BMFOU Berkeley Pit and Discharge Pilot Project Polishing Facility

Butte, Montana 59701

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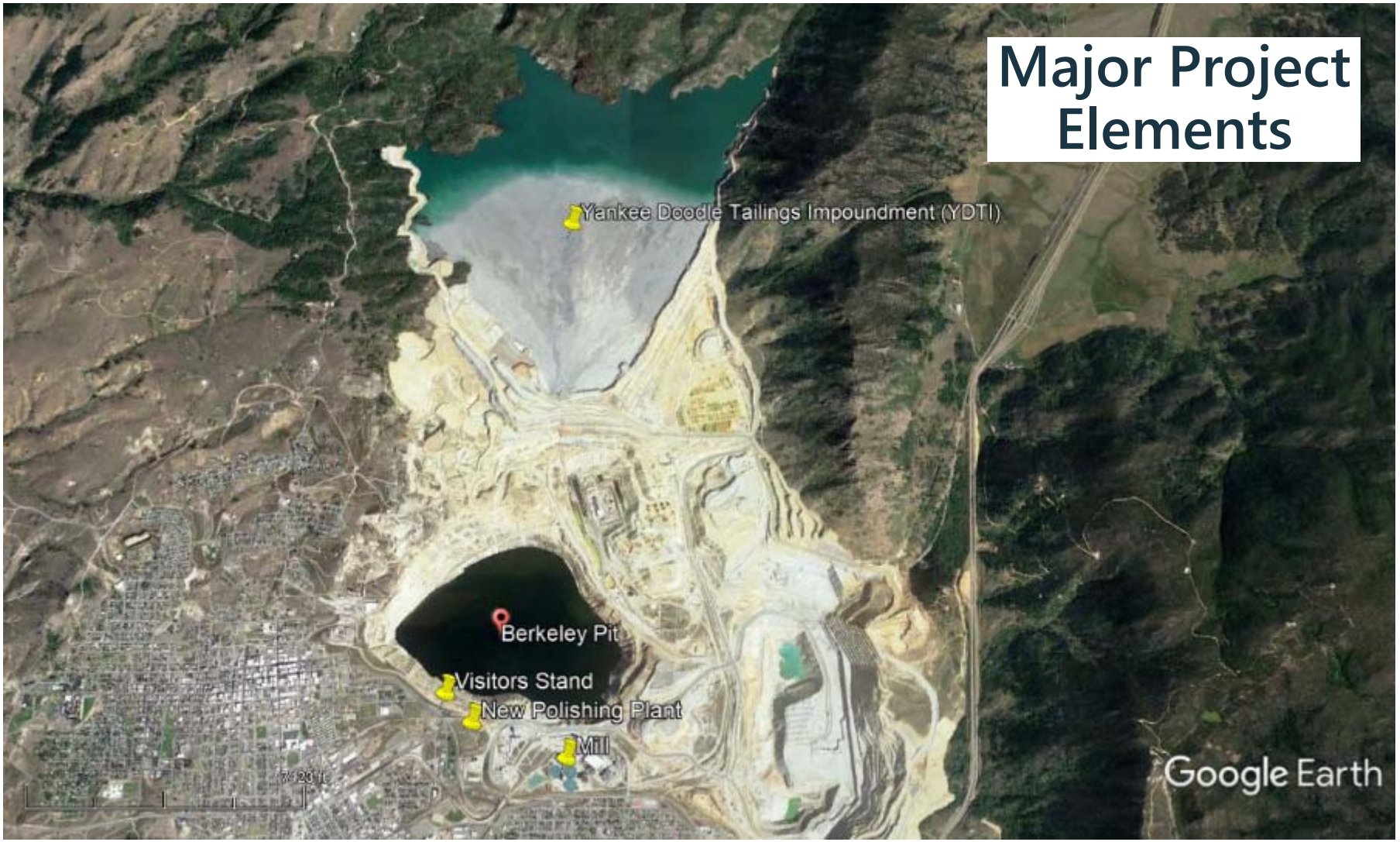
Agenda

- Project Overview
- Basis of Design
- Technical Approach
- Operational Configurations
- Summary

Project Overview

- Pilot Project Objective
  - Conduct a full-scale pilot test to evaluate treatment technologies and water management methods for meeting BMFOU Consent Decree requirements at the Berkeley Pit with specific goal of controlling the water elevation in the Pit
- Pilot Project Includes:
  - Withdrawing and treating Berkeley Pit water in the existing Horseshoe Bend Water Treatment Plant. Water will be used in the mill and discharged to the Yankee Doodle Tailings Impoundment (YDTI)
  - Constructing a new Polishing Plant to treat YDTI with off-site discharge
  - Polishing Plant discharge must meet discharge standards stated in the BMFOU Consent Decree
  - Polishing Plant will also be used to reduce the volume of water in the YDTI


Major Project Elements
Yankee Doodle Tailings Impoundment (YDTI)
Berkeley Pit
Visitors Stand
New Polishing Plant
Mill
Google Earth

Major Project Elements

Basis of Design

- Design Feed Flow:
  - 10 MGD
- Influent Water Quality
  - High pH (9.5 to 10.5), consists mostly of calcium sulfate, low metals concentrations, most dissolved metals already meet final CD limits
  - Future water quality estimated to remain similar but with possible increased aluminum concentrations (0.6 and 2.5 mg/L)
- Effluent Discharge Criteria
  - Consent Decree requirements for discharge into creek

Water Quality and Discharge Limits

Parameter	Units	Type	Existing YDTI Water Quality			Predicted Future YDTI Water Quality	Final Discharge Limit (30-day average)
			Min	Max	Average		
pH	s.u.	Field	8.4	10.6	9.6	10.5	6.5 to 9
Total Alkalinity, as $CaCO_3$	mg/L	Total	12	44	43	34	-
Major Anions							
Chloride	mg/L	Total	11.8	13.3	12.6	14.5	-
Sulfate	mg/L	Total	1,030	2,500	1,382	1,458	-
Major Cations							
Calcium	mg/L	Diss	389	715	500	573	-
Magnesium	mg/L	Diss	1.1	1.7	1.4	1	-
Potassium	mg/L	Diss	33	46	38	7	-
Sodium	mg/L	Diss	83	109	95	55	-
Other							
TSS	mg/L	Total	5	43	15	15	20
TDS	mg/L	Total	-	-	2,081	2,147	-
Total Hardness, as $CaCO_3$	mg/L	Total	959	1,260	1,090	1,436	-

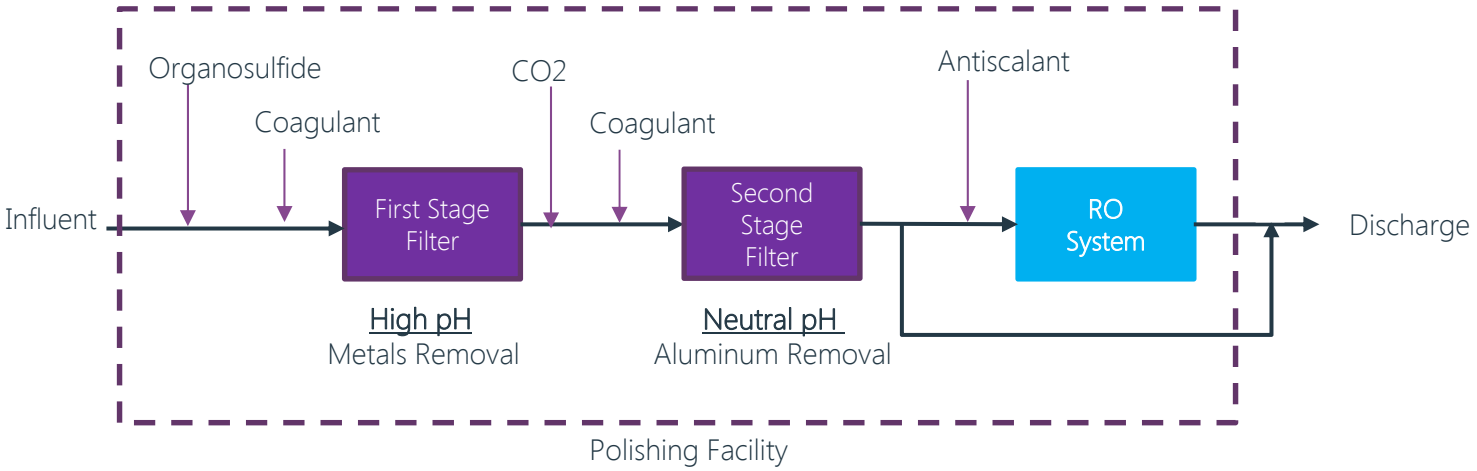
Water Quality and Discharge Limits

Parameter	Units	Type	Existing YDTI Water Quality			Predicted Future YDTI Water Quality	Final Discharge Limit (30-day average)
			Min	Max	Average		
Aluminum	µg/L	Total	64	2,300	410	600 – 2,500	-
	µg/L	Diss	10	69	31	600 – 2,500	-
Arsenic	µg/L	Total	3.76	29.0	6.90	Same	10
	µg/L	Diss	-	-	-	Same	-
Cadmium	µg/L	Total	0.028	3.6	0.32	Same	0.8
	µg/L	Diss	0.028	1.6	0.19	Same	-
Copper	µg/L	Total	4	340	32.5	Same	30.5
	µg/L	Diss	1.1	8.6	3.5	Same	-
Iron	µg/L	Total	18	4,200	722	Same	1,000
	µg/L	Diss	6.8	140	13.5	Same	-
Lead	µg/L	Total	0.3	13.1	1.83	Same	15
Zinc	µg/L	Total	0.82	310	30.2	Same	388
	µg/L	Diss	0.78	16	1.89	Same	-
Acute and Chronic Toxicity							Pass

Polishing Plant Project Overview

- Accelerated Delivery: <12 months
- Design/Build/Operate
- Collaboration between Wood, Pioneer, and Copper Env
- Completely gravity flow
- Simple, proven technologies
- Designed with flexibility to operate system in various configurations
- Target constituents include: aluminum, metals and dissolved salts, if needed
- Majority of equipment was pre-fabricated for quick installation
- Completely automated with remote monitoring and operator call-out

Conceptual Design of the Polishing Facility



Multimedia Filters

- Design Flow: 10 MGD
- Design Filtration Rate: 5.1 gpm/ft^2
- Integrated, low volume backwash
- 6 Filter Vessels, 3 Cells/Vessel, 150 ft^2/cell
- Media:
  - 18" fine sand
  - 18" anthracite
- Effluent turbidity target:
  - Turbidity< 0.2 NTU
  - SDI <3-4
- Designed for single or two stage operation

Reverse Osmosis

- Design Capacity: 3 MGD permeate
- Recovery: 75%
- Design Flux: 12.2 to 12.8 gfd
- 2 Skids, 3 RO Systems:
  - Skid 1: 2 x 0.75 MGD
  - Skid 2: 1 x 1.5 MGD
- Membranes:
  - Hydranautics: ESNA1-LF2-LD-400
  - Low pressure, low fouling
  - 96% calcium rejection
- Operating Pressure: 100 to 150 psig

Carbon Dioxide System

- Supplier: Praxair
- 54 ton horizontal cylinder with vaporizer
- Three diffuser injection locations
- pH target 6.8 to 7.2 at discharge
- Typical dosage: 20 to 40 ppm

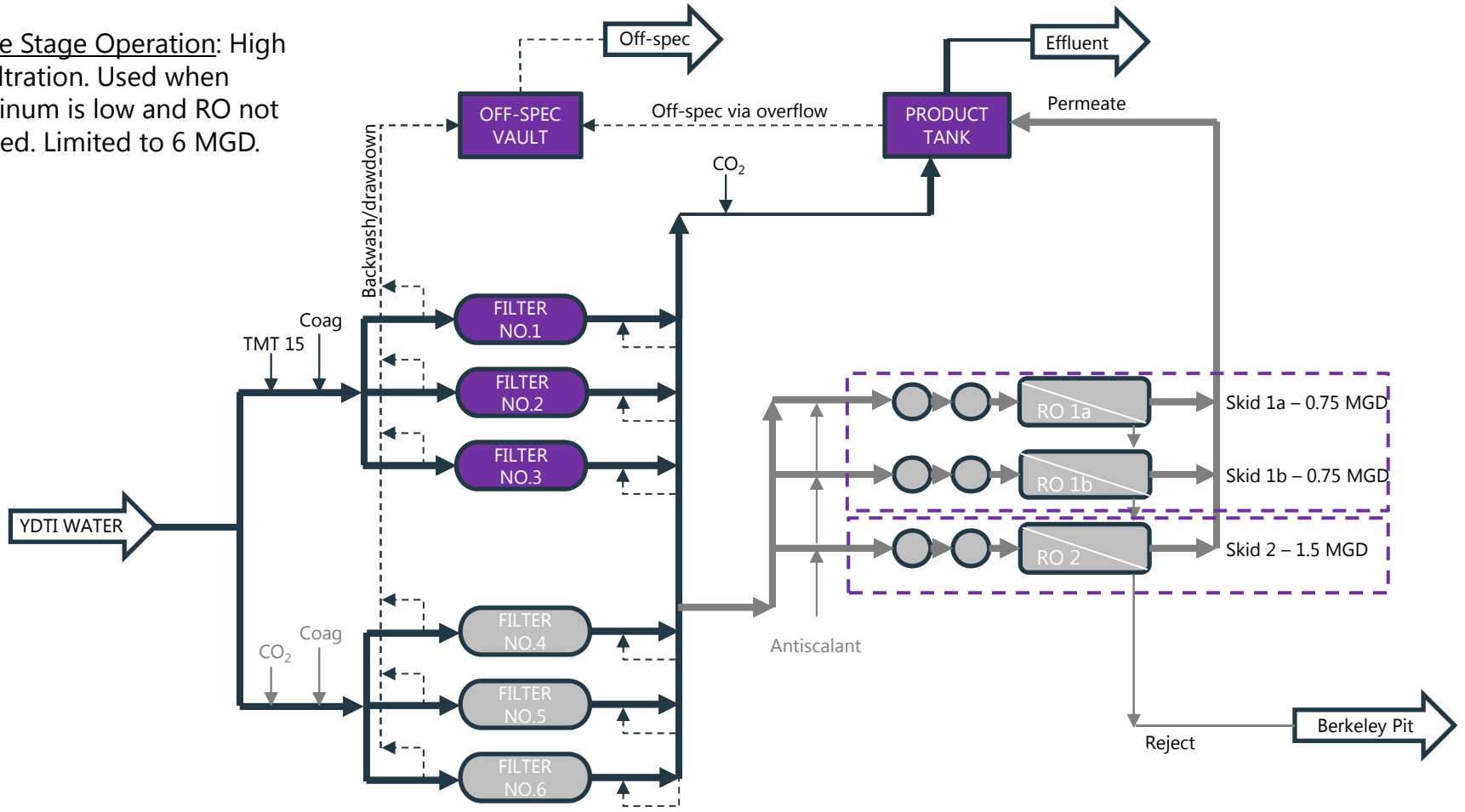
Chemical Feeds

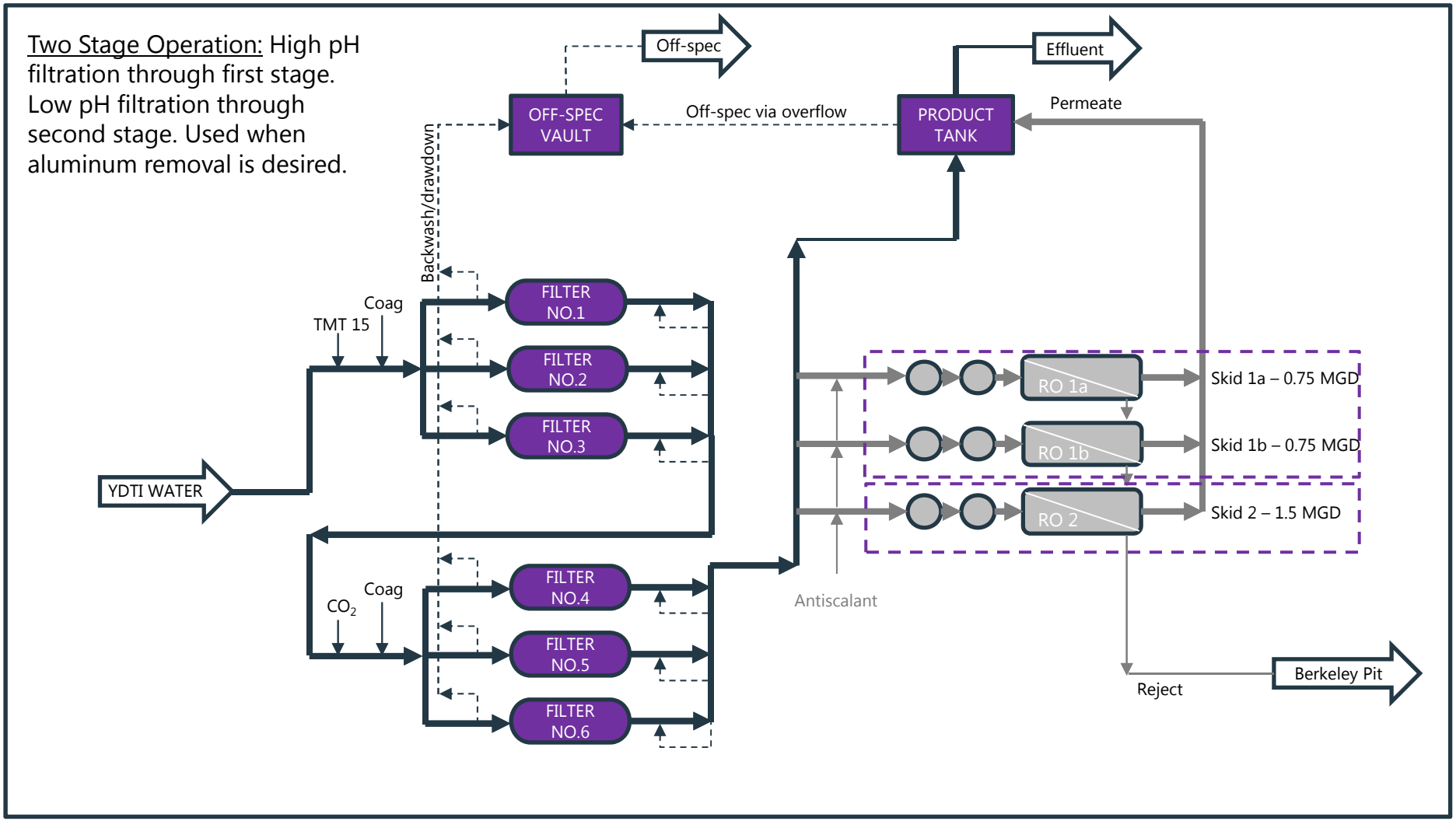
- Coagulant
  - Cationic polymer
  - RoQuest 3000 (Avista)
  - Vichem 2001
  - Dosage 0.5 to 1.0 ppm
- TMT-15
  - Organosulfide
  - Precipitates heavy metals to low levels
  - Dosage < 3 mg/L
- Antiscalant
  - Vitec 7000 (Avista)
  - Nalco 9714
  - Dosage 2 to 3 mg/L

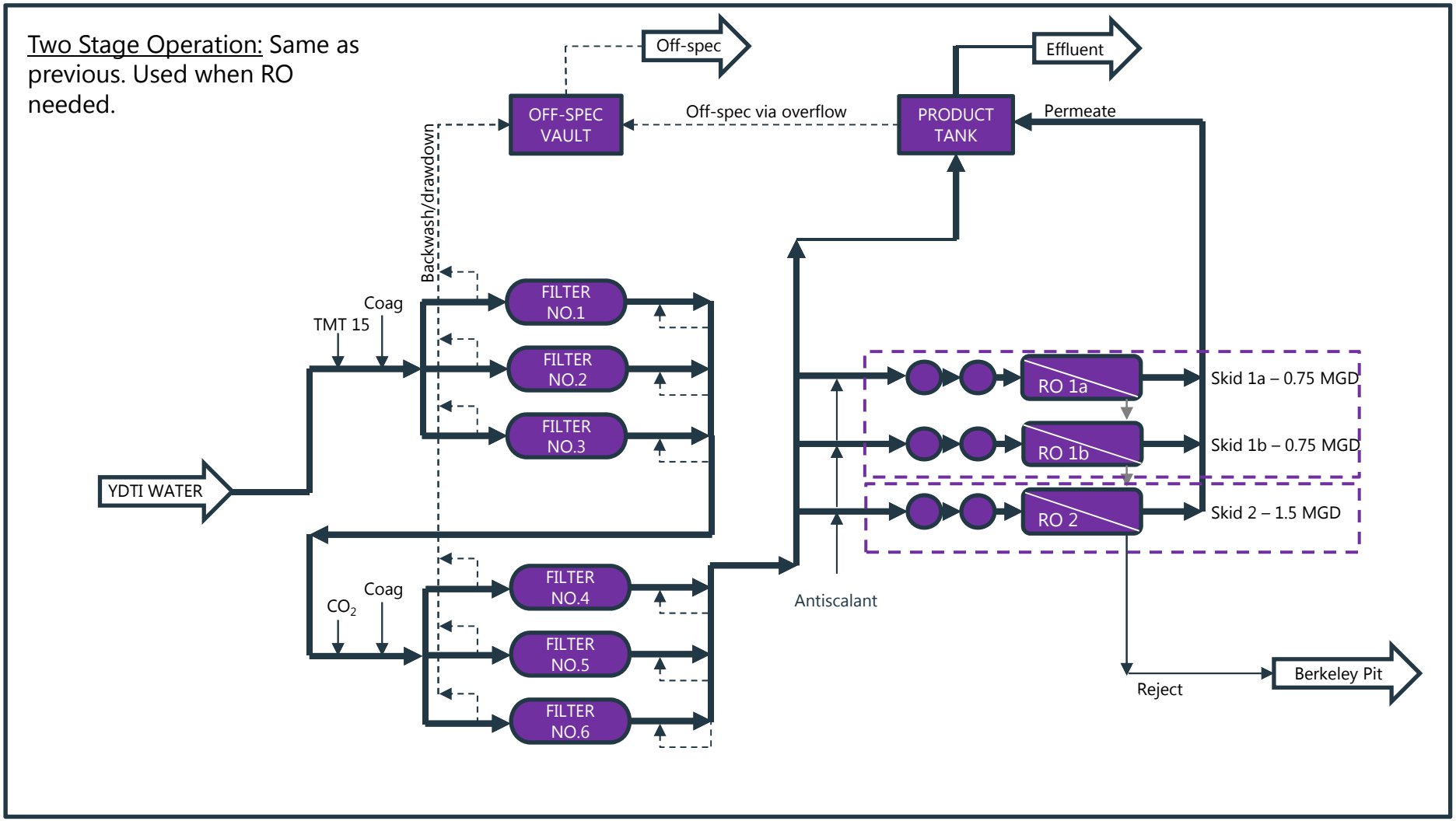
Product Tank

- 7,000 gallon FRB tank
- Blends Filtered Effluent and RO permeate
- 1 min retention time at max flow
- Simple design; internal weirs direct flow to discharge (lower weir) or off-spec/ waste vault (upper weir)
- Equipped with pH and conductivity instruments for online measurement and control

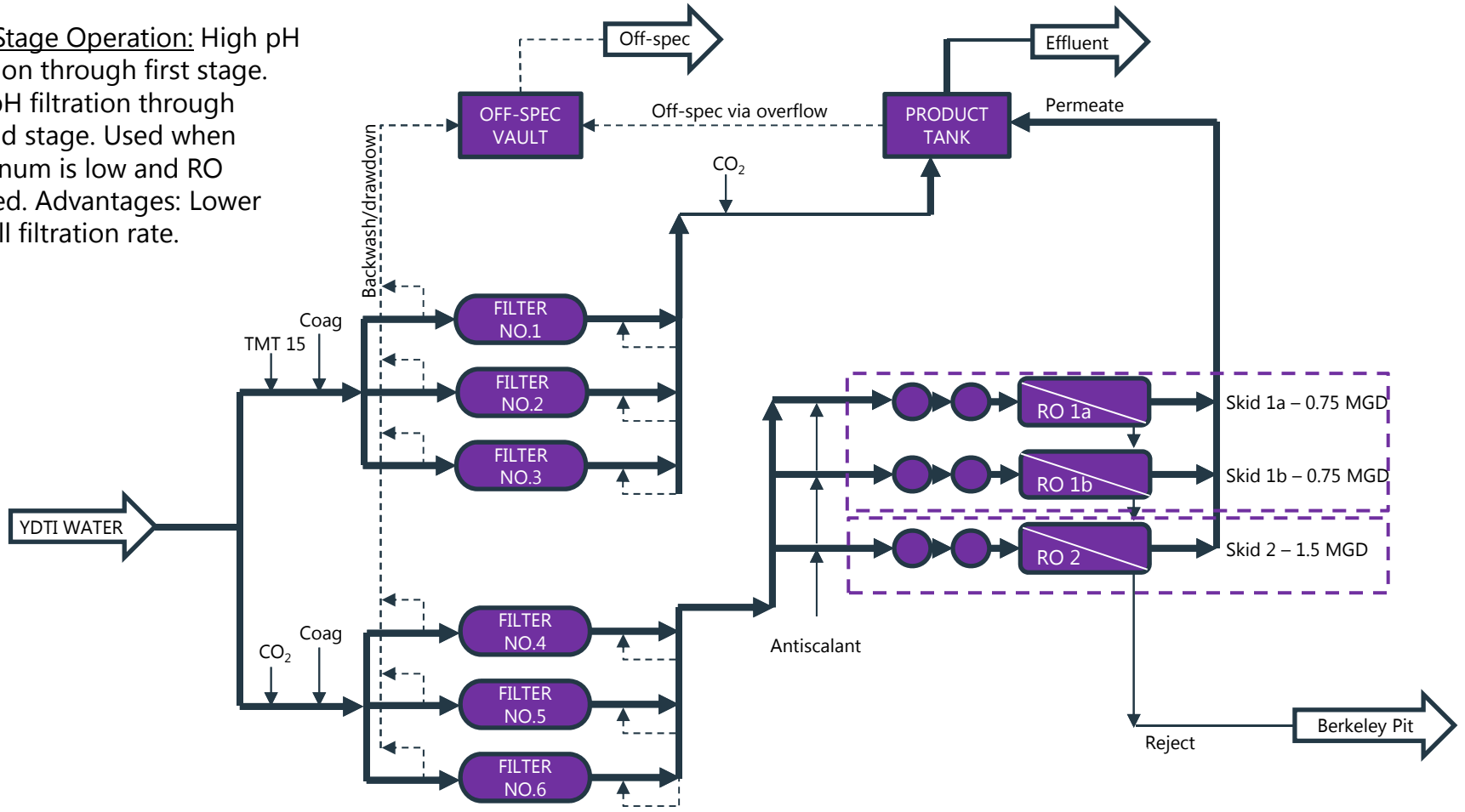
Single Stage Operation: High pH filtration. Used when aluminum is low and RO not needed. Limited to 6 MGD.




Two Stage Operation: High pH filtration through first stage. Low pH filtration through second stage. Used when aluminum removal is desired.
Off-spec
Effluent
OFF-SPEC VAULT
Off-spec via overflow
PRODUCT TANK
Permeate
Backwash/drawdown
FILTER NO.1
FILTER NO.2
FILTER NO.3
Coag
TMT 15
YDTI WATER
RO 1a
RO 1b
RO 2
Skid 1a – 0.75 MGD
Skid 1b – 0.75 MGD
Skid 2 – 1.5 MGD
Antiscalant
FILTER NO.4
FILTER NO.5
FILTER NO.6
Coag
CO_2
Reject
Berkeley Pit


Two Stage Operation: Same as previous. Used when RO needed.
Off-spec
Effluent
OFF-SPEC VAULT
Off-spec via overflow
PRODUCT TANK
Permeate
Backwash/drawdown
FILTER NO.1
FILTER NO.2
FILTER NO.3
Coag
TMT 15
YDTI WATER
RO 1a
RO 1b
RO 2
Skid 1a – 0.75 MGD
Skid 1b – 0.75 MGD
Skid 2 – 1.5 MGD
FILTER NO.4
FILTER NO.5
FILTER NO.6
Coag
CO_2
Antiscalant
Reject
Berkeley Pit

Split Stage Operation: High pH filtration through first stage. Low pH filtration through second stage. Used when aluminum is low and RO needed. Advantages: Lower overall filtration rate.



Summary

- Design/Build/ Operate Project
- Completed in less than 12 months
- Simple treatment process with flexible operating configurations
- Startup: May
- Discharge Target: June

Questions