Reinventing CSO Solutions

City of South Bend, Indiana

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Population: 101,516
Established: 1865
Treatment Plants: 1 (70MGal/day)
Outfalls: 35
CSO Overflow: 1-2 BGal/year
Abatement Plan: $860MM
Phase 2 is an exclusively grey infrastructure approach. Unfortunately no smart or green technology.

- 7 Storage tanks
- 1 Storage conduit
- 1 parallel interceptor
Residential Indicator across South Bend

• MHI 35% below National Average

• 1 in 5 Residents over 10% of MHI

Per Capita Income $19K

>20% residents make <$15K

Phase 2 cost $713m. That’s $10K for man, woman and child
#1 Turn on the lights

2008:
150 Sensors
Flow and level
5 Minute Data in Real Time

Most densely monitored Sewer System in the World
11,826,000 hours or 1,350 years of data
#2 Operate the Sewershed

Interceptor: “I’ve got capacity at $3 per gallon”

CSO 3: “I’ll buy it at $1.5”

CSO 6: “I’ll buy it at $2 per gallon”

CSO 22: “Wait, I’ll pay you $4 a gallon!”

“I’m about to overflow!”
#3 Modeling; the basis of any LTCP

A Conservative Model or an Underestimating Model? Both at the same time!
#3 Old/Existing LTCP Model

Nash-Sutcliffe Coefficient for Original LTCP Model: 0.29

Score of 1 = Perfection
#3 New Data Driven Model

Nash-Sutcliffe Coefficient for CHRS Model: 0.93
Revising the LTCP - summary of previous slides

1. Data-driven maintenance created increased capacity;
2. Real Time Control exceeded expectations in reducing overflows;
3. New hyper-accurate model shows deficiencies in old LTCP model;
4. Original LTCP builds infrastructure but would not address the problem.

Novel South Bend Proposal:
We use our smart sewer data and new model to optimize the LTCP in the cloud!
Revising the LTCP: OptiSWMM

Previously we described how we came up with a better model- meaning, from a quality perspective, it was a better, more quality, product.

The next step regards the frequency of ‘running’ that new model.

Introducing OptiSWMM- allows us to run 1000s upon 1000s of model runs, not just a few scenarios like before. This allows many more permeations of LTCP alternatives to be considered.
LTCP update- how we were able to change

Sewer sensors + time = system knowledge

System knowledge informing model with real data (CHRS data)

Real Data (CHRS data) + Optimization modelling x 10,000’s runs (via OptiSWMM)

Next Generation Data Driven alternative
Smarter Alternative for a Greener Alternative

Plus Green stormwater Infrastructure
Smart Infrastructure Results

100% Dry Weather Overflow Reduction within 18 months
SMART SEWER RESULTS
WET WEATHER REDUCTION

Overflow Volume, MG
Rain, IN

Removing 1,000 year storm of August 2016
### Cost of Compliance

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Typical Year Overflow (MG)</th>
<th>Reduction (MG)</th>
<th>Cost (MM)</th>
<th>Cost/Gal ($/Gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline (no improvements)</td>
<td>2,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Now</td>
<td>607</td>
<td>1,393 (all projects)</td>
<td>115</td>
<td>0.08</td>
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<tr>
<td></td>
<td></td>
<td>462 (non-CSOnet)</td>
<td>105</td>
<td>0.23</td>
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<td>931 (only CSOnet)</td>
<td>10</td>
<td>0.01</td>
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</tbody>
</table>

Note: South Bend separated approximately 3K acres of its 13K acres of combined sewers. Non CSOnet-attributed CSO reductions estimated as Dec 17 of baseline overflow volume or 462MG.
Revising the LTCP: Optimization

Try every possible grey, green, and smart infrastructure option.

$713MM

$200MM

Equivalent Environmental Benefit

$608 savings per household/year