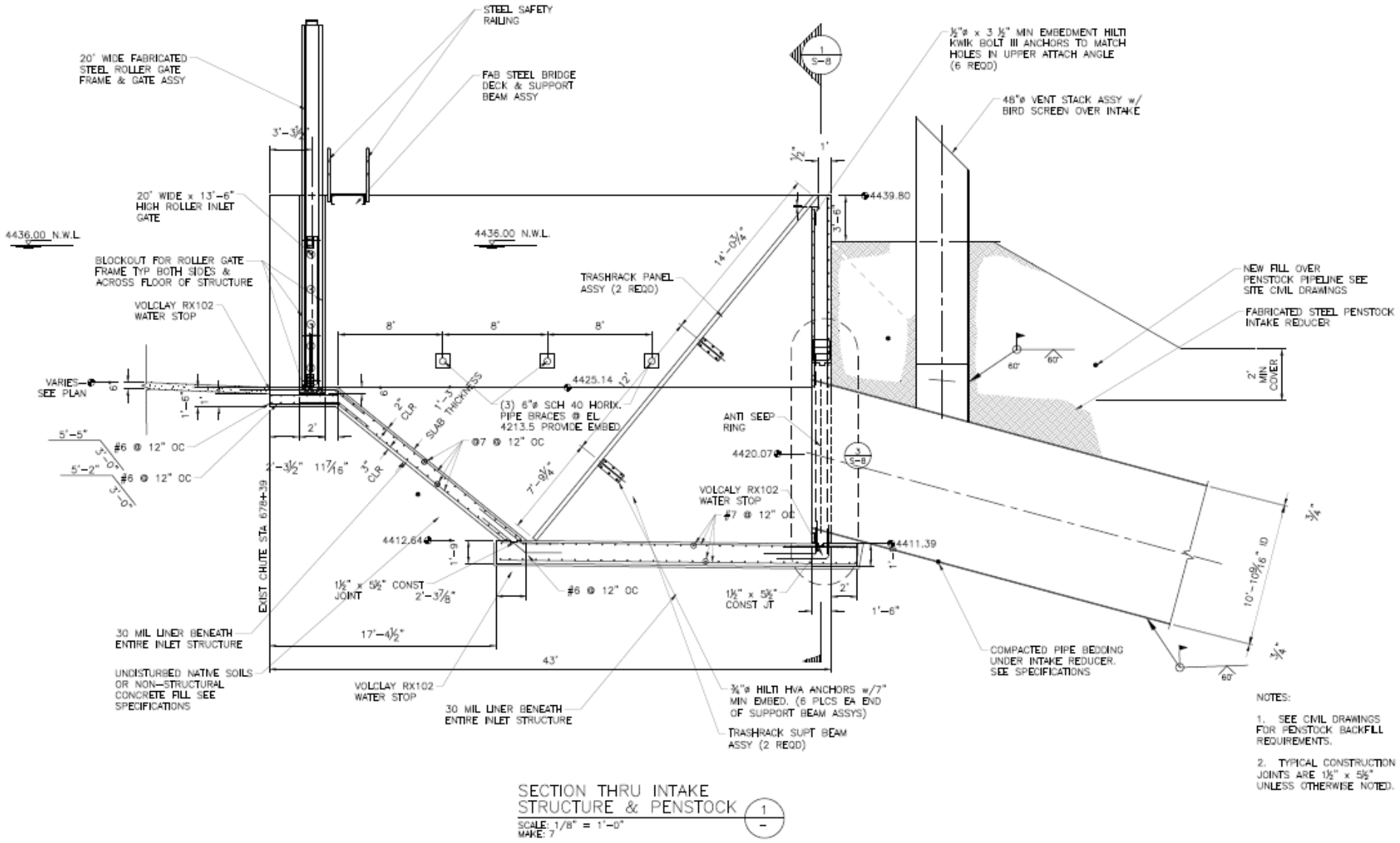
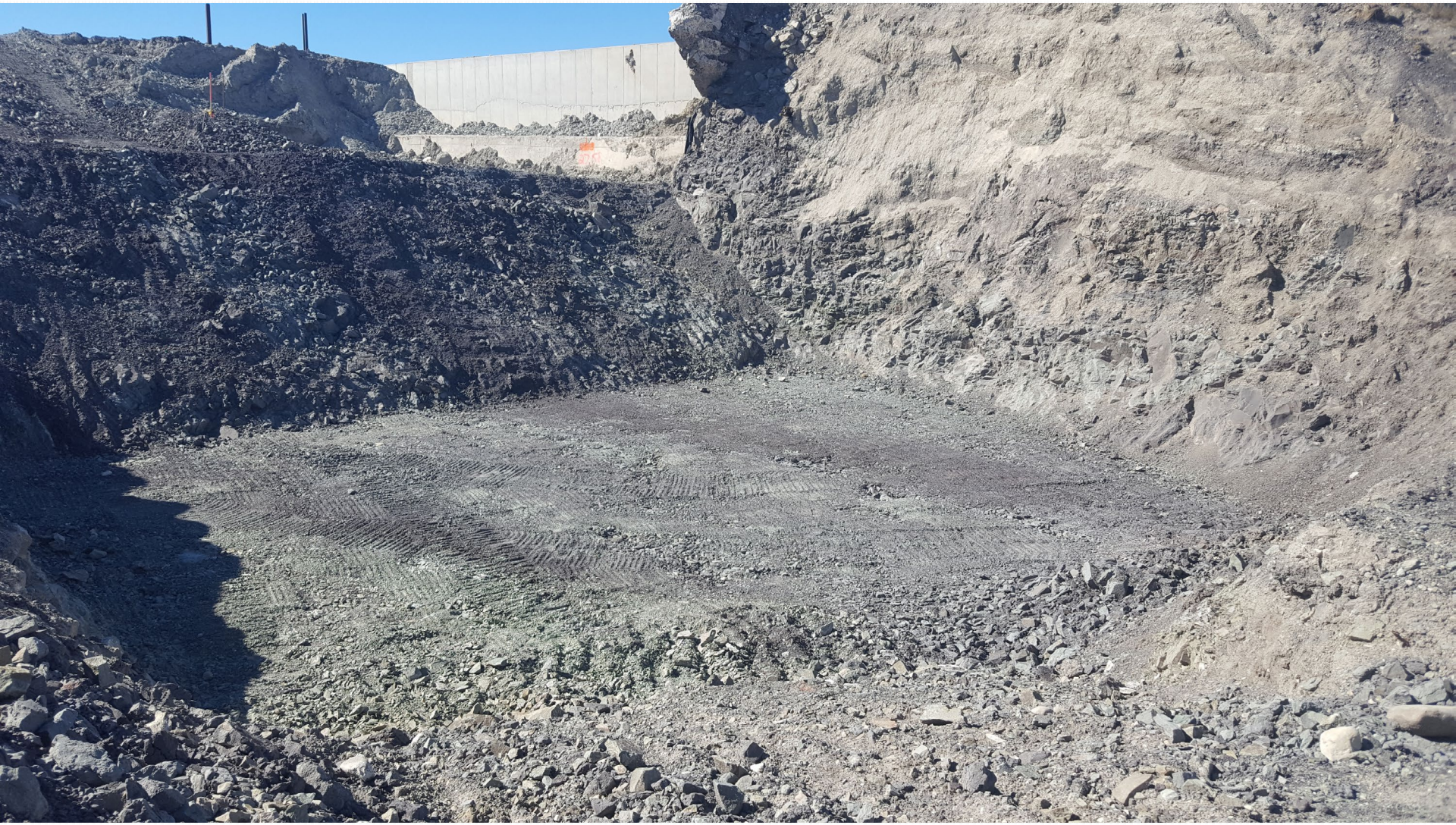


SECTION THRU INTAKE STRUCTURE & PENSTOCK

1 / –

SCALE: 1/8" = 1'-0"
MAKE: 7




LINK-BELT
CAT
CAT


CAT


VERSALIFT

ARNOLD COULEE PROJECT STATUS

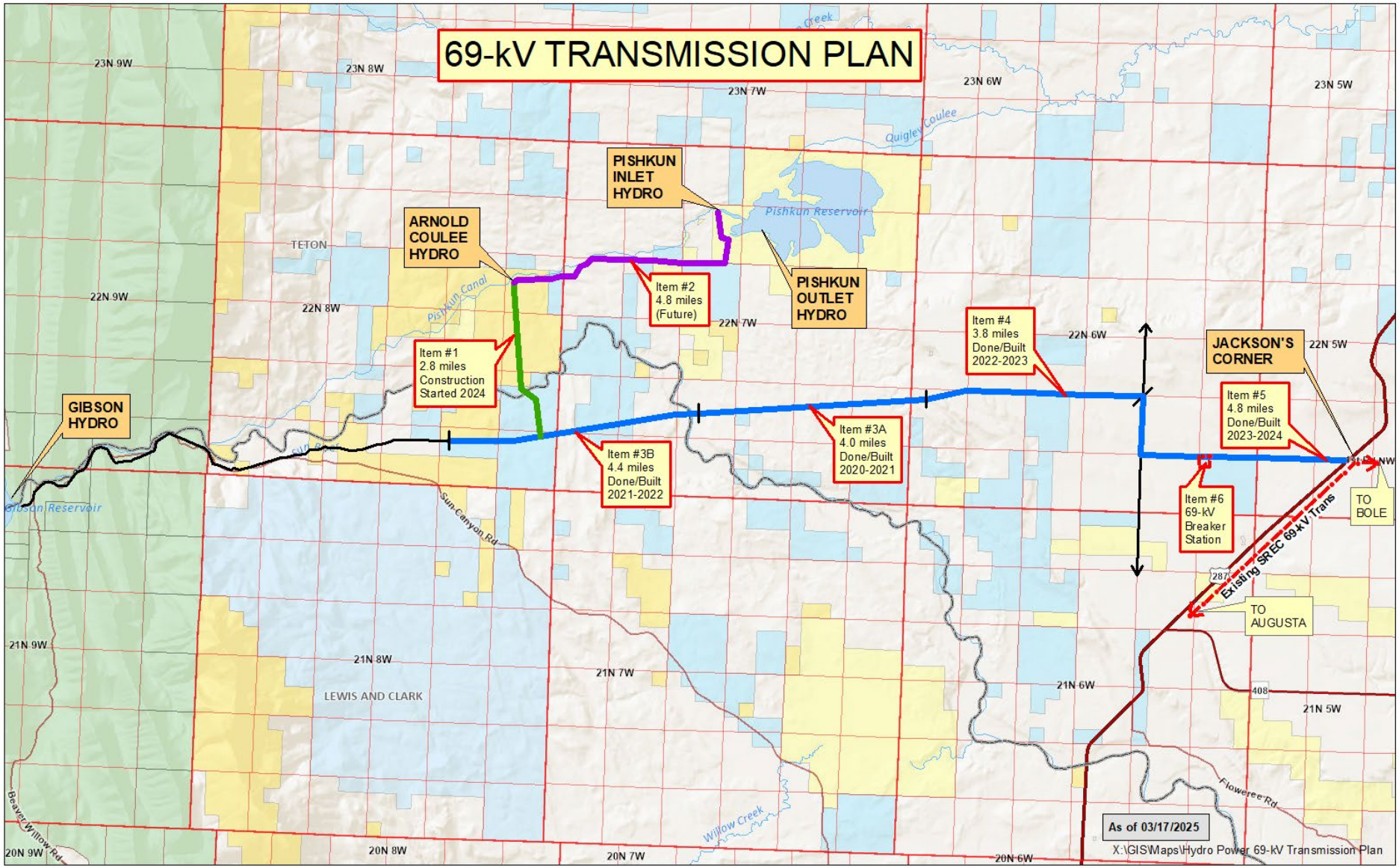
- Cancelled 2nd Pour on the Upper Thrust Block
- 1st Two Pieces of Penstock Arrive on the 20th & 21st
- Still Plan on Being On-Line May 2026
- Still Need to
  - Finalize PPA Negotiations
  - Installed Transitions and Penstocks
  - Take Delivery of Generators
  - Finish Powerhouse and Pre-Engineered Building
  - Finish Intake Structure and Intake Gates
  - Interior Controls and Electronics

ARNOLD COULEE PROJECT STATUS

- Still Need to
  - Site Transformer and Substation
  - Construct Tailrace Channel
  - Construct Jackson Corner Metering/Breaker Substation
  - Make Tie-In to SREC's Existing 69-kV Transmission

GREENFIELDS IRRIGATION DISTRICT
Next Project – Pishkun Inlet

- Very Similar to the Arnold Coulee Project
- Downstream on the Pishkun Supply Canal
- Q= 1,400 cfs, +38-ft Drop
- Seasonal Operation, Late April to Early Sept.
- 110 days = 7,920 MWh
- Keep Old Drop for Emergency By-Pass
- Varying Site Parameters, non-Steady-State
- Dual, 1.5MW Vertical Kaplan Turbines
- Start Transmission Line This Fall- Winter


69-kV TRANSMISSION PLAN
PISHKUN INLET HYDRO
ARNOLD COULEE HYDRO
PISHKUN OUTLET HYDRO
GIBSON HYDRO
Item #1 2.8 miles Construction Started 2024
Item #2 4.8 miles (Future)
Item #3A 4.0 miles Done/Built 2020-2021
Item #3B 4.4 miles Done/Built 2021-2022
Item #4 3.8 miles Done/Built 2022-2023
Item #5 4.8 miles Done/Built 2023-2024
Item #6 69-kV Breaker Station
JACKSON'S CORNER
TO BOLE
TO AUGUSTA
Existing SREC 69-kV Trans
Pishkun Reservoir
Gibson Reservoir
Pishkun Canal
Sun Canyon Rd
Willow Creek
Floweree Rd
Beaver Willow Rd
TETON
LEWIS AND CLARK
23N 9W
23N 8W
23N 7W
23N 6W
23N 5W
22N 9W
22N 8W
22N 7W
22N 6W
22N 5W
21N 9W
21N 8W
21N 7W
21N 6W
21N 5W
20N 9W
20N 8W
20N 7W
20N 6W
As of 03/17/2025
X:\GIS\Maps\Hydro Power 69-kV Transmission Plan


Pishkun Inlet Drop

QUESTIONS????