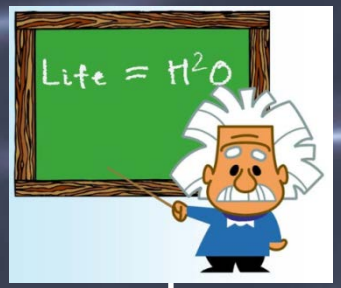

2015 AWWA INTERMOUNTAIN SECTION ANNUAL CONFERENCE

COMPLIANCE STRATEGIES FOR HIGH LEVELS OF ARSENIC, NITRATES AND OTHER CONSTITUENTS IN GROUNDWATER

Benjamin D. Miner, MPA, PE

September 17, 2015

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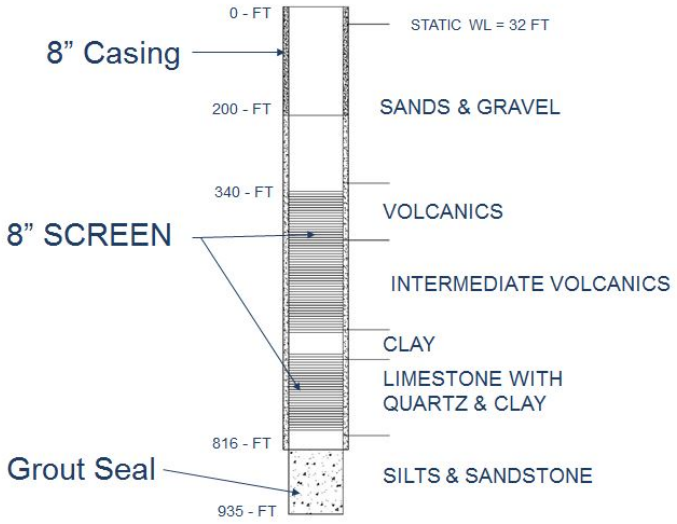
INTRODUCTION

- ***Wells and Springs are popular sources of high quality water.***
  - ***Municipal Supplies***
  - ***Agriculture***
  - ***Industry***
  - ***Residences***

- ***Lately we have seen an increase in water quality problems with our Clients groundwater sources.***

- ***Today, let's explore the causes and possible remedies.***



PRESENTATION OUTLINE

- Introduction
- Water Quality Goals
- Data Collection
- Causes of Poor Water Quality
- Regulation
- Technical and Regulatory Solutions
- Case Studies
- Recommendations
- Questions

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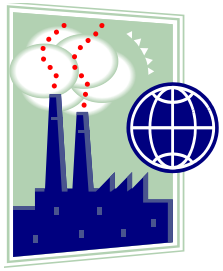
GOALS

- ***Regulatory Compliance***
- ***Public Acceptance***
- ***Low Cost Solutions***
- ***Minimize Maintenance***

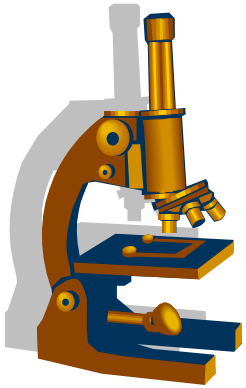
WATER QUALITY – CAUSES OF CONCERN

- ***Changes in Regulation***
- ***Natural Changes Over Time***
  - ***Drought***
  - ***Decay/Dissolution***
  - ***Aquifer Changes***
- ***Operational Change***
  - ***Pumping Rates***
  - ***Pumping Levels***
- ***Discharges***
  - ***Industrial Facilities***
  - ***Agricultural***

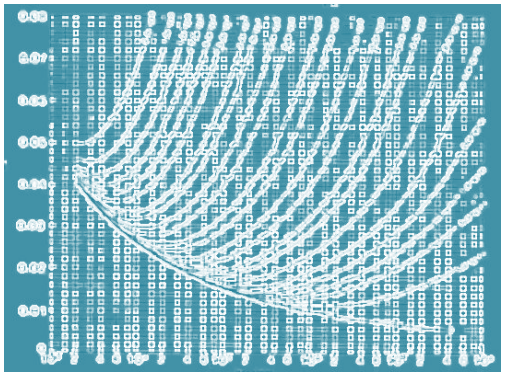


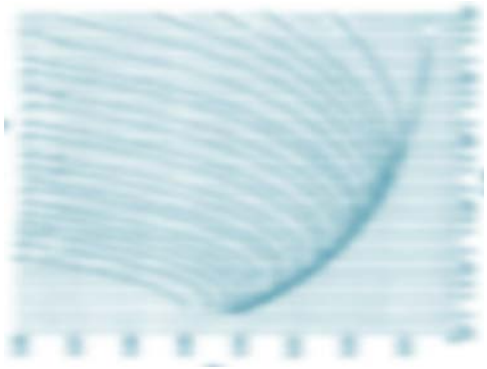
DATA COLLECTION

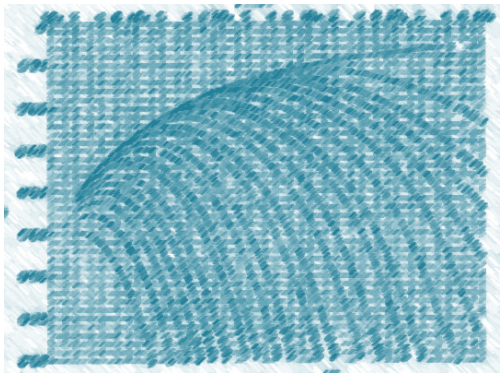
- ***Where?***
- ***What?***
- ***When?***



"How good is your data?"







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REGULATION

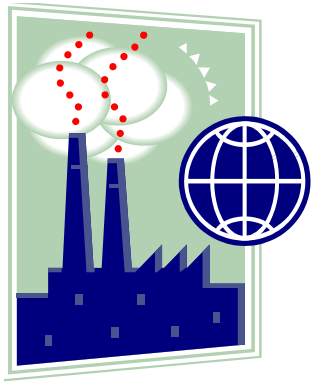
- **CONSTITUENTS:**
  - **Antimony, Arsenic, Asbestos, Barium, Beryllium, Cadmium, Chromium, Cyanide, Fluoride, Mercury, Nickel, Selenium, Sulfate, Thallium**

- **CONCERN**
  - **Long Term Exposure / Chronic Effects**

- ***STANDARD***
  - ***Running Annual Average Below MCL***

REGULATION

- **CONSTITUENTS:**
  - **Nitrate and Nitrite**
- **CONCERN**
  - **Immediate Exposure / Acute Effects**
- ***STANDARD***
  - ***Every Sample Below MCL***



TECHNICAL AND REGULATORY SOLUTIONS

- ***Sampling Location*** $
- ***Sample Averaging*** $
- ***Source Zonal Isolation*** $$
- ***Blending*** $$$
- ***Treatment*** $$$$$
- ***Abandonment*** $$$$$

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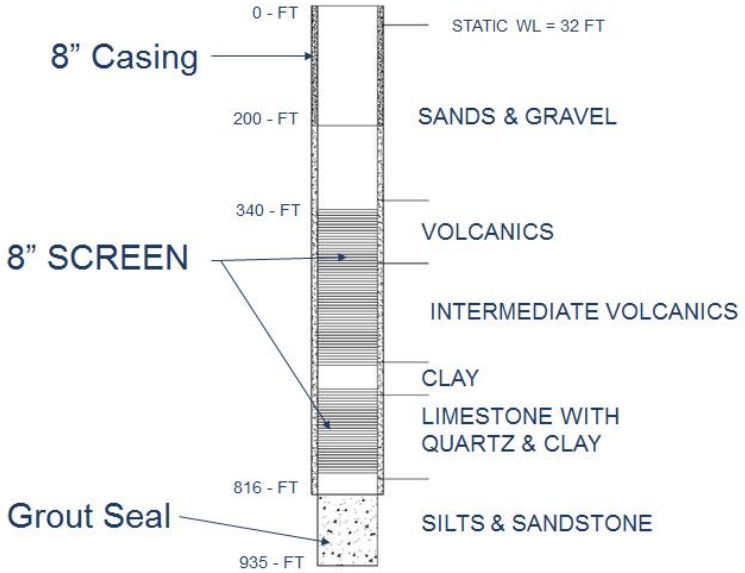
CASE STUDIES

- ***EXAMPLE WATER SYSTEM NO. 1***

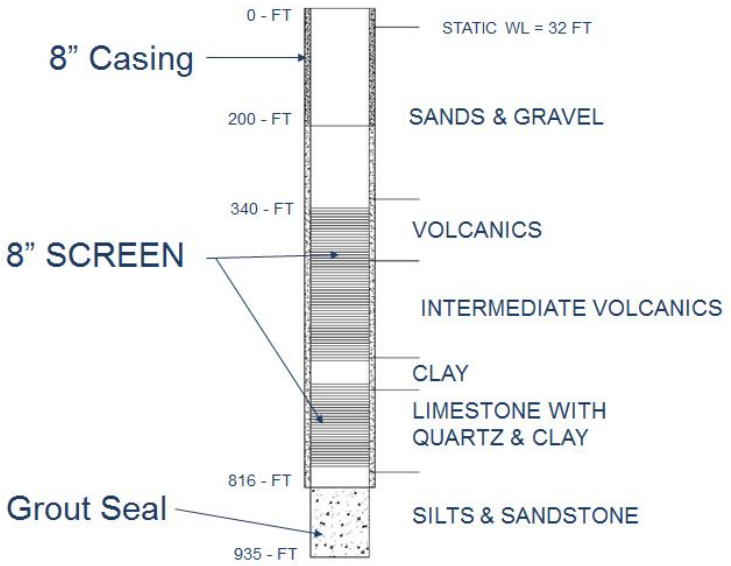
WELL A

Arsenic = 4 ppb (MCL = 10 ppb)
Meets Demand, Except a Few Weeks in Summer



WELL B

Arsenic = 15 to 22 ppb
Violation



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CASE STUDIES

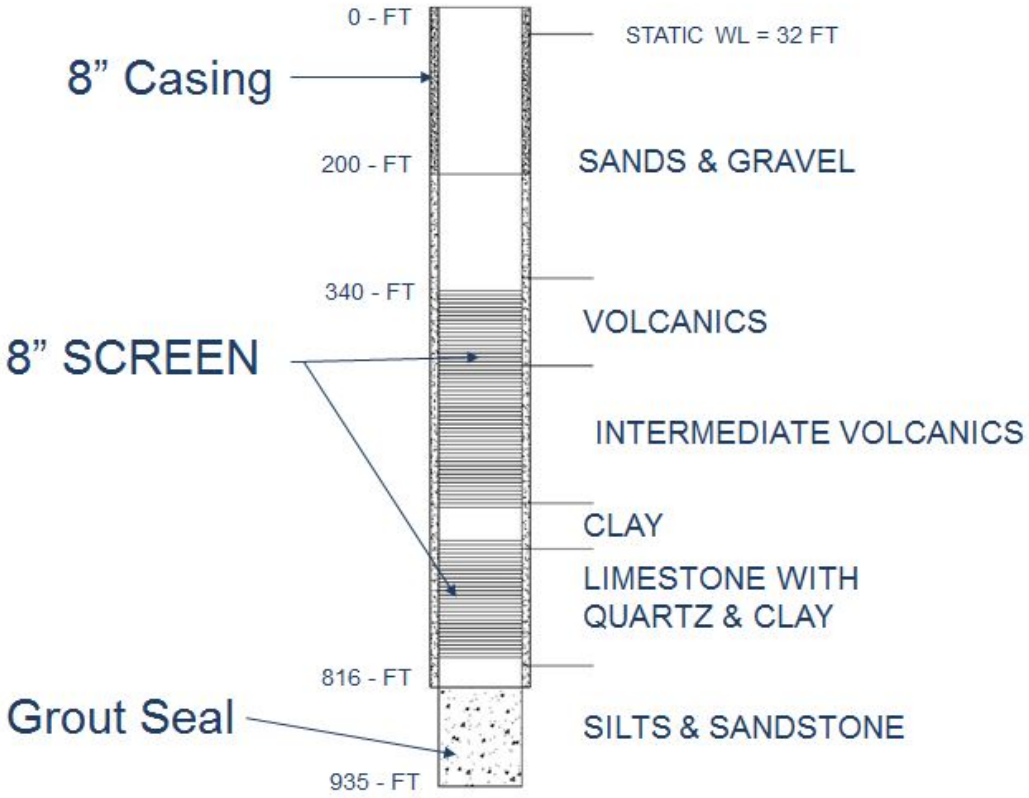
- ***EXAMPLE WATER SYSTEM NO. 1***

WELL A	WELL B
Arsenic = 4 ppb **Meets Demand, Except a Few Weeks in Summer**	**Arsenic = 15 to 22 ppb** **Violation?**

- ***Solutions Considered:***
  - ***Treatment Plant – Too Expensive***
  - ***Well Modification – Expensive & Risky at This Location***
  - ***Connection with Nearby Water System – Too Expensive***
  - ***Abandonment – Too Expensive / Lost Investment***
  - ***Blending/Change in Sampling Plan – Winner!***

CASE STUDIES

- ***EXAMPLE WATER SYSTEM NO. 1***



WELL B

Arsenic = 15 to 22 ppb

Violation?

ZONAL MODIFICATION?

CASE STUDIES

- ***EXAMPLE WATER SYSTEM NO. 1***

WELL A	WELL B
Arsenic = 4 ppb	**Arsenic = 15 to 22 ppb**
Meets Demand, Except a Few Weeks in Summer	**Violation**

- ***Solution:***
  - ***Change Sample Point from Well Head to Distribution System***
  - ***Blending and More Representative Sampling***
  - ***Limit Well B Supply to Summer Peak Weeks***
  - ***Increased Sampling Schedule to Monthly***
  - ***Increased Number of Sampling Locations***
  - ***Increased Tracking***

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CASE STUDIES

- ***EXAMPLE WATER SYSTEM NO. 1***
- ***Solution***

CASE STUDIES

- ***EXAMPLE WATER SYSTEM NO. 1***
- ***Results***

TABLE 1
SS278 ARSENIC SAMPLING RESULTS AND SUMMARY

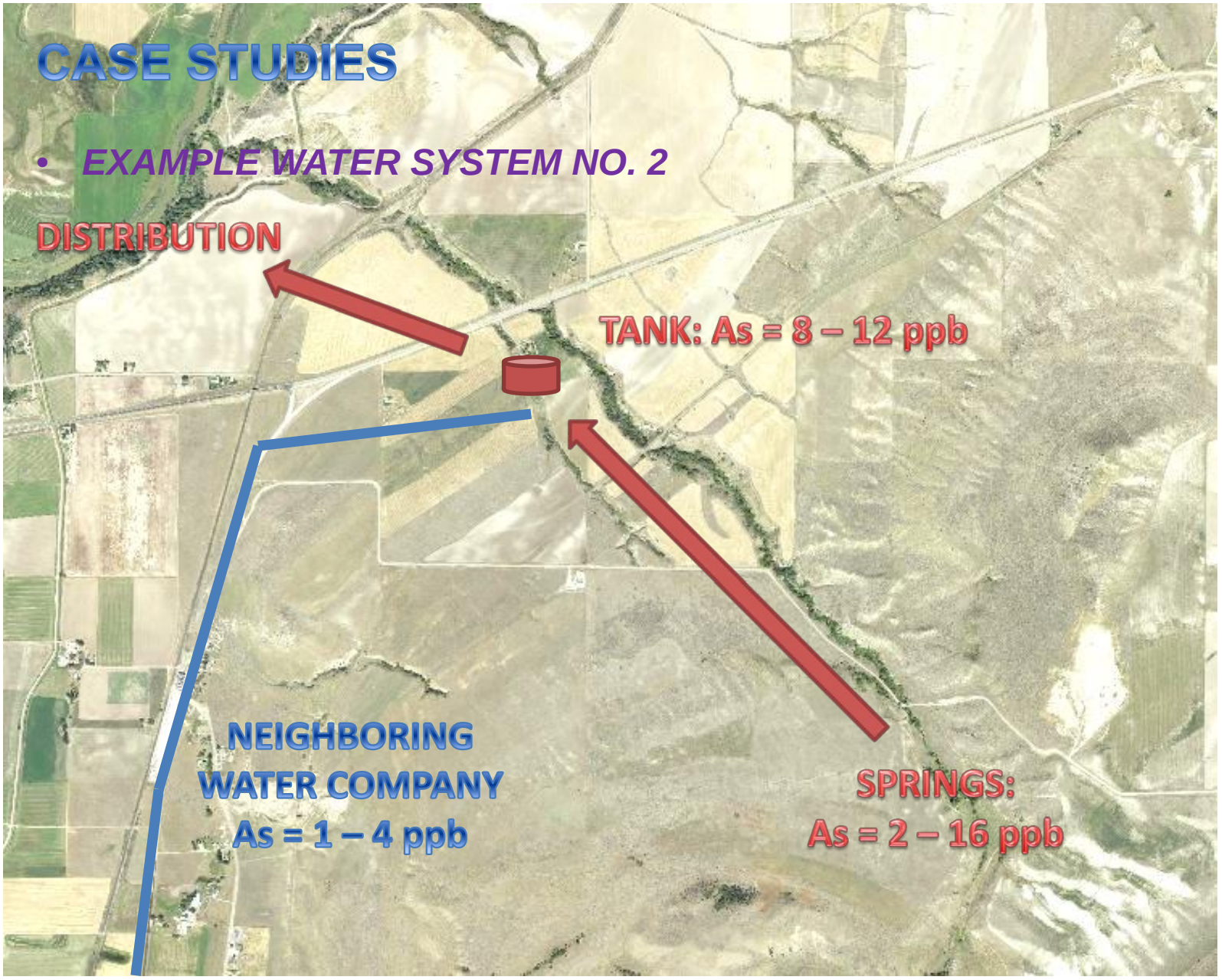
Quarter	Month	Arsenic Level (ppb)	Quarterly Average (ppb)
1st Quarter 2015	January	4.0	4.3
	February	4.3	
	March	4.6	
2nd Quarter 2015	April	4.2	4.1
	May	4.2	
	June	3.9	
3rd Quarter 2014	July	8.8	7.3
	August	8.1	
	September	5.1	
4th Quarter 2014	October	4.5	5.2
	November	6.1	
	December	5.1	
		Annual Average	**5.2**

CASE STUDIES

- ***EXAMPLE WATER SYSTEM NO. 1***
- ***Results***
  - ***Adequate Water Supply***
  - ***Arsenic < 6 ppb (Average Annual)***
  - ***Considerable Cost Savings***

CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 2*
  - *Sources*
    - *7 Springs: Arsenic 2 ppb – 16 ppb (MCL = 10 ppb)*
      - *Annual and Seasonal Variations*
    - *Springs Feed Common Tank: Arsenic = 8 to 12 ppb*
    - *Tank Supply to Distribution*
    - *Exceeds MCL - Violation!*


CASE STUDIES
• EXAMPLE WATER SYSTEM NO. 2
DISTRIBUTION
TANK: As = 8 – 12 ppb
NEIGHBORING
WATER COMPANY
As = 1 – 4 ppb
SPRINGS:
As = 2 – 16 ppb

CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 2*
  - ***Solutions Considered:***
    - ***Treatment – Too Expensive***
    - ***Abandon Springs – Water Too Valuable/WQ Variable***
    - ***Change Sampling Plan – Arsenic Consistently High***
    - ***Connect with Neighboring Water System and Blend – Winner!***

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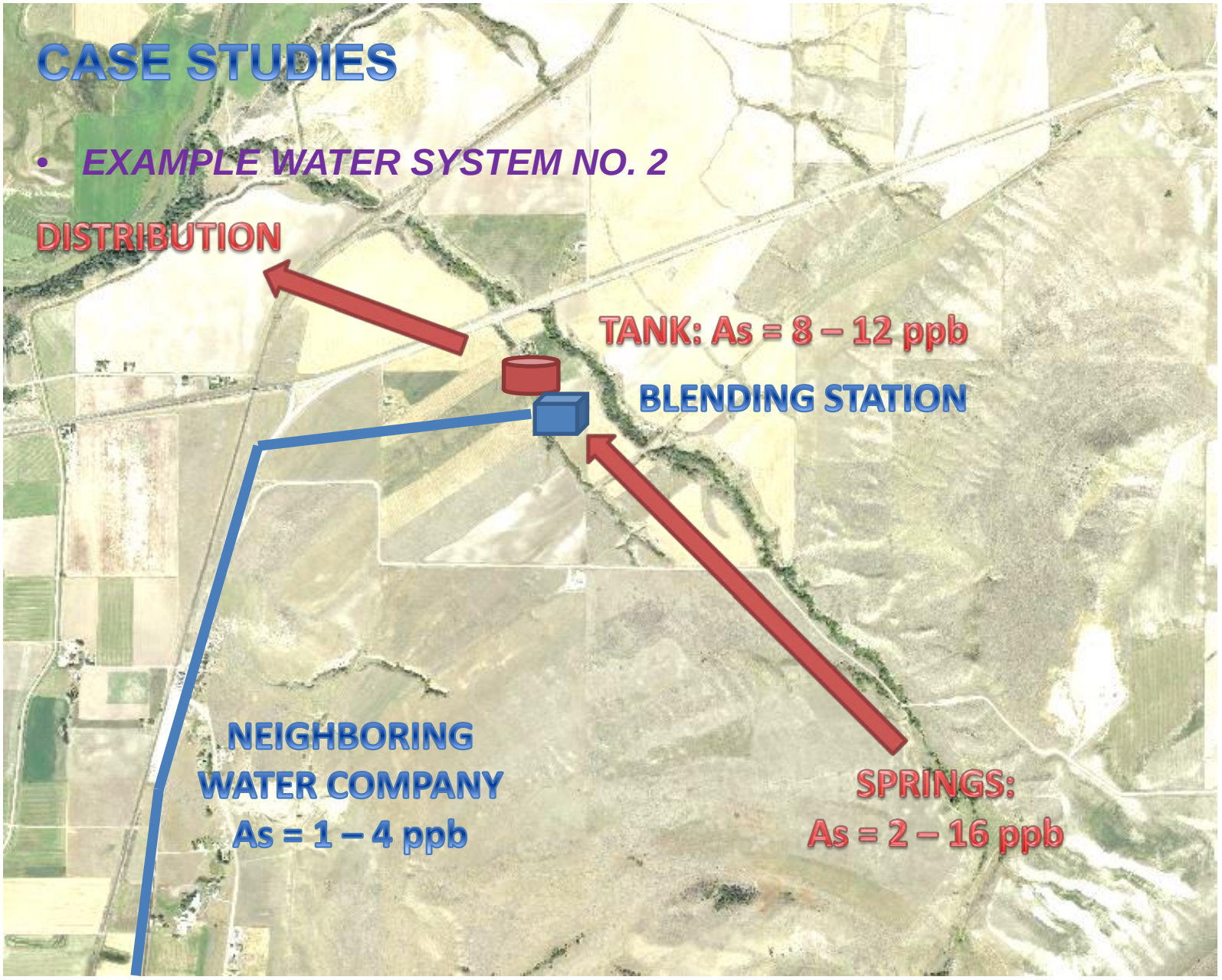
CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 2*



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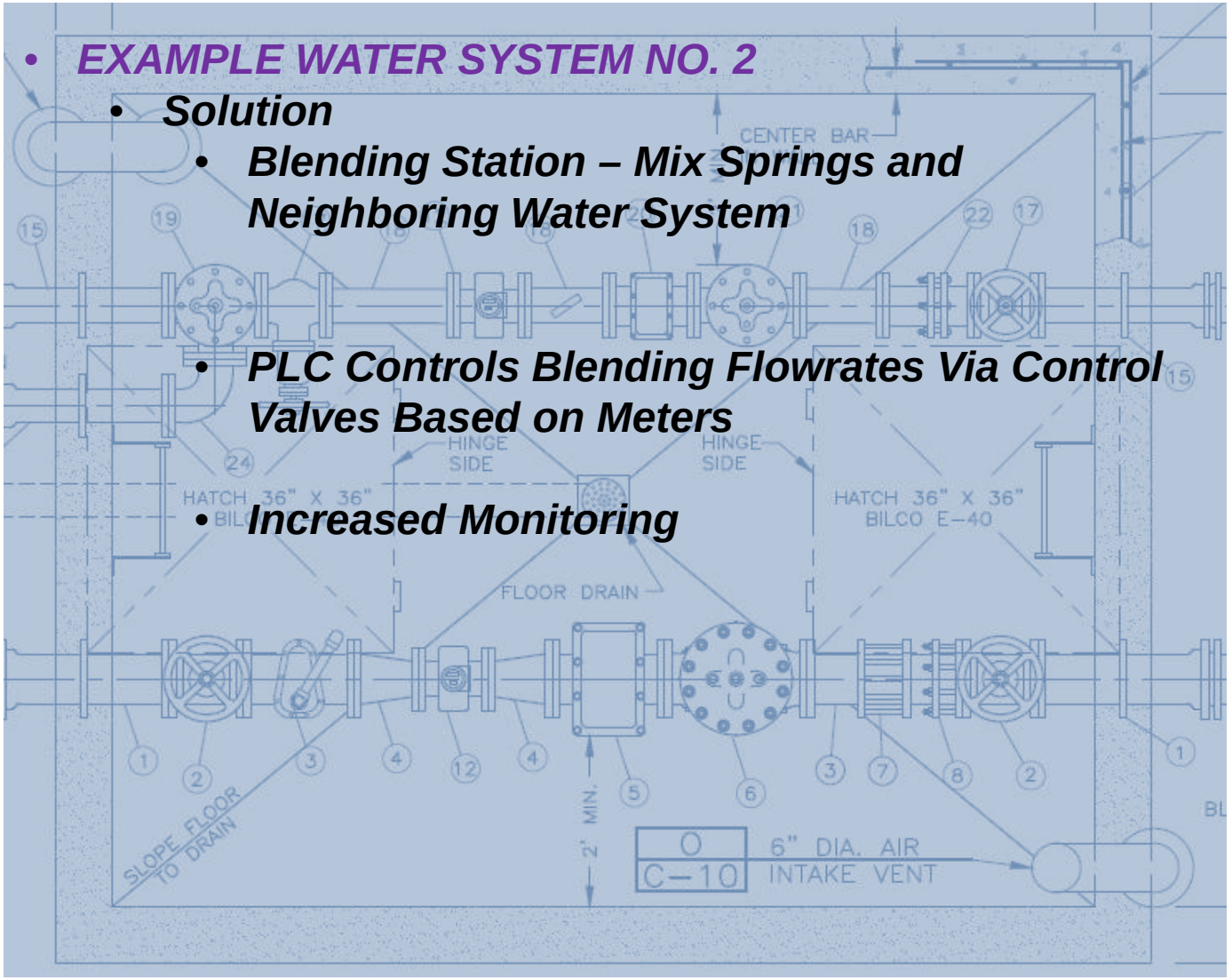
CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 2*
  - *Solution*
    - *Blending Station – Mix Springs and Neighboring Water System*
    - *PLC Controls Blending Flowrates Via Control Valves Based on Meters*
    - *Increased Monitoring*

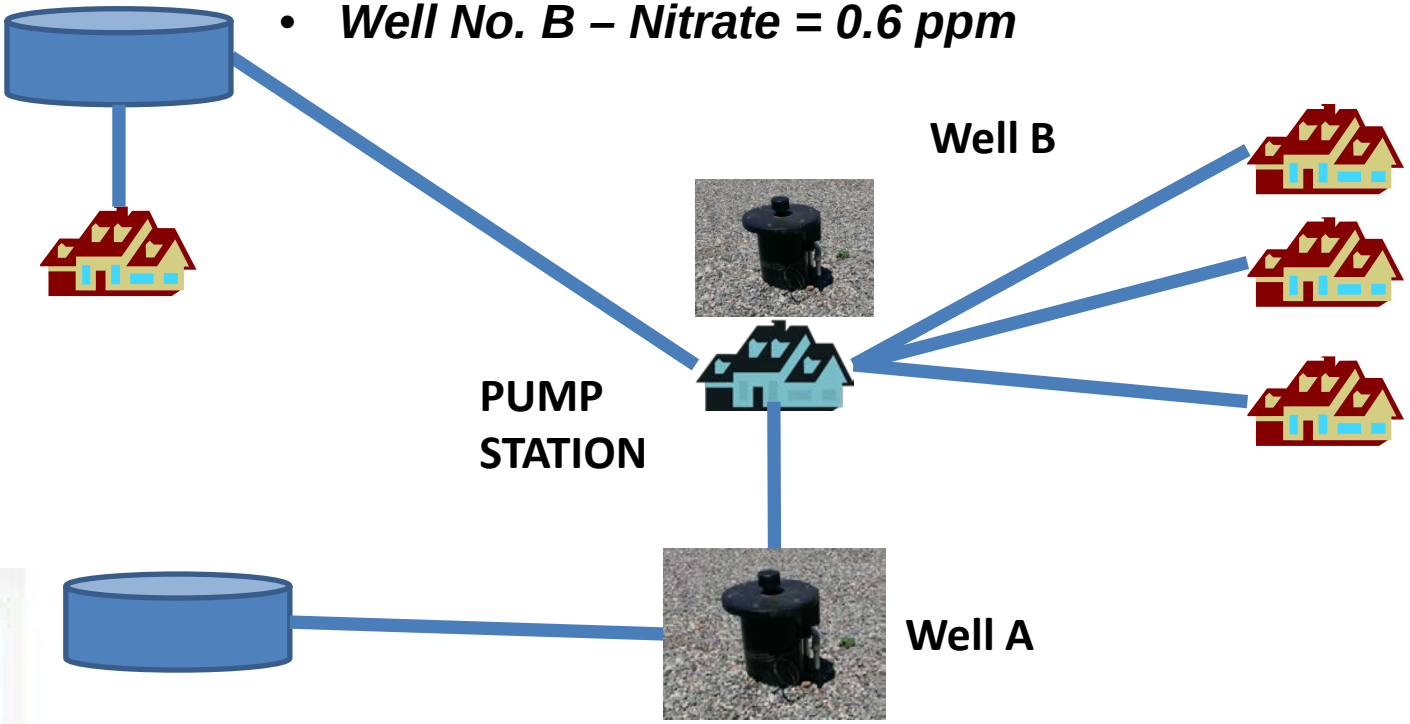


CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 2*
  - ***Results***
    - ***Arsenic < 5 ppb***
    - ***Additional Water and Backup Water Supply***

CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 3*
  - *Sources*
    - *Well No. A – Nitrate = 10.1 ppm*
      - *Exceeds MCL (10 ppm)*
      - *Violation / Acute Health Concern*
    - *Well No. B – Nitrate = 0.6 ppm*



CASE STUDIES

- ***EXAMPLE WATER SYSTEM NO. 3***
  - ***Solutions Considered:***
    - ***Treatment – Too Expensive***
    - ***Sampling Location Changes – Not Enough, Nitrate Levels are Consistently High***
    - ***Sample Averaging – Not Applicable / Acute Risk***
    - ***Abandon – Too Expensive / Loss of Investment***
    - ***Blending – Possible***

CASE STUDIES

- ***EXAMPLE WATER SYSTEM NO. 3***
  - ***Solution:***
    - ***Modify Existing Booster Pump Station for Blending***
    - ***Construct an Isolated Pipeline from Each Well to Pump Station***
    - ***PLC, SCADA, VFD and Flowmeters used to assure blending ratio.***
    - ***Update Sampling Plan for Blended Water***
    - ***Multiple Sampling Points***
    - ***Increased Sampling Frequency***

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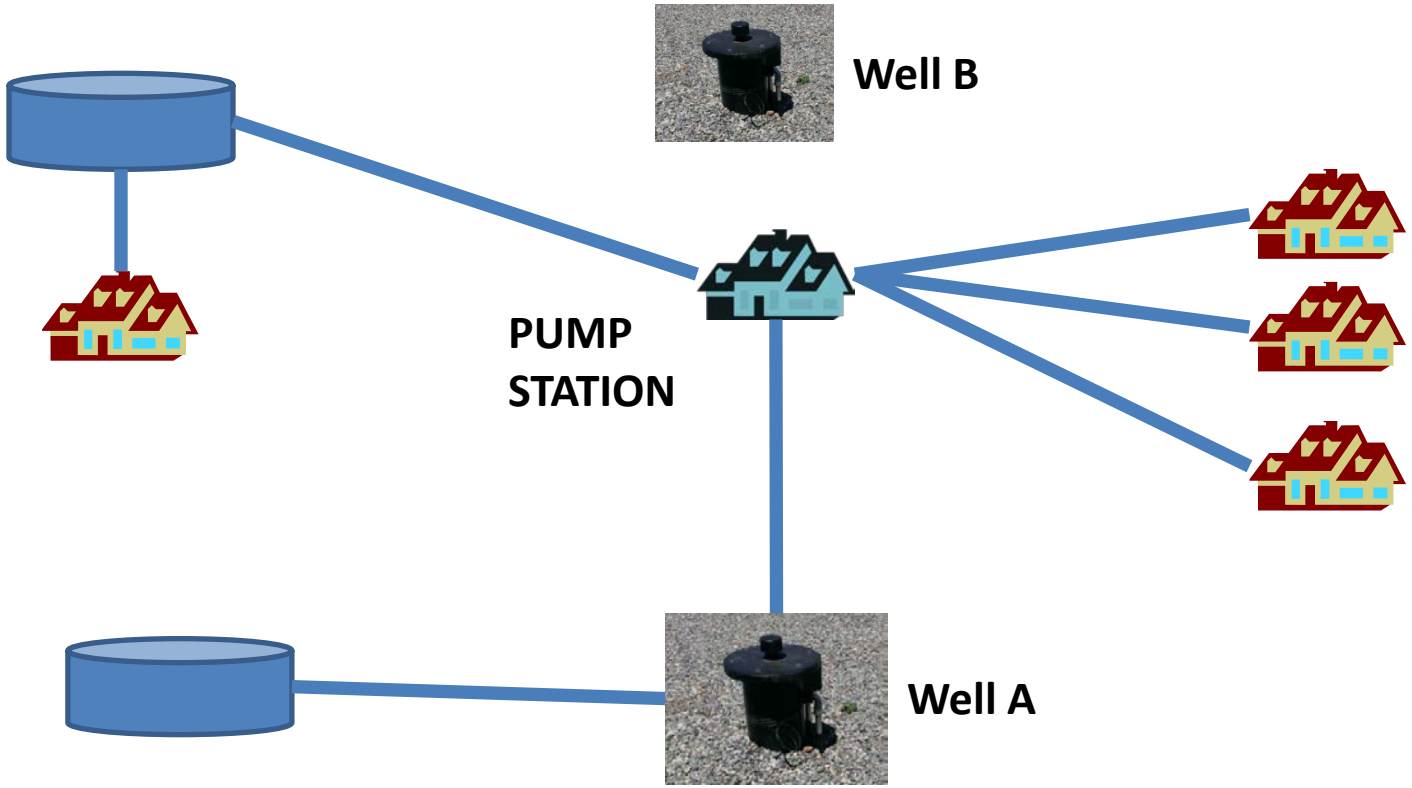
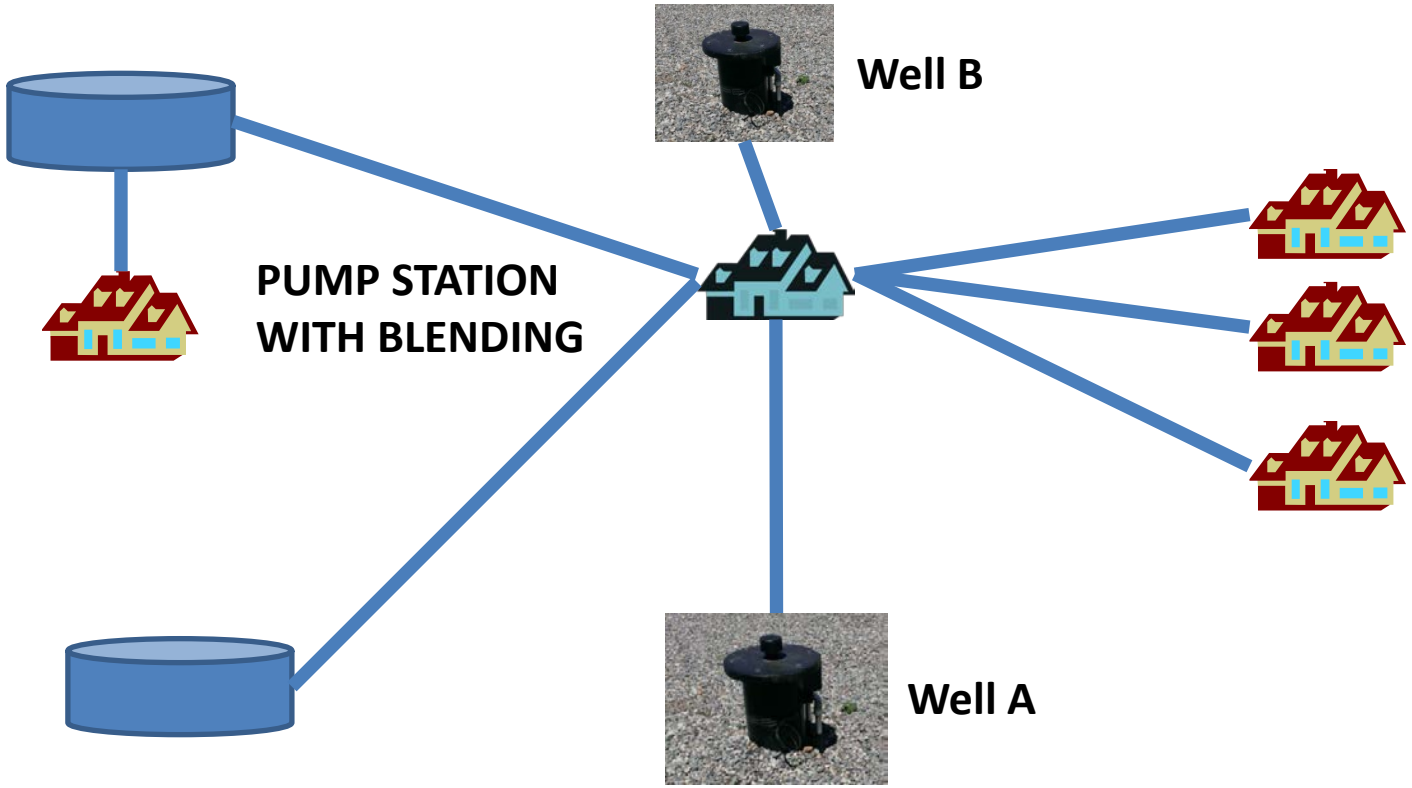
CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 3*
  - ***Before***



CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 3*
  - *After*



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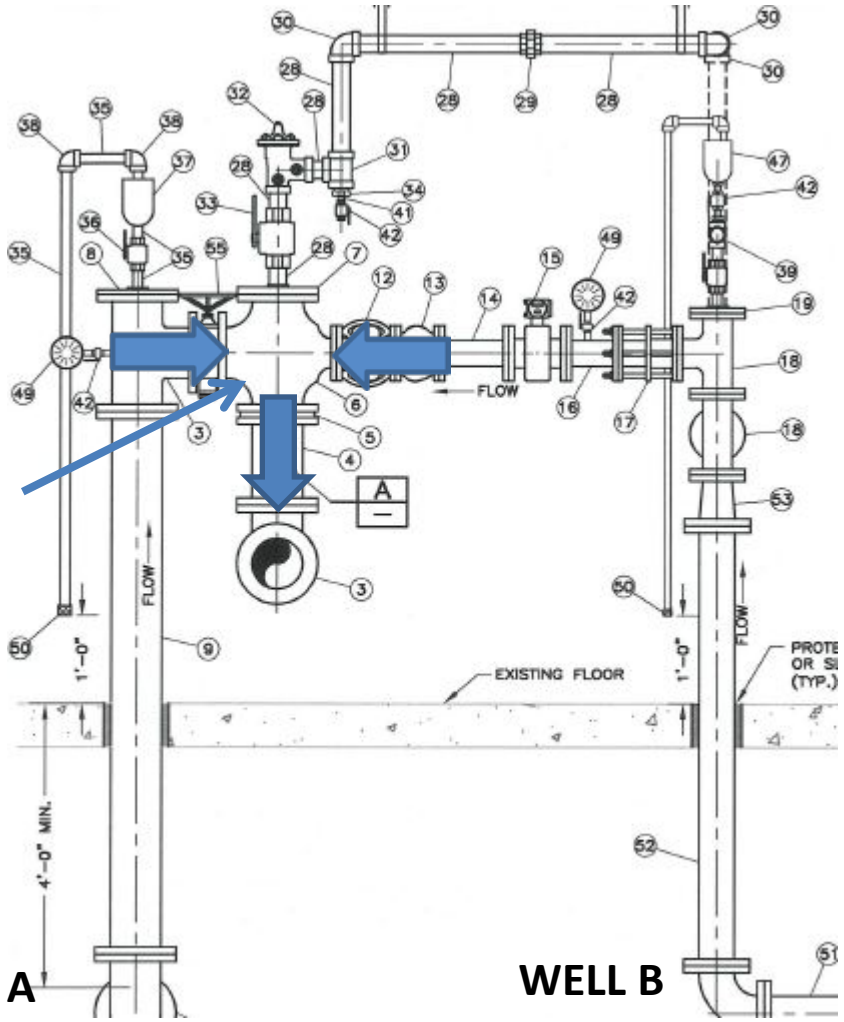
CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 3*
  - *After*



CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 3*
  - *Results*

Well

PARAMETER	RESULT	UNITS	RL*	STD Methods (18th Ed)	DATE/TIME ANALYZED	ANALYZER INITIALS
Nitrate + Nitrite	**10.3**	**mg/L**	0.005	4500-NO3 E	08/18, 12:15	RW

Mixing Chamber

PARAMETER	RESULT	UNITS	RL*	STD Methods (18th Ed)	DATE/TIME ANALYZED	ANALYZER INITIALS
Nitrate + Nitrite	**5.09**	**mg/L**	0.005	4500-NO3 E	08/18, 12:15	RW

Booster Pump

PARAMETER	RESULT	UNITS	RL*	STD Methods (18th Ed)	DATE/TIME ANALYZED	ANALYZER INITIALS
Nitrate + Nitrite	**0.800**	**mg/L**	0.005	4500-NO3 E	08/18, 12:15	RW

Distribution

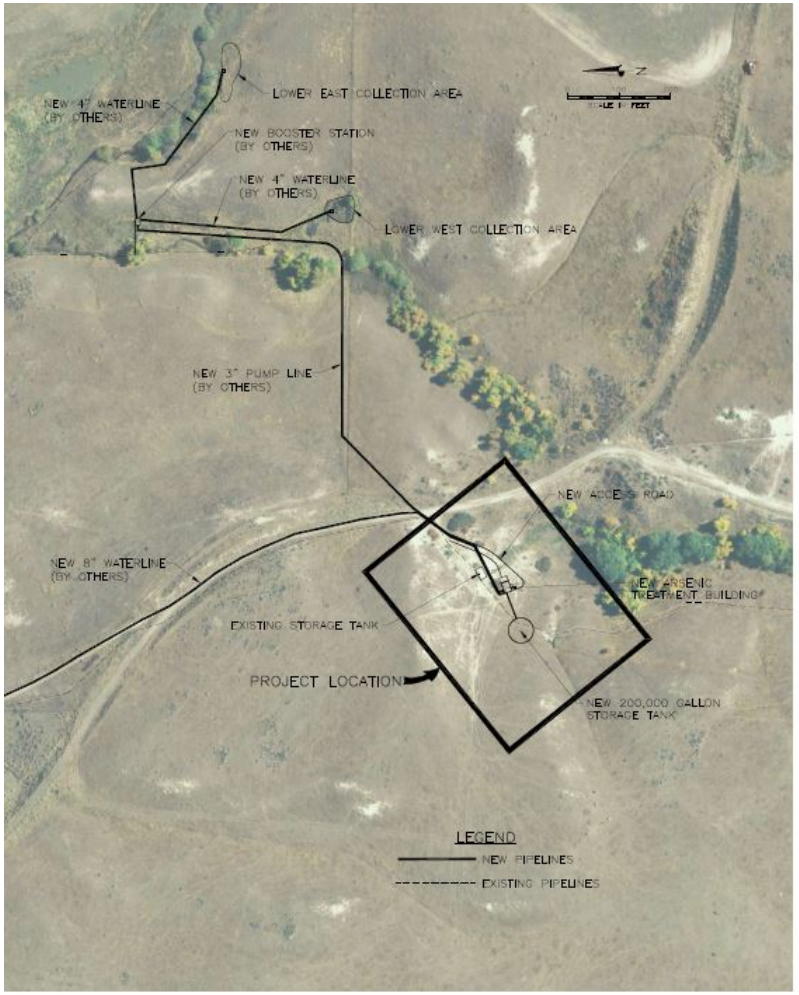
PARAMETER	RESULT	UNITS	RL*	STD Methods (18th Ed)	DATE/TIME ANALYZED	ANALYZER INITIALS
Nitrate + Nitrite	**4.24**	**mg/L**	0.005	4500-NO3 E	08/18, 12:15	RW

CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 3*
  - *Results*
    - *Acceptable Levels of Nitrate / Compliance*
    - *Continued Utilization of High Nitrate Well*

CASE STUDIES

- ***EXAMPLE WATER SYSTEM NO. 4***
  - ***Sources***
    - ***Three Mountain Springs***
    - ***Arsenic = 12 ppb (MCL = 10 ppb)***

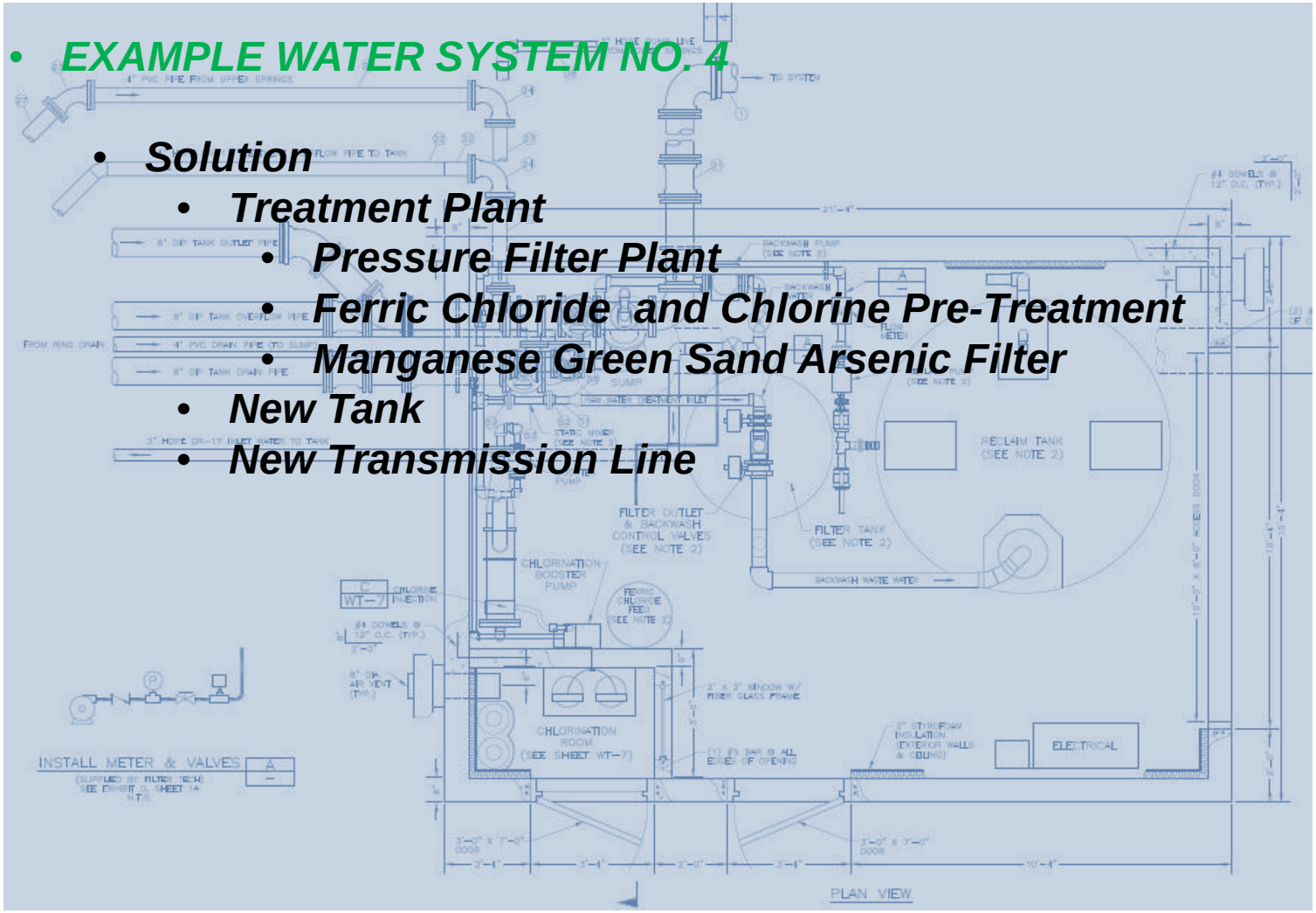


CASE STUDIES

- ***EXAMPLE WATER SYSTEM NO. 4***
  - ***Solutions Considered:***
    - ***Sampling Location Changes – Arsenic Levels are Consistent***
    - ***Sample Averaging – Arsenic Levels are Consistent***
    - ***Abandon – Too Expensive / Loss of Investment***
    - ***Blending – No Blending Source***
    - ***Treatment – Expensive but Feasible***

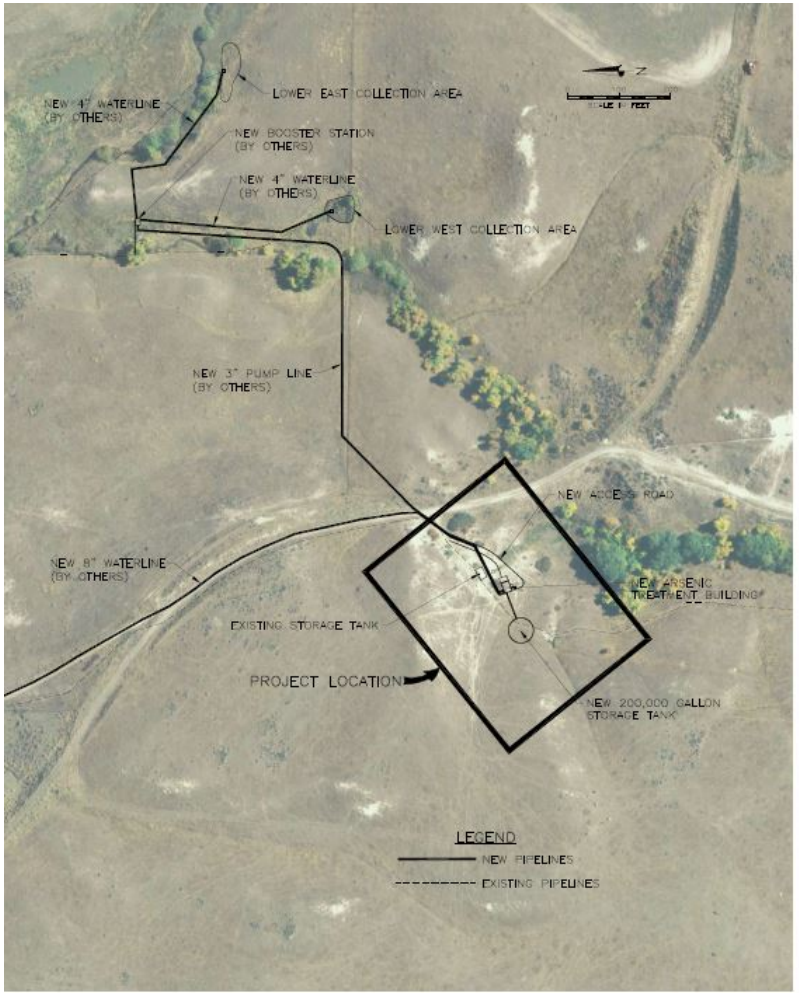
CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 4*
  - *Solution*
    - *Treatment Plant*
      - *Pressure Filter Plant*
      - *Ferric Chloride and Chlorine Pre-Treatment*
      - *Manganese Green Sand Arsenic Filter*
    - *New Tank*
    - *New Transmission Line*



CASE STUDIES

- *EXAMPLE WATER SYSTEM NO. 4*
  - *Results*
    - *Arsenic < 5 ppb*
    - *Continued use of source*



RECOMMENDATIONS

- ***Study, Study, Study***
- ***Spend Study Money Up Front, Save on Construction Costs***
- ***Look at All the Options***
- ***Consider Simple Low-Cost Options Before Deciding on Treatment***

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QUESTIONS ?

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