Big Pipes Plus Low Flows Equals Cost Savings
Timothy Ruggaber, P.E., EmNet, LLC
Oluwale McFoy, P.E., Buffalo Sewer Authority
The Tale of One City

Buffalo's Population

Collection Systems 2015
The Tale of One City

June 6, 2013 - 1.4" Rain - Monitored Depth vs. Pipe Height
Bird Ave. Trunk

HUGE, UNUSED PIPES!
The Tale of One City

- 16 in-line storage sites
- Primary focus of LTCP
- 3 unique watersheds
- 1 WWTP (560 MGD)
The Tale of Two Sites

• Two Sites In Construction
  – Bird Ave. RTC Site
  – Lang RTC Site
• Very Different
The Tale of Two Sites

Bird Ave. RTC Site

1880’s
1.0 MG Volume
270 cfs capacity

Lang RTC Site

1960’s
0.8 MG Volume
500 cfs capacity
The Tale of Two Sites

Bird Ave. RTC Site

Granite
(no blasting allowed – densely populated)

Lang RTC Site

Granite
(blasting allowed – loosely residential)
The Tale of Two Sites

Bird Ave. RTC Site

Lang RTC Site
But what about the big storms?
Design Criteria

- Water must stay below safe level at **ALL** times
  - 8’ freeboard or fully contained in pipe
- Redundant redundancy
  - Two gates
  - Overflow weir
  - Backup generator
- Pass pipe capacity (5 year storm)
- Self cleaning
- Easily understood, KEEP IT SIMPLE!
RTC Chamber
Each gate can pass >50% pipe capacity
Plan View

Weirs can pass full pipe capacity
Bird Ave., Before RTC
Peak of 5 Year Storm
Bird Ave., After RTC
Both Gates Closed
Peak of 5 Year Storm
Profile View
Self Cleaning

Velocity Comparison with and without gates

- Velocity without gates (fps)
- Velocity with gates (fps)
Control Logic

Begin
LeadGate=0
LagGate=1

BirdUSLevel < STARTCONTROL TRIGGER (0.75 ft)

AUTOEXERCISE

AutoExercise

AutoExercise Routine

Set LeadGate@100%
Set LagGate@100%

KeepLevelBird

Swapping Gates

Set LeadGate@SetPoint
Set LagGate@0%

BirdUSLevel < MAXLEVELTRIGGER (8.05 ft)

Calculate SetPoint from Lookup table (X=BirdUSLevel, Y=SetPoint) (see table)

ClampSetPoint

SetPoint <= 100%

Set LeadGate@SetPoint
Set LagGate@0%

SetPoint < OPENING090

Set LeadGate@SetPoint
Set LagGate@0%

SetPoint > NORMALTRIGGER (0.65 ft)
Current Status
Current Status
Storage and Integrated Planning
Storage and Integrated Planning

- Smith St. Drain
- 16’ W x 11.5’ H
- Storage in overflow line
- 45 regulators send flow
- Multi-faceted solution
  - Storage is the foundation
  - Green augments
  - Gray caps it off
In-line Storage

Outfall

South Interceptor
In-Line Storage

- Fill and drain by gravity
- 4.6 MG of storage
In-Line Storage

May 31, 1993 Storm Event
Flows at Perry Gate on Smith St. Drain

- 90 MG annual overflow reduction
Green Augmentation

Turn abandoned properties into green space
Localized Separation
Get Downstream Regulators in Compliance
Result

Storage + Green + Gray =

ALL REGULATORS IN COMPLIANCE
Benefits

- ROI figures of 5X or larger are considered viable
- Unit cost of avoided CSO is typically < $2 per gallon
- 423MG of avoided CSO during the typical year @ $37M

<table>
<thead>
<tr>
<th>Site</th>
<th>CSO storage</th>
<th>Cost</th>
<th>$/gal</th>
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</thead>
<tbody>
<tr>
<td>Lang</td>
<td>1.8MG</td>
<td>$3.2M</td>
<td>$1.78</td>
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<tr>
<td>Bird</td>
<td>4.6MG</td>
<td>$5.0M</td>
<td>$1.09</td>
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</table>
Keys to Success

**Transparent:** Glass Box approach enables 3\(^{rd}\) party verification

**Collaborative:** Co-design with utility staff and consultants

**Sustainable:** Open source and open architecture design

**Scalable:** Iterative or comprehensive implementation

**Robust:** Fault tolerance built in by design

**Partnership:** Continuous system improvement over time
Questions?