PRESENTATION

Water Quality and Quantity on a Limited Budget

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Typical Groundwater Challenges

- Common water quality challenges
  - Primary water standards for typical groundwater contaminates

Pollutant	Primary MCL
Arsenic	10 µg/L
Nitrate	10 mg/L
Nitrite	1 mg/L
Total Coliforms	No Positives
Uranium	30 µg/L

  - Other water standards
  - Redundant water supply
  - Emergency operation standards
  - Required fire protection
  - Water pressure standards

Parameter	Standard
Hydrogen Sulfide	Detection
Ammonia	N/A
Iron	0.30 mg/L
Manganese	0.05 mg/L
Color	15 Units
pH	6.5 to 8.5
TDS	500 mg/L

Options

- Well abandonment
- Well blending
- In-situ groundwater conditioning
- Chemical treatment and sequestration
- Adsorption and filtration
- Ion exchange
- Reverse osmosis
- Aeration
- Capitalizing on existing infrastructure

Dietrich, Idaho

- System Background
  - 98 EDUs
  - 1 well and 0.1 MG tank
  - 6” to 10” water mains
  - Shallow bedrock
- Problem
  - Single well water supply
  - Not compliant with redundant and emergency operation standards
  - Insufficient fire protection

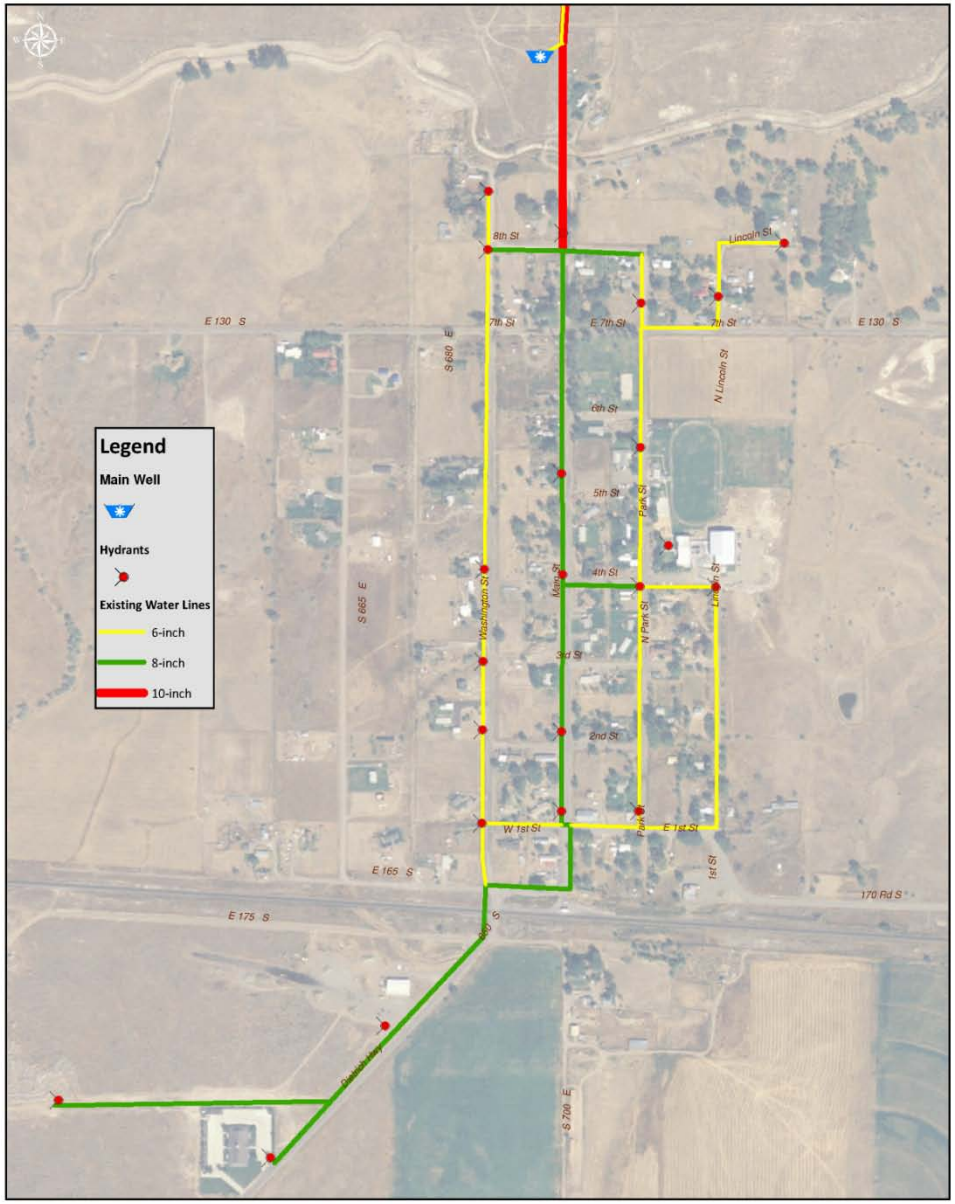


Figure 4.1. Dietrich, Idaho: Existing Distribution System

Supply, Storage, Distribution – Alternative 1

- 0.35 MG bench reservoir
- New well near existing well
- Transmission improvements (see figure)
- Comparative cost estimate = $1,991,500
- Advantages:
  - Better tank circulation
  - More efficient operation
  - May be able to use existing easements
  - Slightly less expensive
- Disadvantages
  - More transmission pipeline improvements (rock excavation)
  - USDA-RD may not fund fire flow improvements

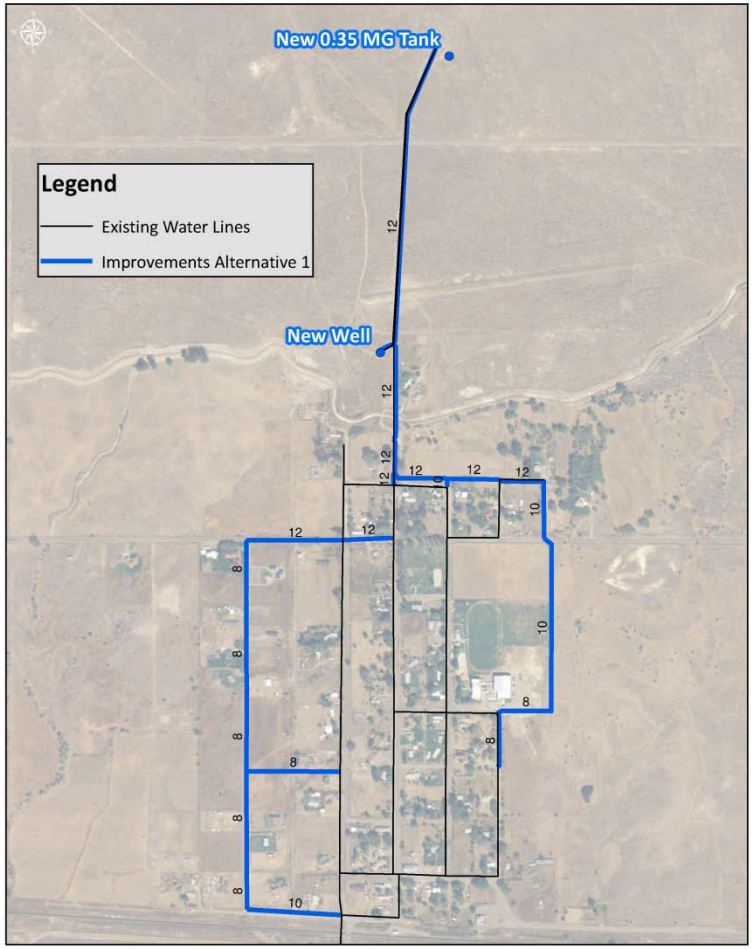


Figure 6.1 Dietrich, Idaho: Alternative 1 Improvements

Supply, Storage, Distribution – Alternative 2

- 0.35 MG ground level tank
- New well and booster station near tank
- Transmission improvements (see figure)
- Comparative cost estimate = $2,121,800
- Advantages:
  - Fewer transmission pipeline improvements
  - Water source closer to structures needing fire protection
- Disadvantages
  - Requires booster station
  - Requires property acquisition or easement
  - Requires continuous pumping / power use
  - Slightly more expensive

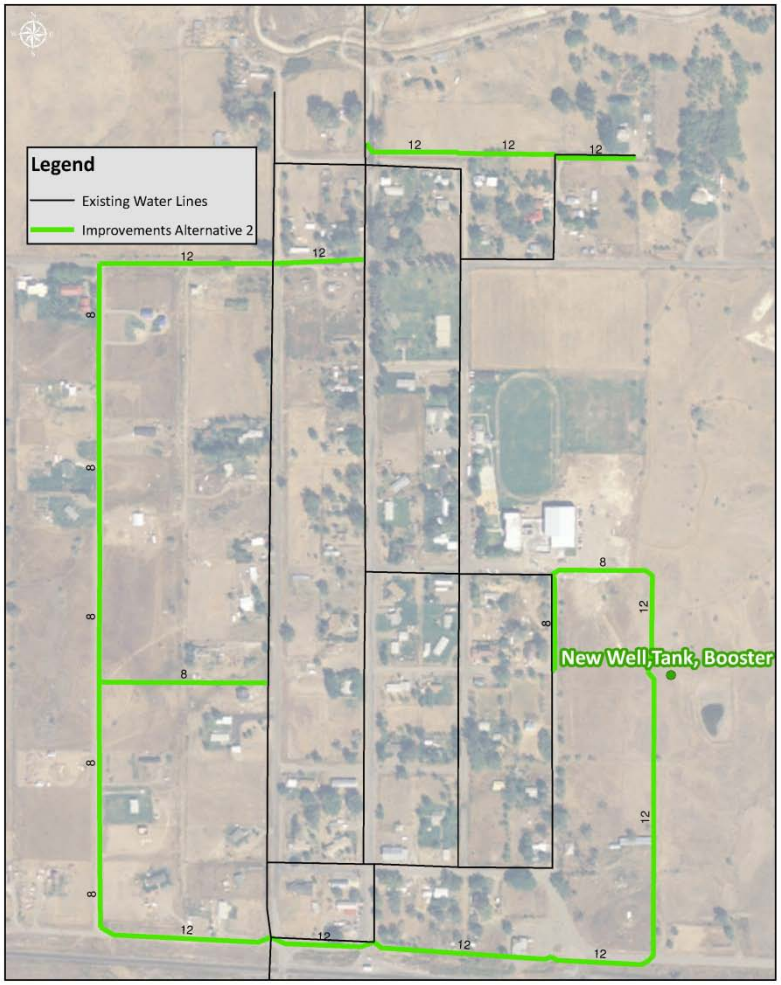


Figure 6.2 Dietrich, Idaho: Alternative 2 Improvements

Dietrich Summary

- Saved the City over $100,000
- Improved energy conservation
- Simplified system operation
- Minimized rock excavation

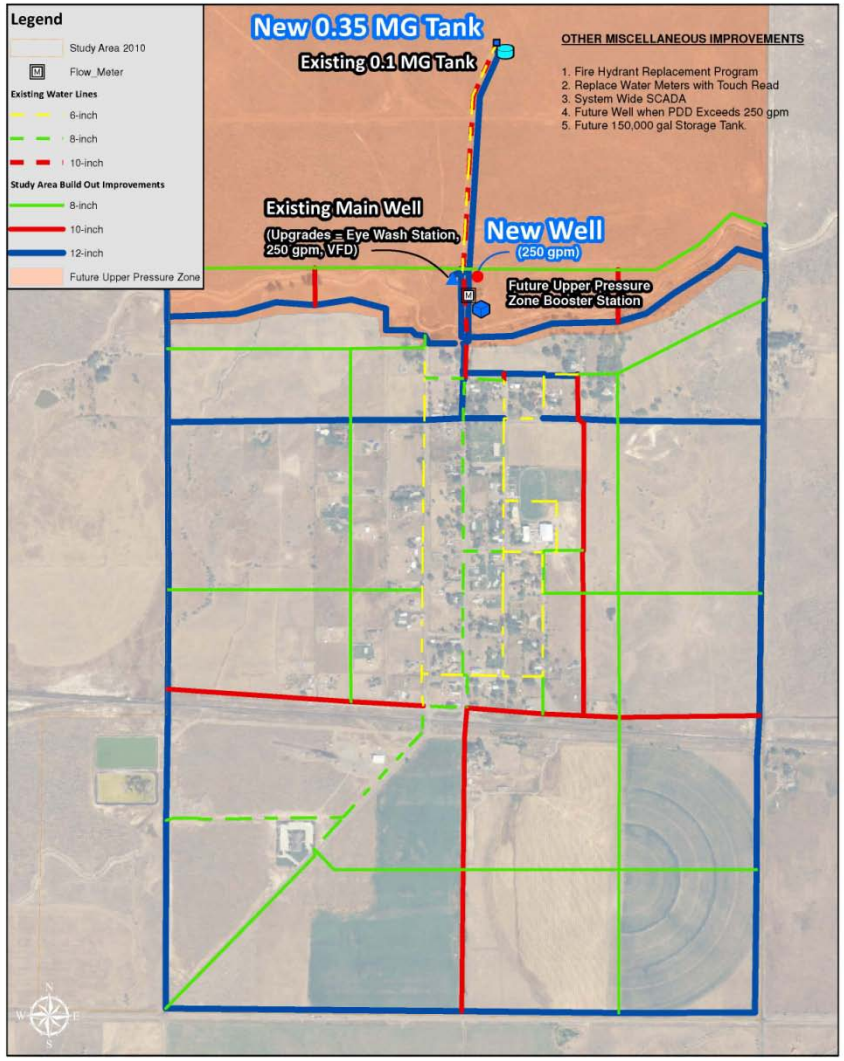
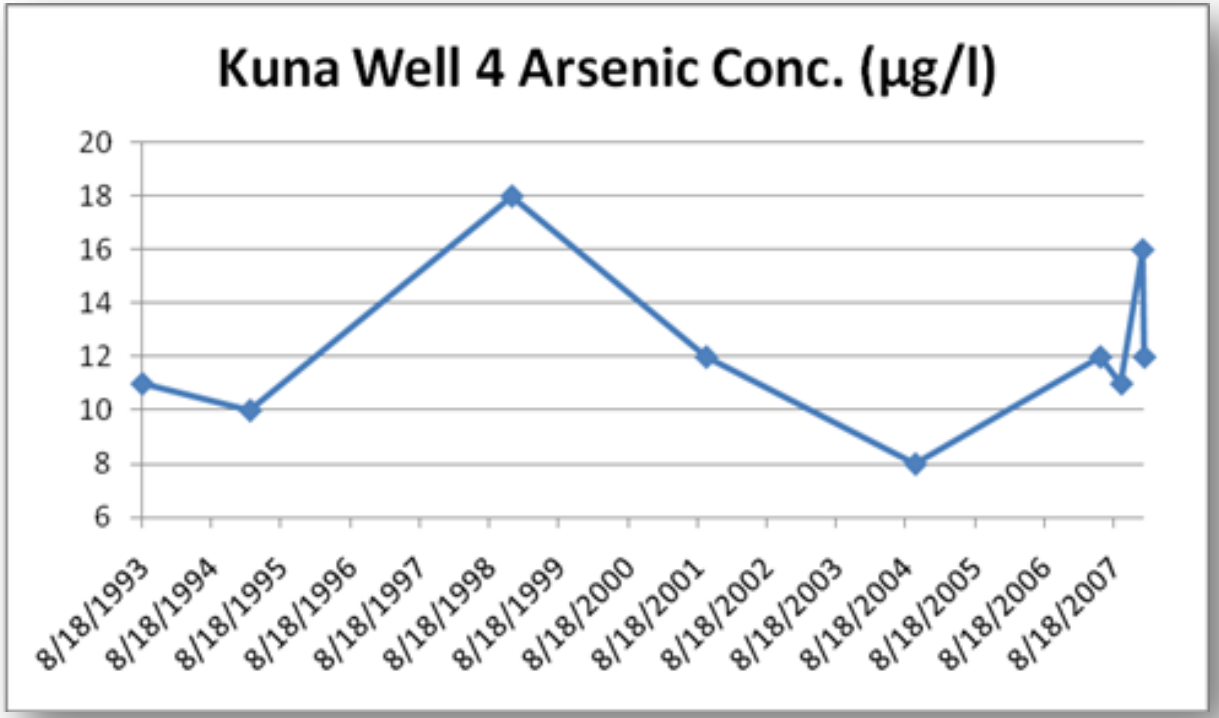


Figure 7.1 Dietrich, Idaho: Build-Out Master Plan

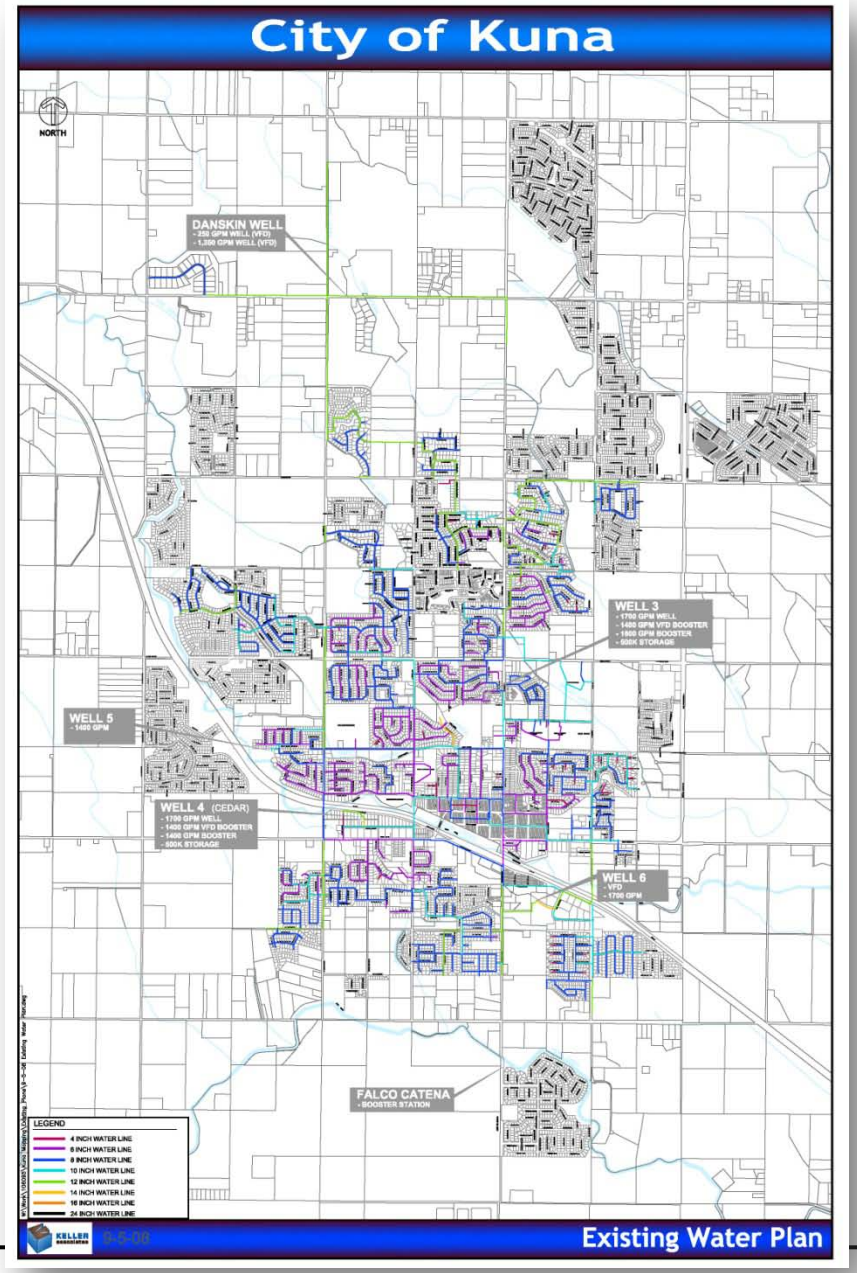
Blending Case Study: Kuna Well 4 & Well 9

- Background:
  - 500,000 gallon ground-level welded steel tank
  - 500' deep well with 1,700 gpm pump
  - (2) 1,400 gpm booster pumps
  - Average of four consecutive quarterly readings exceeded MCL in January 2007



Well Blending

- Hydraulic issues to consider:
  - Compliance is at first costumer
  - Controls required to prevent contaminated well from running without blending well
  - Mass balance calculations documenting compliance with MCL
  - Pipe modifications to force water circulation
  - Sufficient sampling ports for monitoring



Well Blending (continued)

- Hydrogeologic issues to consider:
  - Well interference
  - Water bearing zones
  - Water quality testing
  - Test well and monitoring
  - Well development procedures
  - Drilling depth

Blending Case Study: Kuna Well 4 & Well 9

- Solution – Hydrogeology
  - Drilled a test well on same site to characterize aquifer conditions
  - Identified clean aquifer lenses (shallower depths than existing screens)
  - Performed water quality tests and completed mass balance necessary to meet MCL
  - Developed production well that met targeted production
  - Test and production wells cost approximately $350,000

Case Study: Kuna Well 4 & Well 9 (continued)

- Solution – Pumping Facilities
  - Connected new Well 9 to discharge piping going to tank
  - New air release valve, check valve, motor-activated valve, flow meter, isolation valve, and liquid chlorine dosing pump
  - Added pump to waste piping
  - Control logic protection
  - Startup issues (clattering check valve, leaking air release valve)
  - Construction Cost = $42,000

Case Study: Emmett Water Quality Project

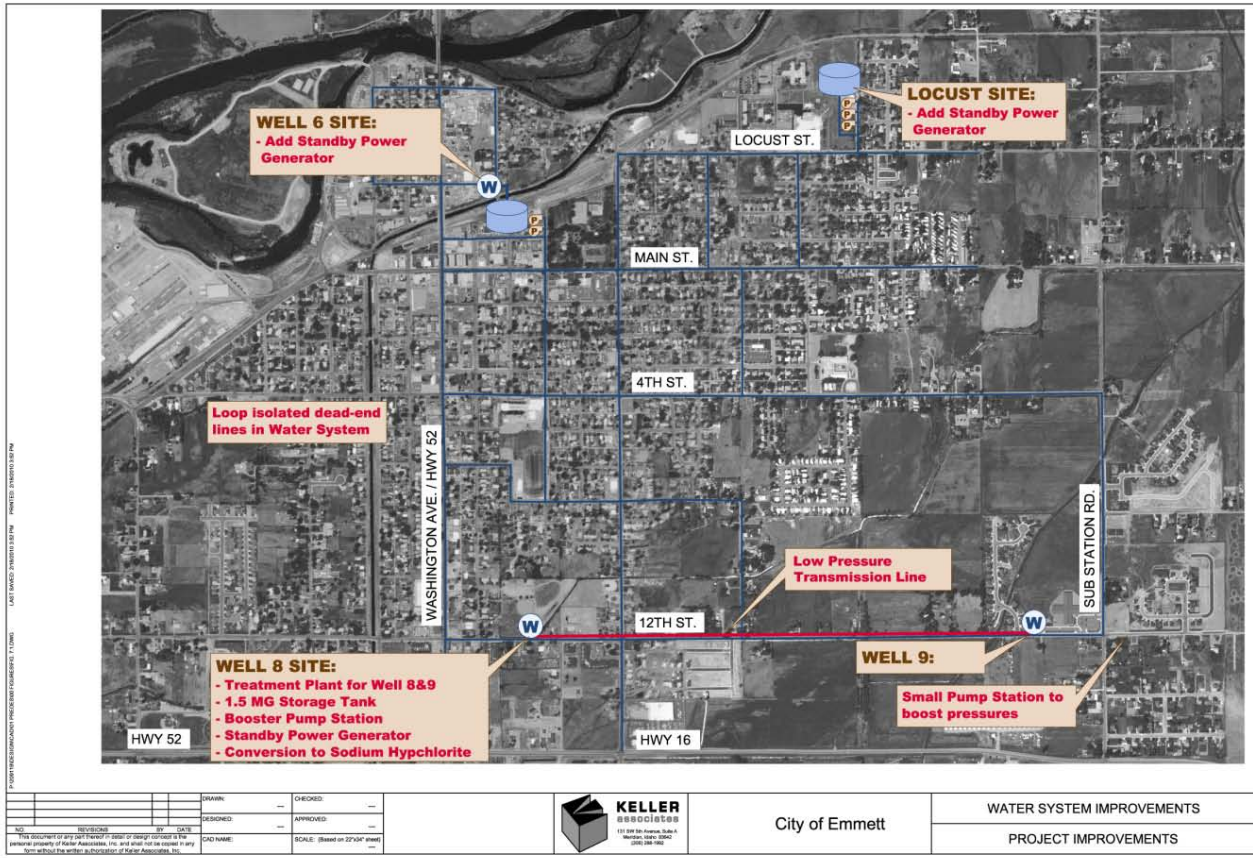
- In addition to Water Quality Concerns the Master Plan identified the following needs:

•Additional standby power at 3 locations

•A new well

•On-site hypochlorite generation system at existing booster station

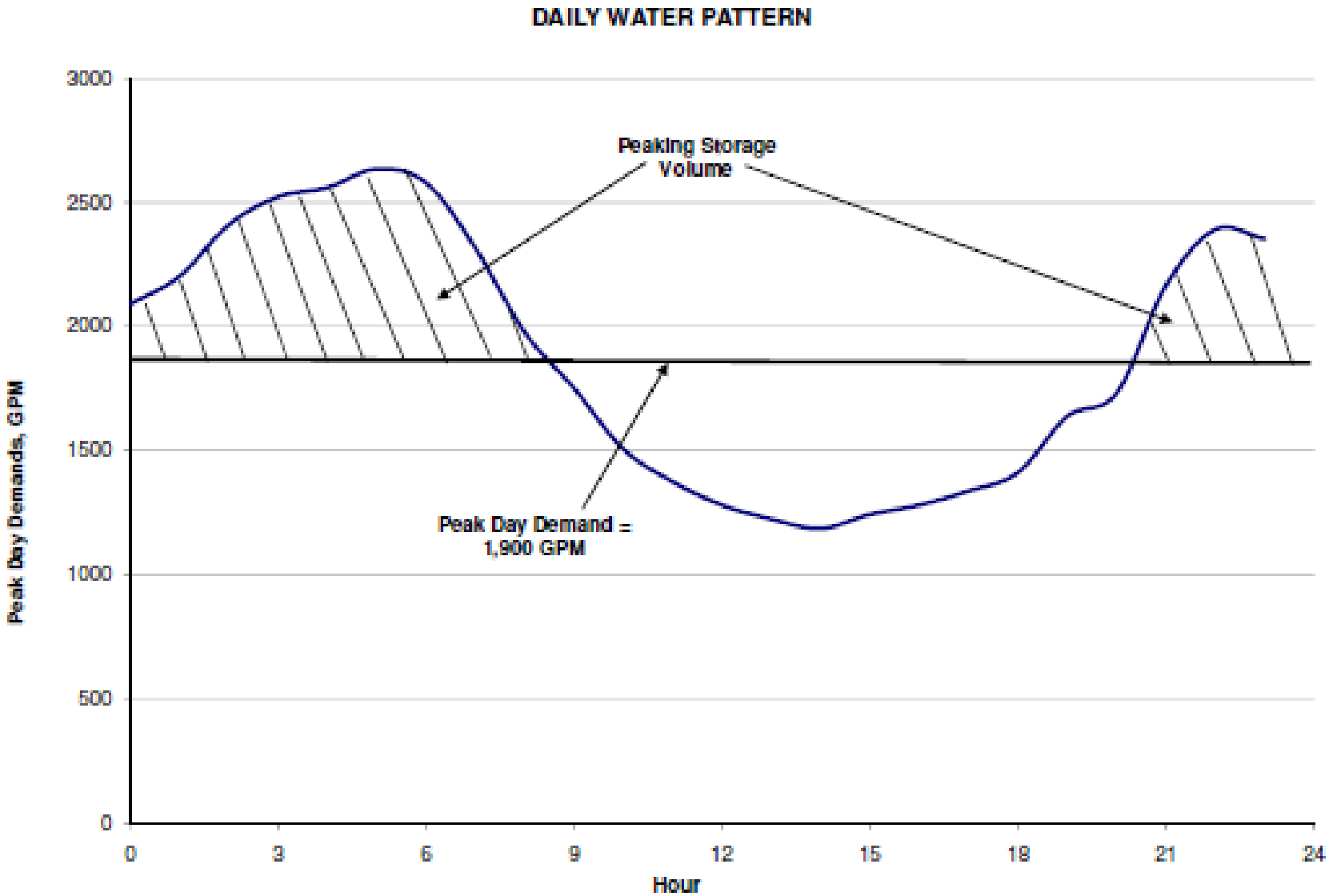
•Additional storage reservoir



Case Study: Emmett Water Quality Project (Cont.)

- Background
  - Elevated levels of manganese, iron, and hydrogen sulfide
  - Persistent taste, odor, and staining problems
  - Insufficient standby power

Items	Constituent		
	Manganese mg/L	Iron mg/L	Sulfide
Well 6 (2,200 gpm)	0.07	0.24	<0.05
Well 8 (1,250 gpm)	0.142	<0.05	2.52
Well 9 (2,000 gpm)	0.2	0.1	<0.05
Secondary Limit	0.05	0.3	N/A
Noticeable Effects	black to brown color, black staining, bitter metallic taste	rusty color, sediment, metallic taste, orange staining	rotten egg smell from hydrogen sulfide


DAILY WATER PATTERN
Peaking Storage Volume
Peak Day Demand = 1,900 GPM
Peak Day Demands, GPM
3000
2500
2000
1500
1000
500
0
0
3
6
9
12
15
18
21
24
Hour

Case Study: Emmett Water Quality Project (Cont.)

- The Recommendation in the Master Plan was to begin by treating Well 8 which was considered the worst quality
- As an alternative approach Keller Associates looked at designating Well 8 as a backup well and relying on Well 9 and Well 6 to supply the City's water demands
- Other cost saving measures included an option for the City to install piping, combining the booster station in the filter building

Case Study: Emmett Water Quality Project (Cont.)

- Five alternative solutions evaluated:
  - Treatment Option One: pH adjustment/aeration/adsorption/oxidation/filtration for treating Well 8 and Well 9 continuously
  - Treatment Option Two: pH adjustment/adsorption/oxidation/filtration without aeration for treating Well 9 continuously and Well 8 only in emergency situations
  - Treatment Option Three: Ion exchange for treating Well 9
  - Treatment Option Four: Abandon Well 8 and treat Well 9 and new well with adsorption/oxidation/filtration
  - Treatment Option Five: Sequestration only

Items	Option			
	Option 1 (Aeration for Well 8 Only, Oxidation/ Adsorption/ Filtration for Well 8 and 9)	Option 2 (Oxidation/ Adsorption/ Filtration of Well 9, Well 8 as Backup)	Option 4a (Oxidation/ Adsorption/ Filtration for Well 9 and New Well)	Option 4b (Oxidation/ Adsorption/ Filtration of Well 9, No Treatment for New Well)
Total Construction Cost (2010 dollars)	$ 5,133,000	$ 4,185,000	$ 6,308,000	$ 4,576,000
Annualized Cost (4% for 20 years)	378,000	308,000	464,000	337,000
Annual O & M Cost	168,000	125,000	132,000	107,000
Total Annualized Cost	**$ 546,000**	**$ 433,000**	**$ 596,000**	**$ 444,000**

Case Study: Emmett Water Quality Project
(Cont.)

KELLER associates

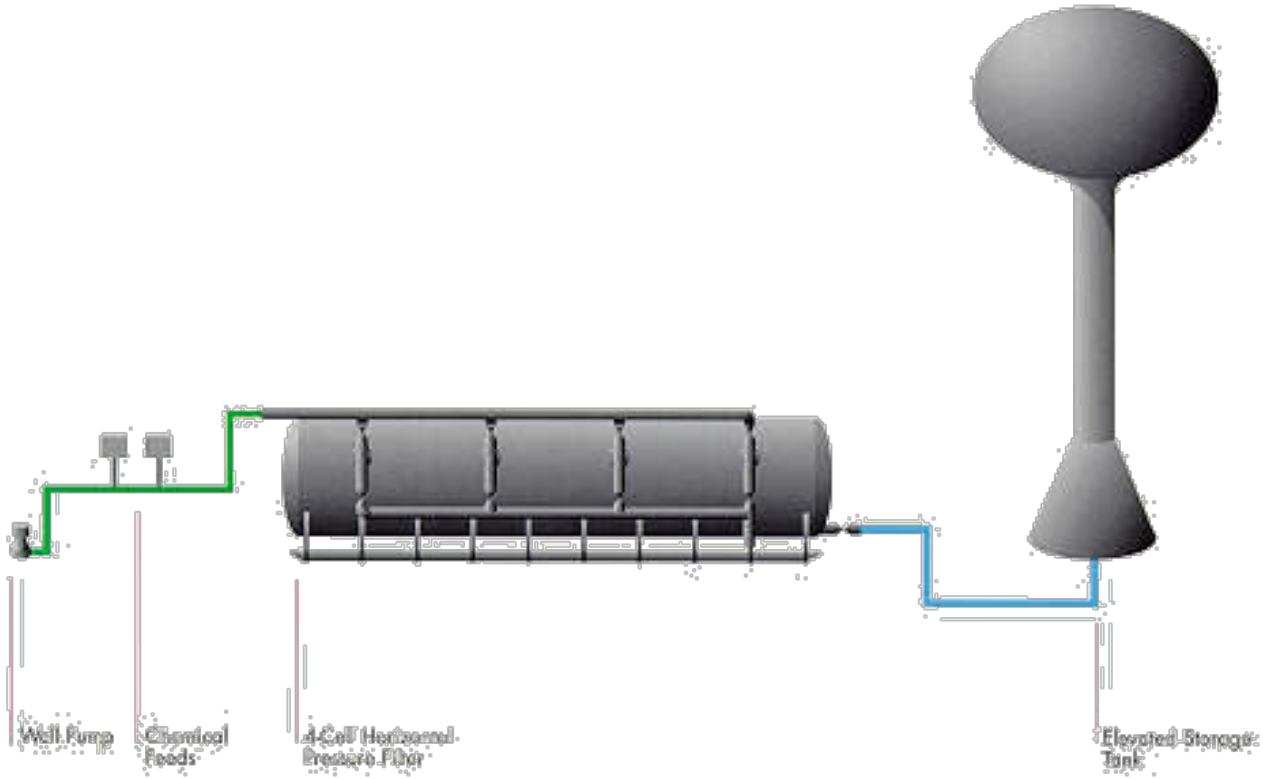
Water System Improvement Costs		
Item	**Proposed**	**Keller Associates' Alternative**
Waterline Materials[1]	$363,000	$240,000
Green Sand Filtration[2]	$1,694,000	$1,350,000
Booster Pump Station[3]	$200,000	$150,000
Emergency Generator	?	$65,000
Aeration Tower	$350,000	NOT RECOMMENDED
Gas Scrubber	$100,000	NOT RECOMMENDED
Chemical Adjustment	$100,000	NOT RECOMMENDED
2 MG Storage Reservoir[4]	$1,600,000	$900,000
Total Construction Cost	$4,407,000	**$2,705,000**
Administration/Legal/Engineering /Construction Inspection @15%	$791,000	$405,000
Total Project Cost	$5,198,000	**$3,110,000**

[1]-Installation furnished by City Staff (includes 6,000 LF of 16" pipe).
[2]-Includes 1,500 feet^2 building and 3,000 gpm of filtration
[3]- Building included in filter building
[4]- Bolted steel reservoir w/piping and valves

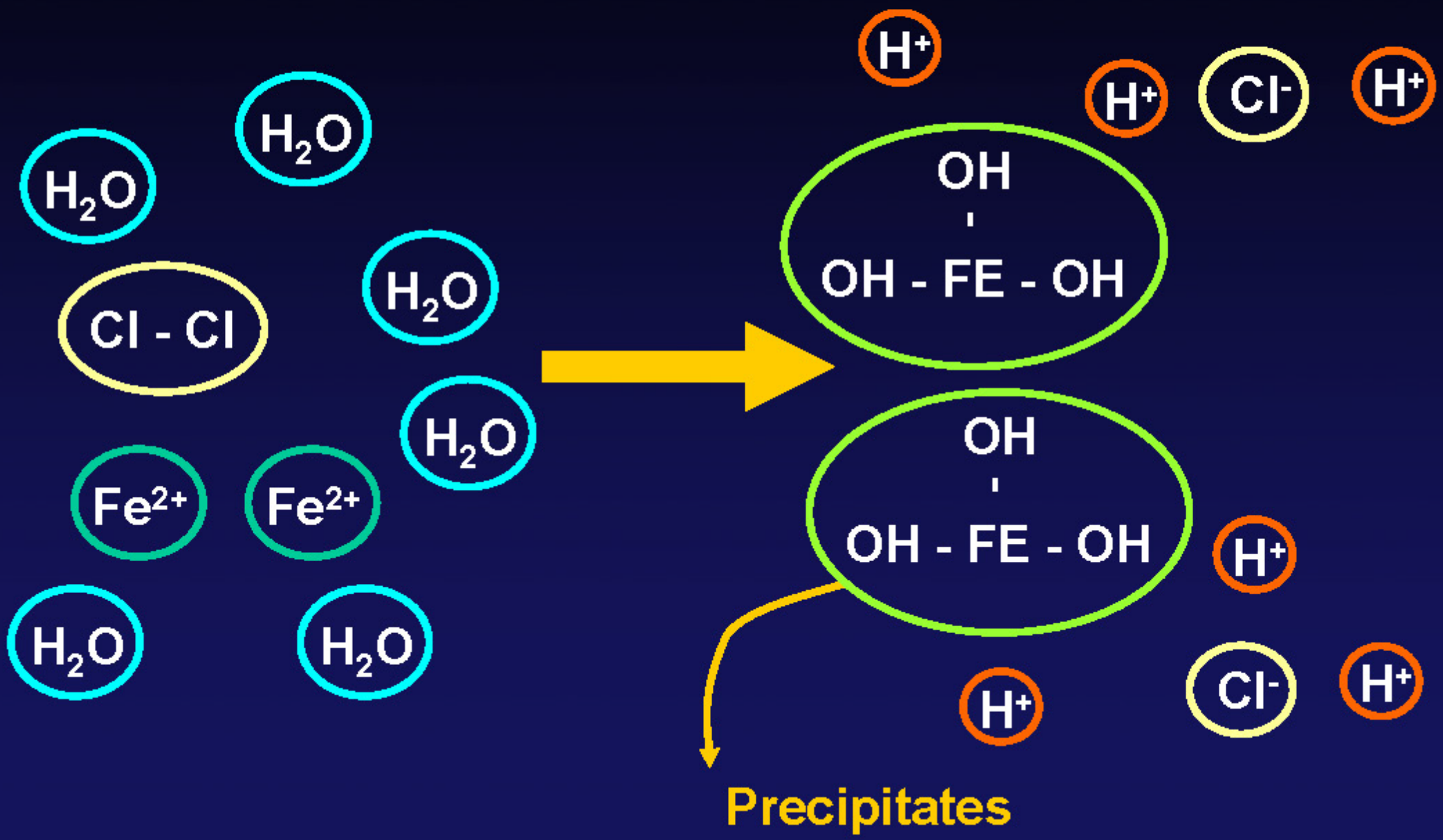
Phase 1 - Proposed
Phase 2 - Proposed
Phase 3 - Proposed

Treatment Technology: Oxidation, Filtration

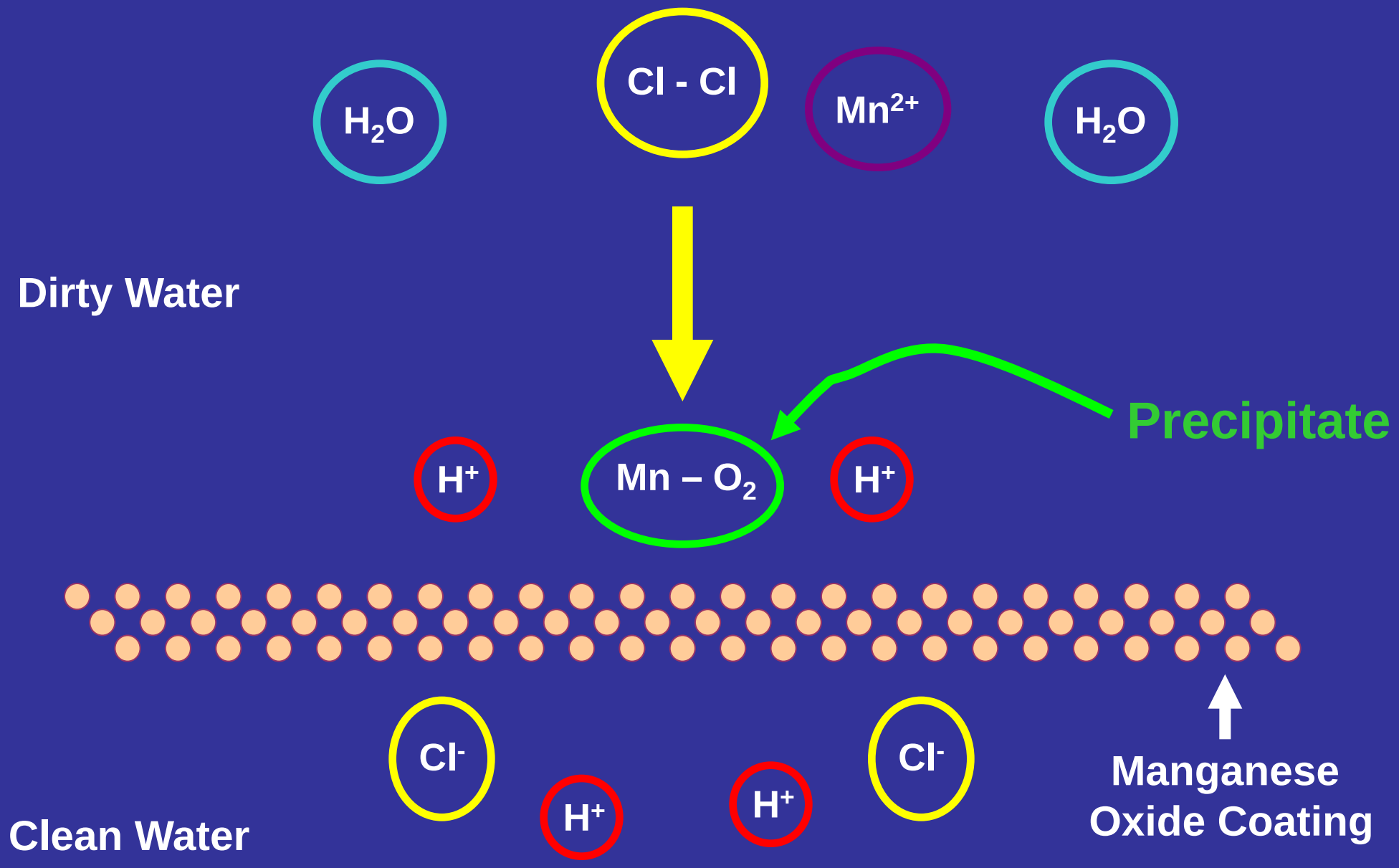
- Effective for iron and manganese removal
- Good for lower concentrations of H_2S
- Oxidants include chlorine, chlorinate dioxide, potassium permangate, and ozone
- Manganese has slower reaction rate adsorbs on media and oxidizes
- Filter media include manganese green sand, anthra / sand, electromedia, and ceramic


Well Pump
Chemical Feeds
4-Cell Horizontal Pressure Filter
Elevated Storage Tank

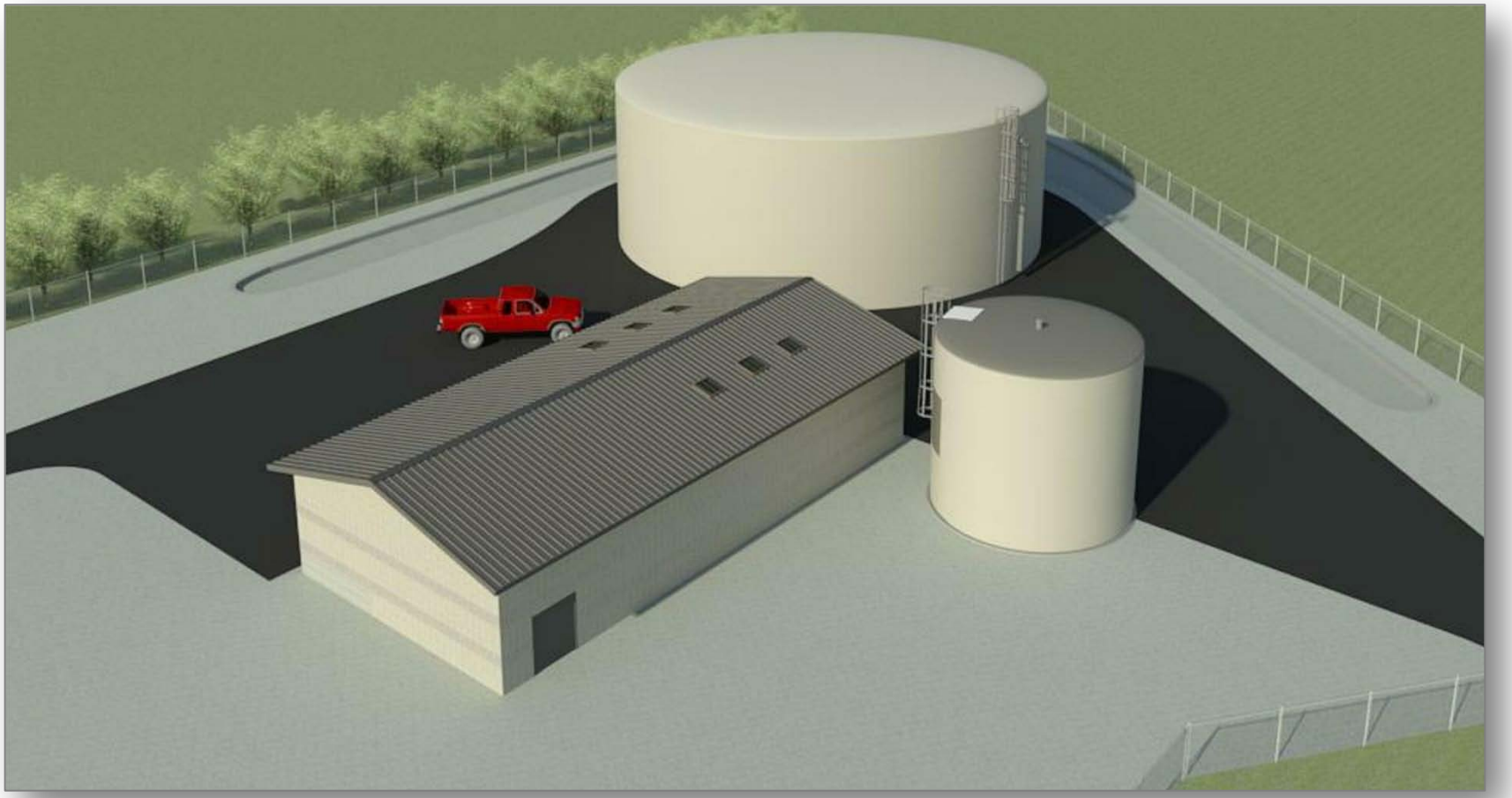
Iron Precipitation by Cl_2



Manganese Precipitation by Cl_2



Case Study: Emmett Site Plan (Cont.)



Case Study: Emmett Facility (Cont.)

	Bid Results	Planning Estimate
Base Bid	$2,559,700.00	$2,465,000
Pipeline from Well 9	$216,605.00	$240,000
Additional Storage	$90,800.00	Not Broken Out
Generator at Well 6	$102,600.00	Not Included
Generator at Well 9	$87,400.00	Not Included
Connecting Valves and Piping at Treatment Plant Site	$5,600.00	Not Included
TOTAL	$3,062,705.00	$2,705,000

Summary

- Take advantage of existing infrastructure
- Consider blending options prior to full treatment
- If treatment is needed:
  - Target the treatment source by looking at the overall system needs
  - Select the Right Technology
  - Pilot Testing (every system is water quality dependant)
  - Centralized Facility vs. Individual

Any questions?