STORMSENSOR

Disruptive Clean Technologies in Stormwater

ERIN ROTHMAN
CEO

My name is Erin.

I have **15 years of experience** as a stormwater and remediation consultant.

I've worked on projects with **cities across the U.S.**

I've spent more **time in sewers** than I ever expected, and it's an honor.

And I've learned a hell of a lot about **sensors, software, and analytics** over the past 3 years.

Erin K Rothman, CEO
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STATE OF STORMWATER (AND WASTEWATER)

Source: Congressional Budget Office, using data from the Office of Management and Budget and the Bureau of the Census
Includes water supply and wastewater treatment facilities
Includes water containment systems (dams, levees, reservoirs and watersheds) and sources of freshwater (lakes and rivers)

STATE OF STORMWATER (AND WASTEWATER)

1 MILLION MILES OF PUBLIC SEWER PIPES

$1.4 TRILLION REQUIRED FOR UPGRADES

- Aging
- Overuse
- Water Quality Issues

STATE OF STORMWATER (AND WASTEWATER)

$48 BILLION REQUIRED TO ADDRESS CSOs

CLIMATE CHANGE

In 2018: 25 cities set new annual rainfall records; FIVE 1000-year events

$88.5 BILLION TO REDUCE SSOs TO ONE EVENT EVERY 5 YEARS

STATE OF STORMWATER (AND WASTEWATER)

FLOODING & CLIMATE CHANGE

75%

of declared disasters in the U.S. are from flooding

$14.1 BILLION

drop in property values along the east coast from flooding & sea level rise (2005 to 2017)

$3.6 TRILLION

in impacts to coastal infrastructure

STATE OF STORMWATER (AND WASTEWATER)

NO VISIBILITY INTO OUR SEWER INFRASTRUCTURE

=

inability to monitor, maintain, and retrofit

530 MILES
of sanitary mains

500 MILES
of storm sewer drains

1,020 MILES
of combined sewers

277
storm drain outfalls

43
combined sewer outfall control systems

MARKET NEED

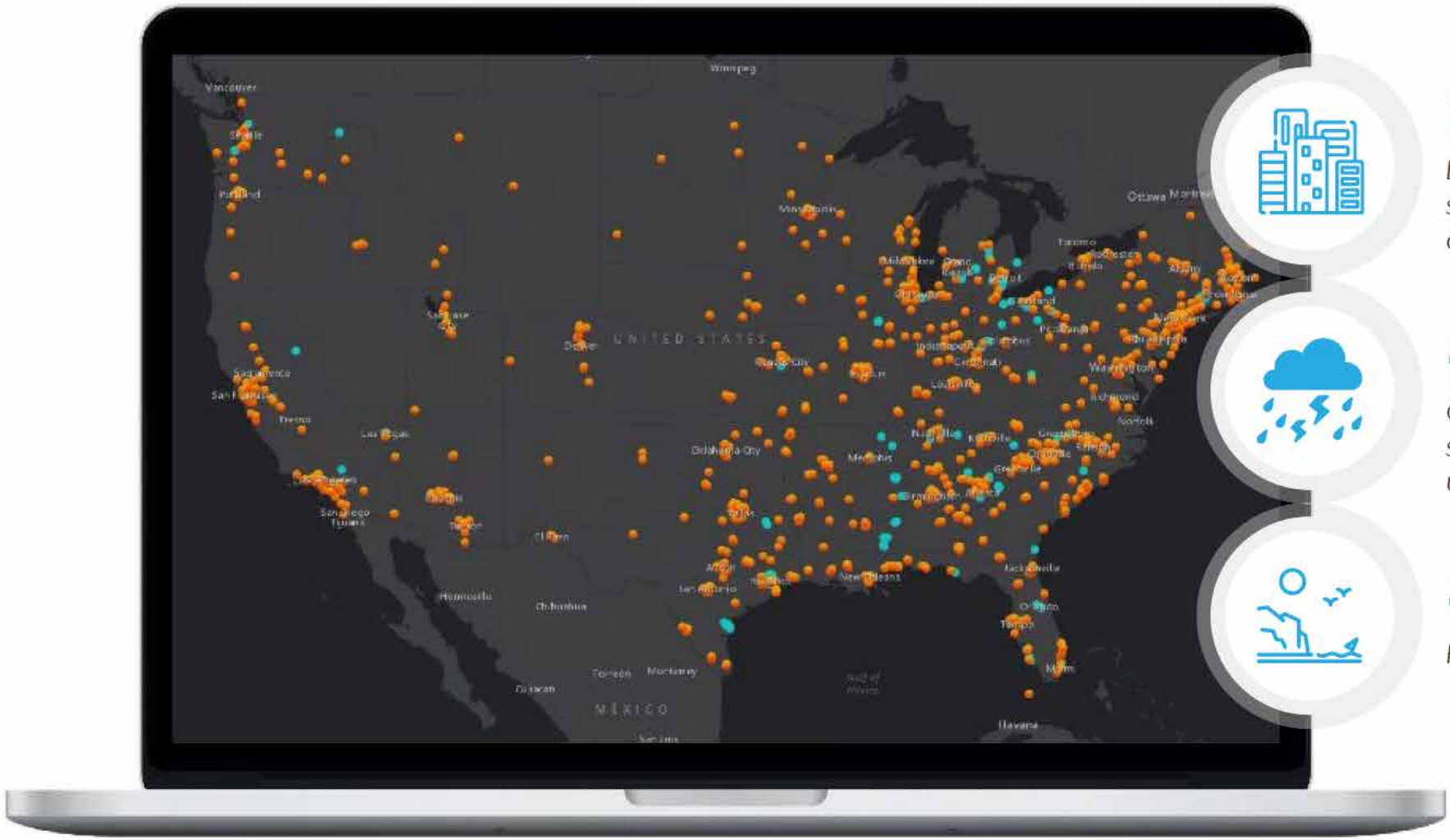
$12.5 BILLION
Total annual U.S. market opportunity (stormwater monitoring only, incl. CSOs and fines)

85,000
Cities, water utilities, ports, states, and DOTs in the U.S. alone

$400
Per household average annual stormwater spend

$100,000+ ARR
Average per customer

STATE OF STORMWATER (AND WASTEWATER)



1,100 CITIES

Discharging more than 10 million gallons of sewage to rivers, lakes, and oceans every day

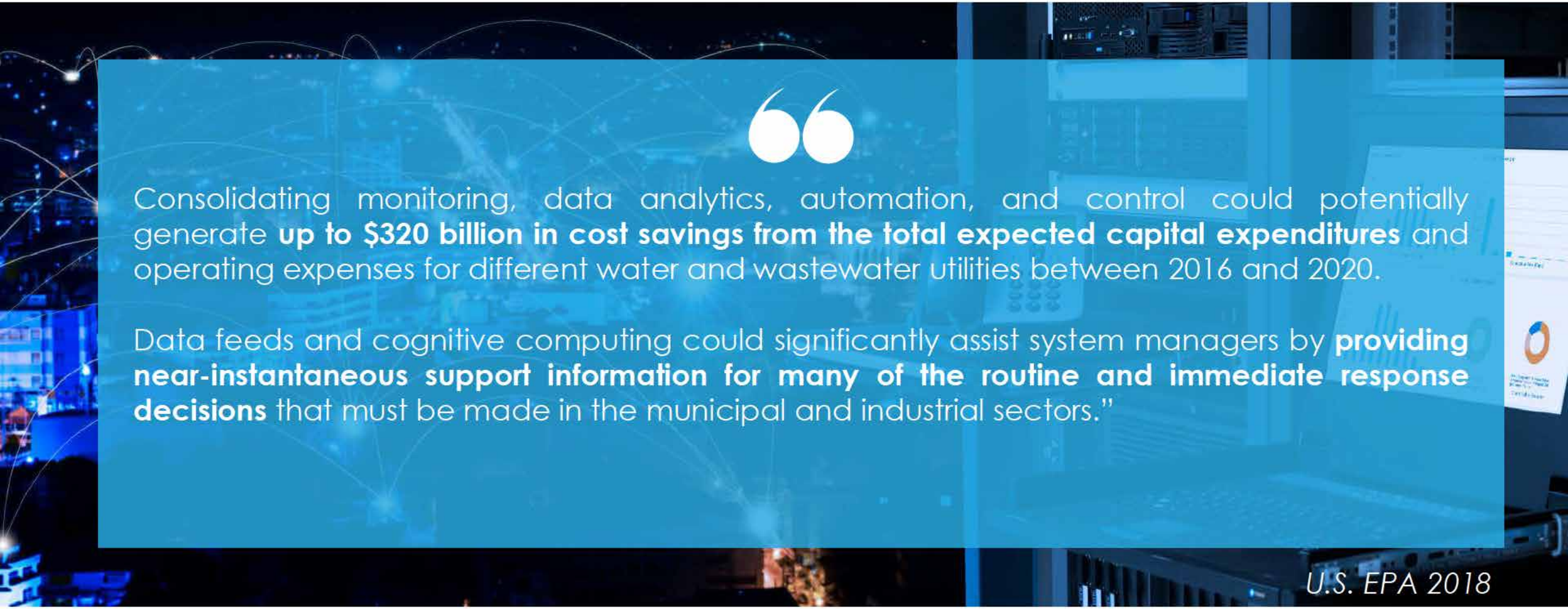
+830 CITIES

Cities with aging and illegal combined sewer systems that require upgrade/replacement

+COASTAL CITIES

Prioritized due to tidal intrusion

REAL-TIME MONITORING & REAL-TIME CONTROLS

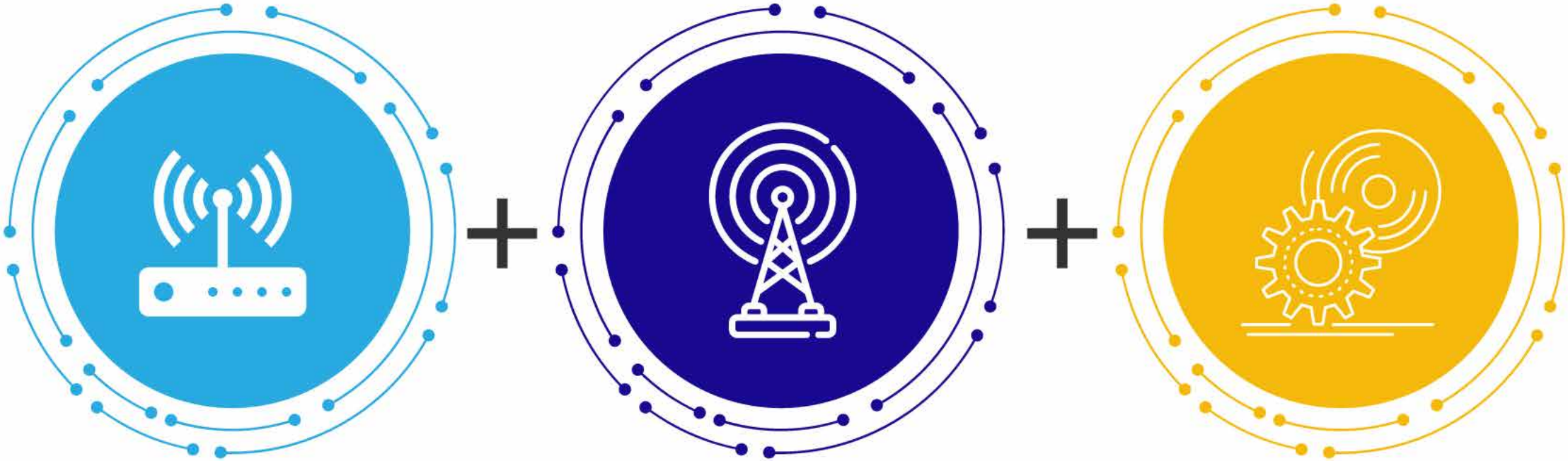


Consolidating monitoring, data analytics, automation, and control could potentially generate **up to $320 billion in cost savings from the total expected capital expenditures** and operating expenses for different water and wastewater utilities between 2016 and 2020.

Data feeds and cognitive computing could significantly assist system managers by **providing near-instantaneous support information for many of the routine and immediate response decisions** that must be made in the municipal and industrial sectors."

U.S. EPA 2018

REAL-TIME MONITORING & REAL-TIME CONTROLS

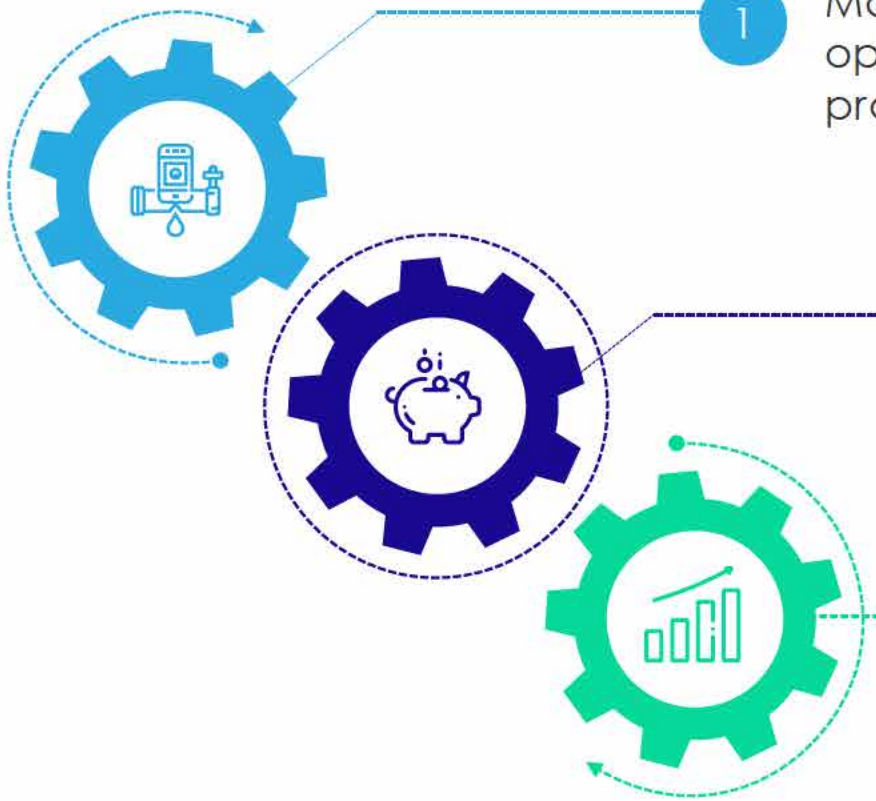


HARDWARE
Sensors, meters, monitors, and actuators

COMMUNICATIONS
Wireless networks between hardware and systems

SOFTWARE
Dashboards, analytics, insights, and data visualization

REAL-TIME MONITORING & REAL-TIME CONTROLS

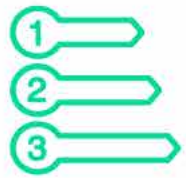


1. Maximizing existing infrastructure and optimizing operations and responses to be proactive, not reactive.
2. Providing savings in capital and operational spending.
3. Improving asset management and understanding of collection and treatment system performance.

REAL-TIME MONITORING & REAL-TIME CONTROLS

Improving long-term control plan (LTCP) implementation, modification, and development.

Meeting regulatory requirements.



Prioritizing critical assets and future capital planning.

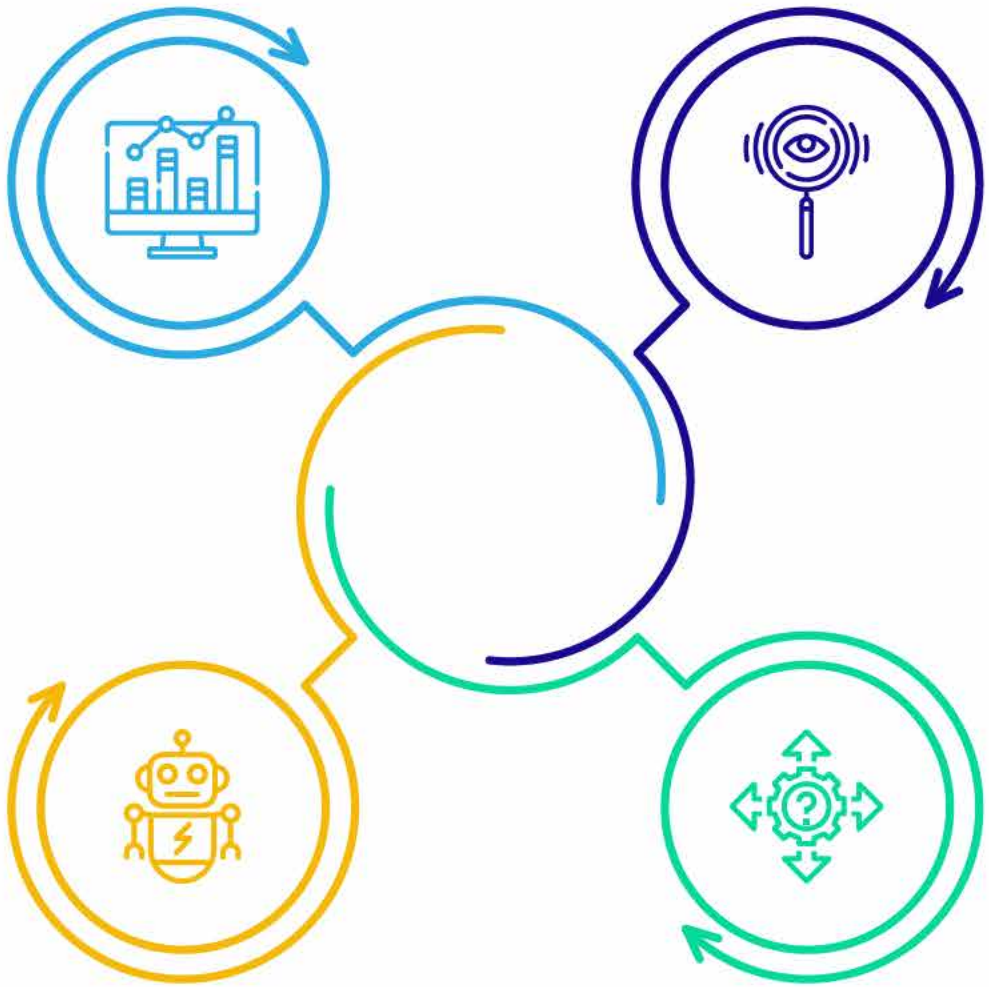
Optimizing collection system storage capacity to reduce peak flows and the occurrence of overflows.

Enabling effective customer service and enhancing public notification.

REAL-TIME MONITORING & REAL-TIME CONTROLS

BETTER INFORMATION
with improved monitoring

CLEAN INSIGHTS
with sophisticated analytics



EFFECTIVE O&M
with increased automation

INFORMED DECISIONS
with data-driven support

U.S. EPA 2018

ROADMAP TO IMPLEMENTATION

DEFINE YOUR VISION

What do you need? Want? What are your wildest infrastructure management dreams?

IDENTIFY YOUR SCHEDULE.

Change is hard, so give your team time to embrace and implement your vision.

ROADMAP TO IMPLEMENTATION

IMPLEMENTATION!

Deploy the technologies and the platform, and make sure everyone has the tools they need to make this a success.

CONTINUOUS IMPROVEMENT

IT STARTS WITH DATA

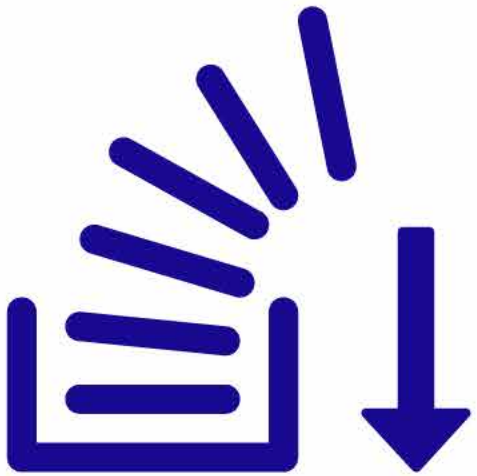
FLOW

LEVEL

CONTINUOUS MONITORING

RAINFALL

ACTIONABLE INSIGHTS = SYSTEM OPTIMIZATION



ELIMINATE SANITARY SEWER OVERFLOWS & COMBINED SEWER OVERFLOWS

CAUSE OF PROBLEM	POTENTIAL SOLUTION	REQUIRED DATA
▪ Rainfall-derived I/I ▪ Undersized Pipes/Facilities ▪ Illicit flows	→ Pipe replacement → I/I & IDD mitigation	▪ Level & flow ▪ Sewer & land characteristics ▪ Temperature*
▪ FOG ▪ Sedimentation ▪ Roots/debris	→ Improved O&M → Cleaning/flushing → Pipe replacement	▪ Level, velocity, & flow
▪ Pipe breaks ▪ Leaking manholes ▪ Offset joints	→ Repairs → Pipe Replacement	▪ Flow measurements

ACTIONABLE INSIGHTS = SYSTEM OPTIMIZATION

REDUCE FLOODING

CAUSE OF PROBLEM	POTENTIAL SOLUTION	REQUIRED DATA
▪ Rainfall-derived I/I ▪ Undersized Pipes/Facilities ▪ Illicit flows	→ Pipe replacement → Facility upgrade → I/I & IDD mitigation → Add green/grey infrastructure	▪ Level & flow ▪ Sewer & land characteristics ▪ Operational & physical constraints ▪ Critical elevations
▪ FOG ▪ Sedimentation ▪ Roots/debris	→ Improved O&M → Cleaning/flushing → Pipe replacement	▪ Level, velocity, & flow

COST SAVINGS

By implementing just real-time monitoring, the EPA estimates that the costs paid by communities from flooding and sewage overflows can be reduced dramatically.

$88.5B
Total

ELIMINATE SANITARY SEWER OVERFLOWS
by tracking and identifying undersized pipes and rainfall-derived I/I (inflow & infiltration), sediment & debris buildup, pipe breaks and leaks, offset joints

$7.5B – 50%
of estimated O&M, annual

MINIMIZE OPERATING COSTS
by reducing high electricity costs for pump & gate ops

$7.5B – 50%
of estimated O&M, annual

MINIMIZE MAINTENANCE COSTS
by tracking and identifying equipment failure rates and sedimentation issues

$6B
Fines, fixes, and litigation, annual

MINIMIZE CSOs
by tracking and identifying rainfall-derived I/I and undersized facilities.

$270B
Flood damages in 2017

REDUCE FLOODING RISKS
by tracking and identifying rainfall-derived I/I and undersized facilities

BUT WE STILL HAVE SOME LIMITATIONS: RTC REQUIRES DATA

BUT

DATA ARE EXPENSIVE

So I asked myself: how do we get AS MUCH DATA as possible from AS LARGE AN AREA as possible… underground?

…and how do we make it actionable?

NETWORKED APPROACH TO REAL-TIME MONITORING

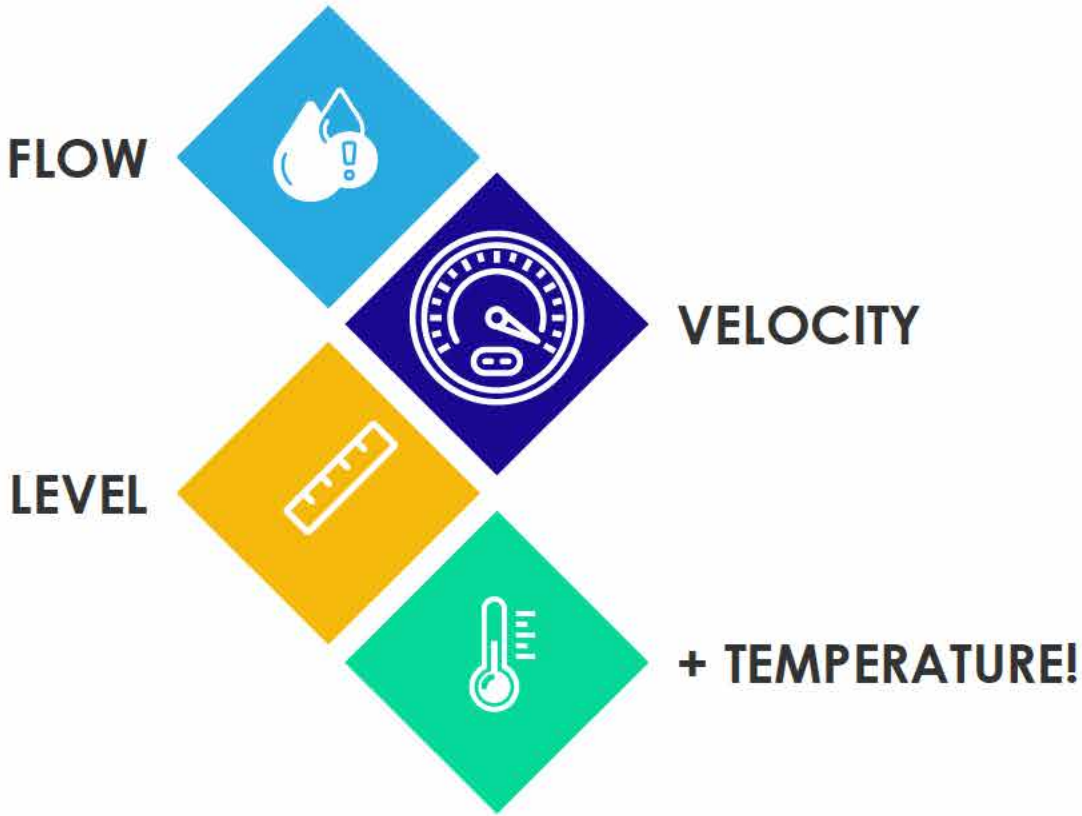
DATA: Advanced Infrastructure Analytics and Mapping

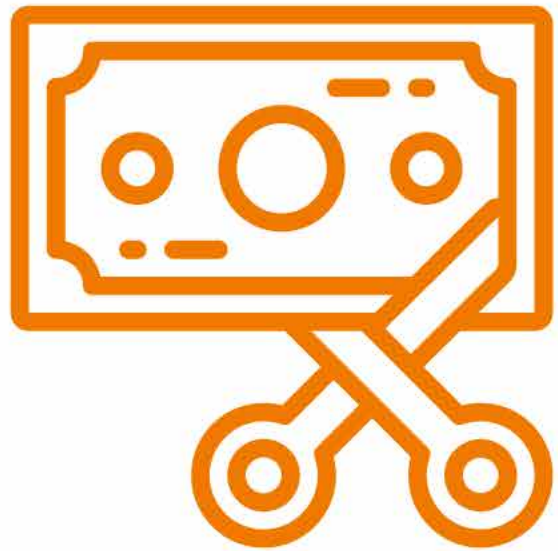
VIA

Patented design for low-cost, high-reliability sensors (Scutes™)

Cloud-connected via IoT

NETWORKED APPROACH TO REAL-TIME MONITORING





10X

COST REDUCTION