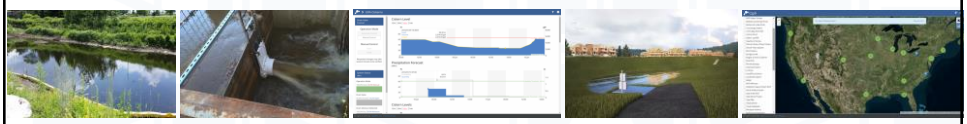
ADDRESSING STORMWATER GOALS WITH CONTINUOUS MONITORING AND ADAPTIVE CONTROL

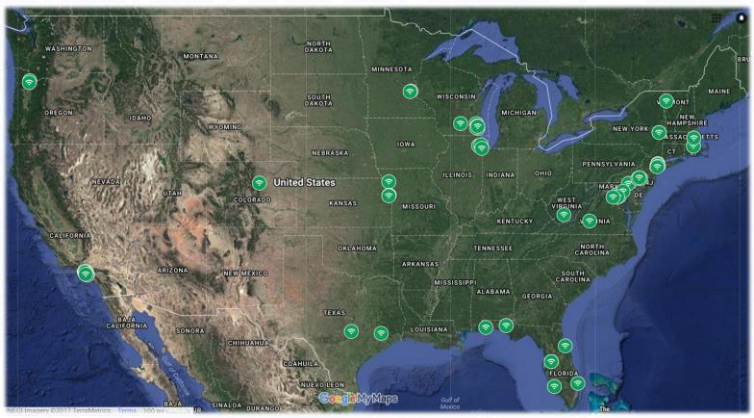
WEF eShowcase

July 27, 2017



Marcus Quigley - OptiRTC, Inc.

The Opti Community



- Initial research by NOAA, EPA, WERF in 2007
- Full commercialization of technology in 2014
- Deployed over 130 commercial and public projects across 21 states
- >45M gallons storage under active management

Regulatory Approvals

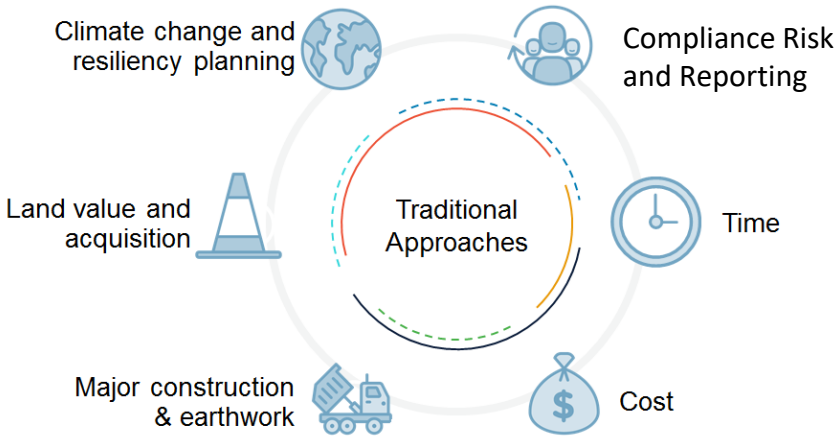
MD Dept. of the Environment
01/27/2016

Chesapeake Bay Program
11/15/2016

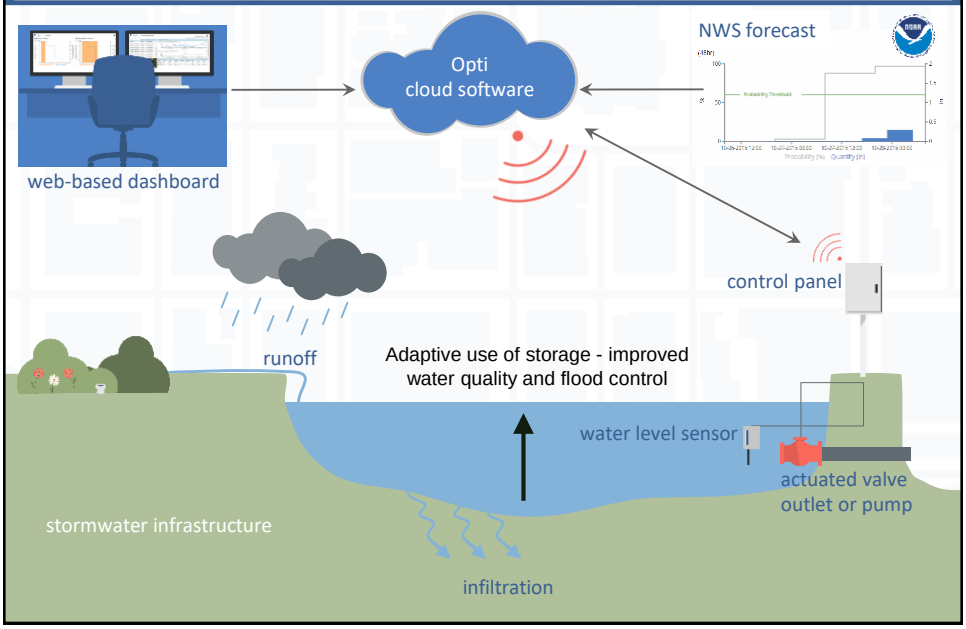
Typical Urban Stormwater Challenges

Flooding	Combined Sewer Overflows	Water Quality
		
• Economic Impact • Social Impact • Environmental Impact	• 40 million people in 32 states • 850 Billion gallons of untreated sewage	• Sediment • Nutrients • Trash/Debris

Opportunities to enhance traditional approaches



Continuous Monitoring and Adaptive Control (CMAC)



Field View of Hardware Components

Range of CMAC applications

Small	Medium	Large
		
Application Water Reuse **Scale** Residential (gallons)	**Application** Water Quality **Scale** Development (cubic feet)	**Application** Flood Control **Scale** Regional (acre feet)

Case Study: Philadelphia

CSO mitigation on private property

8-acre drainage area
Adaptively Controlled Retention

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PHILADELPHIA WATER

SMIP CMAC retrofit at Cintas Corporation

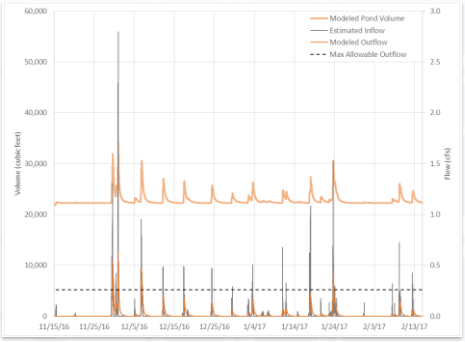
Integrated CMAC

Project Timeline (award to run)	6 months
Incremental Benefit	3.3 Green Acres
Capital Cost	$48,000/GA
Net Savings for Cintas	~$17,000/yr

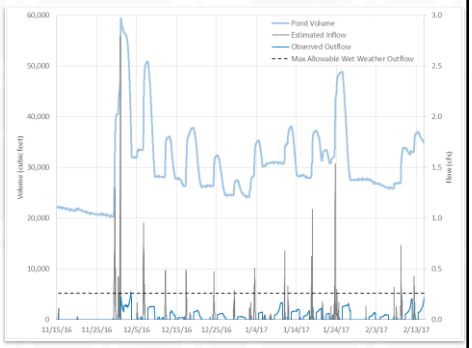
CMAC performance analysis

Integrated CMAC

Modeled pond volume and flows with passive outlet control



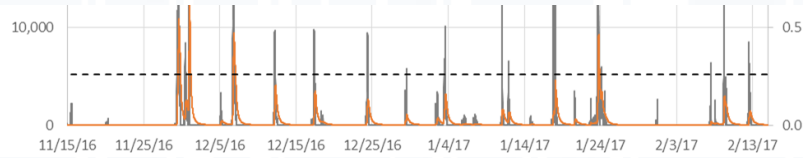
Observed pond volume and flows with Opti system control



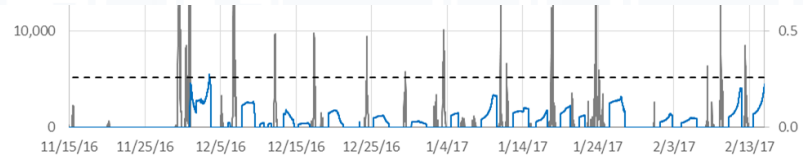
- CMAC system exceeded PWD's criteria for wet weather site discharge by completely avoiding wet weather outflow for nearly all rain events.
- In total, during a period with approximately 1.01 million gallons of runoff generated from 14 storm events, the system prevented 0.97 million gallons of water from entering the combined sewer during wet weather.

A closer look at flow

Integrated CMAC



Modeled flows with passive outlet control



Observed flows with Opti system control

CMAC resulted in a **96% reduction** in wet weather flow volume
(1.01M gallons of runoff to 40K gallons)

Case Study: Ormond Beach, FL

Flood protection

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CITY OF ORMOND BEACH ★ FLORIDA ★

2009 flood, a historic storm event in Ormond Beach

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Laurel Creek Basin project background

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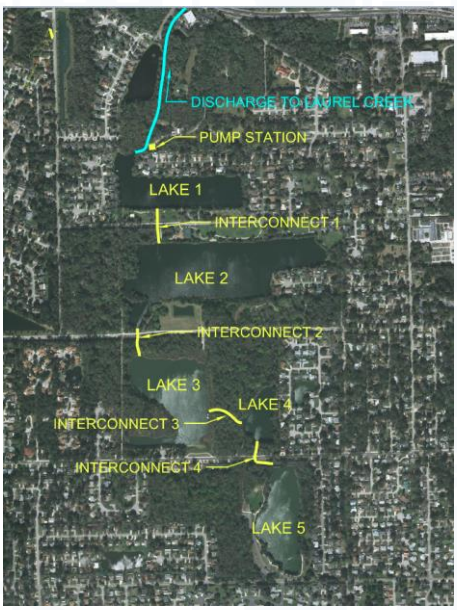
550-acre drainage basin

5 existing lakes (low lying area)

Single family developments

Existing pumps at Lake 1



Responding to the floods in Ormond Beach

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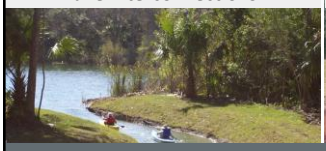
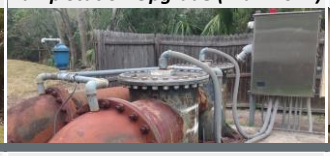
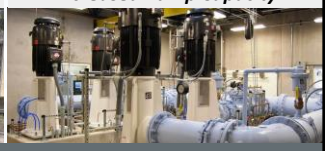
Phase 1: $3.4M *Lake Interconnections*	Bridge: $200K *Pump Station Upgrade (Mar. 2017)*	Phase 2: $8M *Increased Pump Capacity*
		
Why ● Reduce localized flooding	**Why** ● Address uncertainty of Phase 2	**Why** ● Eliminate localized flooding
What ● Interconnection of 5 Lakes ● Downstream sluice gates for tide control (bypass pumping)	**What** ● **Forecast-based control** ● Variable Frequency Drive ● Generator	**What** ● Additional pump stations with discharge to intercoastal waterway
Additional Benefits ● Aesthetic and recreational	**Additional Benefits** ● Asset management and maintenance inspections ● Decision support ● Insurance policy	**Additional Benefits** ● Reduction of 100-year flood stage

Ormond Beach web-based dashboard

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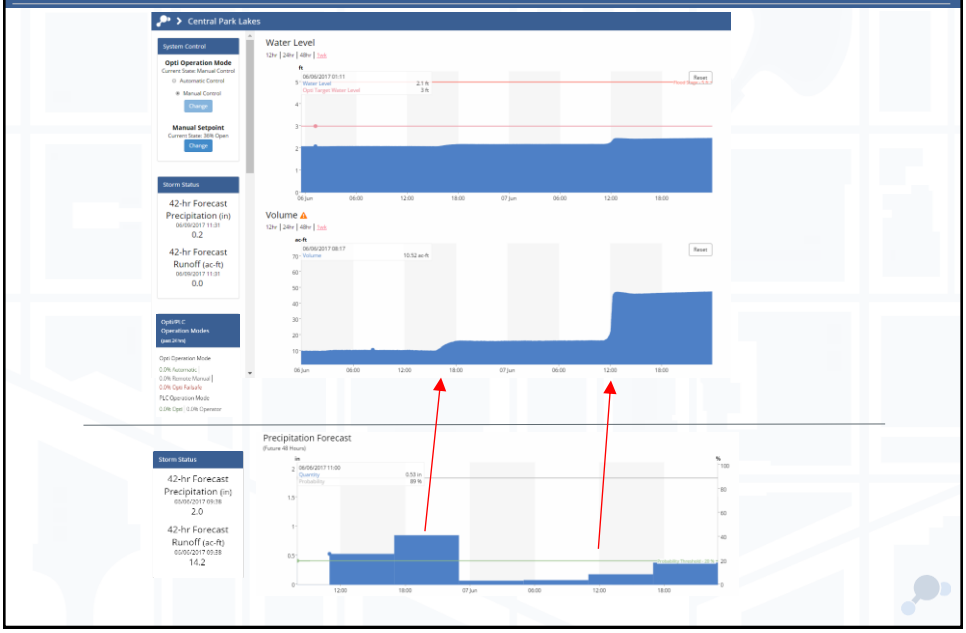

Case Study: Lenexa, KS
water quality + flood protection

Adaptively Controlled Retention

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Lenexa KANSAS

CMAC in Lenexa, KS

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Goal: Water quality improvement while increasing flood control capacity
Construction: Retrofit existing outlet structures (City of Lenexa performed retrofit)

CMAC in Lenexa, KS

Integrated CMAC

CMAC Simplified Logic

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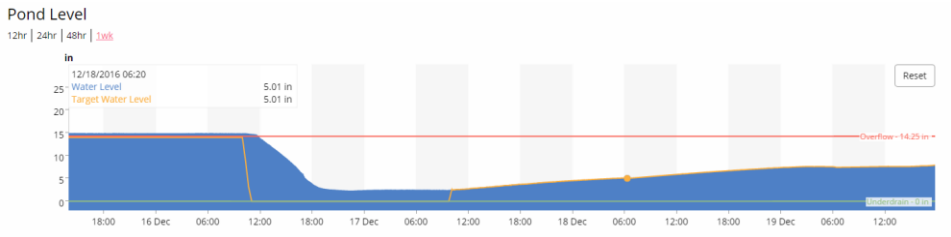
- **Coon Creek Ponds** – Release Before Forecasted Storm
- **Coon Creek North and South** – Adjust release timing and watershed area to maximize benefit of facilities in the same watershed
- **City Center** – Allow storm to fill pond above permanent pool, release after retention period

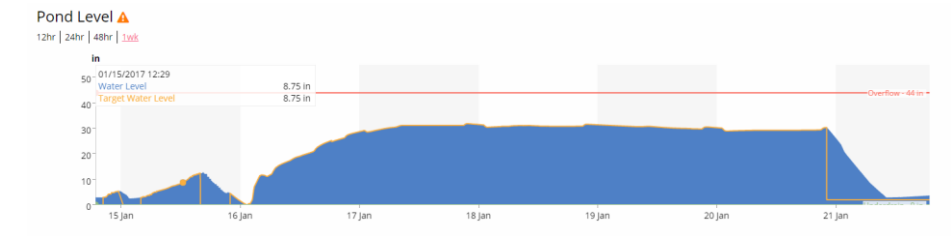
CMAC Preliminary Storms

Integrated CMAC

Coon Creek East – December 17



City Center – January 15



CMAC Preliminary Storms

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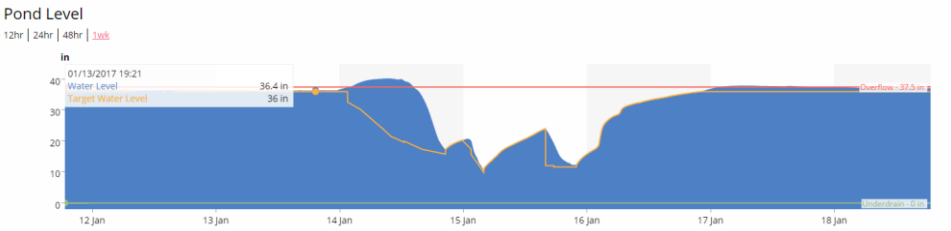
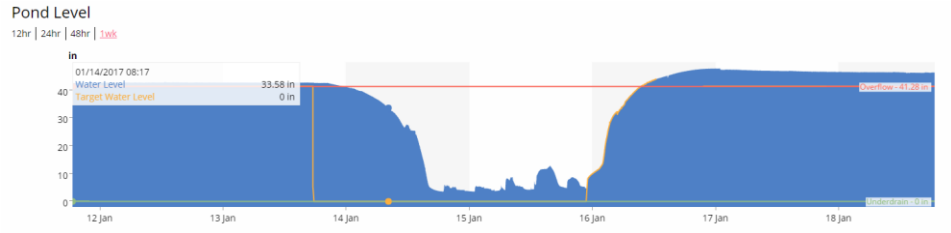
Coon Creek North – January 15



Coon Creek South – January 15



Case Study: Montgomery County, MD

peak flow reduction + water quality

15 ac-ft
Adaptively Controlled Detention/Retention

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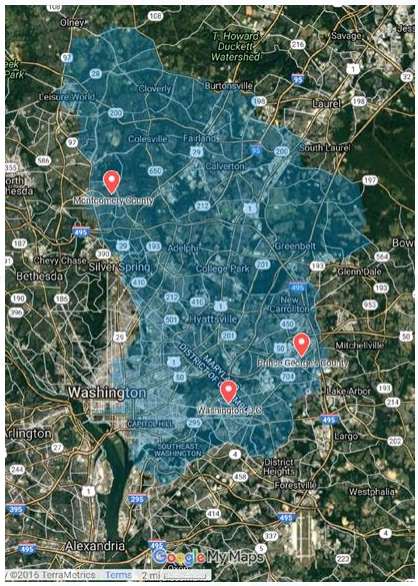
University Blvd. Wet Pond

Integrated CMAC



- Anacostia River Watershed
- 15 ac-ft wet pond
- 440 acre drainage; 36% imp.
- In line on Sligo Creek
- Retrofit November 2015

METROPOLITAN WASHINGTON
Council of Governments

University Blvd. Wet Pond – Hardware

Integrated CMAC

University Blvd. Wet Pond – Web Dashboard

Integrated CMAC

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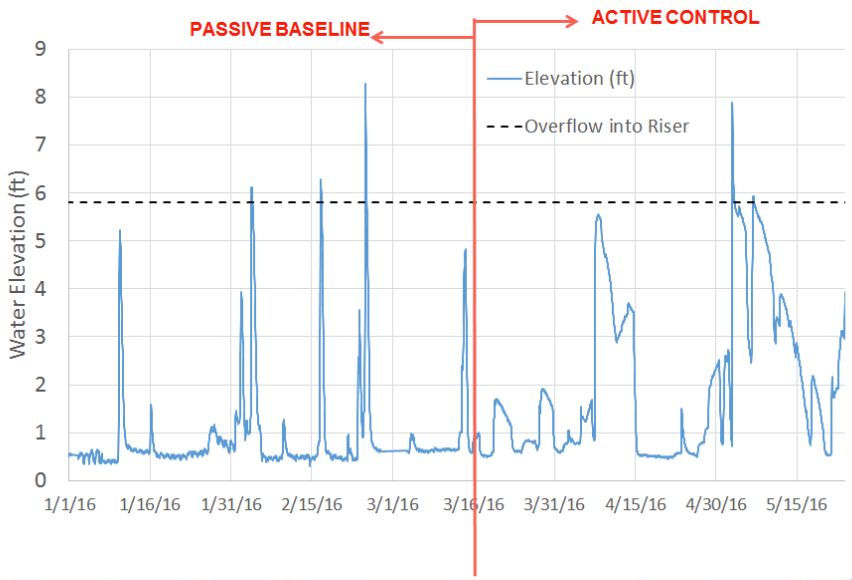
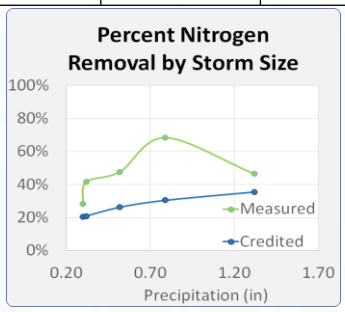
University Blvd. Wet Pond – Hydraulic Monitoring

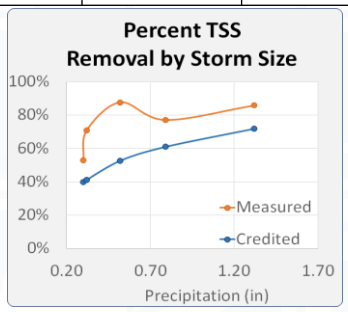


Integrated CMAC

University Blvd. Wet Pond – DRAFT Pollutant Removal

Storm Size	Nitrogen Percent Removal		Storm Size	TSS Percent Removal	
	CMAC	MDE Wet Pond*		CMAC	MDE Wet Pond*
0.30	28%	20%	0.30	53%	40%
0.32	42%	21%	0.32	71%	41%
0.52	48%	26%	0.52	88%	53%
0.79	68%	30%	0.79	77%	61%
1.32	47%	36%	1.32	86%	72%





*Credits given for water quality volumes in Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated, MDE,2014

Case Study: Washington County, OR
flow-duration control + peak control + water quality

2M Gallons
Adaptively Controlled Detention/Retention

Geosyntec consultants
engineers | scientists | innovators

Clean Water Services

Opti

Flow control and hydrograph matching

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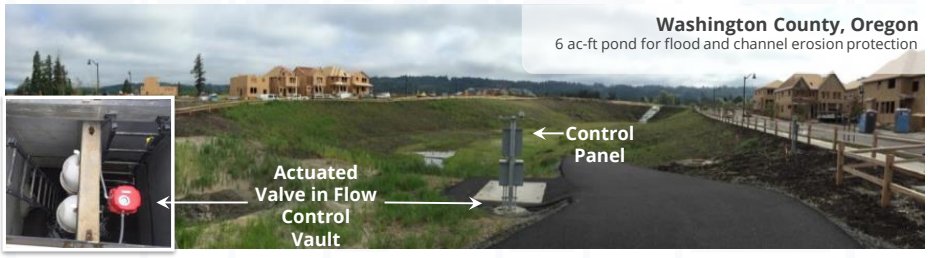

Based on continually updated precipitation forecasts, automated valve controls discharge to achieve **flow-duration goals**

CMAC performance

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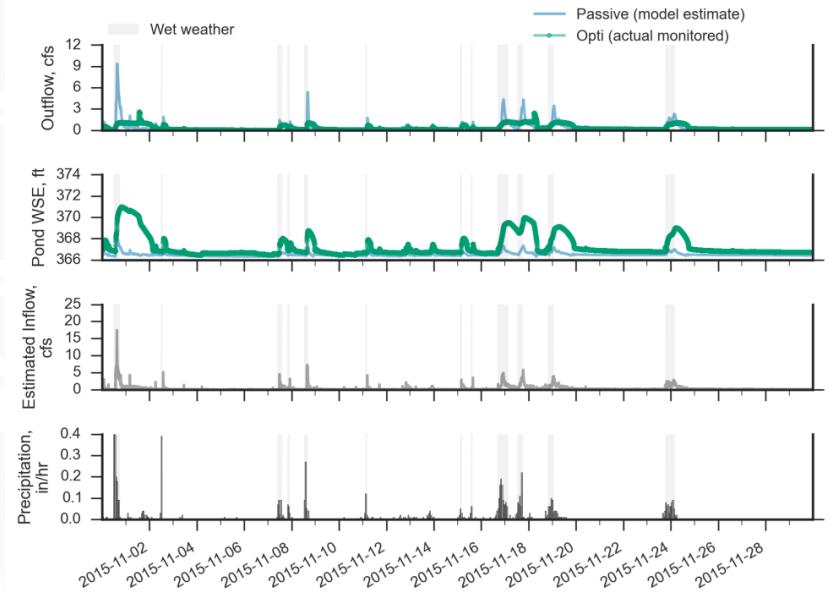
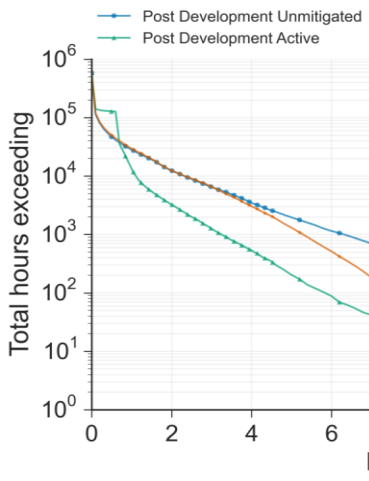


Flow-duration control results

Integrated CMAC



Highlights

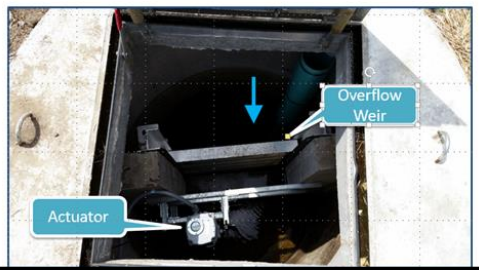
- 60% reduction in wet weather volume
- 70% reduction in volume within erosive flow range
- Increase in residence time from 1 to 19 hours
- 30% lower peak flow in large events
- Ability to adjust control parameters to target alternative goals

Case Study: Curtiss Pond
Capitol Region Watershed District, MN
flood control retrofit

Adaptively Controlled Retention

Integrated CMAC

Adaptive Control of Existing Storage for Flood Reduction



How CMAC operates for Curtiss Pond

Integrated CMAC

Case Study: NYCDEP GI-RD

Continuous Monitoring

Opti

ARCADIS Design & Consultancy for natural and built assets

Project Description

Continuous Monitoring

The data collected as part of the GI-RD project is being stored and managed using the Opti platform.

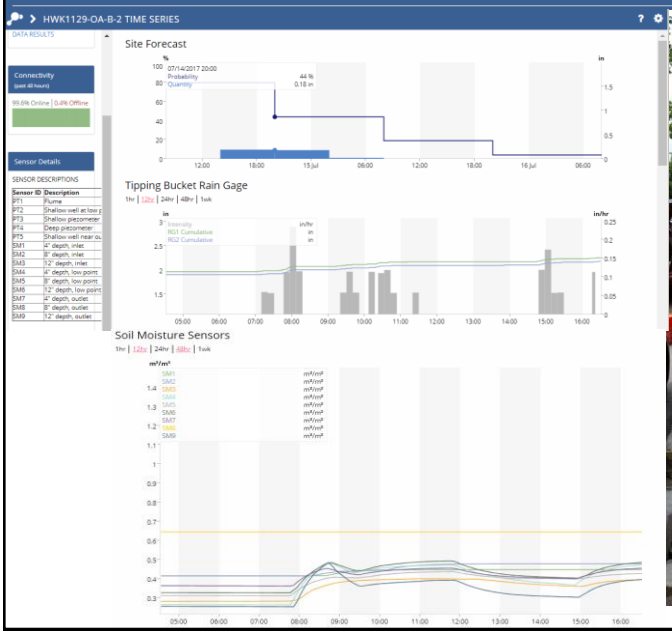
Environmental data storage on the Opti Platform

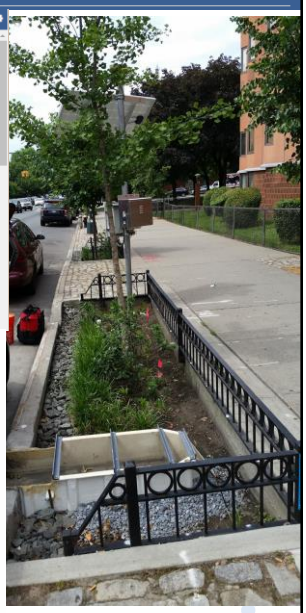
Advanced data visualization

Secure data validation

Project Results

Continuous Monitoring



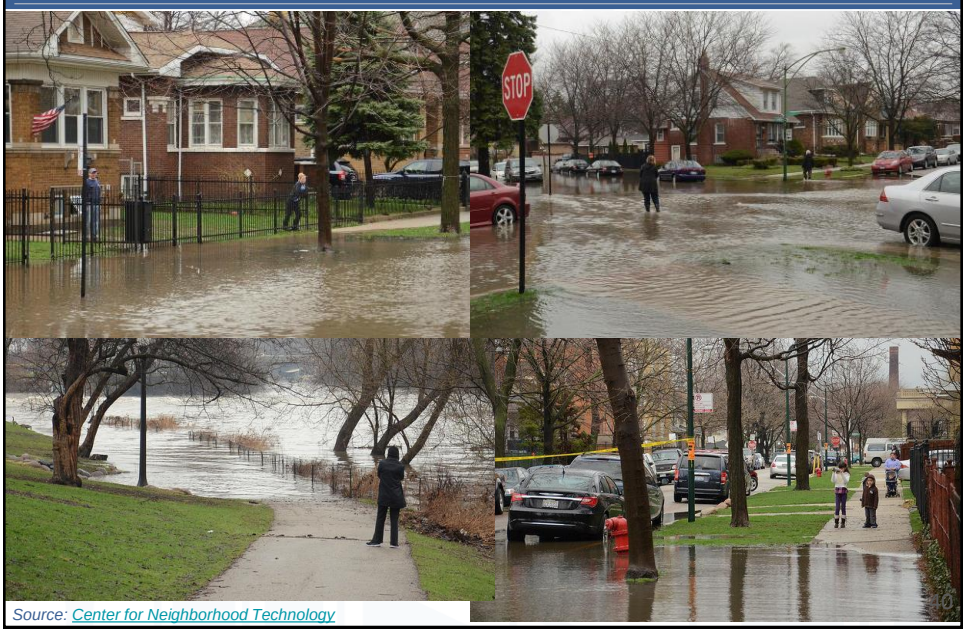


Case Study: Chicago
Smart Green Infrastructure Monitoring

Microsoft AECOM UI LABS SENFORMATICS Sensing • Informatics • Innovation Opti

Continuous Monitoring

2007-2011 flooding in Chicago: $773M in property damage



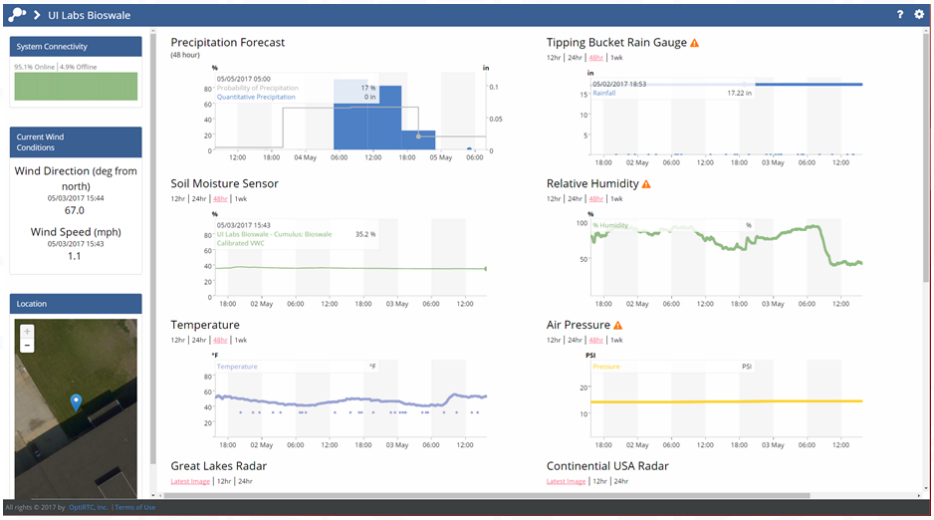
Source: Center for Neighborhood Technology

Continuous Monitoring

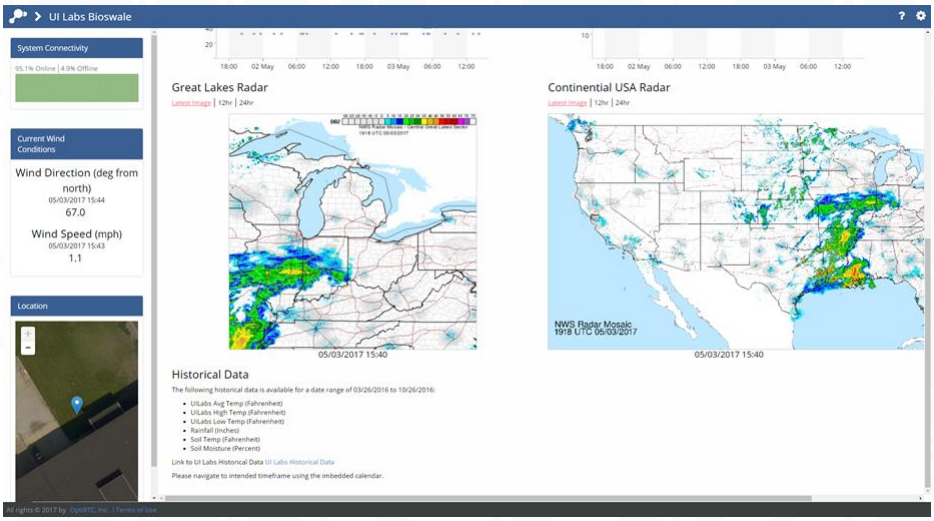
Pilot at UILabs' bioswale

Continuous Monitoring

Opti monitoring platform



Opti monitoring platform (continued)



Case Study: Milwaukee, WI

Rain:NET Green Infrastructure Monitoring

Opti

MMSD
PARTNERS FOR A CLEANER ENVIRONMENT

VEOLIA

Continuous Monitoring

Rain:NET - Collaborative Program in Milwaukee

Project: Performance, Operation & Maintenance of Green Infrastructure (POMGI)

Goals of the Project

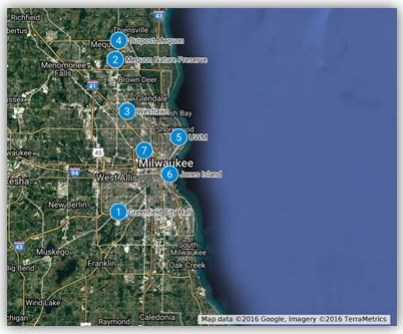
- Investigate real-time monitoring strategies for Performance monitoring and O&M support
- Explore techniques that are scalable at relatively low-cost

Functionalities

- Evaluate performance
- Display the data in real-time
- Automatically alert operators when equipment maintenance is needed

10 Sites monitored

- 4 Green Roofs
- 5 Biofiltration Sites
- 1 Cistern



Questions & contact

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ACKNOWLEDGEMENTS

Philadelphia Water Department
City of Ormond Beach
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Metro Washington Council of Governments
Montgomery County, MD
Clean Water Services
Capitol Region Watershed District
NYC DEP
City of Chicago
Milwaukee Metropolitan Sewerage District