OPERATIONS / WATER QUALITY PLANNING CONSIDERATIONS WHEN ADDING A NEW SOURCE TO AN EXSTING DISTRIBUTION SYSTEM

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By

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Gray & Osborne, Inc.

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Typical Source Considerations

- How much capacity?
- When is it needed?
- Where will it be located?
- When can it be constructed?
- Do we have water rights?
- If not, can we get water rights?
- How much will it cost?

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Operations Source Considerations

- How will a new source impact operation of the water system?
  - Number and size of source increments
  - Type of pumping systems
  - Type of treatment facilities needed
  - Operation and control strategy
- How will a new source impact distribution system water quality?

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Background

- City of Olympia
  - Residential Population of ~ 60,000
  - Service Area of ~ 28 square miles
  - Existing Water Sources

Source	Capacity	Share of Production
McAllister Springs	15 mgd	84%
Kaiser Well Allison Well	0.4 mgd 2.2 mgd	11%
Shana Park Well Hoffman Well Indian Summer Well	1.3 mgd 1.3 mgd 1.0 mgd	5%

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Background

- Replace Existing McAllister Springs Source with Wells
  - Avoid Additional SWTR Requirements
  - Provide More Protected Water Supply
  - Partner with Nisqually Tribe on Water Rights
- Started Process in 1990's
- Two Wells Drilled in 1999
  - TW-22 (12" diameter)
  - PW-24 (20" diameter)

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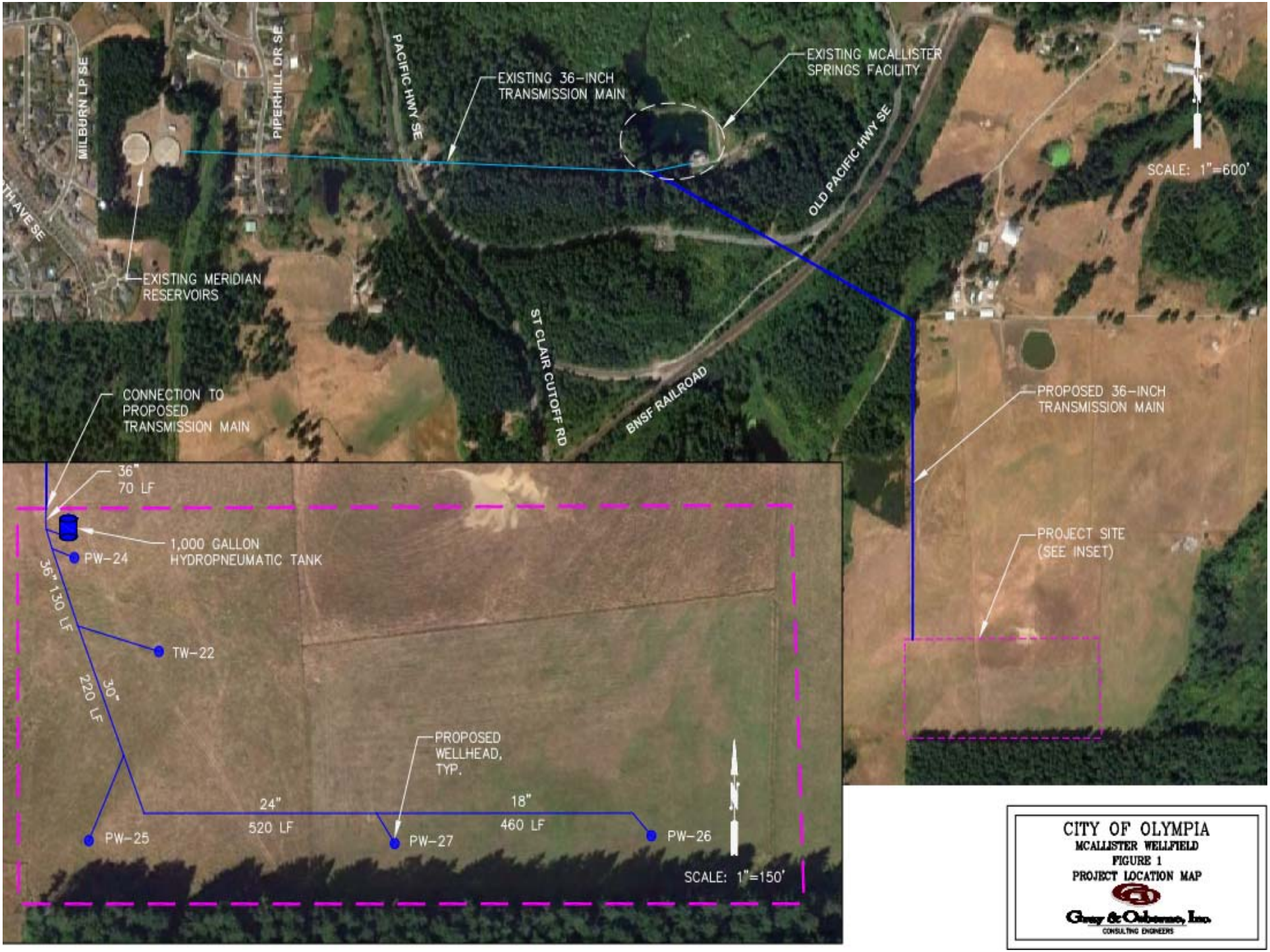

CITY OF OLYMPIA
MCALLISTER WELLFIELD
FIGURE 1
PROJECT LOCATION MAP

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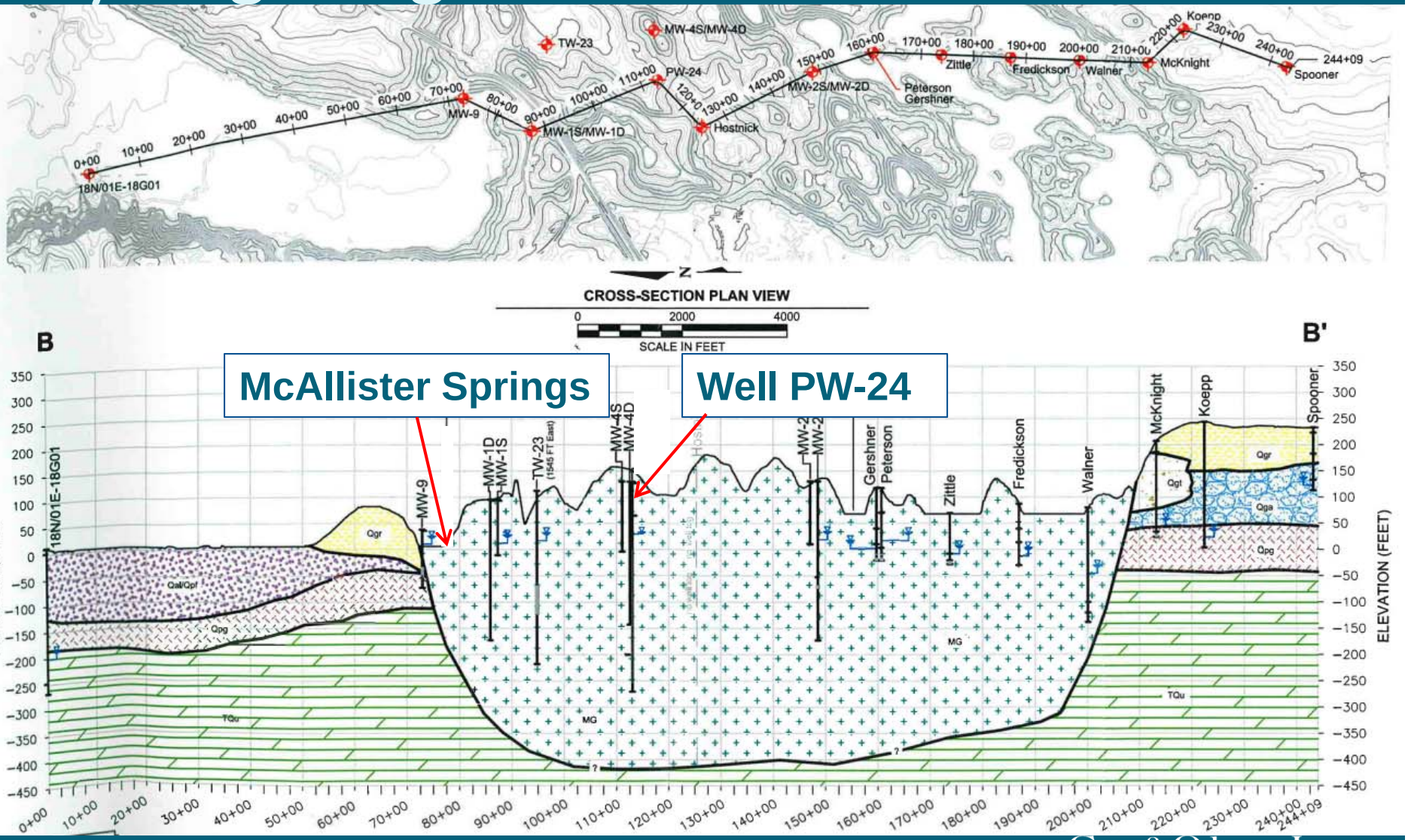
Hydrogeologic Cross Section



Source: Golder Associates

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Number / Size of Wells

- Alternatives for Initial Capacity (gpm) –

Alternative	Well 1	Well 2	Well 3	Well 4
1	1,500	3,000	3,000	3,000
2	3,500	3,500	3,500	
3	1,500	3,000	3,000	3,000
4	1,500	3,000	6,000	

- Alternatives for Future Capacity (gpm)

Alternative	Well 1	Well 2	Well 3	Well 4	Well 5
1	1,500	3,000	3,000	3,000	5,500
2	3,500	3,500	3,500	5,500	
3	1,500	3,000	5,750	5,750	
4	1,500	3,000	6,000	5,500	

Design Considerations

- Initial Capital Cost
- Build-out Capital Cost
- Reliability
- Operational Flexibility
- Environmental Impact
- Aesthetics

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Alternative Assessment

Alternative	Well 1	Well 2	Well 3	Well 4
1	1,500	3,000	3,000	3,000
2	3,500	3,500	3,500	
3	1,500	3,000	3,000	3,000
4	1,500	3,000	6,000	

- Costs were similar, but options with fewer wells have a slightly lower cost
- Fewer wells also have less environmental impact and better aesthetics
- Engineers and operators can have different opinions on reliability and operational flexibility

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Type of Pumps

- Vertical Turbine Pumps
- Submersible Turbine Pumps

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Pump Evaluation

Criteria	Weighting Factor	Vertical Turbine		Submersible	
		Rating	Score	Rating	Score
Capital Cost	30	10	300	9	270
Ease of Maintenance	20	8	160	4	80
Availability of Parts	20	7	140	3	60
Energy Efficiency	15	10	150	8	120
Sensitivity to Well Plumbness	10	4	40	8	80
Aesthetics	5	5	25	9	45
Total Score	**100**		**815**		**655**

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Type of Chlorination

- Gas Chlorine
- Bulk 12.5% Sodium Hypochlorite
- Bulk 4% Sodium Hypochlorite
- On-Site Generation of Sodium Hypochlorite

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Chlorination Evaluation

Criteria	Weight Factor	Chlorine Gas		12.5% Bulk NaOCl		4% Bulk NaOCl		On-Site Generation	
		Rating	Score	Rating	Score	Rating	Score	Rating	Score
Lifecycle Cost	30	10	250	8	200	7	175	7	175
Operational Safety	20	5	100	7	140	8	160	9	180
Simplicity of Operation	20	9	135	7	105	8	120	4	60
Ease of Maintenance	15	9	90	7	70	7	70	4	40
Ease of Handling	10	7	70	8	80	8	80	10	100
Environmental Impact	10	5	50	6	60	6	60	8	80
Regulatory Risk	5	5	50	7	70	8	80	9	90
Total Score	**100**		**745**		**725**		**745**		**725**

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Other Operator Design Considerations

- Type of Facilities Needed
  - Office
  - Storage
  - Restroom
- Layout of Facilities
  - Chemical Feed Room

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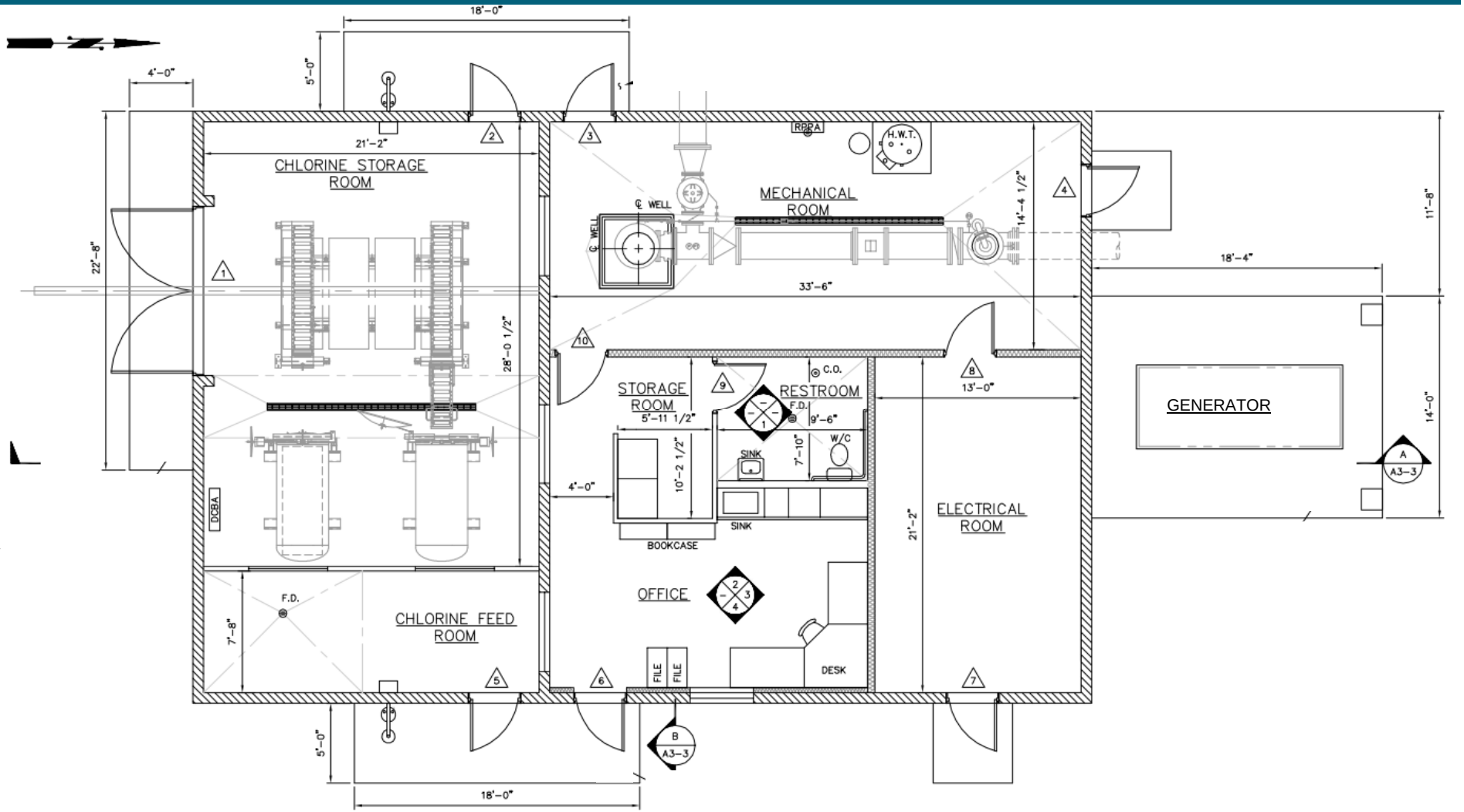
PW-25 / Operations Building Layout



Operational Strategy and Costs

Pumping Scenario	Production (gpm)	Power Draw (kW)	Normalized Power Draw (W/gpm)	Demand Charge
TW-22	1,580	113	71	$900
PW-24	3,120	235	75	$2,000
PW-25	6,600	459	70	$3,800
TW-22 and PW-24	4,620	353	76	$3,000
TW-22 and PW-25	7,940	582	73	$4,900
PW-24 and PW-25	9,200	724	79	$6,100
TW-22, PW-24, and PW-25	10,500	852	81	$7,100

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Operational Strategy and Costs

- Power costs will be similar to existing facility
- Well PW-25 will be the most efficient well to operate
  - Highest efficiency pump
  - Lowest drawdown
- Operating the most efficient pumps will typically provide greater savings than using smaller pumps to limit the demand charge

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Water Quality Considerations

- Potential Blending Impacts
  - Distribution System Scale Stability
  - Aesthetics
  - Chlorine Demand
- Corrosion Control Optimization

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Raw Water Quality Comparison

Analyte	McAllister Springs	McAllister Wellfield
Sodium, mg/L	6.7	7.0
Calcium Hardness, mg/L as $CaCO_3$	54	59
Conductivity, µmhos/cm	139	147
Nitrate-N, mg/L	0.38	1.3
Chloride, mg/L	4.4	4.0
Sulfate, mg/L	3.3	5.0
Iron, mg/L	ND	0.1
Manganese, mg/L	0.002	0.01
TDS, mg/L	105	125
Total Alkalinity, mg/L as $CaCO_3$	55	61
pH	6.6	6.7
Aggressive Index	9.6	9.8
Langelier Index	-2.1	-2.0

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Raw Water Quality Comparison

Analyte	McAllister Wellfield	Kaiser Well	Shana Park Well	Allison Wells	Indian Summer Well
Sodium, mg/L	7.0	<5	7.6	<5	20
Calcium Hardness, mg/L as $CaCO_3$	59	54	58	55	11
Conductivity, µmhos/cm	147	160	164	139	111
Nitrate-N, mg/L	1.3	0.7	3.0	1.0	<0.5
Chloride, mg/L	4.0	<20	<20	<20	2.1
Sulfate, mg/L	5.0	<10	<10	<10	0.2
Iron, mg/L	0.1	0.3	<0.1	<0.1	0.09
Manganese, mg/L	0.01	<0.01	<0.01	<0.01	0.02
TDS, mg/L	125	124	127	106	86
Total Alkalinity, mg/L as $CaCO_3$	61	58	49	48	53
pH	6.7	6.4	7.5	7.7	7.6
Aggressive Index	9.8	9.5	10.5	10.7	10.0
Langelier Index	-2.0	-2.3	-1.3	-1.0	-1.8

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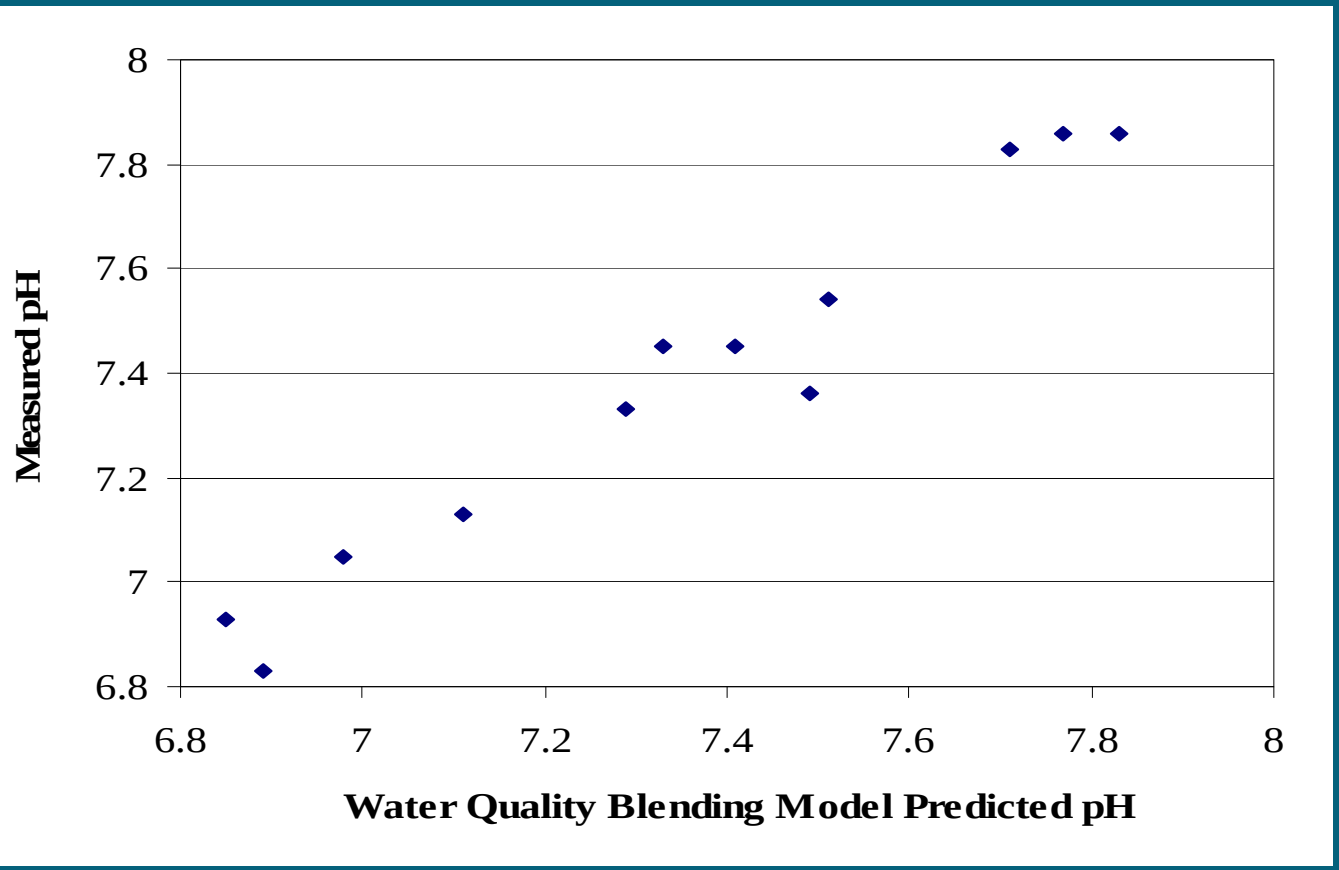
Blending Assessment

Mixture	Source Percentage					Comment
	McAllister (pH)	Allison	Kaiser	Shana	Indian Summer	
1	10% (6.6)	80%	10%	0	0	298 Zone Summer
2	10% (7.3)	80%	10%	0	0	
3	10% (7.9)	80%	10%	0	0	
4	33% (6.6)	0	0	45%	22%	417 Zone Summer
5	33% (7.3)	0	0	45%	22%	
6	33% (7.9)	0	0	45%	22%	
7	60% (6.6)	40%	0	0	0	298 Zone Winter
8	60% (7.3)	40%	0	0	0	
9	60% (7.9)	40%	0	0	0	
10	50% (6.6)	0	0	0	50%	50:50 Blends with Indian Summer
11	50% (7.3)	0	0	0	50%	
12	50% (7.9)	0	0	0	50%	

Blending Assessment

- Water Quality Blending Model
- Bench Scale Tests



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Blending Assessment

- No significant impact was observed by replacing McAllister Springs water with McAllister Wellfield water.
- Raising the pH of the McAllister Wellfield water will likely improve scale stability and reduce corrosion in the distribution system.

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Aesthetics

- No color observed in any blend
- No odors observed in any blend
- Taste noted in Indian Summer blends similar to the nature of complaints received about water when the Indian Summer well is operated.

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Chlorine Demand

Source	Initial Chlorine Level (mg/L)	Duration of Test (days)	Chlorine Demand (mg/L)
McAllister Wellfield (pH = 7.9)	1.05	19	0.5
McAllister Wellfield (pH = 7.3)	1.06	19	0.3
McAllister Wellfield (pH = 6.6)	0.97	19	0.3
Indian Summer	1.23	19	0.3
Shana Park	1.38	20	0.3
Kaiser	0.79	20	0.5
Allison	1.13	20	0.5

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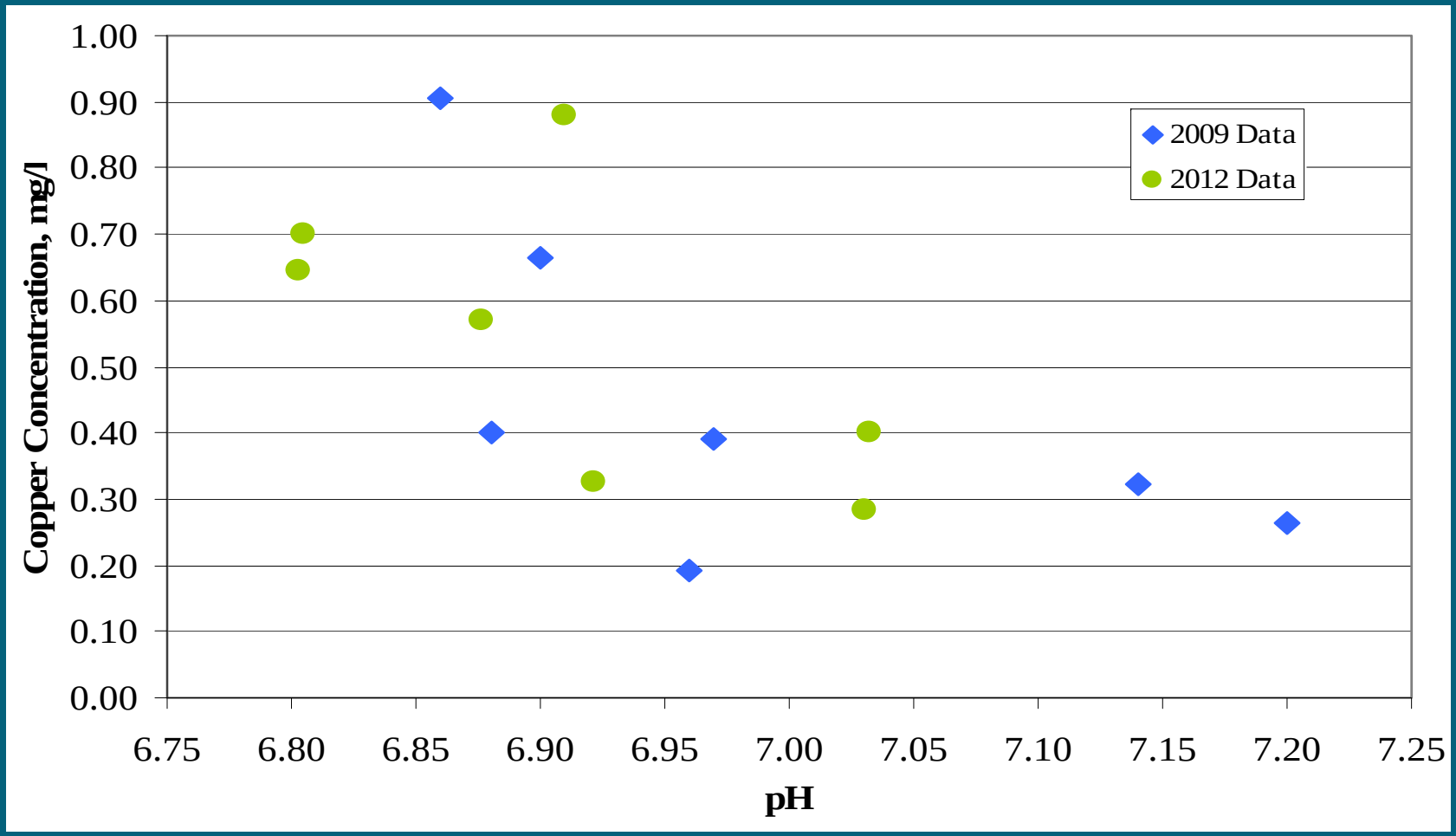
Corrosion Control Optimization



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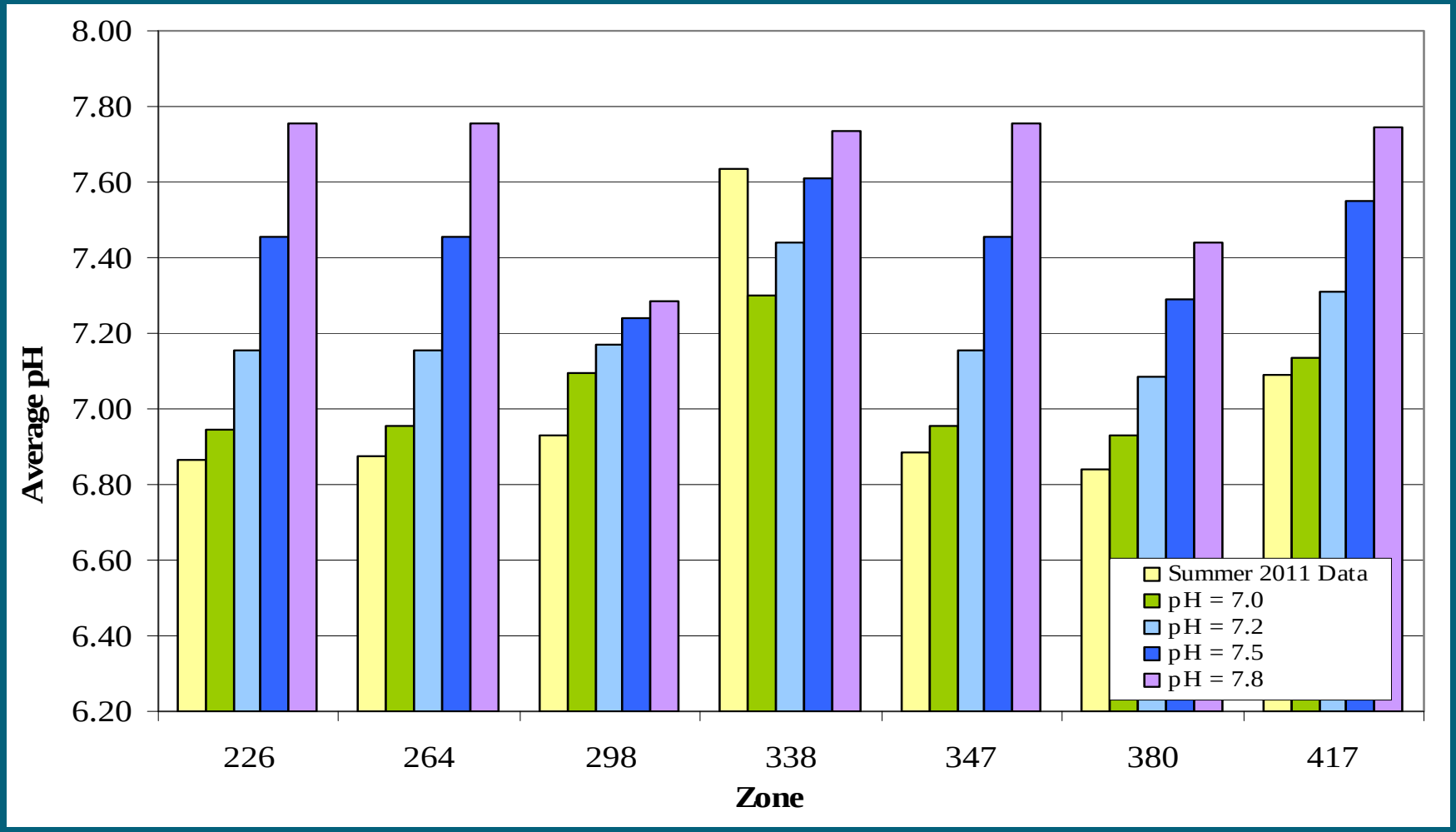

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