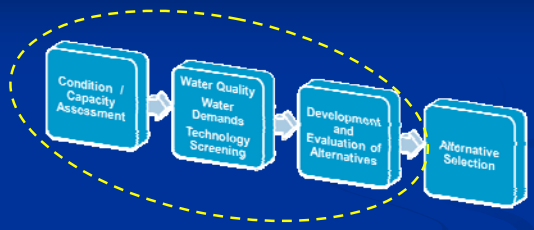
Ames Water Treatment Plant Infrastructure and Capacity Needs Assessment

City Council Workshop

May 19, 2009

What is the process?

How best can the City provide a safe, dependable supply of water?



Where are we so far?

Summary of Work to Date and Today's Presentation

1. Capacity of Existing Water Plant
2. Condition of Existing Water Plant
3. Water Quality Goals
4. Development /Evaluation of Alternatives
5. Water Demand Projections

Capacity Assessment

Capacity Assessment

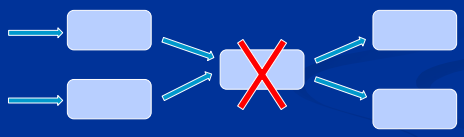
- Ames WTP nominally rated at 12 million gallons per day (mgd)
- Present probable capacity : 11 mgd
- Components generally adequate capacity
  - Source
  - Finished Water Ground Storage
  - Finished Water Elevated Storage

Existing Capacities: by Component

Process or component	Capacity, mgd
Aeration (without bypassing)	10
Rapid Mix Coagulation/Flocculation	< 11
Clarification	12
Recarbonation	11.5
Filtration	12
Disinfection	12
High-Service Pumping (firm)	13

Capacity Assessment

Many parts of the facility lack adequate reliability



Capacity Assessment

Reliability Deficiencies

- Critical piping such as:
  - Raw water supply to aerator
  - Aeration discharge to rapid mix
- Unit processes including rapid mix
- Backwash Pumping

Condition Assessment

Architectural Concerns

- Severely limited access for safety, operation & maintenance
- Code concerns throughout the facility include
  - Stairs, dead end corridors
  - Emergency egress routes
  - Lack of isolation of chemical storage
- Access to areas during possible rehabilitation construction will be problematic

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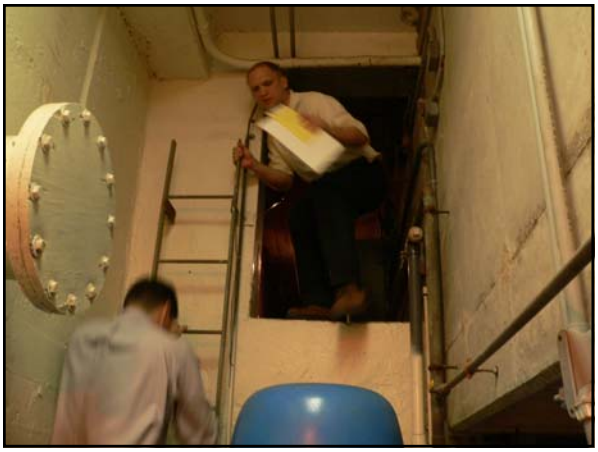

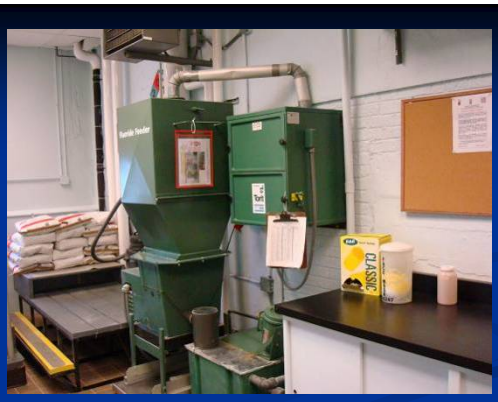

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Structural Concerns

- Some structures are over 80 years old
- Several Structures are near the end of their useful life including
  - Mix Tank No. 1
  - Aeration Tank
  - Recarbonation Tank No. 1
  - ¾ MG Reservoir
- Each of these structures is directly adjacent to Main Building, jeopardizing continued operation of the facility

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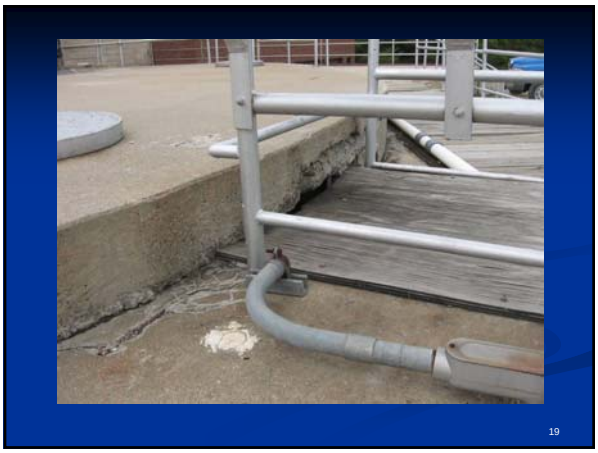

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Mechanical Condition

- Most mechanical equipment (heating and ventilation) is in satisfactory condition
- There are two items that require attention
  - New boilers needed
  - New unit heater needed in East Pipe Gallery

Process Condition

- Much of the process equipment is in satisfactory condition due to the operation and maintenance staff's dedication
- Items that have less than 5 years of estimated life include
  - Two rapid mix mixers
  - One lime slaker
  - Aeration influent piping
  - Clarifier mechanism
  - Hypochlorite (disinfection) tanks and pumps

Process Condition

- Many items are old enough that repair parts are difficult to obtain
- Piping galleries are congested making maintenance difficult
- Due to piping arrangements filters cannot be fully automated or monitored

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Electrical Condition

- SCADA is new and in good condition
- Power distribution
  - Much conduit and wiring needs to be replaced
  - Relocate all electrical equipment/devices to spaces with more favorable environmental conditions
  - Replace/add various panel boards
  - Relocate and perhaps replace emergency generator

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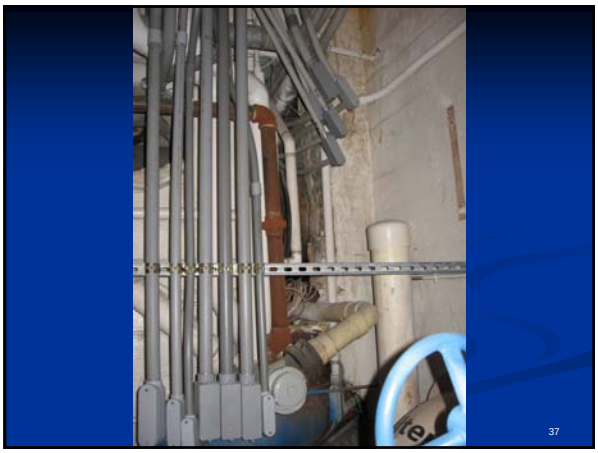

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Condition of Existing Facility – Primary Driver for Project

- Reliability Deficiencies
  - Single Points of Failure without bypass:
    - Examples: Raw Water Piping, Aeration, Rapid Mix Basin and Backwash Supply
  - Firm capacity inadequacies
    - (example: clarifiers)
- Structural Concerns:
  - Aeration, Mix tank No. 1, Recarbonation Tank No. 1, ¾ MG Reservoir

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Condition of Existing Facility – Primary Driver for Project (cont)

- Architectural Concerns:
  - Dead end Corridors, Stairs, Chemical Storage
  - Safety
- Electrical Concerns:
  - Electrical Equipment location and deterioration
  - Safety

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Water Quality Considerations

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Water Quality

- Regulatory Compliance - Comply with Safe Drinking Water Act and Revisions
- Maintain Distribution System Through Treatment
- Maintain Exceptional Taste

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Water Quality and Treatment Goals

- Consideration of Existing and Anticipated Regulations
- Compliance with the Safe Drinking Water Act
- Softened water, finished water hardness 150 – 170 mg/L
- Iron (Fe) and manganese (Mn) removal
- Pathogen destruction
- Hydrogen sulfide (H_2S) removal (no taste or odor)
- Total organic carbon (TOC) reduction
- pH target 9.5 +/- Slightly depositing
- Exceptional taste (same as current)

- Note: Goals listed are currently being met with existing facility.

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Significant Water Quality Monitoring -

- What is in our water?
- Results of special recent testing---

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2009 testing for 24 likely compounds in Iowa waters

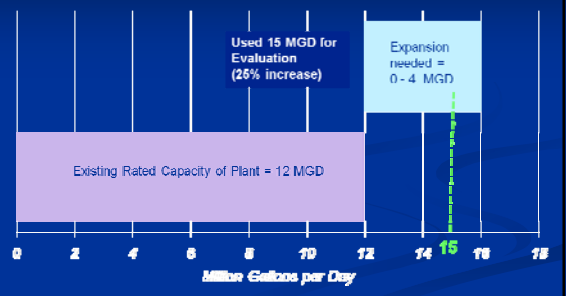
- 22 of the 24 compounds -- non-detectable
- 2 compounds detected at parts-per-trillion level
  - Sulfamethazine (an animal antibiotic)
  - Cholesterol (a plant or animal steroid)
  - Far below any level of concern

Development and Evaluation of Alternatives

Projecting Design Capacity

- Changes in population
- Changes in customer base
  - Residential, Commercial, Industrial
- Changes in water use characteristics
  - Consumptive
  - Conserving
- City / utility policies

Capacity Expansion

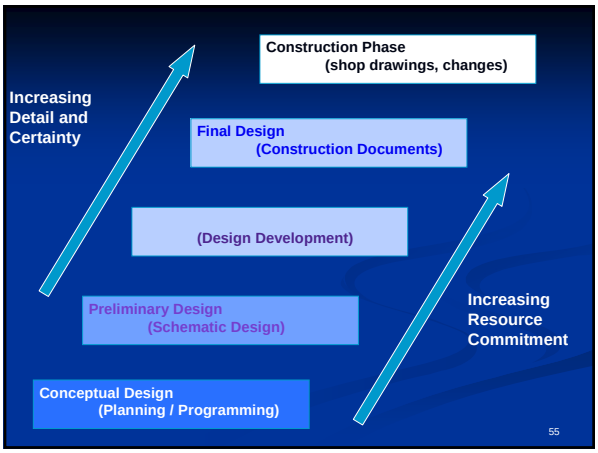


Alternatives Considered

1. Rehab Existing Facilities
2. New Lime Softening Plant at New Location
3. New Membrane Plant at New Location
4. Satellite / Phased New Plant

Conceptual Plan

- Low level of detail relative to the final design documents
- Basis of Analysis -- Assumptions Required
  - General process scheme
  - General type of equipment
  - General layout / configuration
  - Type and quality of construction
  - Materials of construction



Concept Development Considerations

- Treatment Goals
- Available Technology
- Operational Requirements
- Reliability
- Flexibility to handle changing conditions
- Implementation
- Expandability
- Social Impacts
- Environmental Impacts / Sustainability

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Cost Estimates

- Capital Costs
  - Construction, land, engineering, admin.
- O&M
  - Labor, Chemicals, Electricity, Sludge Disposal
- Life-Cycle Costs –
  - total present worth or total annual equivalent
  - Capital, O&M, Replacement, Salvage Value

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Alternative 1 Rehabilitate Existing Lime Softening Plant

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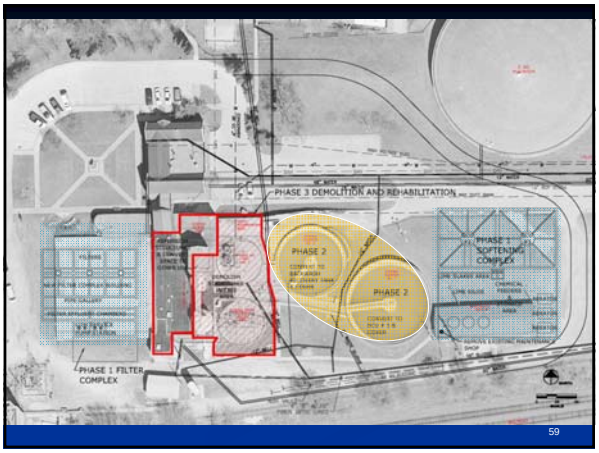


- Lime pond rehabilitation
- High-Service Pumping modifications

Rehabilitate Existing Plant Non-monetary Factors

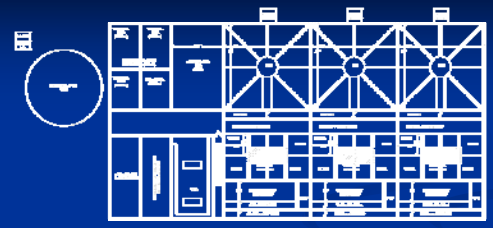
- Pros
  - Process is similar to existing
  - Multiple treatment units provided
- Cons
  - Difficult phased construction while maintaining operation
  - Aesthetic and construction issues for neighbors
  - Limited site and space constraints, limited expandability
  - Difficult chemical delivery
  - Inefficient Operator movement

Opinion of Probable Costs

Alternative	Capital Cost (Million $)	O&M Cost ($/1000 gal.)
Alt. 1 – Rehab Existing Plant	**$54.786**	**$1.18**
Alt. 2 – New Lime Softening Plant		
Alt. 3 – New Membrane Plant		
Alt. 4a – 10 MGD Lime w/ 5MGD Later		
Alt. 4b – 15MGD Lime & Phase Demo and Admin		
Current Annual Operation and Maintenance (O&M) cost	**N/A**	**$1.18**

Alternative 2 New Lime Softening Plant

New Lime Softening Plant



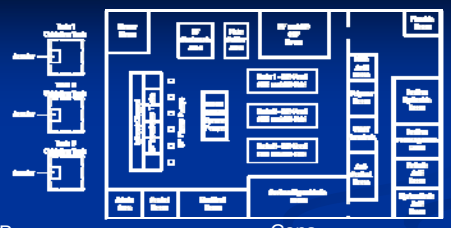
- Pros
  - Process similar to existing
  - Compact layout
  - Multiple treatment units provided
  - Expansion possible
  - Existing Site Available
- Cons
  - New site required

Opinion of Probable Costs

Alternative	Capital Cost (Million $)	O&M Cost ($/1000 gal.)
Alt. 1 – Rehab Existing Plant	**$54.786**	**$1.18**
Alt. 2 – New Lime Softening Plant	**$48.431**	**$1.17**
Alt. 3 – New Membrane Plant		
Alt. 4a – 10 MGD Lime w/ 5MGD Later		
Alt. 4b – 15MGD Lime & Phase Demo and Admin		
Current Annual Operation and Maintenance (O&M) cost	**N/A**	**$1.18**

Alternative 3 New Membrane Softening Plant

New Membrane Plant



- Pros
  - Compact layout
  - Multiple treatment units provided
  - Expansion possible
  - Existing Site Available
- Cons
  - Unfamiliar process with greater complexity and training required
  - Pilot study required
  - New site required
  - Possible short term water taste issue
  - Greater energy and raw water use

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New Membrane Plant

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Opinion of Probable Costs

Alternative	Capital Cost (Million $)	O&M Cost ($/1000 gal.)
Alt. 1 – Rehab Existing Plant	$54.786	$1.18
Alt. 2 – New Lime Softening Plant	$48.431	$1.17
Alt. 3 – New Membrane Plant	$72.032	$1.35
Alt. 4a – 10 MGD Lime w/ 5MGD Later		
Alt. 4b – 15MGD Lime & Phase Demo and Admin		
Current Annual Operation and Maintenance (O&M) cost	N/A	$1.18

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Alternative 4 Phased Construction Lime Softening Plant

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Phased Construction

- Alternative 4a:
  - Phase 1 – New 10 MGD Lime Softening Plant at a new location with existing lime sludge lagoon upgrades
  - Phase 2 – Additional 5 MGD Lime Softening train built, old plant demolition and administration upgrades
- Pros
  - Process similar to existing
  - Compact Layout
  - Expansion possible
  - Existing Site Available
- Cons
  - Total desired capacity not available in first phase
  - Only two treatment trains in first phase
  - New site required

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Opinion of Probable Costs

Alternative	Capital Cost (Million $)	O&M Cost ($/1000 gal.)
Alt. 1 – Rehab Existing Plant	$54.786	$1.18
Alt. 2 – New Lime Softening Plant	$48.431	$1.17
Alt. 3 – New Membrane Plant	$72.032	$1.35
Alt. 4a – 10 MGD Lime w/ 5MGD Later	$36.502 + $16.572 = $53.074	$1.17
Alt. 4b – 15MGD Lime & Phase Demo and Admin		
Current Annual Operation and Maintenance (O&M) cost	N/A	$1.18

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Phased Construction

- Alternative 4b:
  - Phase 1 – New 15 MGD Lime Softening Plant at new location with existing lime lagoon upgrades
  - Phase 2 – Old Plant Demolition and administration upgrades
- Pros
  - Process similar to existing
  - Compact layout
  - Expansion possible
  - Meet desired capacity in first phase
  - Multiple treatment units provided
  - Existing Site Available
- Cons
  - New site required

Opinion of Probable Costs

Alternative	Capital Cost (Million $)	O&M Cost ($/1000 gal.)
Alt. 1 – Rehab Existing Plant	$54.786	$1.18
Alt. 2 – New Lime Softening Plant	$48.431	$1.17
Alt. 3 – New Membrane Plant	$72.032	$1.35
Alt. 4a – 10 MGD Lime w/ 5MGD Later	$36.502 + $16.572 = $53.074	$1.17
Alt. 4b – 15MGD Lime & Phase Demo and Admin	$43.588 + $5.907 = $49.495	$1.17
Current Annual Operation and Maintenance (O&M) cost	N/A	$1.18

Notes on Opinion of Costs Presented - Capital

- Based on February 2009
- Amounts shown do not include escalation
- Escalation based on several factors
  - Bidding Climate
  - Overall Economy
  - Bid Date and Construction Duration
- Historical ~3% per year

Notes on Opinion of Costs Presented - O&M

- Do not include administrative costs
- Alternative costs based on average production rate of 7.5 MGD (today's $, 2033 average demand)
- Current plant costs are actual at average rate of approximately 6.5 MGD
- Current plant equipment and capital replacements are low due to expectation of upcoming replacement project

Going deeper on the issue of Water Use Projections

Projecting Design Capacity

- Changes in population
- Changes in customer base
  - Residential, Commercial, Industrial
- Changes in water use characteristics
  - Consumptive
  - Conserving
- City / utility policies

Scope and Constraints

- Used population information from city's planning documents as a starting point
- Extended projections to the design year 2033
  - 20 years from anticipated completion of project in 2013
- Allowed for capacity to accommodate time required to implement further expansion at end of original design life.

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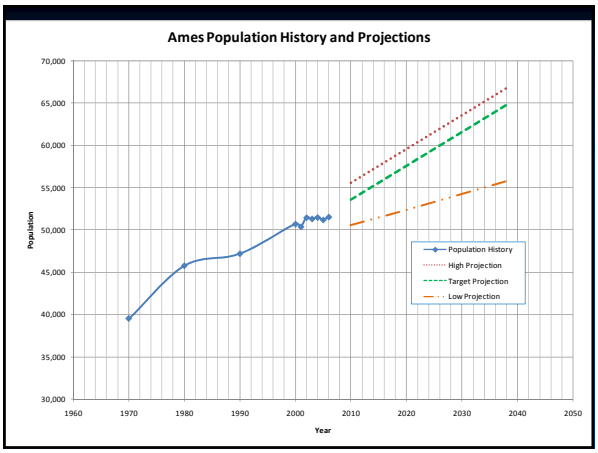

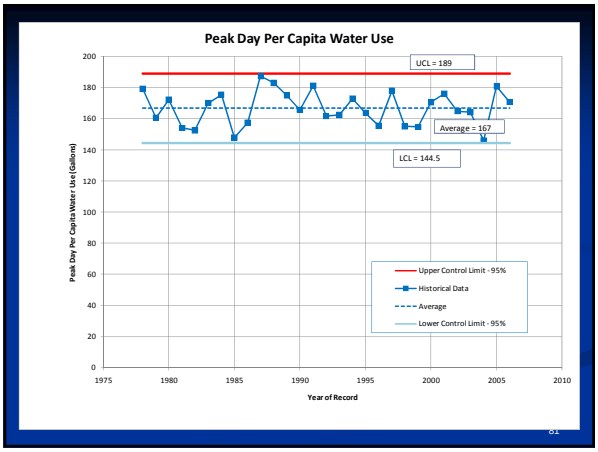

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Allowance for Industrial Demand

- Demand projections using population projections account for general commercial activity related to population growth (restaurants, shopping centers, light industry, etc)
- Other Industrial Use - not accounted for by general population growth
  - Level 1 – no additional industrial allowance
  - Level 2 -- 5 industries at 100,000 gpd
    - 0.5 mgd
  - Level 3 -- 1-2 very large water users
    - 1 – 2 mgd

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Current Conservation Measures

Interior Water Reduction (Average Demand)

- Community Education: displays at events, brochures,
- Public awareness campaign
- Metered Customers

Exterior Water Reduction (Peak Demand)

- Seasonal Rates, Irrigation Rates
- Inverted Block Rate Structure
- Metered Customers

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Aggressive Conservation Measures

Interior Water Reduction (Average Demand)

- Clothes Washer Rebates
- Faucet and Showerhead Rebates
- Toilet and Urinal Rebates
- Additional Education
- Indoor Audit
- Distribution System Maintenance and Upkeep

Exterior Water Reduction (Peak Demand)

- Outdoor Audits
- Irrigation Kits; Manual, ET and Rain Sensors

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Very Aggressive Conservation Measures

Interior Water Reduction (Average Demand)

- Ultra High Efficiency Toilet Rebates
- Waterless Urinal Rebates
- Process Water Audits for Industry
- Water Budget Rates
- Require Retrofit of Homes upon Sale

Exterior Water Reduction (Peak Demand)

- Require Native/Low Water Use Plants
- Limit Irrigation Landscaping
- Promote Dormant Lawns
- Lawn Buy Back Programs
- Prohibit Lawns

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Design Capacity Selection

- Four example scenarios for consideration based on:
  - Base demand (Population x per capita use)
  - Conservation effort
  - Industrial allowance

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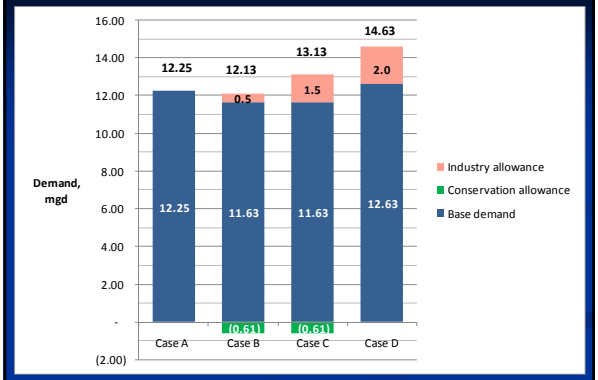

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Cost – Capacity Sensitivity

Design Capacity	15 mgd	12 mgd
Estimated Capital Cost	$ 48.4 million	$ 46.4 million
Capacity difference		- 20 % (- 3 mgd)
Capital Cost difference		- 4.1 % (- $ 2.0 million)

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Recommendation

Alternative 4b --Phased construction of a new lime softening plant on a new site.

- Meets water quality needs for Ames Residents
- Ranks high in regard to:
  - Operational requirements
  - Reliability
  - Flexibility
  - Ability to implement
  - Expandability
  - Social / Environmental impacts
- Most cost-effective and Lower rate impact

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Potential Rate Impact Comparison Alternate 2 vs. Alternate 4B

	FY 09-10	FY 10-11	FY 11-12	FY 12-13	FY 13-14	FY 14-15	FY 15-16	FY 16-17	FY 17-18	FY 18-19
Base	10%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Alternative 2	10%	15%	15%	10%			10%			5%
Alternative 4B	10%	10%	10%	10%	10%		10%	9%		

Projections by City of Ames staff

Sample Customer Bills

	FY 09-10	FY 18-19		
		Base	Alt. #2	Alt. #4B
Residential 600 cu. ft./mo.	$17.53	$22.91	$29.43	$30.75
Commercial 20,000 cu. ft./mo.	$380.40	$496.03	$638.21	$667.05

29.3%

34.5%

Next Steps

- Final Draft of Report
- Develop recommendation for Council
- July 14 – Recommendation to City Council