Wastewater Utility

• 15.5 MGD rated two stage Trickling filter facility with tertiary filtration and year round disinfection
• 189 miles of dedicated sanitary sewer within the City limits
• 14 lift stations constructed to serve the City
• Collection system is maintained by DPW staff and invoiced to WWTF
• WWTF is manned 24/7 with a staff of 6 Operators, 3 maintenance staff of which one is an electrician, 2 lab staff, 3 Supervisory/office
History of WWTF

- Plant was built on its current site in 1939
- Plant upgrades were started in 1954, 1974, and 1998
- Plant design is for solids and carbonaceous BOD removal – not designed for ammonia removal and no Bio –P is possible
Manitowoc WWTF - 1939

- The first treatment plant was built on the site at a cost of $980,000.
- This was a primary treatment plant consisting of primary clarifiers, a primary and secondary digester, and sand sludge drying beds.
- The plant was typical of its time and none of the original plant remains on the site today.

The above modern disposal plant was completed and placed in operation in October, 1940. The intercepting sewers and river crossings carry the sanitary sewage to the plant by gravity. The entire project was completed as P.W.A. Project No. Wis. 1560-F.
First Upgrade – 1954-1956

• The first upgrade began in 1954 and was completed at a cost of $1,430,000.
• The major additions included 3 square final clarifiers, secondary sludge pumping and with the most visible addition being the rock trickling filters.
Rock filters

- Low tech and effective secondary treatment using attached growth process for bioconversion
- Distributors are pushed hydraulically and still in operation today
Second upgrade 1974-1976

- Major plant upgrade to increase both hydraulic and organic capacity and to accommodate growth within the city and the Clean Water Act of 1972.
- The project addressed organic overloading by adding stack trickling filters along with three circular secondary clarifiers, and repurposing the then three square finals as primary clarifiers.
- Tertiary sand filters were constructed to further remove suspended solids and BOD.
- Chemical storage tanks and feed pumps were added to precipitate and settle phosphorus from the effluent.
- Completed in 1976 the upgrade cost was $19,500,000
Third Upgrade 1998-2001

• The most recent upgrade was completed in 2001 at a cost of $20.3M.
• Three separate structures were demolished and replaced with a new preliminary treatment building that incorporated influent pumping, screening, and grit removal into one building.
• A new circular primary clarifier was built effectively doubling primary clarifier capacity
• The stack filter booms were refurbished and motorized drives were added to control media wetting rates and biogrowth
• A new rock filter pumping station and replacement and automation of the tertiary filter operations were the major liquids process improvements
Third Upgrade 1998-2001

• The primary digester covers were replaced with new floating gas holder covers with integrated draft tube mixers
• Belt presses and cake loading station were included to provide for flexibility in disposal of biosolids
• PLC’s, SCADA controls, and automation were a major component of the plant upgrade
Since 2001 ..... 

• 2014 Digester roof replacement (leaking section) 
• 2014 Rebuilt West stack filter pump 
• 2014 Installed new Varec methane flare 
• 2014 Replaced final clarifier actuators and valve shafts 
• 2013 Stack filter Roof replacement (leaking) 
• 2013 Chem Scan Ortho P analyzer & programming 
• 2013 ONR Review-Strand Associates 
• 2012 Chlorine Feed Equipment replaced 
• 2011 Digester recirculation pump (West)
Since 2001 ..... 

• 2010 WWTF Facility Assessment
• 2010 Step screens and washer/compactors
• 2010 Digester recirculation pump (East)
• 2009 40th and Archer LS replacement
• 2008 Tertiary Filter Upgrade/Media replacement
• 2007 SCADA software update, programming, and computer replacement
• 2006 Ferric Chloride storage tank
• 2005 Laboratory Remodel (asbestos hoods)
• 2005 Irving Circle LS replacement
Current Processes

- Preliminary treatment
- Primary Treatment
- Biological conversion
- Chemical addition – ferric chloride
- Clarification/Filtration
- Disinfection
- Solids handling and Disposal
Preliminary Treatment

• Raw wastewater pumping
• Screening
• Grit removal
Raw Wastewater Pumps

- Influent wastewater enters plant through 60” gravity interceptor sewer
- Three 84” Lakeside spiral screw pumps has 18 MGD capacity and raises the sewage into the preliminary treatment building
Screening 1998 → 2010

Bar Screens ¾” spacing

Step Screens 1/8” spacing
Step Screens 2010

- Vulcan step screens remove debris that can cause clogging to pumps & piping

- Screens deposit debris to a mated washer compactor that reduces organic material and squeezes out free water from the collected screenings
Grit Removal

• Grit removed by two pista grit systems to remove heavy inorganic material
• Removing grit helps minimize abrasion and wear on pumps and equipment further down the treatment line
Primary Clarifiers

• Wastewater flows from preliminary treatment building into four primary clarifiers, three rectangular and one circular
• Primary sludge averages from 4-5% solids and goes directly to the primary digesters – the primary effluent moves onto the stack filters for biological treatment
Trickling filters

- Manitowoc uses a trickling filter process consisting of two stack filters followed by two rock filters
- Stack effluent typically contains 40-60 mg/L soluble BOD
Stack Filters

- Added in 1974
- Two high-rate filters with plastic media in a 20-foot honeycomb pattern provide a large surface area for growth and attachment of aerobic bacteria
- Three pumps pump the primary effluent from the wet well to the center column and rotary distributors
Rock Filters

- Built in 1954 and continue in service to provide polishing for the remaining BOD
- 8’ deep rock media
- Sloughed biomass dies off and releases from the media and is captured in the final clarifiers
Phosphorus Removal

- Ferric chloride added prior to the final clarifiers
- Ferric is precisely dosed based on the output from an online orthophosphate analyzer that samples every 15 minutes and adjusts the chemical pump output if needed
## Ferric Chloride Consumption

<table>
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<th></th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
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| Gallons FeCl3  | 140952  | 138736  | 104174| 97016 | 113600|     |     |       |           |         |          |         |
Final Clarifiers

- Four tanks receive the effluent from the rock trickling filters
- Sludge removed by a rotating arm collector mechanism and pumped into the primary digester
- Trickling filter sludge settles readily to about 3.0% solids
Tertiary Filters

- Four tertiary sand filters remove the fine solids
- Media is a uniform particle size and density so it doesn’t wash through the filter during the backwash sequence
- Filters remove remaining suspended solids lowering the effluent BOD and some phosphorus being held in the solids
Disinfection

• Chlorine is added to the tertiary filter effluent to meet the year round disinfection permit requirement
• Sodium bisulfite is added to scavenge remaining chlorine prior to discharge to Lake Michigan
## Plant Design Parameters-2001

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<tr>
<th>Plant Design Parameters</th>
<th>Design Capacity of Plant</th>
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<td>EFFLUENT L Monthy Average</td>
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<tr>
<td>P, mg/l</td>
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Anaerobic Digesters

- Sludge from primary and secondary clarifiers pumped directly to the 2 primary digesters
- Methane produced is utilized in plant boilers for digester and plant heat in a hot water loop system
- The secondary digester is unheated and is essentially a decanting storage tank
Biosolids lagoons

• Digested biosolids are trucked to clay lined storage lagoons located on the west side of Manitowoc

• Veolia uses floating dredge or manure pump to mix and pump biosolids for trucking to the application sites
Land Application

- Biosolids are land applied in fall and injected into the soil.
- Applied at the agronomic rate indicated by soil analysis testing and future crops to be grown.
- In 2014 we produced 6.4 million gallons biosolids that were applied to 395 acres.
Questions?
Driving Directions

1222 South Alverno Road, Manitowoc, WI 54220, USA

5.6 mi - about 11 mins

1. Head south on S Alverno Rd 79 ft toward W Custer St
2. Turn left at the 1st cross street onto W Custer St
3. Turn right onto S Rapids Rd 0.5 mi
4. Turn left onto Dewey St 2.5 mi
5. Turn left onto S 10th St 0.7 mi
6. Turn right onto Madison St 0.2 mi
7. Continue onto S Lakeview Dr 11.8 ft
   Destination will be on the right

1015 South Lakeview Drive, Manitowoc, WI 54220, USA