# Water Treatment Plant Design at the Idaho Cobalt Project

Mine Design,
Operations & Closure
Conference
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Mark Reinsel, Ph.D., P.E.

Apex Engineering, PLLC

Craig Henrikson, P.E., CSP

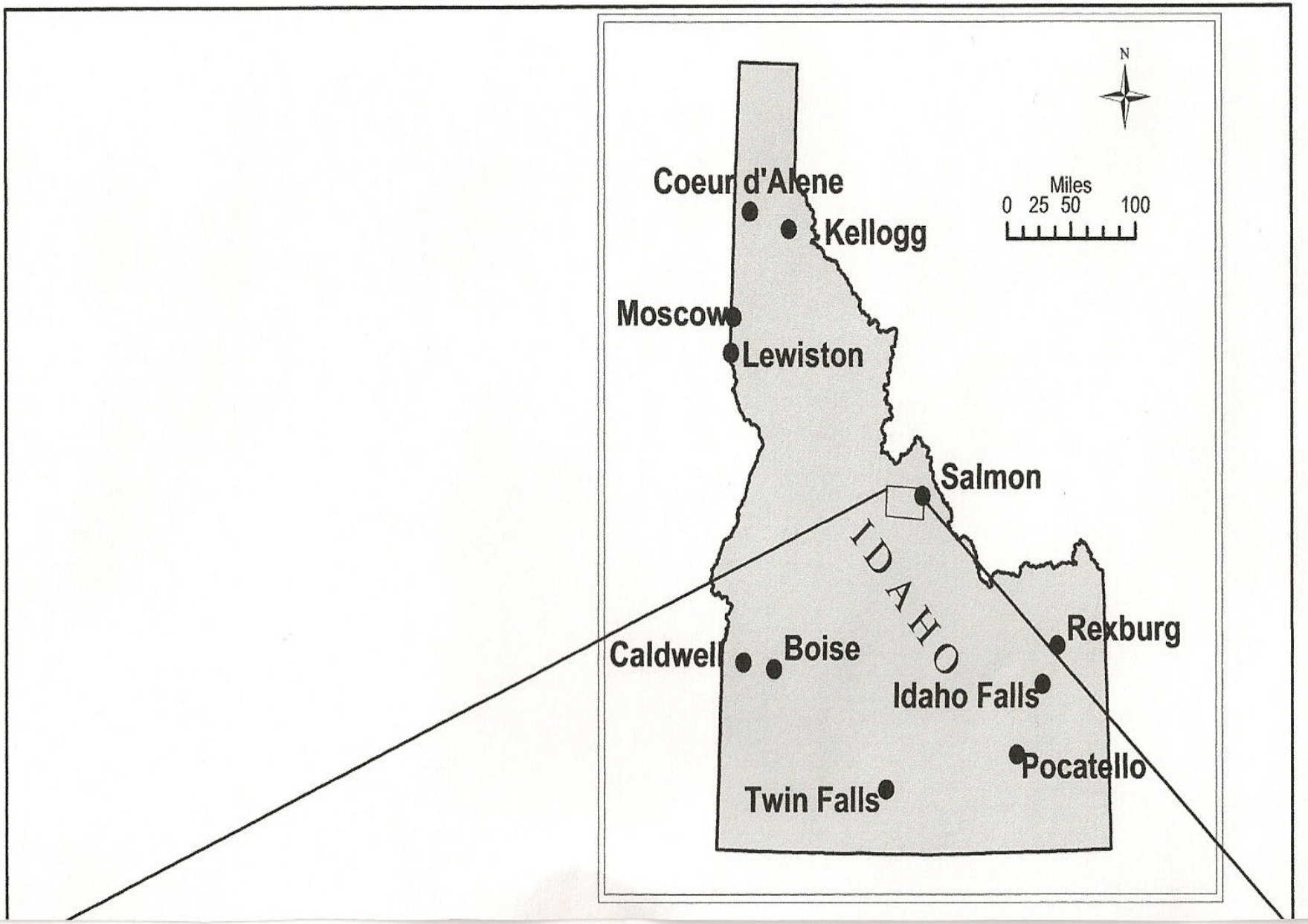
Morrison Maierle, Inc.

# *Presentation Outline*

1. **Project Background**
2. **Preliminary Work and Design Process**
3. **Full-Scale Design**

# *Idaho Cobalt Project (ICP)*

1. **Owner is Formation Capital Corporation, U.S. (FCC)**
2. **Conducting mineral exploration in area since 1993**
3. **ICP: Underground cobalt-copper mine, flotation mill and ancillary facilities**
4. **Apex/MMI contracted for water treatment design work in April 2007**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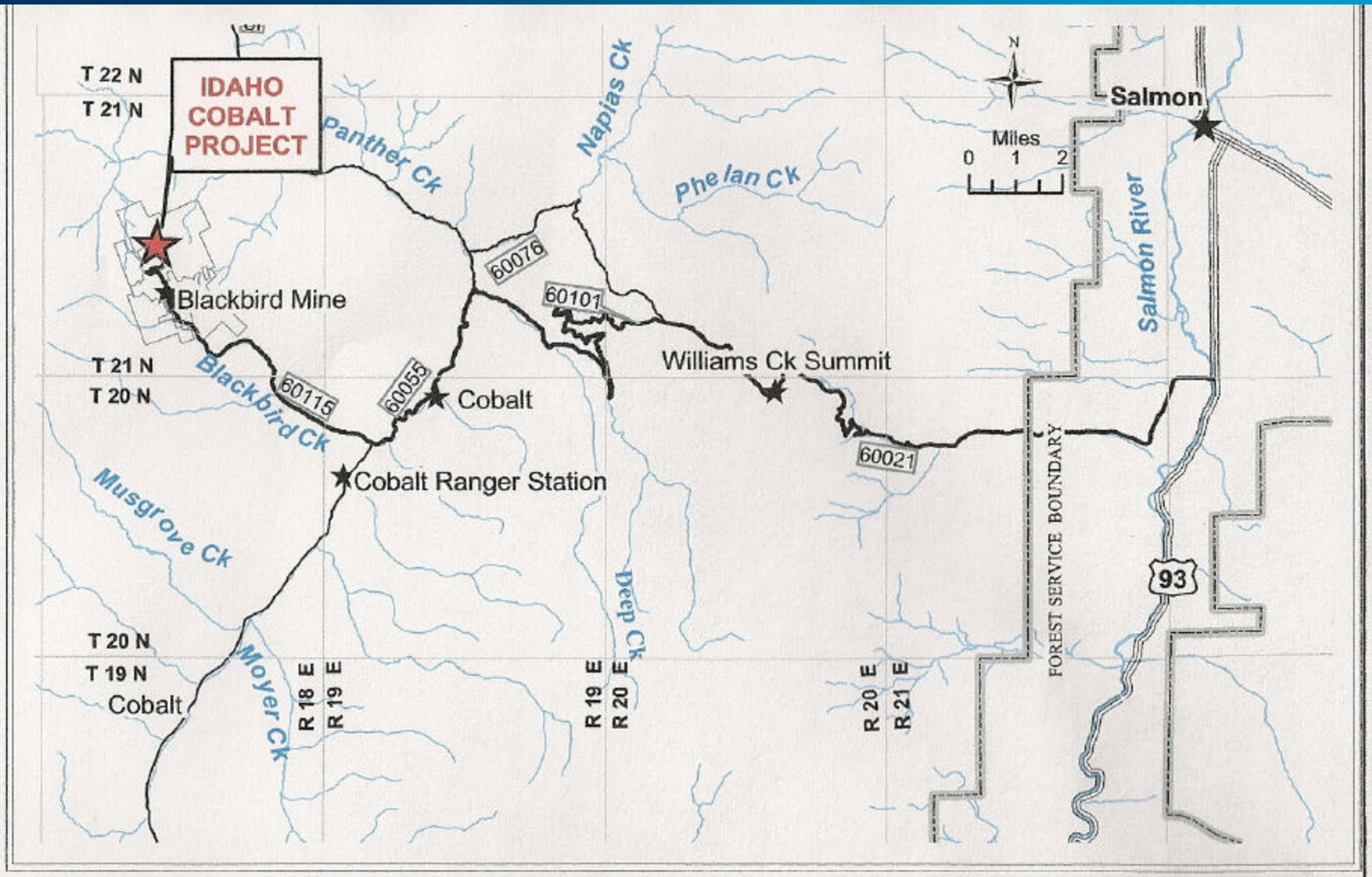
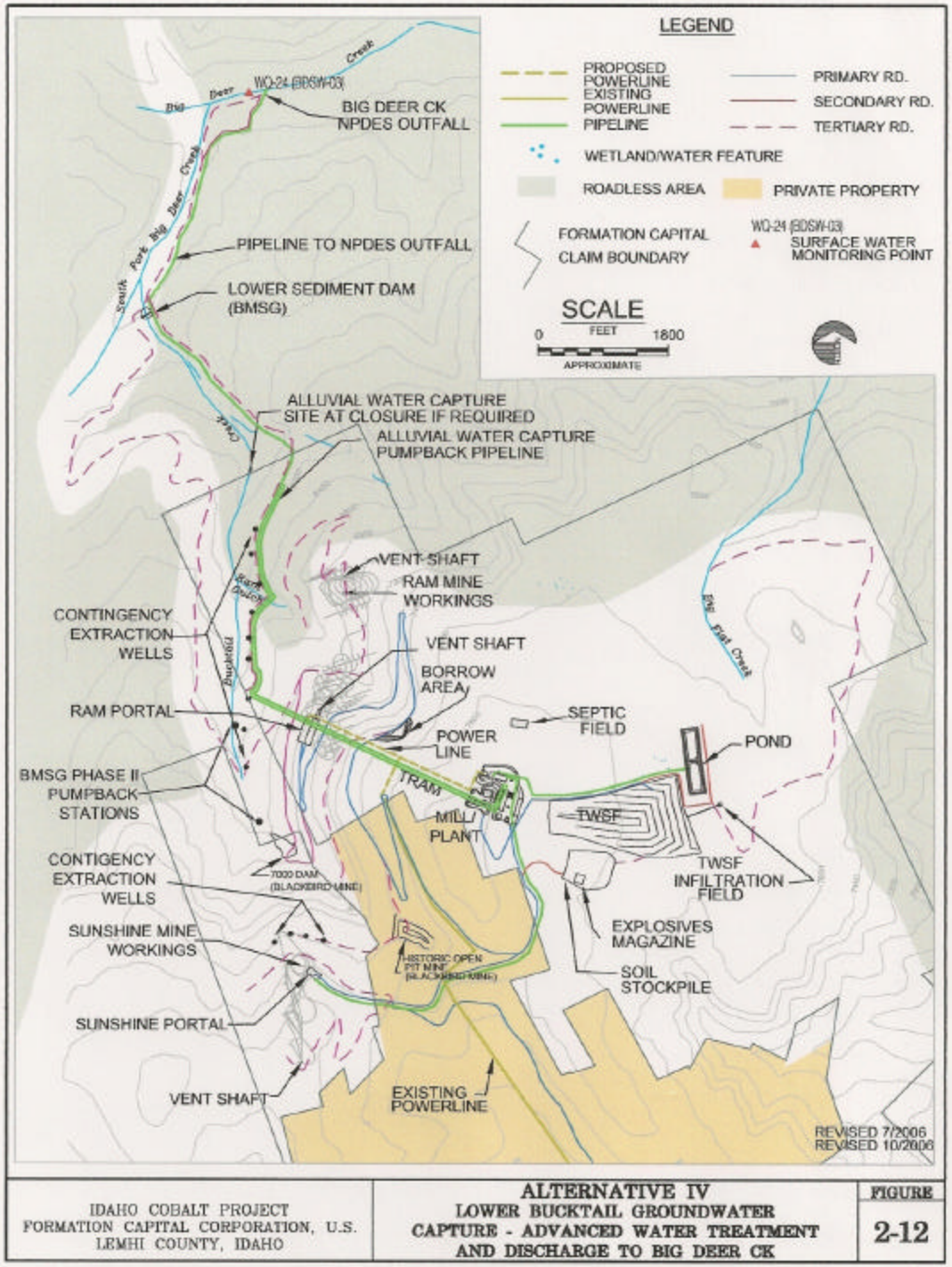
Miles
0 25 50 100
Coeur d'Alene
Kellogg
Moscow
Lewiston
Salmon
IDAHO
Rexburg
Caldwell
Boise
Idaho Falls
Pocatello
Twin Falls




| | | |
|---|---|---|
| IDAHO COBALT PROJECT<br>FORMATION CAPITAL CORP. U.S.<br>LEMHI COUNTY, IDAHO | **GENERAL LOCATION MAP<br>IDAHO COBALT PROJECT** | Figure<br>1-1 |

# Regulatory History

1. Draft NPDES permit issued 12/06
2. Draft EIS issued 2/07
3. Final EIS and Record of Decision issued 6/08
4. ROD was remanded in 10/08
5. Revised ROD issued 1/09
6. Final NPDES permit issued 2/09, effective 4/1/09




IDAHO COBALT PROJECT
FORMATION CAPITAL CORPORATION, U.S.
LEMHI COUNTY, IDAHO

**ALTERNATIVE IV**
**LOWER BUCKTAIL GROUNDWATER CAPTURE - ADVANCED WATER TREATMENT AND DISCHARGE TO BIG DEER CK**

**FIGURE**
**2-12**

# *Design Process*

- Treatment Technology Investigation: report 5/07
- Bench Tests:  report 7/07
- Conceptual Flow Sheet:  7/07
- Pilot Tests:  8/07 – 7/08
- Conceptual Treatment Plant Design: reports 3/08 and 2/09

# *Bench Testing*

- Sulfide precipitation jar tests
- Biotite jar tests
- Ion exchange (IX) column tests
- Natural zeolite column tests
- Zero-valent iron (ZVI) column tests

# *Pilot Testing*

- Ion exchange resin
- Zero-valent iron
- Natural zeolites

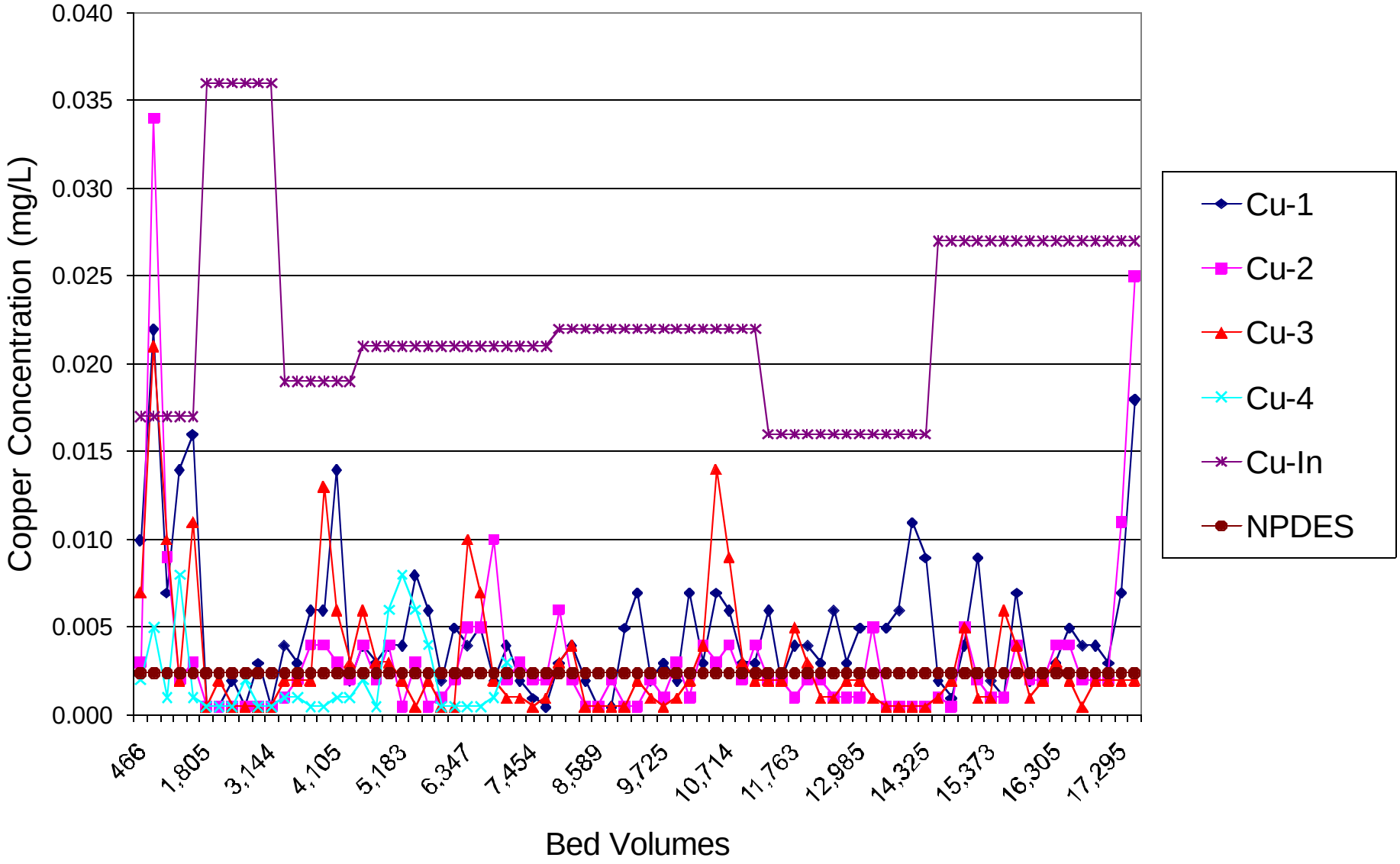
# *Pilot Testing Goals*

- Demonstrate treatment effectiveness in a continuous-flow test, as required by EIS;
- Select best treatment process to meet NPDES permit limits;
- Determine types and quantities of product or waste generated; and
- Estimate capital and operating costs for full-scale process.

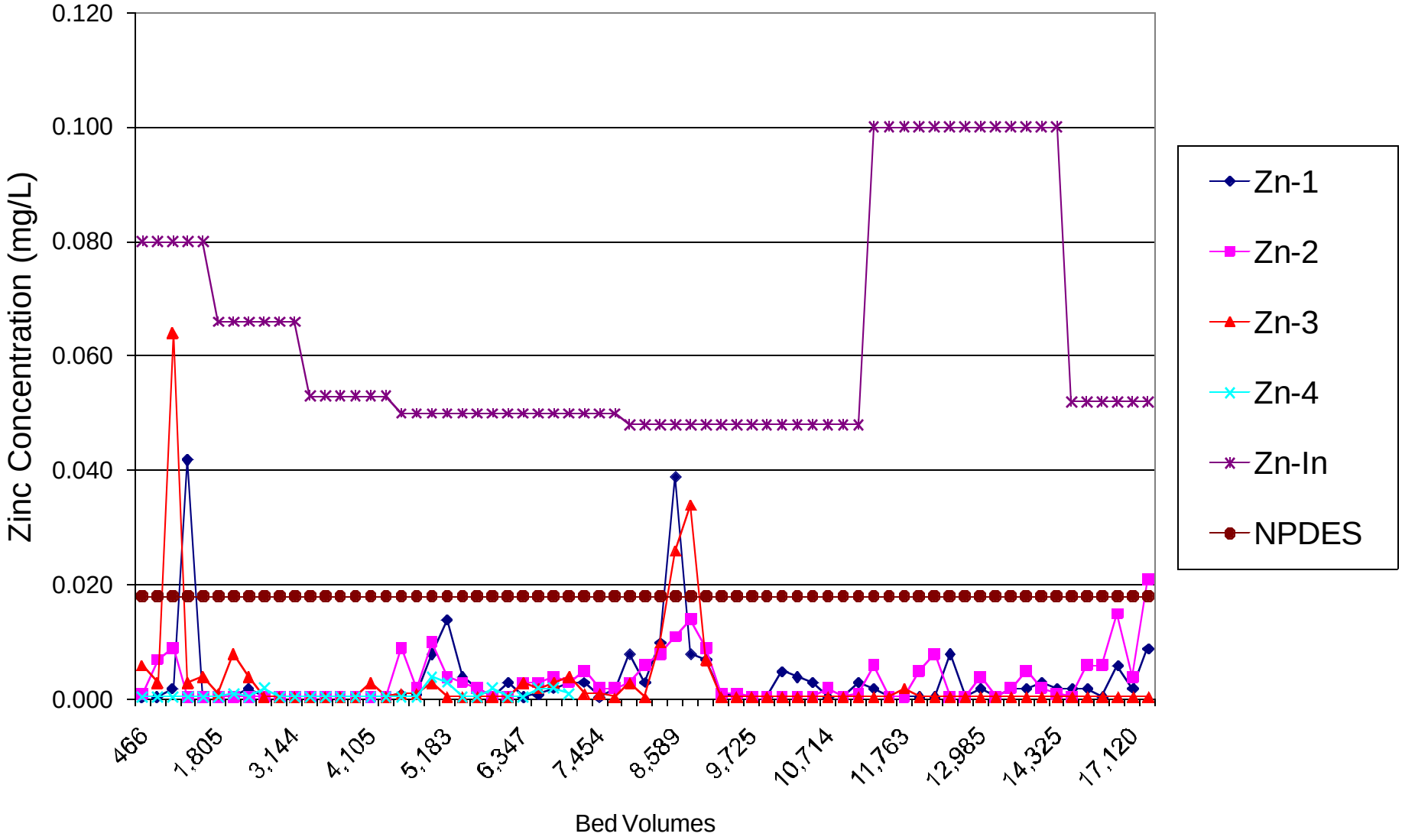
# *Advantages of IX vs. ZVI*

- More proven in large-scale applications;
- Can be chemically regenerated, reducing waste;
- No handling problems; and
- Will not leach contaminants such as iron.

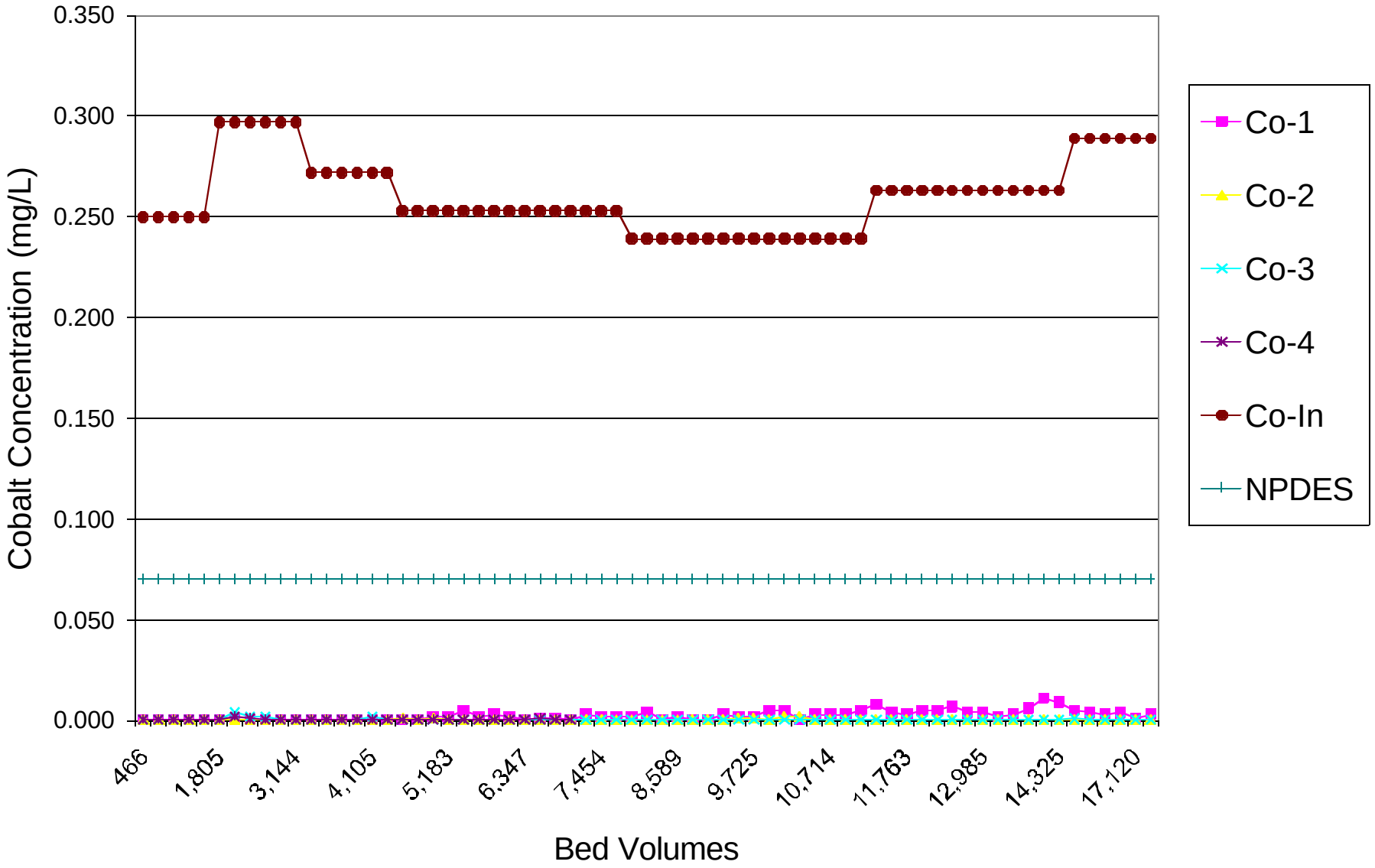
# COPPER REMOVAL, COLUMN TEST 3



# ZINC REMOVAL, COLUMN TEST 3



# COBALT REMOVAL, COLUMN TEST 3



# *Regeneration Results*

- Removed 95-99% of metals (Cu, Zn, Co, Mn) from IX resin
- Regeneration estimated to be required after 10,000-20,000 bed volumes (BV)
- Liquid waste will be 0.04% of influent water volume

# *Full-Scale Design*

- Design criteria
- Influent water quality
- Treatment processes
- Estimated costs
- Considerations
- Recommendations
- Current status

# Design Criteria

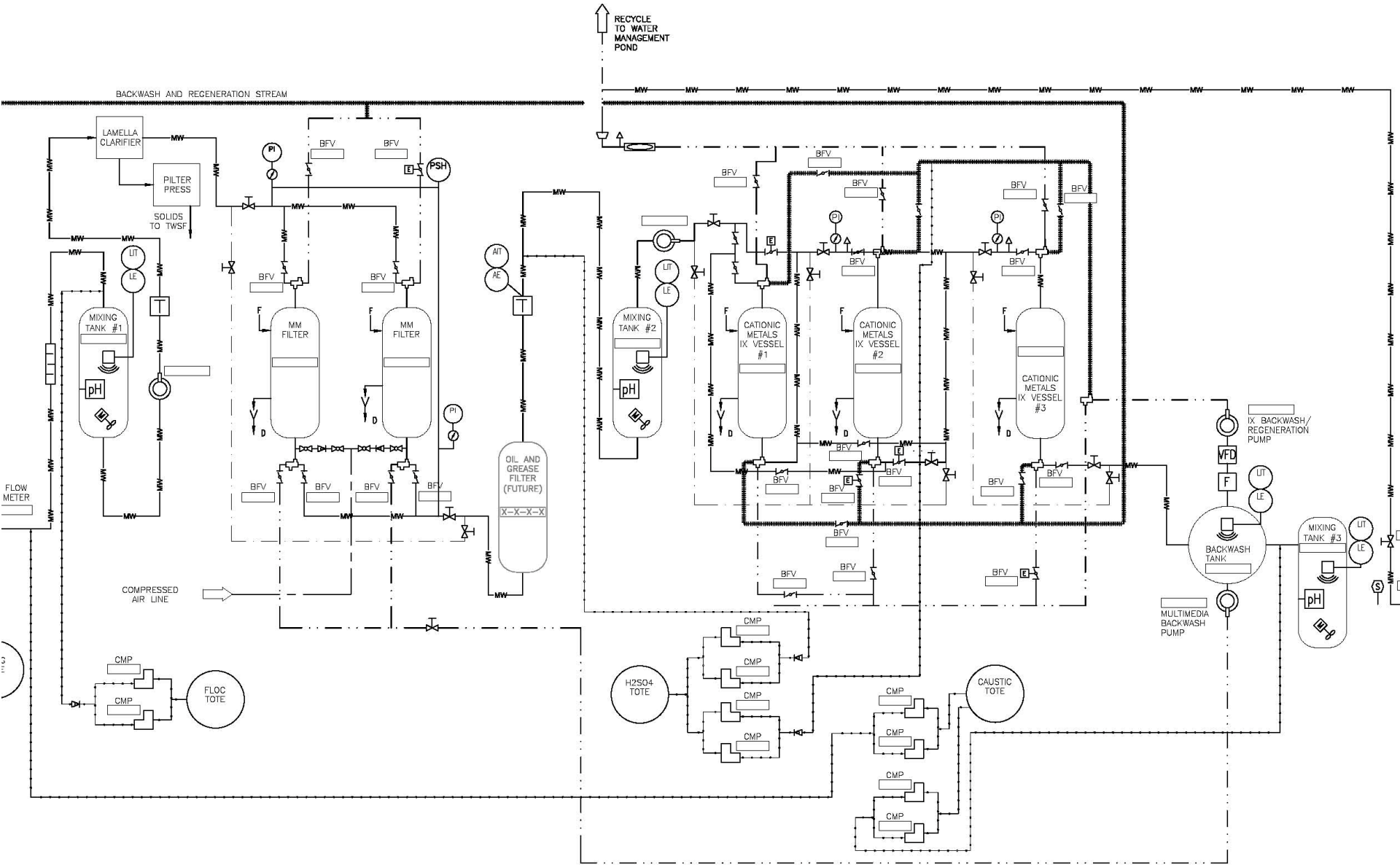
- Maximum flow = 150 gpm
- Average flow = 100 gpm
- Copper, zinc and cobalt are the only metals requiring treatment.
- Arsenic will co-precipitate with iron, eliminating specific arsenic treatment.
- Influent will be combination of mine water and Water Management Pond water.

# *Anticipated Water Quality*

| | Concentration (mg/L) | |
|---|---|---|
| **Parameter** | **Influent** | **NPDES Limit** |
| Sulfate | 556 | 930 |
| Nitrate-N | 25 | 10 |
| Ammonia-N | 3.0 | 2.8 |
| Arsenic | 0.093 | 0.010 |
| Cobalt | 0.287 | 0.070 |
| Copper | 0.032 | 0.0024 |
| Iron | 1.0 | |
| Manganese | 5.6 | |
| Zinc | 0.044 | 0.018 |
| pH | 5.7 | 6.5 - 9.0 |

# *Treatment Processes*

- pH Adjustment
- Clarification
- Multimedia Filtration
- Ion Exchange for Cationic Metals
- Nitrification (Biological Ammonia Removal)
- Denitrification (Biological Nitrate Removal)




WATER PROCESS DIAGRAM

POTABLE WATER LINE

COMPRESSED AIR LINE

PRIMARY TREATMENT LINE

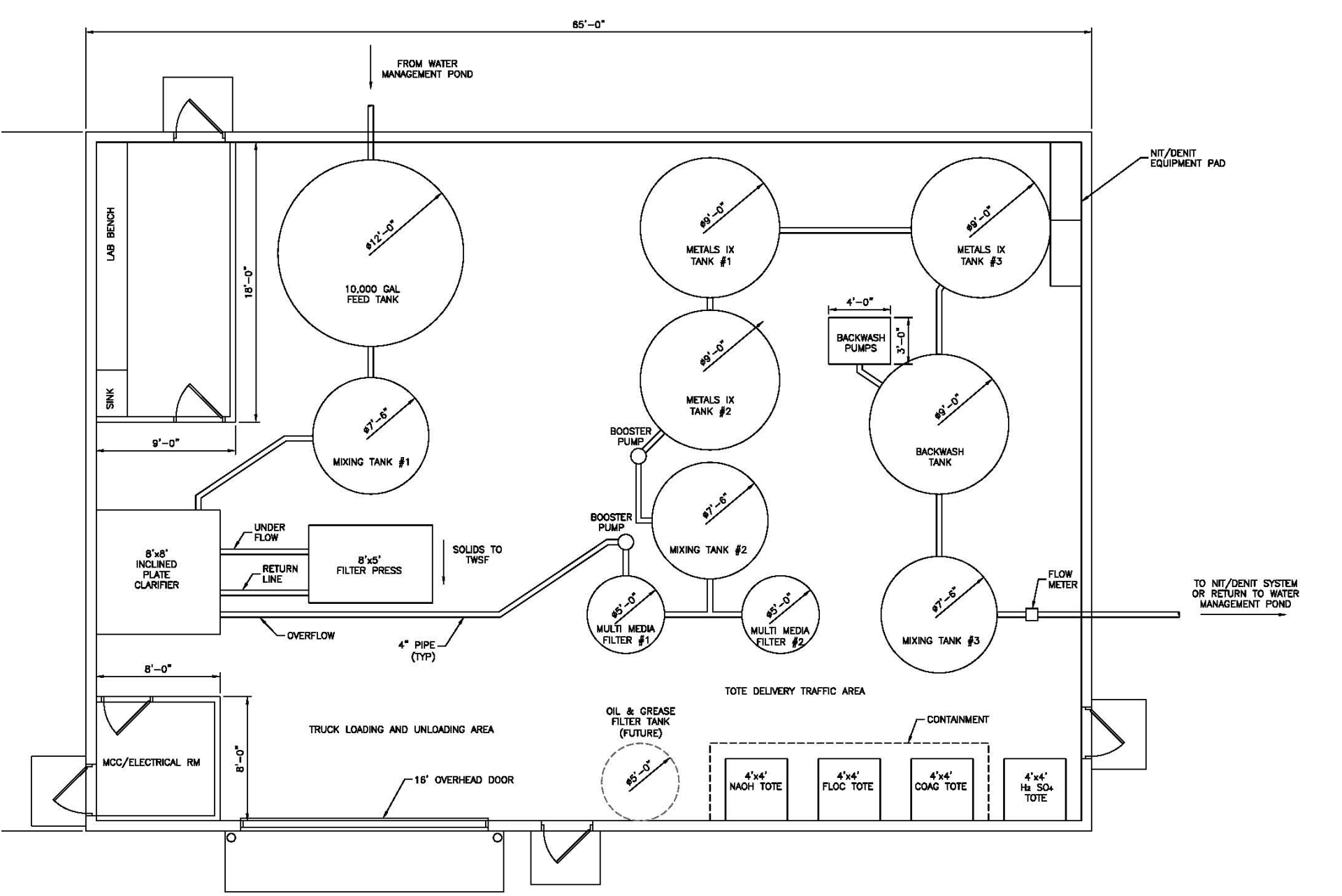
BYPASS LINE

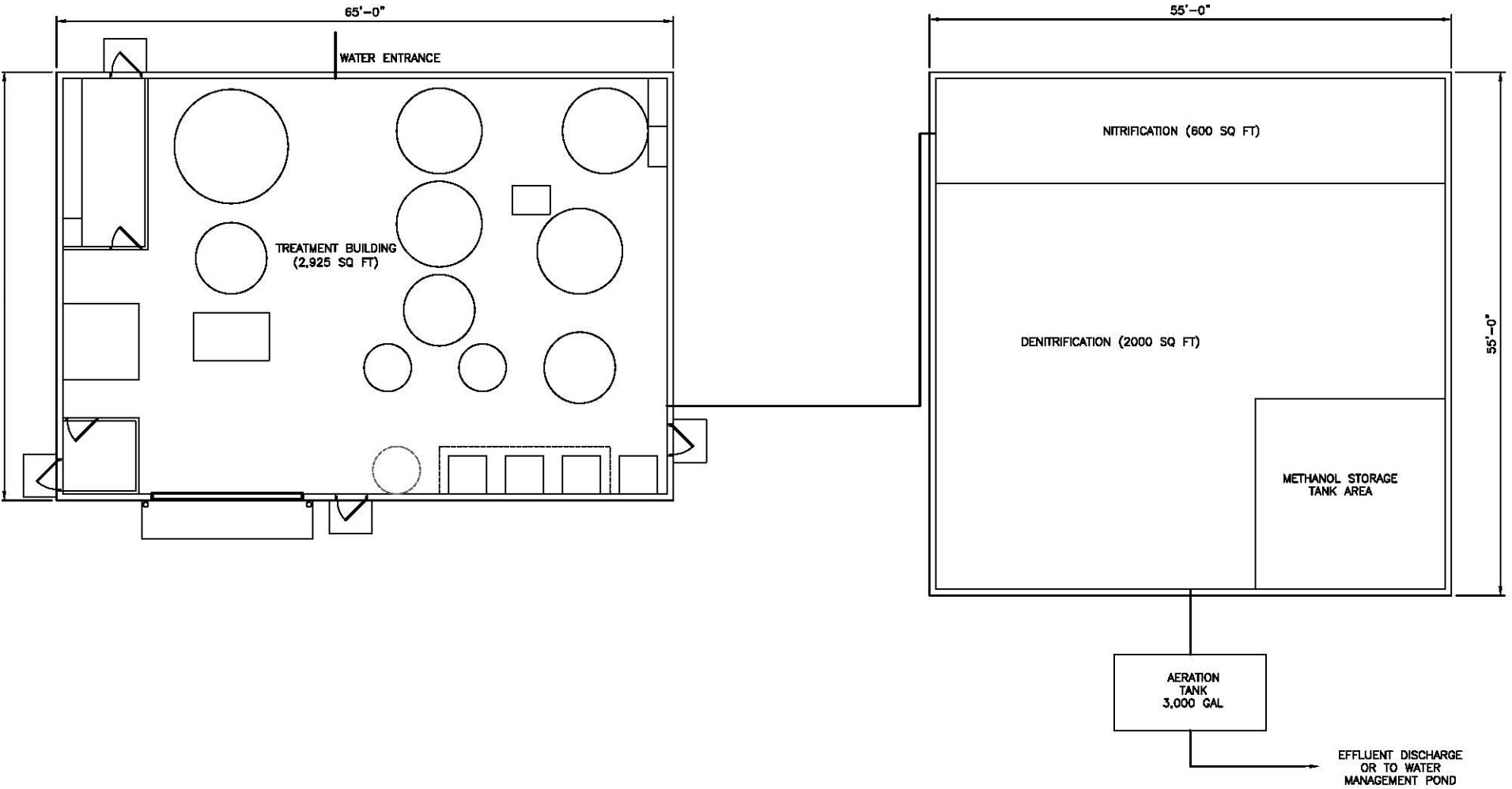
REGENERATION & BACKWASH

PRESSURE SENSING LINE

BACKWAS

CHEMICAL


65'-0"
FROM WATER MANAGEMENT POND
LAB BENCH
SINK
18'-0"
9'-0"
ø12'-0"
10,000 GAL FEED TANK
ø7'-6"
MIXING TANK #1
ø9'-0"
METALS IX TANK #1
ø9'-0"
METALS IX TANK #2
ø9'-0"
METALS IX TANK #3
NIT/DENIT EQUIPMENT PAD
4'-0"
BACKWASH PUMPS
3'-0"
ø9'-0"
BACKWASH TANK
BOOSTER PUMP
BOOSTER PUMP
ø7'-6"
MIXING TANK #2
8'x8' INCLINED PLATE CLARIFIER
UNDER FLOW
RETURN LINE
8'x5' FILTER PRESS
SOLIDS TO TWSF
OVERFLOW
4" PIPE (TYP)
ø5'-0"
MULTI MEDIA FILTER #1
ø5'-0"
MULTI MEDIA FILTER #2
ø7'-6"
MIXING TANK #3
FLOW METER
TO NIT/DENIT SYSTEM OR RETURN TO WATER MANAGEMENT POND
8'-0"
TOTE DELIVERY TRAFFIC AREA
TRUCK LOADING AND UNLOADING AREA
OIL & GREASE FILTER TANK (FUTURE)
ø5'-0"
CONTAINMENT
MCC/ELECTRICAL RM
8'-0"
16' OVERHEAD DOOR
4'x4' NAOH TOTE
4'x4' FLOC TOTE
4'x4' COAG TOTE
4'x4' H2 SO4 TOTE




## SITE PLAN

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

# Equipment Costs

| Item | Installed Cost | Size |
|---|---|---|
| Feed tank & pump | $25,000 | 10,000 gal |
| Caustic pump skid with totes | $10,000 | 4' x 4' |
| Mixing tank (3) | $36,000 | 7.5' diam. |
| Polymer feed skids (2) | $11,700 | 4' x 4' |
| Clarifier | $187,500 | |
| Booster pump (2) | $14,000 | |
| Multimedia filter (2) | $37,000 | 5' diam. |
| Acid feed pump skid with totes | $10,000 | 4' x 4' |
| Metals IX (3) | $800,000 | 9' diam. |
| Backwash tank and pumps | $28,000 | 9' diam. |
| PLC and controls | $50,000 | |
| Filter press | $50,000 | 8' x 5' |
| Package nitrification/denitrification | $520,000 | 2600 sq. ft. |
| Aeration tank | $15,000 | 3000 gal |
| Misc. piping/valves | $100,000 | |
| Evaporator & appurtenances | $88,000 | |
| Treatment building | $220,000 | 65' x 45' |
| Instrumentation & Other | $8,000 | |
| **Installed Equipment Total** | **$2,228,000** | |

# Capital Cost

| Item | Cost | Assumption |
|---|---|---|
| Equipment (w/o install.) | $2,228,000 | |
| Installed equipment | $2,930,000 | 35% installation cost |
| Site civil & electrical | $223,000 | 5% each of equip. cost |
| Mobilization, taxes & other | $290,000 | Total 13% of equip. cost |
| Engineering | $446,000 | 20% of equip. cost |
| Contingency | $334,000 | 15% of equip. cost |
| **Total** | **$4,223,000** | |

# Operating Costs

| | Cost | |
|---|---|---|
| **Category** | **$/kgal** | **$/yr.** |
| Electrical | $1.228 | $64,544 |
| Materials | $1.426 | $74,951 |
| Labor | $1.624 | $85,357 |
| Maintenance | $0.968 | $50,878 |
| Waste disposal | $0.230 | $12,089 |
| **Total** | **$5.48** | **$287,819** |

# Materials

- IX resin
- Flocculent
- Sodium hypochlorite
- Caustic soda
- Sulfuric acid
- Methanol

# Considerations

1. IX regeneration is anticipated after 10,000 to 20,000 BV of water treated.

2. Zeolites are not required for metals removal.

3. Co-current or counter-current regeneration of IX resin? This was still being discussed with resin manufacturers to optimize operations for this project.

# Recommendations

1. Reduce manganese concentration to low level (e.g., 0.05 mg/L) prior to IX.
2. Also reduce iron concentrations prior to IX.
3. Operate IX vessels in series.
4. Do not use galvanized fittings in treatment plant.

# Current Status

1. Crown Solutions was awarded plant design and procurement contract in December 2009.

2. Crown has recommended adding ultrafiltration prior to IX.

3. FCC finished Stage 1 in March (clearing trees on 125 acres).

4. Stage 2 (WTP design & procurement) scheduled to begin this month, pending financing.


UF-1
BACKWASH
WATER

# QUESTIONS?