Sustainable Maintenance Approaches

Sanitary Sewer Siphons vs. Pump Stations
An analysis of a recent siphon blockage in the Millbury/Vernon Street Area
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- Population: approximately 181,000 residents
- Miles of Sewers: 377 miles of sewers (8” to 96”)
  329 miles of drain (8” to 156”)
  59 miles of combination (8” to 240”)

Images of sewer infrastructure.
City of Worcester, MA

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• Number of manholes:
  – 2,621 combination manholes
  – 13,919 drain manholes
  – 14,710 sewer manholes
  – 3,213 twin manholes
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- Number of catch basins: 15,751
- Number of Outfalls: 344 (8” to 72”x74”)
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- Number of sewer pump stations: 30 (1,500 GPD to 4 MGD)
- Number of stormwater pump stations: 2
- One CSO treatment facility
- Number of siphons: 19
- Number of regulators: 30
Major Sewer Service Areas

- Cambridge Street
- Western Interceptor
- Eastern Interceptor
- Lake Ave Corridor
<table>
<thead>
<tr>
<th>Street Name/PS Name</th>
<th>Service Area Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUINSIGAMOND AVE</td>
<td>Cambridge - Gravity</td>
</tr>
<tr>
<td>GRAFTON ST</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>DUNKIRK AVE</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>MILLBURY ST</td>
<td>Under Construction - Pumped</td>
</tr>
<tr>
<td>HEMLOCK ST</td>
<td>Cambridge - Gravity</td>
</tr>
<tr>
<td>BRIDLE PATH</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>SOUTHWEST CUTOFF</td>
<td>No Sewers</td>
</tr>
<tr>
<td>MAJOR TAYLOR BLVD</td>
<td>East - Gravity</td>
</tr>
<tr>
<td>CROWNINGSHIELD RD</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>LIVERMORE ST</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>OAK BEACH TER</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>PROCTOR ST</td>
<td>East - Gravity</td>
</tr>
<tr>
<td>SHREWSBURY ST</td>
<td>East - Gravity</td>
</tr>
<tr>
<td>SUNTAUG RD</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>BROOKHAVEN RD</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>WHITLA DR</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>PINELAND AVE</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>BROOKHAVEN RD</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>SEARS ISLAND DR</td>
<td>East - Gravity</td>
</tr>
<tr>
<td>JAMES ST</td>
<td>Cambridge - Gravity</td>
</tr>
<tr>
<td>WEBSTER ST</td>
<td>Cambridge - Pumped</td>
</tr>
<tr>
<td>LAKE AVE</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>GREENWOOD ST</td>
<td>Main Interceptor - Pumped</td>
</tr>
<tr>
<td>HOLDEN ST</td>
<td>East - Pumped</td>
</tr>
<tr>
<td>MILLBURY ST</td>
<td>Main Interceptor - Gravity</td>
</tr>
<tr>
<td>CAMBRIDGE ST</td>
<td>Cambridge - Gravity</td>
</tr>
<tr>
<td>MAIN ST</td>
<td>Cambridge - Pumped</td>
</tr>
<tr>
<td>LINCOLN SQ</td>
<td>East - Gravity</td>
</tr>
<tr>
<td>WALLER AVE</td>
<td>Cambridge - Pumped</td>
</tr>
<tr>
<td>WHITLA DR</td>
<td>East - Pumped</td>
</tr>
</tbody>
</table>

**Sewershed Areas**
- Cambridge, Gravity
- Cambridge, Pumped
- East, Gravity
- East, Pumped
- Main Interceptor, Gravity
- Main Interceptor, Pumped
- West, Gravity
- No Sewers
- Under Construction, Pumped

1 inch = 5,000 feet
Pump Stations Issues

• Software/SCADA can be a headache.
• Require maintenance & upgrades.
• Expensive. City has $500,000/year maintenance budget.
• Mechanical parts break.
• Uses electricity.
• Finite life spans.
# Siphons in the City of Worcester

<table>
<thead>
<tr>
<th>Address</th>
<th>Size</th>
<th>Length</th>
<th>Directions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newton Ave North @ Suburban Rd</td>
<td>15&quot;</td>
<td>27.5</td>
<td>Flush from MH4 to MH5</td>
</tr>
<tr>
<td>267 Chandler</td>
<td>8&quot;</td>
<td>52.2</td>
<td>Flush from MH9 to MH12</td>
</tr>
<tr>
<td>559 Park Ave</td>
<td>15&quot; and 10&quot;</td>
<td>66.3</td>
<td>Flush from MH8 to MH9 in 10&quot; and 15&quot; sewer</td>
</tr>
<tr>
<td>24 Mill St</td>
<td>30&quot; and 18&quot;</td>
<td>57.8</td>
<td>Flush both 30&quot; and 18&quot; sanitary from MH21388</td>
</tr>
<tr>
<td>19 Glenine St</td>
<td>Twin 10&quot;</td>
<td>60.4</td>
<td>Flush both barrels from East to West</td>
</tr>
<tr>
<td>Glenine St @ Millbrook St</td>
<td>Twin 24&quot;</td>
<td>64.8</td>
<td>Flush both barrels form MH 9 (South) to MH 9 1/2 (North)</td>
</tr>
<tr>
<td>151 West Boylston Dr</td>
<td>8&quot; and 12&quot;</td>
<td>38.7</td>
<td>Flush both 8&quot; and 12&quot; from MH 29 1/4 (West) to MH 29 1/2 (East)</td>
</tr>
<tr>
<td>Home Depot @ Gold Star Blvd</td>
<td>Twin 24&quot;</td>
<td>48</td>
<td>Flush both barrels from MH 16 1/4 (South) to MH 16 1/2 (North)</td>
</tr>
<tr>
<td>160 Gold Star Blvd</td>
<td>Twin 18&quot;</td>
<td>34.1</td>
<td>Flush both barrels from MH 17 (S) to MH 18 (N)</td>
</tr>
<tr>
<td>Garden St - A</td>
<td>Twin 10&quot;</td>
<td>68</td>
<td>Flush both barrels from MH 2 1/2 (West) to MH 2 1/4 (East)</td>
</tr>
<tr>
<td>Garden St - B</td>
<td>Twin 15&quot;</td>
<td>60.4</td>
<td>Flush both barrels from MH 3 (West) to MH 2 (East)</td>
</tr>
<tr>
<td>40 Webster St</td>
<td>18&quot;</td>
<td>72.5 (?)</td>
<td>Flush from MH 6 (North) to MH 7 (South)</td>
</tr>
<tr>
<td>241 Grove St</td>
<td>20&quot;</td>
<td>55</td>
<td>Flush from MH near North St (SE) to MH near Sagamore Rd (NW)</td>
</tr>
<tr>
<td>51 Summer St</td>
<td>4 x 24&quot;</td>
<td>135</td>
<td>Flush four barrels from MH 13 or closer (SE) to MH 14 (NW)</td>
</tr>
<tr>
<td>Southbridge St Under 290 Bridge</td>
<td>24&quot;</td>
<td>200</td>
<td>Flush from MH 7 (N) to MH 8 (S)</td>
</tr>
<tr>
<td>1090 Main St</td>
<td>30&quot;</td>
<td>83.6</td>
<td>Flush from MH 1 (East) to MH 8 (W)</td>
</tr>
<tr>
<td>Quinsigamond Ave @ Cambridge St</td>
<td>3 x 30&quot;</td>
<td>215</td>
<td>Flush three barrels from Cambridge St side towards Quinsig Ave</td>
</tr>
<tr>
<td>Quinsigamond Ave @ 146 on ramp</td>
<td>3 x 30&quot;</td>
<td>65</td>
<td>Flush three barrels from Cambridge St side towards Millbury St</td>
</tr>
<tr>
<td>Millbury St Under 146</td>
<td>18&quot;</td>
<td>110'</td>
<td>Flush from MH S-3 to MH S-2 (Millbury St)</td>
</tr>
</tbody>
</table>
Siphon Issues

• Different designs and applications in the city.
• Lower maintenance than pump stations.
• Blockages can get messy and are tough to resolve.

Siphon crossing under the Millbrook Conduit @ Quinsigamond Ave
Millbury Street Siphon

- Approx. 650 feet in length.
- Entire length is under pressure.
- Two cleanouts.
- Enters into 84” RCP sanitary sewer near McKeon Rd.
Sewer crosses under:
- Rt. 146
- Mill Brook Conduit
- P&W Railroad Location
- Middle River
Siphon Timeline

• 18” sewer first mentioned in 1915 Annual Report.
Siphon Timeline

• Intended to flow as a gravity sewer.
1915: Conversion to 18”

- Pipe was installed in an existing 42” host pipe.

“An 18” Akron pipe was placed inside and close to the arch of the old sewer, and the remaining space was completely filled with screened gravel.”
1980s: Contract 19

- 84” interceptor sewer
- 18” sewer
- Inv Elev = 430’
Mill Brook Conduit work included removing top 4’ of granite arch and replacing it with a cast-in-place reinforced concrete cap.
Siphon Blockage and SSO
Millbury St Siphon Service Area

- Approximately 600 parcels.
- An estimated 6,600 gallons of sewage entered the Blackstone due to blockage.
Saturday 9/24/16

• Passerby see sewage coming out of manhole on Millbury St and calls customer service.

*This is not the actual SSO*
Saturday

- Flusher responds and frees blocked sewer.
- We believe debris was flushed downstream and blocked up the siphon.
Saturday night into Sunday

• Flow is managed by three hired septic haulers.
• No loss of service reported in the area.
• Dumped sewage into a local gravity sewer.
Monday Morning

- Septic haulers continue to work around the clock.
- A pump is set up on the downstream side of the second siphon to lower the operating elevation of the system.
Monday – Siphon is blocked

• Catch basin machine set up on Rt. 146 due to limited access to downstream MH.

• Dredger removes 6-10 yards of rags, flushable wipes and grease from MH.
Tuesday

- Dredger work shuts down at 4 PM due to safety concerns.
- Two legs coming into the siphon became exposed overnight on Tuesday due to the low flow conditions and increased capacity downstream.

Flow into the siphon was plugged overnight on Tuesday

Upstream MH S-3
Wednesday

• 3” submersible pump brought in to expose invert of outgoing siphon pipe.

• Hired vac-flusher brought in to clean 18” siphon from upstream MH.

• One yard of gravel removed from siphon.
Cost

- 10 Sewer Operations personnel dedicated to this location over a three day span.
- Overnight supervision of job site.
- Three large septic haulers: three straight days.
- Hired vac-flusher for 15 hours.
- Police detail for Rt. 146 – two officers for three eight-hour shifts.
- Still much cheaper than designing, building and maintaining a pump station to service this area.
Lessons learned/conclusions

- Improve monitoring of pre-1900 sewers.
- Schedule & document inspections and cleanings when necessary.
- Record drawings need to be readily available and properly catalogued.
- GIS needs to be updated to ensure accuracy.

LIST OF REFERENCE DRAWINGS

- 1915 Annual Report
- Worcester Sewer Dept. 40-Scales Book 10 - Sheets 14 and 15
- Rt.146 - Hurley Sq Contract Utility Plan Sheet 3 and 6
- Contract 19 Sheet 14
Lessons learned/conclusions

• Targeted public outreach/education associated with flushable wipes, grease, etc. to entire service area.
Questions?

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Thanks!