# Digitalization of Stormwater Infrastructure

## Rain-mX and SOIL-Sense Application

Biofiltration (Bioswale) System
Milwaukee, WI

P4 INFRASTRUCTURE

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November 30, 2023

# Introduction

Background

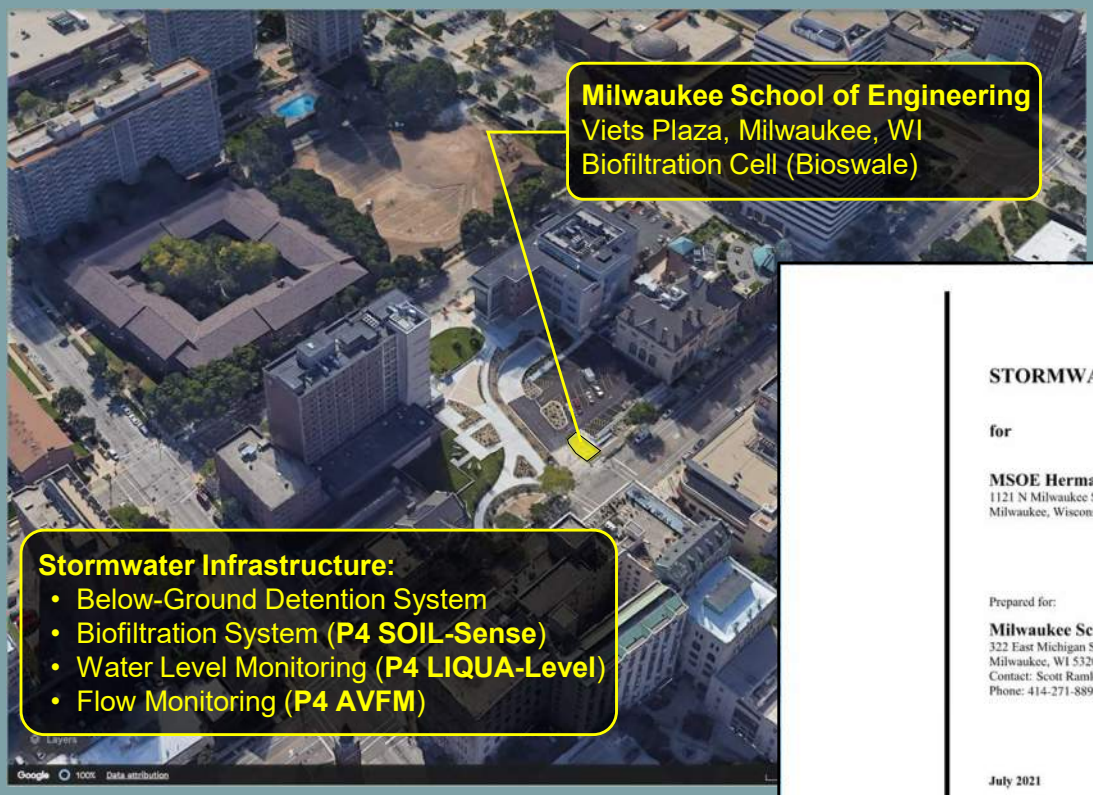
Customer Needs

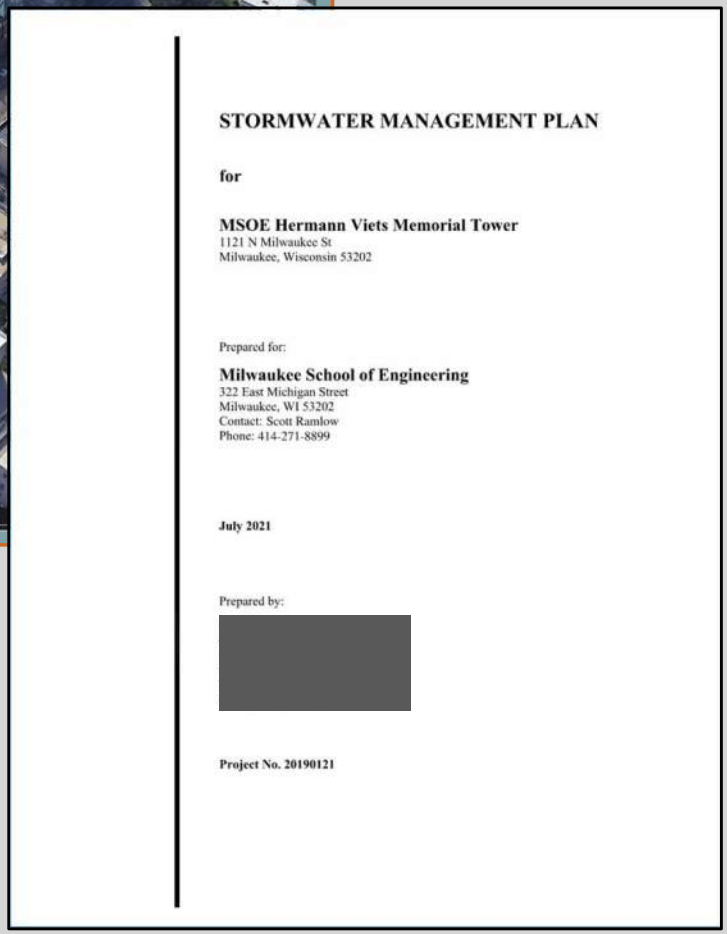
P4 Solution

**Higher-Education Campus**

**Dense Urban Environment**

**City with Combined Sewer Systems**



STORMWATER MANAGEMENT PLAN

for

MSOE Hermann Viets Memorial Tower
1121 N Milwaukee St
Milwaukee, Wisconsin 53202

Prepared for:

Milwaukee School of Engineering
322 East Michigan Street
Milwaukee, WI 53202
Contact: Scott Ramlow
Phone: 414-271-8899

July 2021

Prepared by:

[redacted]

Project No. 20190121

**Stormwater Management Plan**

- Detailed Site Description
- Visual Inspection Methods
- Hazardous Materials Abatement
- Hydrologic Analysis
- Green Infrastructure Considerations
- Formal **On-Going Resource Commitment**

# Questions, Answers & Long-Term Commitments

## Operations

*What is the current water holding capacity of soil in the bioswale?*

Continuous soil moisture content monitoring throughout height of bioswale.

*Are the infiltration rate characteristics of the bioswale media maintained?*

Continuous observation of moisture content migration into and out of the bioswale.

*What is the average dewatering time for the media?*

Observation of moisture migration after rain events.

## Maintenance

*Is sediment build up preventing function?*

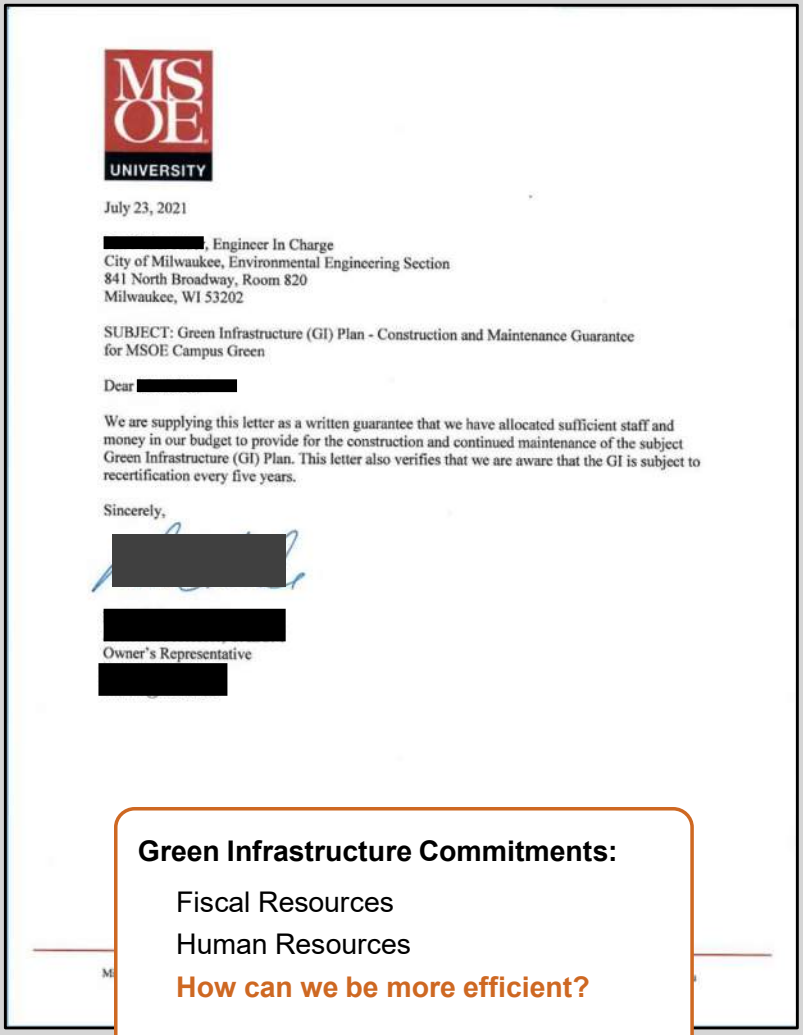
Soil moisture at bottom of bioswale is stagnant at full saturation for extended periods of time.

*How many filter-media cycles have occurred?*

A cycle is migration of soil moisture through the bioswale.

*Is ponding occurring?*

Surface soil moisture content at full saturation for extended periods of time.



MSOE UNIVERSITY

July 23, 2021

[redacted], Engineer In Charge
City of Milwaukee, Environmental Engineering Section
841 North Broadway, Room 820
Milwaukee, WI 53202

SUBJECT: Green Infrastructure (GI) Plan - Construction and Maintenance Guarantee for MSOE Campus Green

Dear [redacted]

We are supplying this letter as a written guarantee that we have allocated sufficient staff and money in our budget to provide for the construction and continued maintenance of the subject Green Infrastructure (GI) Plan. This letter also verifies that we are aware that the GI is subject to recertification every five years.

Sincerely,

[redacted]

[redacted]
Owner's Representative
[redacted]

**Green Infrastructure Commitments:**

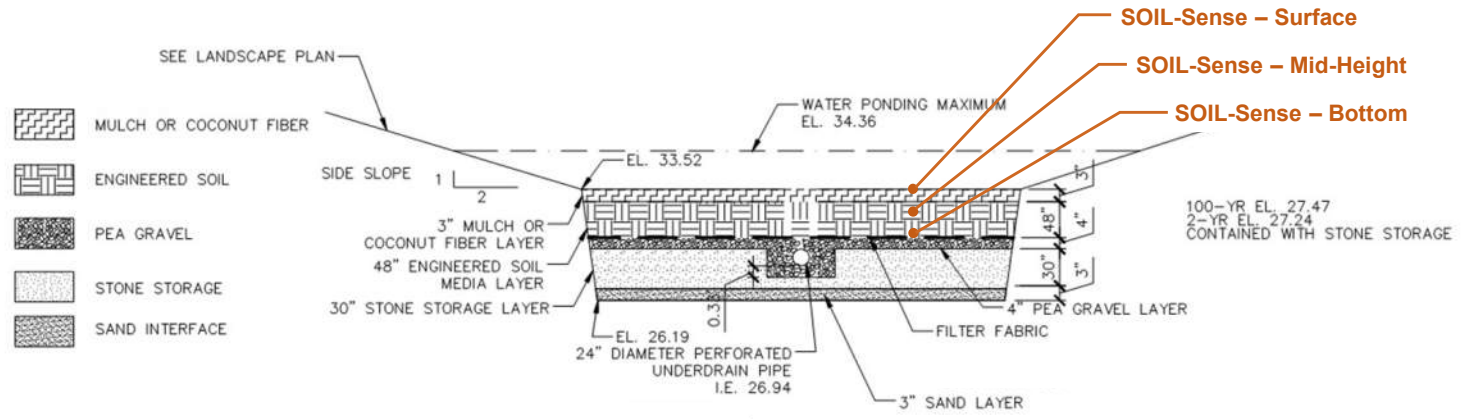
Fiscal Resources

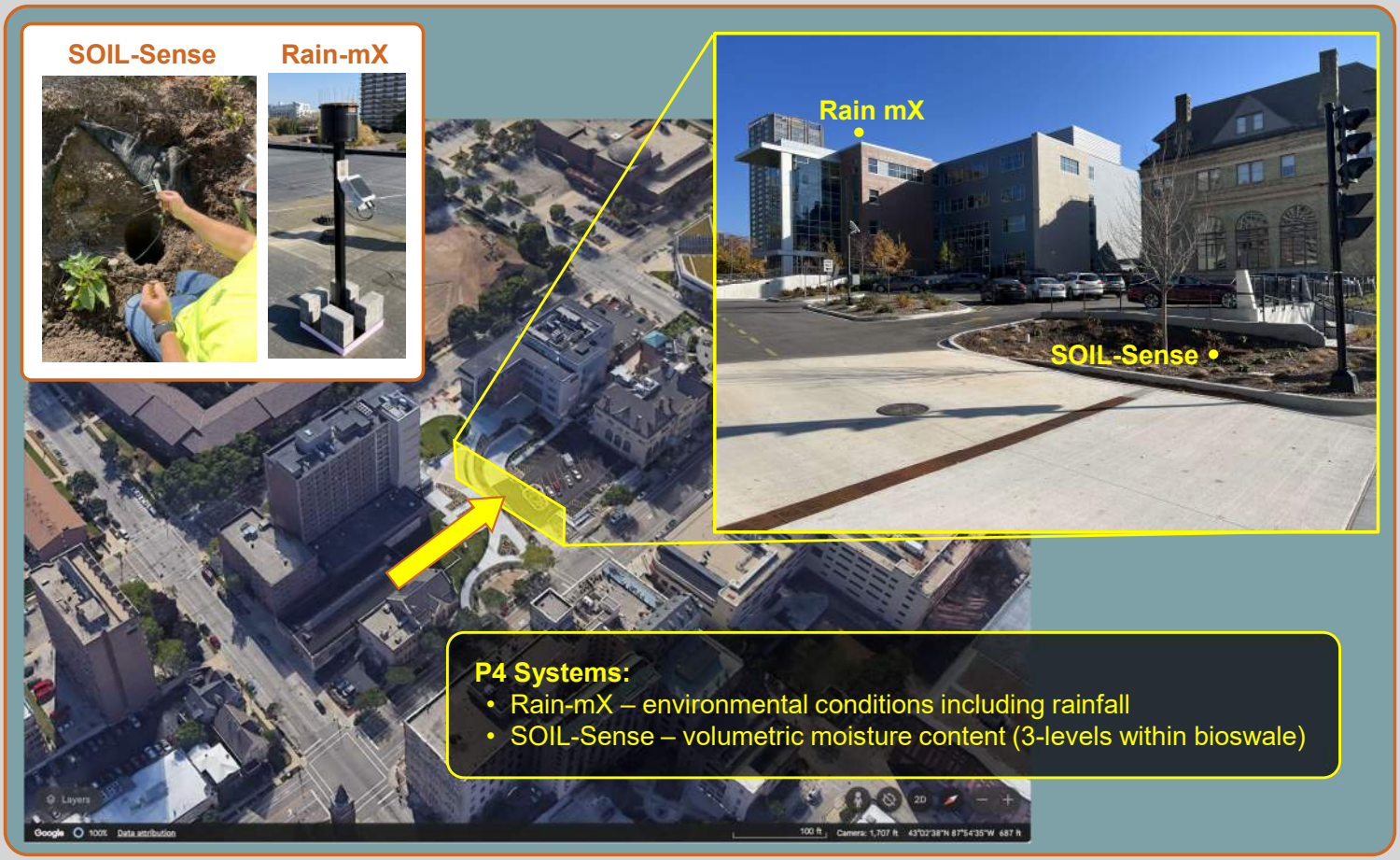
Human Resources

**How can we be more efficient?**

**Five-Year Recertification**

**How can I guarantee recertification?**


SOIL-Sense – Surface
SOIL-Sense – Mid-Height
SOIL-Sense – Bottom
SEE LANDSCAPE PLAN
MULCH OR COCONUT FIBER
ENGINEERED SOIL
PEA GRAVEL
STONE STORAGE
SAND INTERFACE
WATER PONDING MAXIMUM
EL. 34.36
EL. 33.52
SIDE SLOPE 1 : 2
3" MULCH OR COCONUT FIBER LAYER
48" ENGINEERED SOIL MEDIA LAYER
30" STONE STORAGE LAYER
EL. 26.19
24" DIAMETER PERFORATED UNDERDRAIN PIPE
I.E. 26.94
3" SAND LAYER
FILTER FABRIC
4" PEA GRAVEL LAYER
100-YR EL. 27.47
2-YR EL. 27.24
CONTAINED WITH STONE STORAGE


SOIL-Sense
Rain-mX
Rain mX
SOIL-Sense
P4 Systems:
• Rain-mX – environmental conditions including rainfall
• SOIL-Sense – volumetric moisture content (3-levels within bioswale)

# Measured Data

System Function

Operations & Maintenance

> 40% Volumetric Moisture Content = Saturated Soil Media

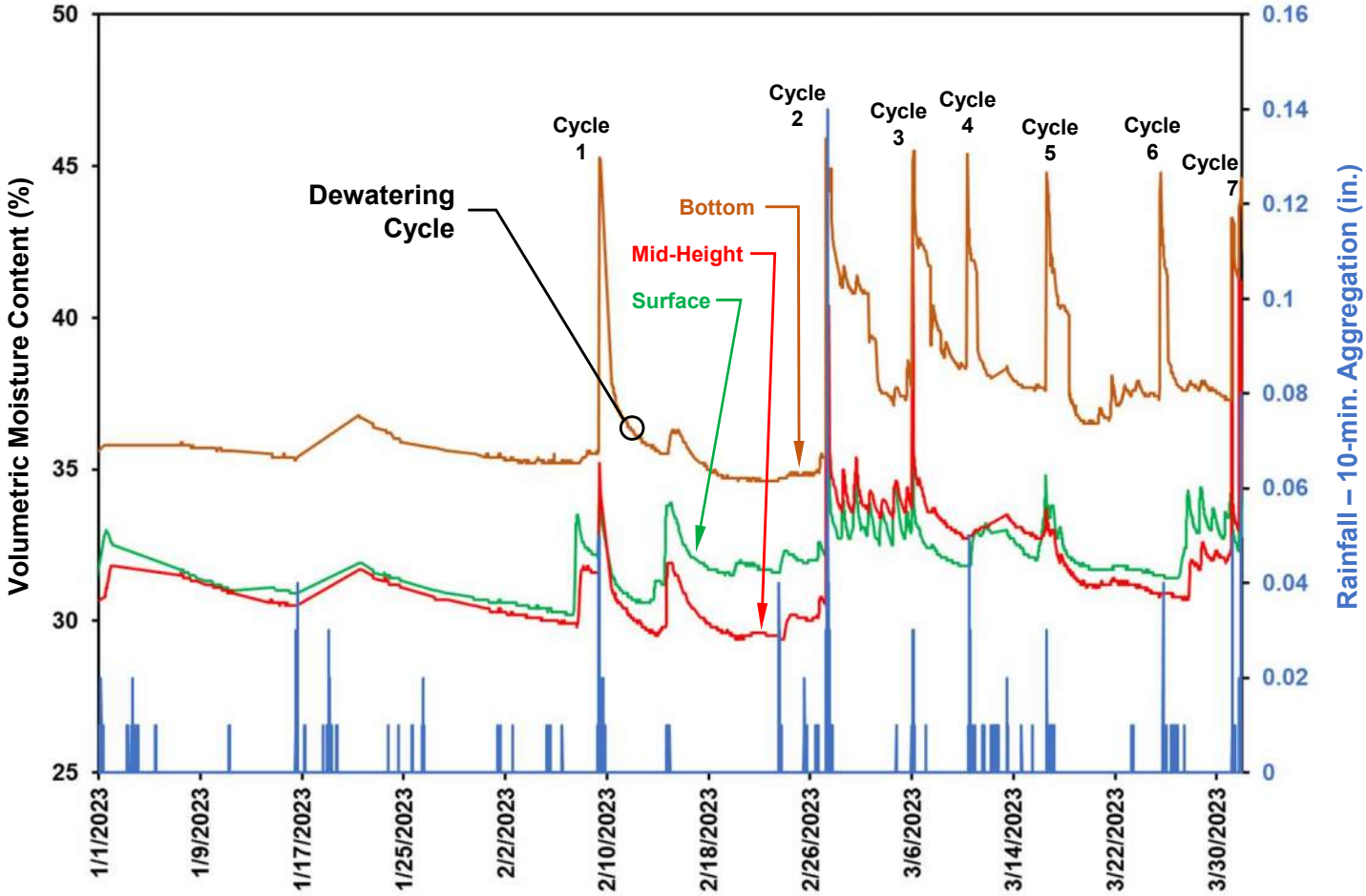
Moisture Content Cycle at Bottom = Filter Media Cycle

## Q1 2023 – 7 Filter Media Cycles

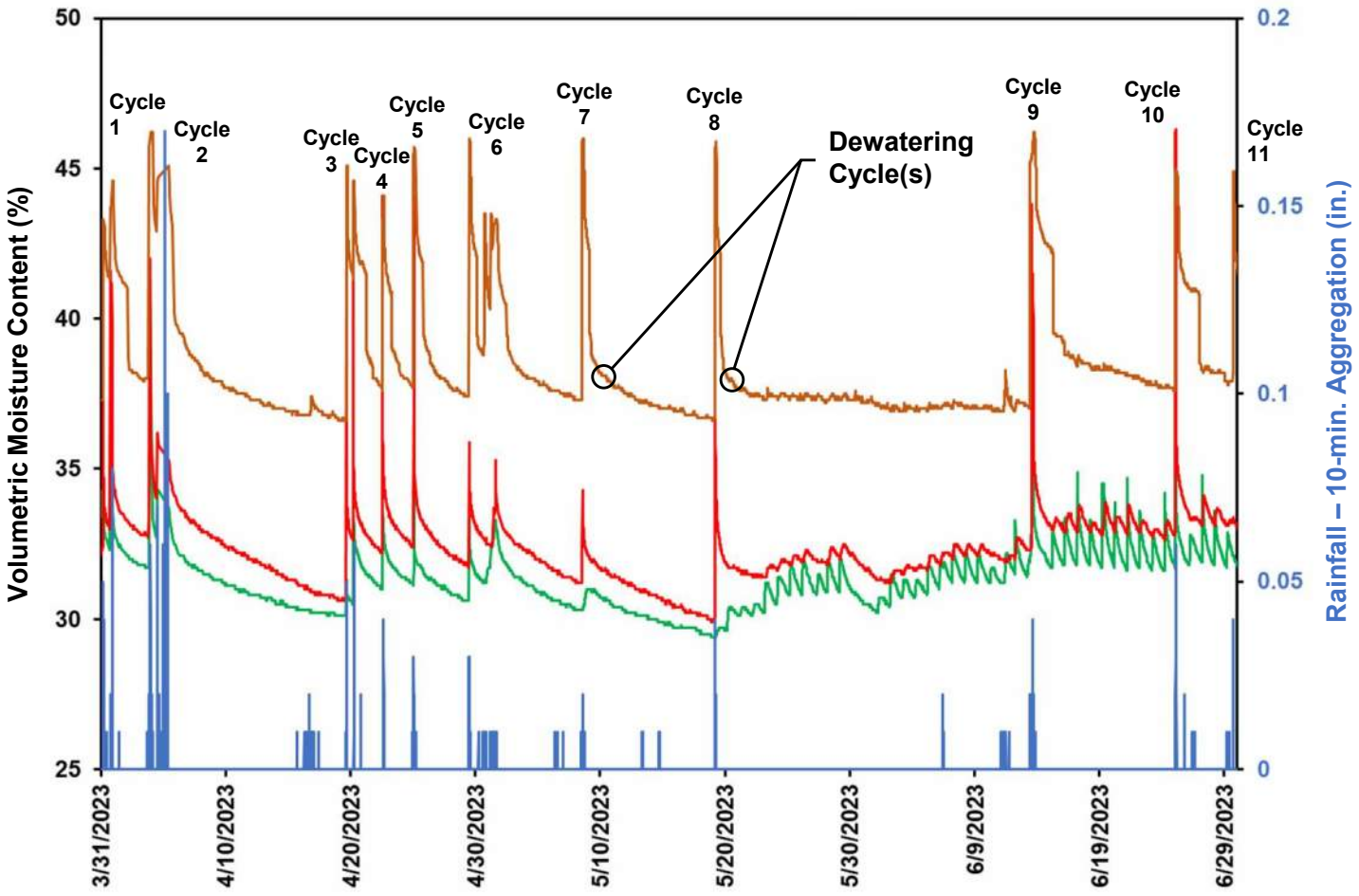
**Clear and Repeated Migration of Moisture**

**Clear Dewatering Cycles Present**

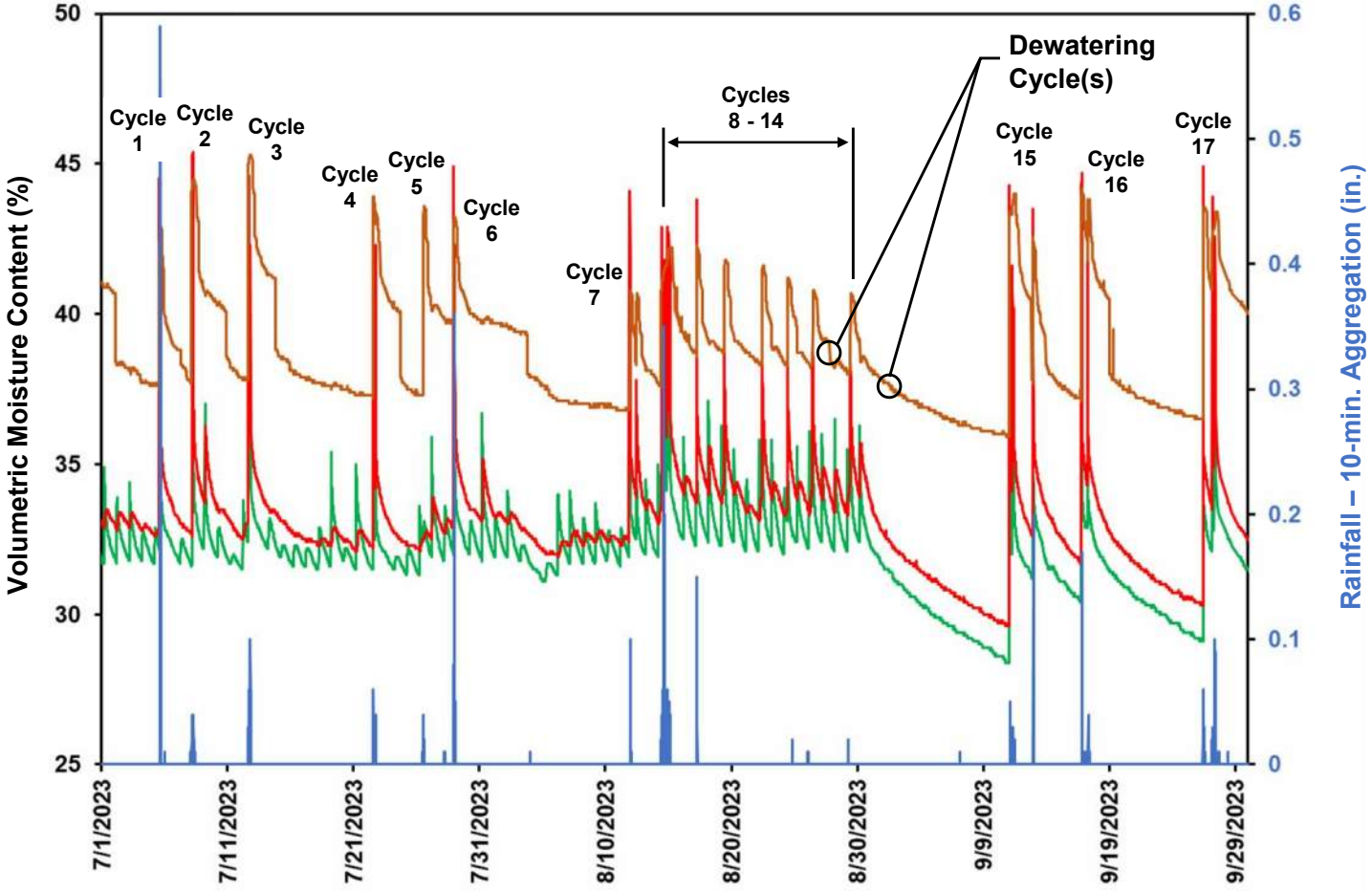
**Moisture In-Flow and Out-Flow Correlated to Rain Events**



## Q2 2023 – 11 Filter Media Cycles (18 cumulative – annual – cycles)



## Q3 2023 – 17 Filter Media Cycles (35 cumulative – annual – cycles)



# The End

Let P4 show you how digitalization of stormwater infrastructure can change the game.

P4 INFRASTRUCTURE