Agenda:

- Large Sewer Inspection with MSI Technologies
  - Traditional CCTV
  - Laser Profiling
  - Sonar Profiling
  - Pipe Penetrating Radar (PPR)
- Alternative Techniques for Sewer and Manhole Inspections
  - Man-Entry Action Camera Video
  - Manhole Inspections
  - Odologgers
- Data Management and Deliverables
Multi-Sensor Sewer Inspections
CCTV, Laser Profiling, & Sonar
Multi-Sensor Sewer Inspections
CCTV, Laser Profiling, & Sonar
Sonar Data / Graph Review

### PCI-745 - PCI-75

<table>
<thead>
<tr>
<th>Asset Number</th>
<th>PCI-745 PC-75</th>
<th>Length</th>
<th>342.9 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upstream MH</td>
<td>PCI-745</td>
<td>Dimensions</td>
<td>48” x 59”</td>
</tr>
<tr>
<td>Downstream MH</td>
<td>PCI-75</td>
<td>Material</td>
<td>Reinforced Concrete Pipe</td>
</tr>
<tr>
<td>Survey Direction</td>
<td>Downstream</td>
<td>Shape</td>
<td>Other</td>
</tr>
<tr>
<td>Date Installed</td>
<td>Match to Reference</td>
<td>1</td>
<td>312.7 ft</td>
</tr>
<tr>
<td>Date Profiled</td>
<td>09 September 2014</td>
<td>Operator</td>
<td></td>
</tr>
</tbody>
</table>

### Observations

<table>
<thead>
<tr>
<th>Debris Graph</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Debris Depth</td>
<td>12 in</td>
</tr>
<tr>
<td>Average Water Level</td>
<td>27 in</td>
</tr>
<tr>
<td>Debris Volume</td>
<td>855.4 cubic feet</td>
</tr>
</tbody>
</table>

### Debris Graph

*The match to reference is the point that best indicates the shape and size of the original condition of the pipe.*
CCTV & Laser Review

Observation Report

Rehab Ph. 1: CCCPL / Geopolymer

$9M / 13k = $700/ft
Pipe Penetrating Radar (PPR) 
Case Study: Cochella Valley CA

- SewerVue
  - In-Pipe Ground Penetrating Radar
  - Identify and quantify voids behind the pipe wall
  - Approximates wall thickness
  - Robot rotated sensors between 9 o’clock & 12 o’clock
  - Rotated sensors between 10 o’clock and 2 o’clock on return
Pipe Penetrating Radar (PPR)

- **SewerVue**
  - In-Pipe GPR
  - Can identify and quantify voids outside/behind the pipe wall
  - ~$10 per foot
Multi Senor Inspections (MSI) Pros and Cons

- **Pros:**
  - Detailed pipe information on dimensions and debris
  - Equipment can tolerate unsafe and toxic gases
  - Multiple sensors/equipment can collect information simultaneously
  - Can float equipment on top of high flow conditions

- **Cons:**
  - Relatively expensive ($4 to $10 per linear foot)
  - Time to collect, process, and analyze data
  - Coordination with limited specialty contractors who are typically very busy
  - Data can be challenging to interpret and sometimes misleading
Man-Entry Sewer and Manhole Inspections

- Storm and Combined Sewer with Action Cameras and Zoom Cameras
  - Provides good alternatives to CCTV
  - Can be done in NASSCO PACP formatting with post processing

- Manhole Inspections with tablets, pole-mounted action camera connected via bluetooth cell phone
  - Allows detailed photos and video that meet MACP Level 2 Inspections
Man-Entry Equipment
Man-Entry Inspection Equipment (cont.)
Man-Entry GoPro Inspections

- Man-entry pipe inspections during the summer of 2016
- 14,060 LF of Man-entry inspections
- 33,750 LF of traditional CCTV
- Man-entry: $2.00 to $3.00 per LF
- MSI: $4.00 to $5.00 per LF
Man-Entry GoPro Inspections

~ 2500’ in one walk
GoPro Data Conversion

- Download data from GoPro
- Open blank .ptd file and code video based on observations
- Use video converter to convert video from .mp4 to .mpg
- Combine .ptd files into a data library and link video files
Manhole Inspection and Assessment

H2S (ppm)

- 60 ppm
- 40 ppm
- 20 ppm
- 10 ppm

Temp.
Scioto Main 120” Assessment and Rehabilitation Project
Columbus, OH Man-Entry with Diving Team
Columbus, OH Man-Entry with Diving Team
Columbus, OH Man-Entry with Diving Team

- Schmidt Hammer Test
- Six test on each side of pipe
- Avg. 54 = 7700 psi
- Avg. 50 = 6700 psi
Columbus, OH Man-Entry with Diving Team

- Successfully performed Schmidt Hammer test
- Confirmed pipe wall is sound
- Removed portion of failing liner
- Determined length of blockage ~44 ft
Man-Entry Pros and Cons

**Pros:**
- Hands-on assessment of pipe condition by experienced engineers
  - NDT Testing (ie. Schmidt Hammer)
  - Measuring Taps, Debris etc.
- Low cost mobilization and deployment
- Less Scheduling Conflicts
- Multiple platforms to collect data
- Crews are able to navigate obstacles (debris, drops etc.)
- No Distance Restrictions
- Better control of lighting and camera location / panning

**Cons:**
- Large onsite crew for safety; Safety Training;
- Must purchase wide variety of Camera, CSE, Traffic, Safety equipment
- Can’t perform all pipes due to flow and gas conditions
- More issues with weather
- No on-screen display of distances and codes were manually written
Questions?