City of Junction City, Kansas

Water and Wastewater Treatment Engineering Analysis and Pre-Design

February 17, 2014
Agenda

- **Background**
- **Water Treatment Plant**
  - Key Issues
  - Recommendations
  - Project Phasing and Costs
- **East Wastewater Treatment Plant**
  - Key Issues
  - Recommendations
  - Project Phasing and Costs
- **Southwest Wastewater Treatment Plant**
  - Key Issues
  - Recommendations
  - Project Phasing and Costs
Background

- **Water Treatment Plant**
  - Constructed 1980
- **East Wastewater Treatment Plant**
  - Constructed 1954
  - Most recent upgrade 2000
- **Southwest Wastewater Treatment Plant**
  - Constructed 1996
  - Most Recent Upgrade 2006
  - Nutrient removal study completed February 2013
- **Facility Contract Operations**
  - November 1989 outsourced operations of Water and Wastewater
  - Amended and restated agreement June 2012 – Water and Wastewater Project
Water Treatment Plant
Key Issues – Water Use/Regulatory

• **Overpumpage of Water Rights to Meet Demands**
  – 2011: over by 7.5%; 2012: over by 9.9%
  – Penalties may be assessed by DWR

• **High Unaccounted-For Water**
  – 2012: 25.5%, typical: 10-15%
  – Existing old meters not measuring water use accurately

• **Inaccuracies in Metering at Plant**
  – Raw water meters
  – High and low service pumping meters
Key Issues – Water Supply

- Declining Well Field Capacity
  - Overpumpage of wells
  - Minimal well maintenance
- Hydraulic limitations
  - Well 16 non-operational
  - Recent issues with Well 18
Key Issues – Water Treatment/Lime Softening

- **Calcium Carbonate Deposition**
  - Lack of stabilization/recarbonation
  - Deposition in piping, filters, hot water heaters, etc.
  - Hydraulic limitations
    - Plant piping
    - Distribution system

- **Lime Sludge Lines Plugging**
  - Large, gravity lime sludge piping plugs
  - Softening basins not operated as intended
Key Issues – Water Treatment/Clarification

- Non-Operational Chemical Equipment
  - Ferric sulfate, polymer
  - Overload filters with particulates
Key Issues – Water Treatment/Disinfection

- **Safety of Chlorine Gas System**
  - OSHA concern with chlorine gas piping
  - No means to close valves upon chlorine leak remotely
  - Manual switching from empty to full cylinders

- **Disinfection By-Products**
  - Stage 1 sample site in compliance but elevated
  - Stage 2 IDSE samples showed one remote site that was high
  - Stage 2 compliance began October 1, 2013
Key Issues – High and Low Service Pumping

• Service Issues
  – One low service pump out of service
  – Increased discharge pressure of pumps
    • Due to calcium carbonate deposition
  – 2400V MCC (medium voltage)
    • Disconnect switch unreliable
    • 30 years old – end of useful life

• Replacement Issues
  – Medium voltage (2400V) vs. low voltage (480V)
    • Low voltage reduces capital costs and maintenance
      – Pump motors, soft starts
      – Electrical switchgear, MCC
      – Eliminates transformers
Key Issues – Plant Finished Water Storage

• Maintenance
  – Exterior paint peeling
    • Aesthetics for community
    • Preserve service life of steel
  – Lead paint

• No Redundancy
  – Maintaining tank is problematic

• Mixing
  – Improve turnover of tank contents
Key Issues – Electrical

• Main Switchgear
  – Main switch not operable
  – Cannot turn power off to plant
  – 15kV (high voltage) vs 480V (low voltage)

• Transformers
  – T-1, T-2

• No Back-Up Power
  – Plant and wells not operable during power outage
Key Issues – SCADA/Instrumentation

• No SCADA system
  – Limits productivity of staff / increased manpower
    • Well flow and water level read locally
    • Filter backwash manually initiated and ended

• Instrumentation
  – Existing phone line signal telemetry unreliable
    • Well #6, 11, 17 Controls
Key Issues – Maintenance

- **Piping / Equipment Requires Painting**
  - Wells, basin equipment, plant piping

- **Building Roof**
  - Roof leaks during rain storm
  - Plant staff mop up water or contain in buckets

- **HVAC**
  - Humidity control is an issue
  - Equipment beyond life expectancy
  - Lack of control within the building
Recommendations

• Water Use
  – Overpumpage of Water Rights to Meet Demands
    • Submit application to DWR for water rights through Water Assurance District
    • Implement water conservation rates
  – High Unaccounted-For Water
    • Replace customer meters
    • Install bulk water station
  – Inaccuracies in Plant Metering
    • Replace raw water meter
    • Replace high and low service meters

• Water Supply
  – Declining Well Field Capacity
    • Install a horizontal collector well
    • Implement well maintenance program for existing wells
Recommendations

• Water Treatment – Lime Softening
  – Calcium Carbonate Deposition
    • Install carbon dioxide feed for recarbonation
    • Clean basin weirs, downstream piping of deposition
  – Lime Sludge Lines Plugging
    • Install smaller lines to lagoons with cleanouts; use existing pump station

• Water Treatment - Clarification
  – Non-Operational Chemical Equipment
    • Install new ferric and polymer feed systems
Recommendations

• **Water Treatment – Disinfection**
  – Safety of Chlorine Gas System
    • Convert from pressure feed system to a vacuum feed system
    • Install automatic shut-off valves on ton cylinders
    • Install automatic switchover
  – Disinfection By-Products
    • Install liquid ammonium sulfate feed to convert secondary disinfection to chloramines
Recommendations

• Water Treatment – Low and High Service Pumping
  – Increased discharge pressure
    • Replace high and low service pumps with pumps capable of higher pressure
    • Install surge relief valves for water hammer
  – Electrical
    • Replace MCC – include soft starters for water hammer
    • Replace switchgear / abandon transformers
    • All work above at 480V (low voltage)

• Water Treatment – Plant Finished Water Storage
  – Historically minimal maintenance
    • Take the tank out of service and sandblast and paint the interior and exterior
  – Redundancy
    • Construct an additional finished water storage tank
  – Mixing
    • Install a mixing system inside the tank
Recommendations

• Water Treatment – Electrical
  – Main Switchgear / Transformers
    • Replace at 480V
    • Abandon transformers
  – Emergency Power
    • Install secondary power feed to plant and wells (in lieu of standby generation)

• Water Treatment – SCADA/Instrumentation
  – SCADA System
    • Install a plant SCADA system
  – Instrumentation
    • Replace well controls
    • Replace other instrumentation in the future upon failure to be compatible with SCADA
Recommendations

• **Water Treatment – Maintenance**
  - Piping / Equipment
    - Clean and paint exposed piping and equipment throughout plant including wells
  - Building Roof
    - Replace roof and skylights
  - HVAC
    - Replace HVAC equipment and controls
    - Install a dedicated air handling unit for the laboratory area

• **Other Recommendations**
  - Install a chlorine feed ahead of the aerators for periodic cleaning of the interior
  - Route lagoon decant to sanitary sewer instead of recycling to process
  - Install turbidimeters on individual filter effluent lines to monitor finished water quality and need for additional filtration capacity
  - Construct secondary containment for existing chemicals (current regulations)
  - Install a new gravel layer on well field access road
Project Prioritization

- Does not include distribution system piping
- Immediate Needs
  - Water rights application
  - Chlorine gas system improvements
- Other Projects
  - Phased according to:
    - Regulatory
    - Safety
    - Water quality
    - Capacity
    - Critical Asset
    - Reliability
    - Financial
    - Service Life
    - Productivity

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East Wastewater Treatment Plant
Key Issues – Preliminary & Primary Treatment

• **Headworks**
  – Gas Detection System Reliability Critical
  – Odor Control – Not Functional
  – Doors, HVAC, Electrical – Severely deteriorated
  – Fine Screens (Hand Rails, Grating) – Upgrade Required
  – Grit Removal - Air Lift Pump, Grit Building Doors, HVAC, Electrical

• **Influent Pump Station**
  – Wet Well Cover – Brittle and collapsed

• **Primary Clarification**
  – Primary Sludge Piping – End of Life
  – Splitter Structure – Uneven Distribution
  – Sludge Pumps, Grinders – End of Life
Key Issues – Secondary Treatment

- **Activated Sludge**
  - Blowers – End of Useful Life
  - Add Blower VFDs, Instrumentation & Controls – Facilitate Proper Process Control, Energy Savings
  - Aeration Diffuser System – Upgrade needed to support capacity
  - Anoxic Mixer – End of Useful Life

- **Secondary Clarifiers**
  - Rehabilitate Clarifiers – Mechanisms require replacement
    - One of two has been fixed to date
  - RAS Pumps, WAS Pumps, Scum Pump - Condition/End of Useful Life
  - Algae in clarifiers needs to be controlled
Key Issues – Biosolids

- **Biosolids Treatment System**
  - Blending Tank – Requires evaluation and recoating
  - Storage Tank – Requires evaluation and recoating; additional capacity needed
  - Sludge Transfer Pumps – Condition/End of Useful Life
  - Tank Blowers - Aged
  - Lime Feed System – End of Useful Life, Deteriorated
  - Lime Feed Room HVAC – Inadequate
Key Issues – Nutrient Removal

• Tankage
  – Need additional zone - Anoxic Zone Required

• Recycle Pumping
  – Required to Support Nitrogen Removal

• Provide Chemical Feed Systems
  – Methanol Feed – Carbon source to facilitate denitrification
  – Alum Feed – Polishing step to meet phosphorus limits
Key Issues – SCADA/Instrumentation

• **No SCADA system**
  – Limits productivity of staff / increased manpower, efficiency of system, operations & maintenance costs increase
    • Alarm response time increased
    • Potential damage to equipment

• **Instrumentation**
  – Aeration System DO Control needed
    • Variable DO concentrations interfere with performance
      – Low DO results in inadequate nitrification
      – High DO wastes energy and can interfere with anoxic zone
Key Issues – Additional East WWTP Needs

- **Site Needs**
  - Laboratory - Small and Deteriorated
  - Locker Room - Small and Deteriorated
  - Pavement (Parking Lot, Walkways, and other deteriorated paved surfaces) - Aged
East WWTP Recommendations

- **Maintenance Needs**
  - Replace Preliminary Treatment Systems
  - Rehabilitate Headworks Building
  - Rehabilitate Primary Clarifier System
  - Rehabilitate Secondary Clarifier System
  - Replace Biosolids Equipment
  - Aeration System Diffusers and DO Control

- **Capacity Needs**
  - Install Additional Biosolids Storage Tanks
East WWTP Recommendations

• Nutrient Removal Needs
  – Modify Existing Secondary Treatment Process
  – Chemical Feed Systems

• Other Recommendations
  – Install SCADA System
  – Remodel Locker Room, Laboratory
  – Replace deteriorated site paving
  – Replace/Upgrade Building HVAC, Electrical
East WWTP Project Prioritization

- Does not include any collection system improvements
- Immediate Needs
  - Replace gas detection/monitoring equipment in screening room
  - Replace failed clarifier bearing
- Other Projects
  - Phased according to:
    - Regulatory
    - Safety
    - Water quality
    - Capacity
    - Critical Asset
    - Reliability
    - Financial
    - Service Life

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City of Junction City, Kansas
Southwest Wastewater Treatment Plant
Key Issues – Preliminary & Primary Treatment

• Industrial Pretreatment
  – Rotary Screen Clogging and Solids Handling Issues
  – Rotary Screen – Single Point of Failure
  – pH Control Equipment Not Online
  – DAF Unit Inefficient and at End of Useful Life
  – DAF Building
    • HVAC, Lighting, Roof/Structure

• Domestic Pretreatment
  – Influent Pumps – End of Life
  – Influent Screen – Normal Wear
Key Issues – Secondary Treatment

- **Activated Sludge**
  - Aeration System
    - Replace Leaky Piping, Replace Blowers, Replace and Update Instrumentation & Controls, Install Diffused Aeration
  - Anoxic Zone Mixers

- **Secondary Clarifiers**
  - Secondary Clarifiers – Mechanisms Worn
  - RAS Pumps, WAS Pumps, Scum Pump – End of Useful Life

- **Disinfection**
  - Chemical Feed Pumps – End of Useful Life
Key Issues – Biosolids & Nutrient Removal

- **Biosolids Treatment System**
  - Sludge Transfer Pumps – Worn and Deteriorated
  - Aerobic Digesters
    - Construct additional tankage and retrofit existing sludge storage tank
    - Install aeration systems in digesters and instrumentation and controls

- **Nutrient Removal (BNR) Needs**
  - Anaerobic Basin
  - Convert secondary clarifiers to anoxic basins
  - New secondary clarifiers
  - Chemical feed systems
    - Methanol and Alum Feed Needed
  - Recycle Systems
    - Pumps, Pipes, Electrical and Controls
Southwest WWTP Recommendations

• **Maintenance Needs**
  – Replace Industrial Pretreatment Systems
  – Replace Municipal Preliminary Treatment Systems
  – Rehabilitate Secondary Clarifier System
  – Replace pumps, blowers, and mixers
  – Replace Disinfection Chemical Feed Pumps

• **Capacity Needs**
  – Install Aeration System Diffusers and DO Control (Capacity and Maintenance Need)
  – Install Biosolids Treatment System
Southwest WWTP Recommendations

• BNR Needs
  – Modify Existing Secondary Treatment Process
    • Convert Secondary Clarifiers to Anoxic Zone, Install New Secondary Clarifiers
  – Install New Anaerobic Basin
  – Install Recycle Pumping System
  – Chemical Feed Systems

• Other Recommendations
  – Replace/Upgrade HVAC, Electrical in DAF Building
Southwest WWTP Project Prioritization

• Does not include any collection system improvements

• Immediate Needs
  – Replace sludge stabilization tank mixers
  – Replace 1 WAS Pump
  – Replace 2 influent pumps
  – Replace DAF recycle pumps
  – Replace chlorine dosing pumps
  – Replace gas detection/monitoring equipment and room lighting in domestic screening room
  – Replace room lighting in industrial screening room
  – Replace water boiler for rotary screen

• Other Projects
  – Phased according to:
    • Regulatory
    • Safety
    • Water quality
    • Capacity
    • Critical Asset
    • Reliability
    • Financial
    • Service Life

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<td>Contingency</td>
<td>25.0%</td>
<td>$1,361,000</td>
<td>$1,886,000</td>
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<tr>
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<td><strong>SUBTOTAL</strong></td>
<td><strong>$6,505,000</strong></td>
<td><strong>$9,429,000</strong></td>
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<tr>
<td>Engineering, Legal, Administrative</td>
<td>20.0%</td>
<td>$1,361,000</td>
<td>$1,886,000</td>
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<td><strong>TOTAL</strong></td>
<td><strong>$8,266,000</strong></td>
<td><strong>$11,315,000</strong></td>
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<td><strong>TOTAL ALL PHASES</strong></td>
<td><strong>$26,230,000</strong></td>
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Next Steps

• **Water and Sewer Rate Analysis**
  - Revenue Bonds
  - Low-interest Loan
  - Grants

• **Discussions with Armour Eckridge to understand their future needs**
Questions