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Stormwater Management and Performance Assessment: A Guide for LID Monitoring

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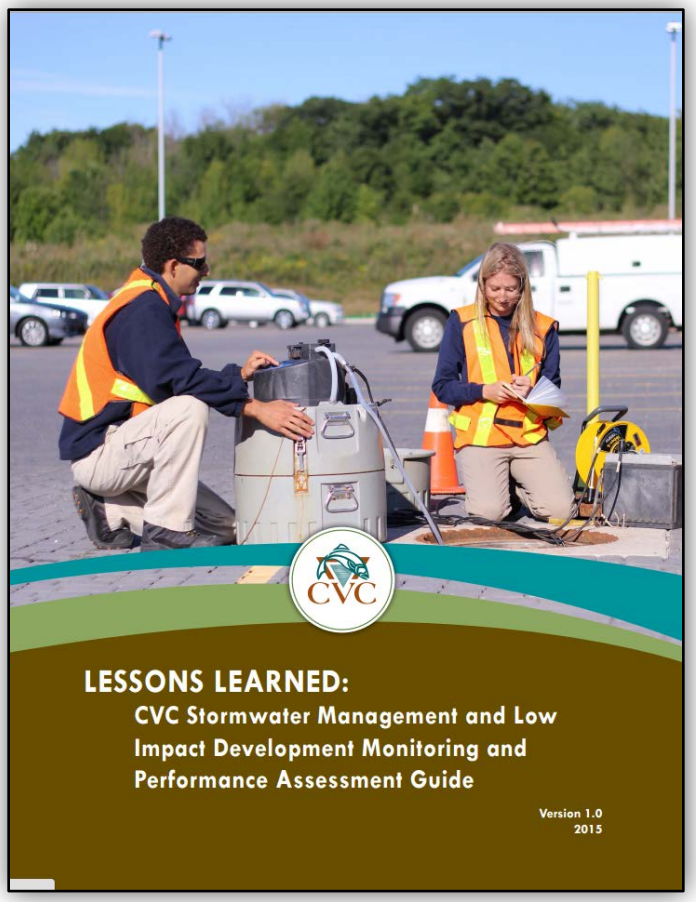
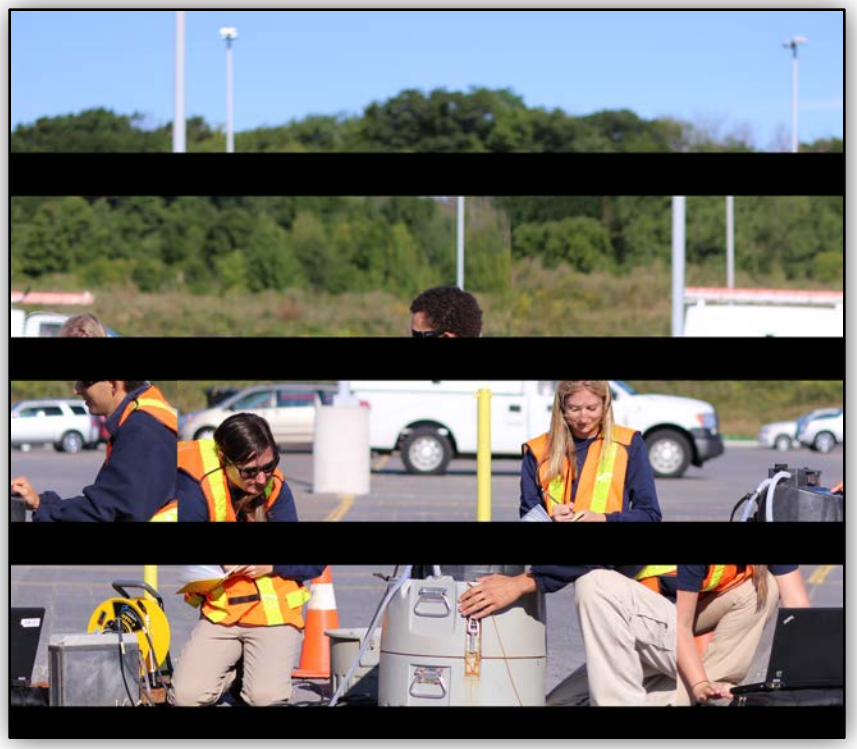
Outline

- Importance and types of monitoring
- CVC Monitoring examples and lessons learned
- An Introduction to CVC's SWM and LID Monitoring and Assessment Guide



Importance of Monitoring

- Provide information on LID performance
- Meet compliance requirements
- Inform design standards
- Inform municipal resolutions for LID implementation
- Provide solutions and procedures for maintenance
- Inform life-cycle costing



Monitoring LID: Why?

Compliance Monitoring

- Environmental Compliance Approval (MOECC's requirement)
- SWM design standards

Performance Monitoring

- To feed into future designs based off performance of existing sites

Monitoring LID: Why?

Adaptive Monitoring

- Adapt to new questions, requirements and designs
- New needs with changing climate
- Develop new criteria and changes to current standards; demonstrate duty of care of our infrastructure

Assumption Monitoring

- Monitoring to ensure site functionality prior to assumption

Example of Compliance Monitoring

Stormwater management design criteria	Compliance Requirement
Flood control (peak flow)	Peak flow reduction compared to pre-retrofit conditions: 2 yr event (33 mm) - 37% 5 yr event (45 mm) - 27% 100 yr event (79 mm) - 13%
Erosion control (runoff volume)	Runoff volume reduction compared to pre-retrofit conditions: 2 yr event (33 mm) - 29% 5 yr event (45 mm) - 19% 100 yr event (79 mm) - 8% Overall erosion control to the extent possible
Water quality	Enhanced level of treatment (80% TSS removal)

Example of Compliance Monitoring: Species at Risk

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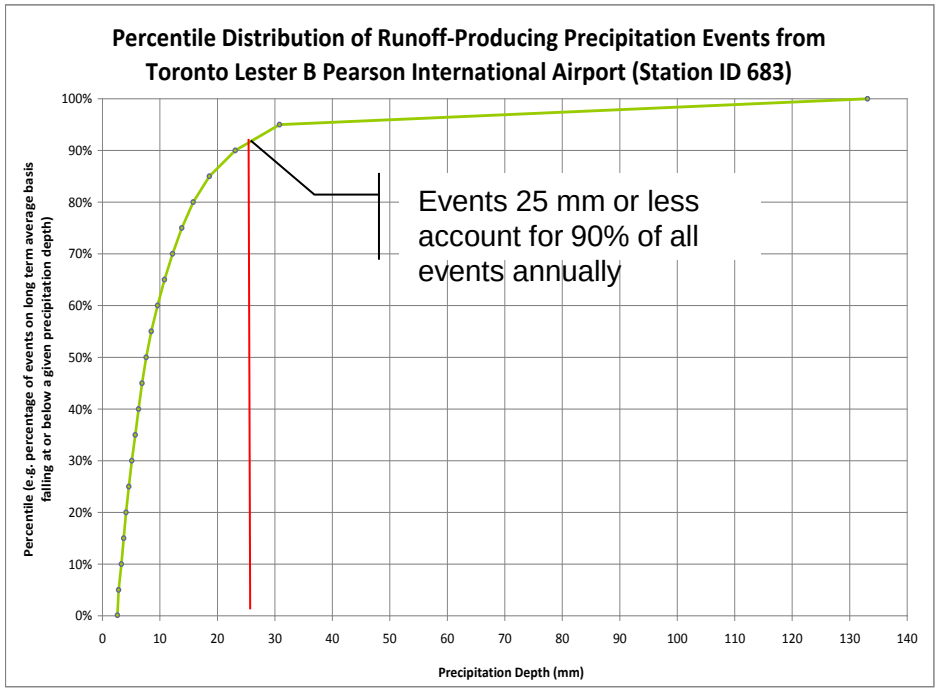
Example of Performance Monitoring

- Informing science and future designs (tight soils, source protection areas, treatment train etc.)
- Defining targets (performance distributed over range of events)
- Life cycle costing
- Asset Management



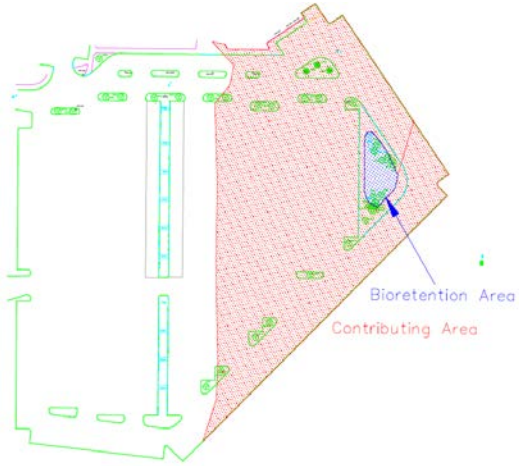
Example of Assumption Monitoring

- Verification of design specifications prior to site assumption

Visual Inspections

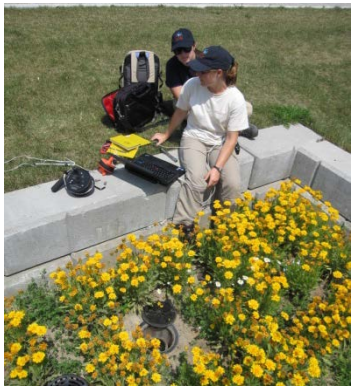
Vegetation Surveys

As Built Survey



Soil Analysis

Water Level monitoring



Infiltration Testing

LID Monitoring Objectives

Monitoring Objective	Demonstration Site									
	Central Parkway	IMAX	CVC Head Office	Lakeview	Elm Drive	Mississauga Road	Meadows in the Glen	Wychwood	Laurelwood	Columbia Forest
										
1. Evaluate how SWM ponds perform with LID upstream. Can the wet pond component be reduced or eliminated by meeting the erosion and water quality objectives with LID?							x	x	x	x
2. Assess performance of measures to determine potential rebates on development charges, credits on municipal stormwater rates and/or reductions in flood insurance premiums. (i.e. can LID reduce infrastructure demand).	x	x	x	x	x	x	x	x		
3. Evaluate whether LID SWM systems are providing flood control, erosion control, water quality, recharge, and natural heritage protection as per the design standard.	x	x	x	x	x	x	x	x	x	x
4. Evaluate and refine construction methods and practices for LID projects.	x	x	x	x	x	x	x	x		
5. Evaluate long-term maintenance needs and maintenance programs, and the impact of maintenance on performance.	x	x	x	x	x	x	x	x	x	x

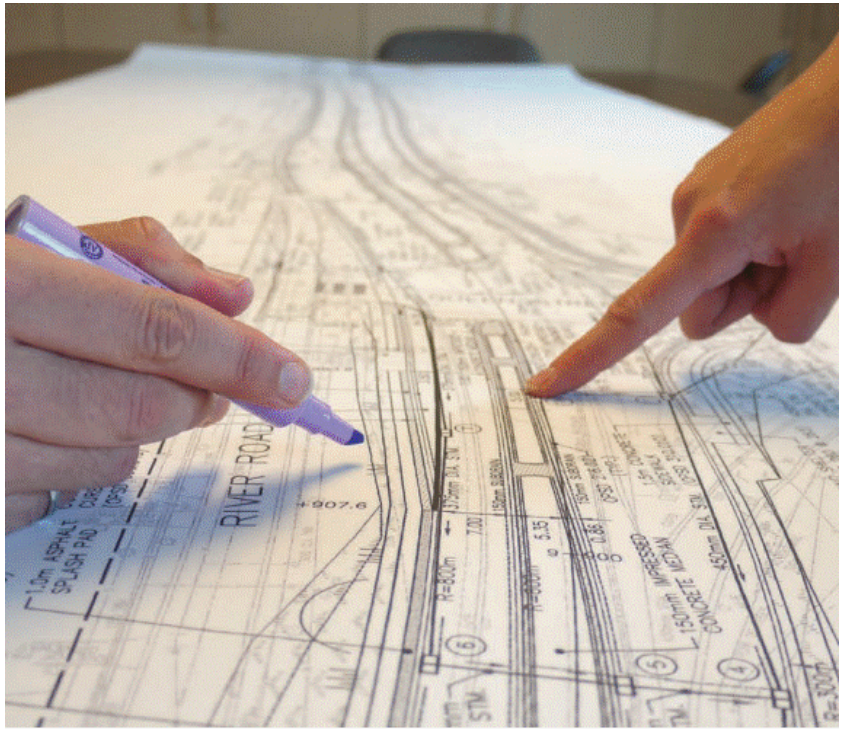
Monitoring Objectives: Top Five Stakeholder Priorities

- Long term maintenance needs and impact on performance;
- Lifecycle costs (asset management);
- Water quality and quantity performance of LID design in low infiltration soils;
- How multiple LIDs treat and manage stormwater;
- Performance of flood control, erosion control, water quality and natural heritage protection.

Lesson Learned #1: *Involve your stakeholders; determine your objectives and tailor your monitoring program accordingly*

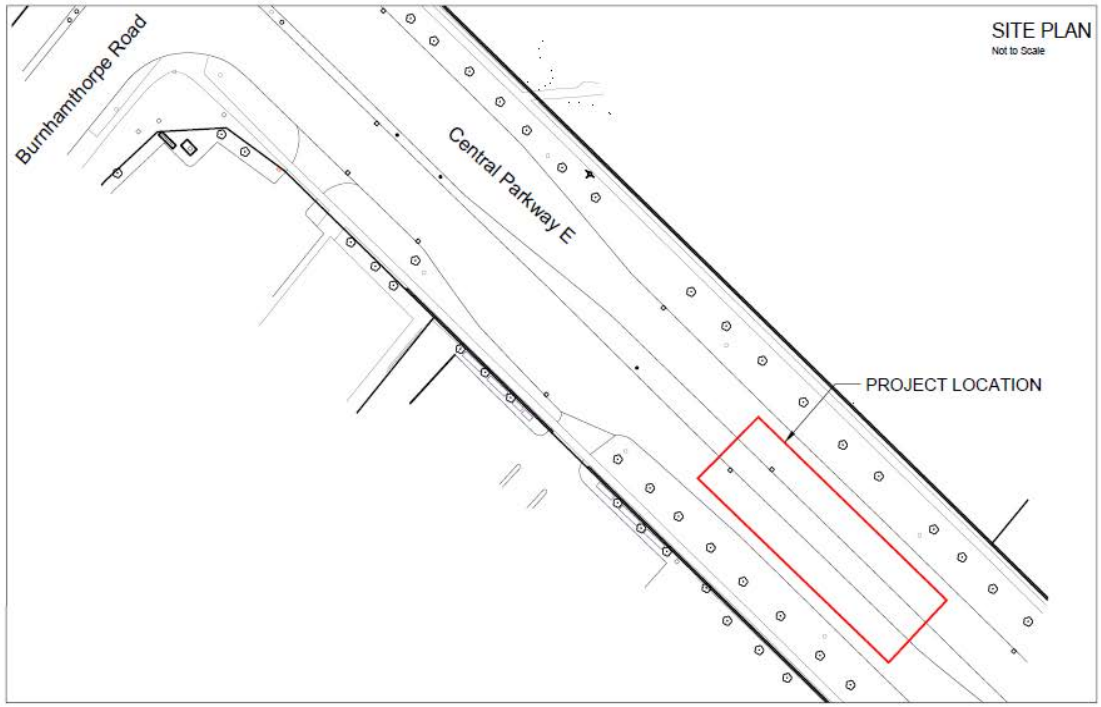
Develop a Monitoring Program: The Design Phase

- Design of monitoring program ⇔ Design of LID site
- Consider monitoring needs and objectives early on in the design phase
- Monitoring infrastructure can be incorporated directly into the design



Lesson Learned #2: *Whenever possible, incorporate monitoring plans early on in the site design phase*

Case Study: Central Parkway



Lesson Learned #3: *Involve your stakeholders and the key players in the early stages of the monitoring plan design.*


BEFORE

Construction

- Monitoring chamber installation

- DeepRoot Silva Cell system installation

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Lesson Learned #4: *Although the opportunity to directly monitor inflow is often not an option, take every opportunity! Consider your options during the design stage. The added certainty greatly simplifies the study design.*

Qualitative Monitoring: a key component of all monitoring programs

- Site observations- videos, photos and inspections
- Should be conducted during all phases of design, construction and monitoring
- Provides invaluable information to inform design, determine site functionality, and assess it's status, in conjunction with monitoring data

Lesson Learned #5: *Conduct detailed documentation of the monitoring location (including photos and inspections) prior to construction and/or installation of monitoring equipment.*

Site: IX-2 Bioswale and Sorptive Media
Inspector: _____
Date: _____

Site Characteristics:

IX-2 Bioswale and Sorptive Media	
Drainage Area	South-west corner of parking lot
Soil Media	Engineered bioretention mix
Pretreatment	Bioswale
Hydraulic Configuration	Online
Inlet Type	Curb cuts from parking lot

Contributing Drainage Area:	**Category:**	**Notes:**
% of Trash/Debris Present	0% --- 5% --- 10% --- 15% --- 20% +	
% of Sediment Accumulation	0% --- 5% --- 10% --- 15% --- 20% +	

Inlets to Bioswale:

% of Trash/Debris Present	0% --- 5% --- 10% --- 15% --- 20% +
% of Sediment Accumulation	0% --- 5% --- 10% --- 15% --- 20% +
% of Erosion	0% --- 5% --- 10% --- 15% --- 20% +
Structural damage?	Yes or No
Is inlet clear and able to accept incoming flow?	Yes or No

Bioswale:

% of Trash/Debris Present	0% --- 5% --- 10% --- 15% --- 20% +
Evidence of Ponding	Yes or No
% of Area Ponding	0% --- 5% --- 10% --- 15% --- 20% +
Approximate Depth of Ponding	_____
% of Bare/Exposed Soil	0% --- 5% --- 10% --- 15% --- 20% +

Qualitative Monitoring: Site Inspections & Photo Log

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Precipitation Video Example: Central Parkway

- Observing a site during precipitation events is critical to identifying how the site is functioning/performing
- These observations can assist in the interpretation of monitoring data, and add to the overall information record of a site

Lesson Learned #6: *Observing precipitation events can provide insight into the functionality of the site that may not become apparent even with detailed monitoring.*

Determine an Approach for Performance Monitoring

- Determine which questions should be answered
- Decide how data will be collected and evaluated
  - Several methods can be used individually or in combination

Lesson Learned #7: *It is essential to go back to your originally selected monitoring goals and objectives through each phase of the monitoring plan design. Don't get too attached to your objectives as they will likely change as your monitoring plan takes shape.*

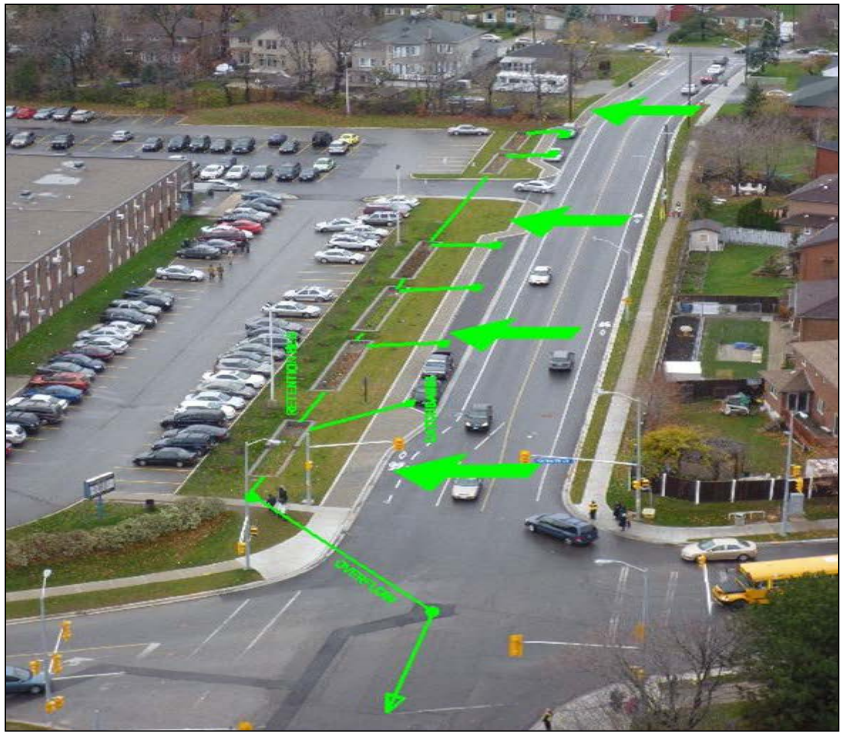
Performance Monitoring Overview

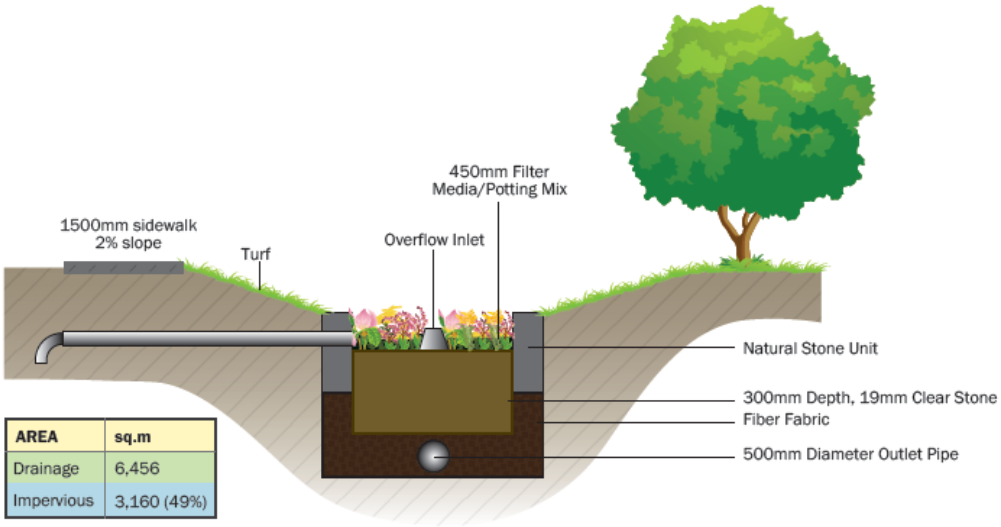
- **Level:** ponding depth, infiltration rate
- **Flow:** water level depth, velocity
- **Thermal:** thermal load through facility
- **Water quality:** determine EMCs, loading
- **Climate station:** antecedent conditions, precipitation depth and intensity

Lesson Learned #8: *Be creative – flow monitoring equipment is typically designed to function in stream settings and may not perform as expected in underground infrastructure.*

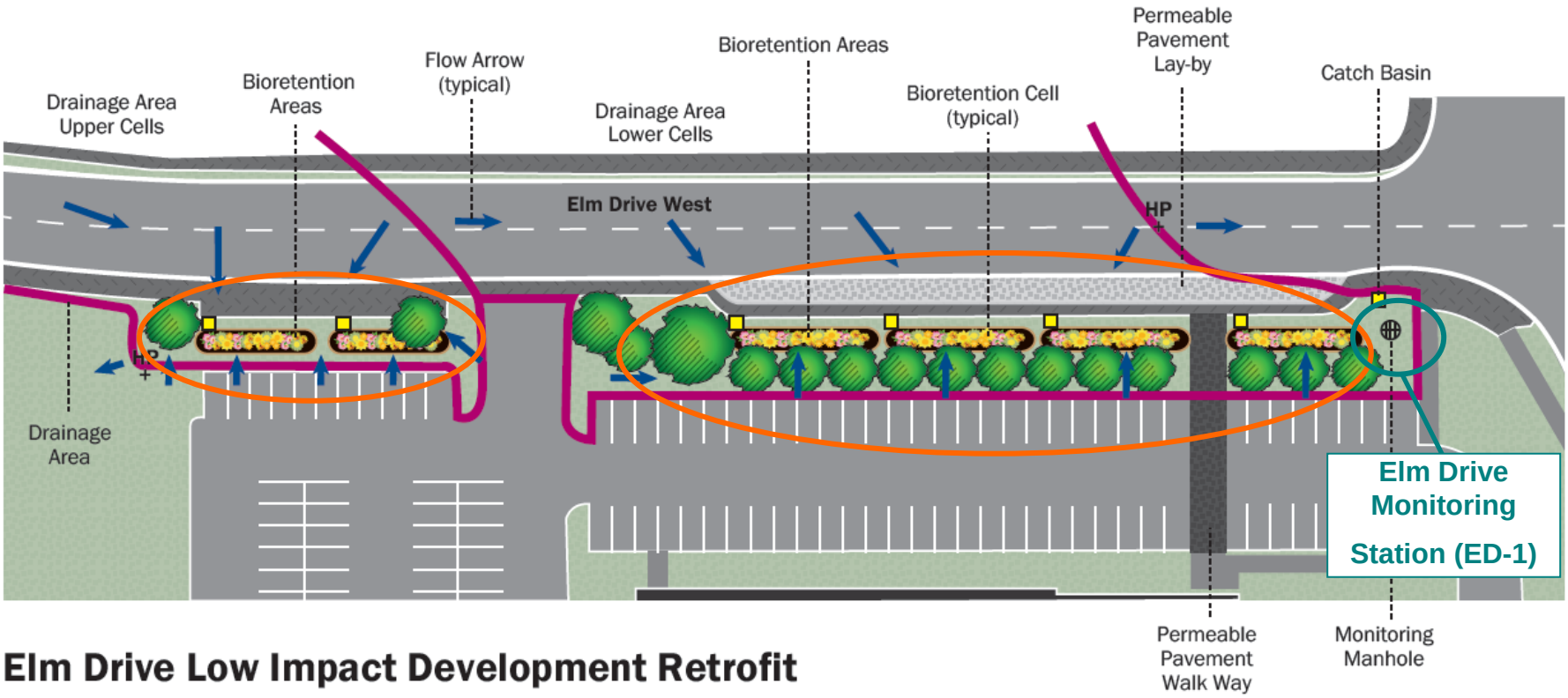
Performance Monitoring Case Study: Elm Drive

- >6000 m^2 drainage area (road drainage)
- Multiple objectives are being evaluated:
  - Water quality, quantity, meteorological, temperature, infiltration, maintenance, soil quality monitoring from 2012





AREA	sq.m
Drainage	6,456
Impervious	3,160 (49%)

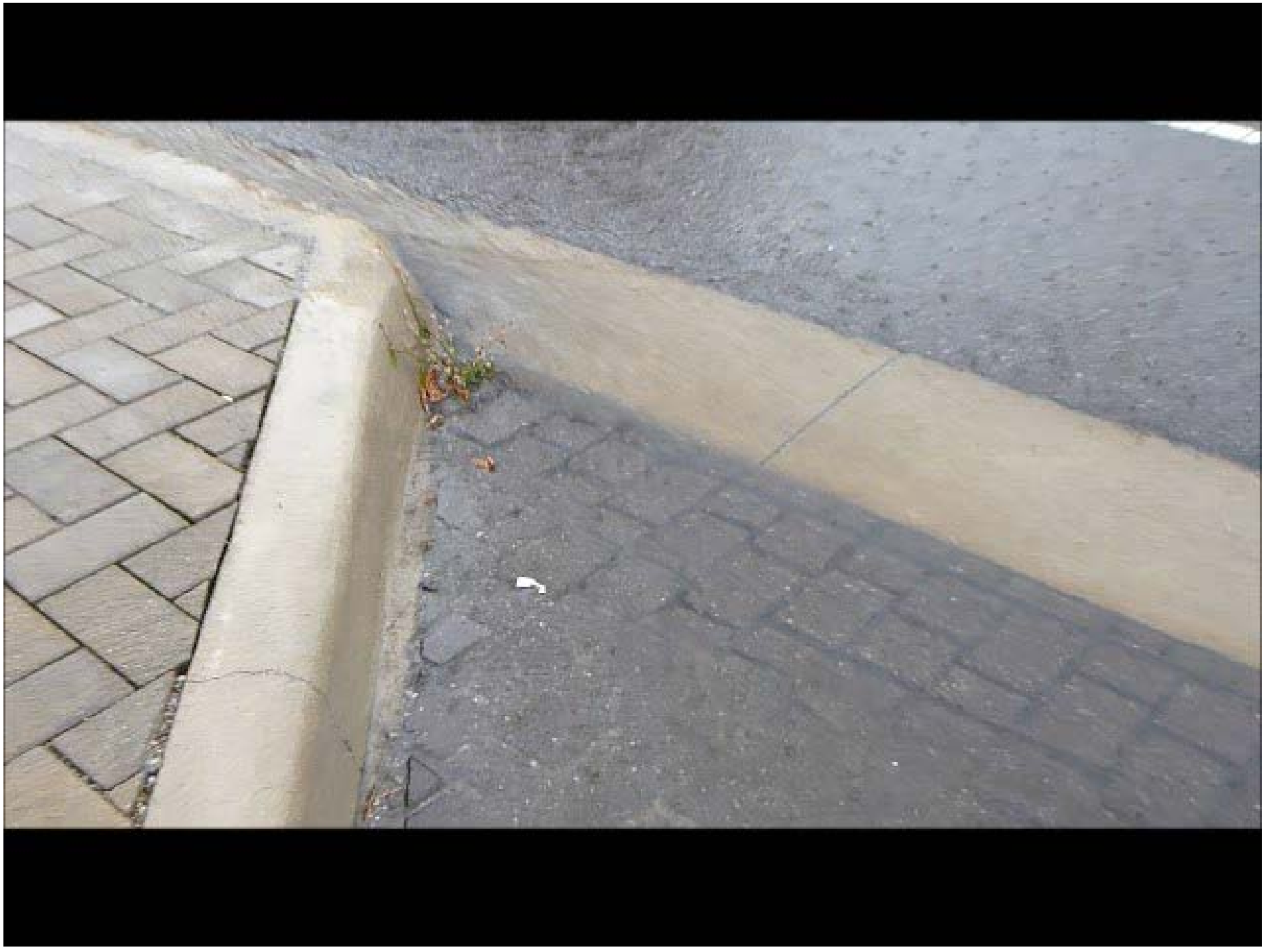


Elm Drive Low Impact Development Retrofit

Elm Drive treatment train

- Observations during rain events as well as use of photos to:
  - Inform redundancy in design
  - Document and verify ponding duration and seasonal changes
  - Inform maintenance needs

Lesson Learned #9: *Treatment trains provide multiple benefits that one system may not be able to provide on its own.*



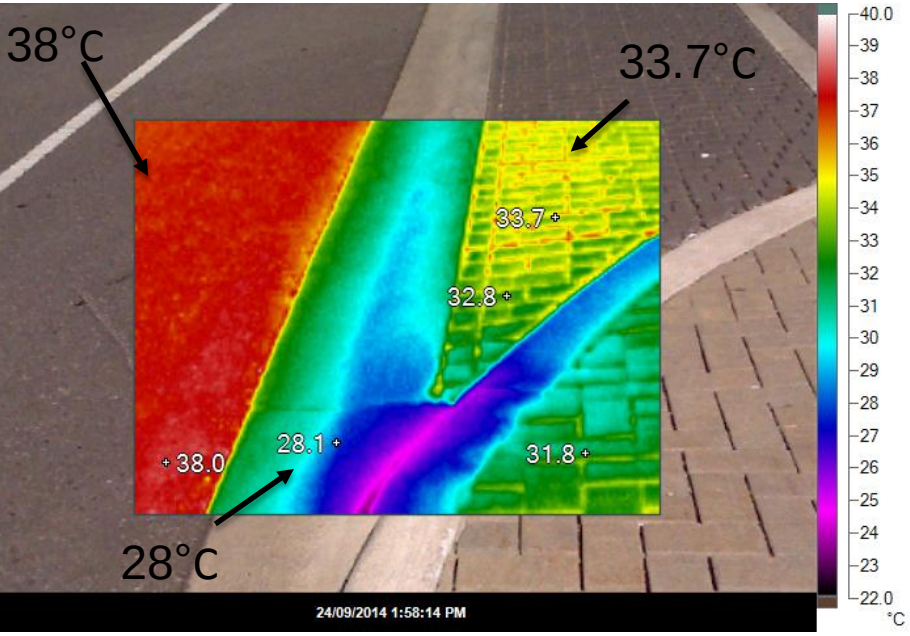
Elm Drive Monitoring

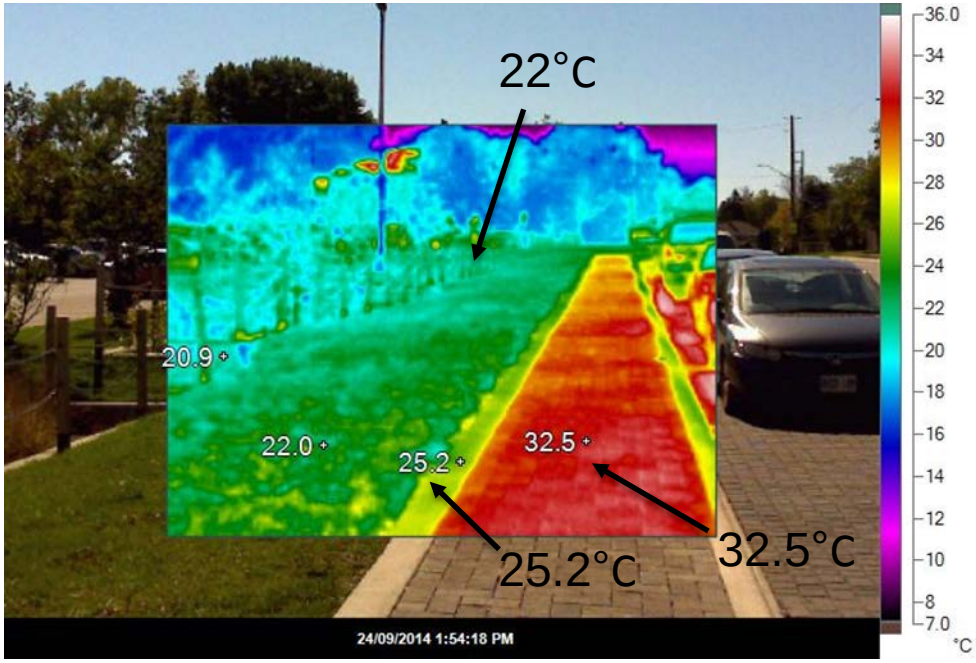
Stormwater management design criteria	Design Estimates	Monitored Results
Flood control (peak flow)	Peak flow reduction compared to pre-retrofit conditions: 2 yr event (33 mm) - 37% 5 yr event (45 mm) - 27% 10 yr event (55 mm) - 8% 25 yr event (64 mm) - 5% 100 yr event (79 mm) - 13%	2-yr to 10-yr events (33 mm to 55 mm) peak flow rate reduction: 45 – 100% 25-yr to 100-yr (64 mm to 79 mm) peak flow rate reduction: 90% (one event)
Erosion control (runoff volume)	Runoff volume reduction compared to pre-retrofit conditions: 2 yr event (33 mm) - 29% 5 yr event (45 mm) - 19% 100 yr event (79 mm) - 8% Overall erosion control to the extent possible	25-yr to 100-yr (64 mm to 79 mm) volume reduction: 56% (one event) No effluent (except for snowmelt) below storm depth of 5 mm ~90% of events below 25 mm have no effluent
Water quality	Enhanced level of treatment (80% TSS removal)	Enhanced level of treatment (94% TSS removal)

Demonstrate the degree to which LID mitigates urban thermal impacts on receiving waters

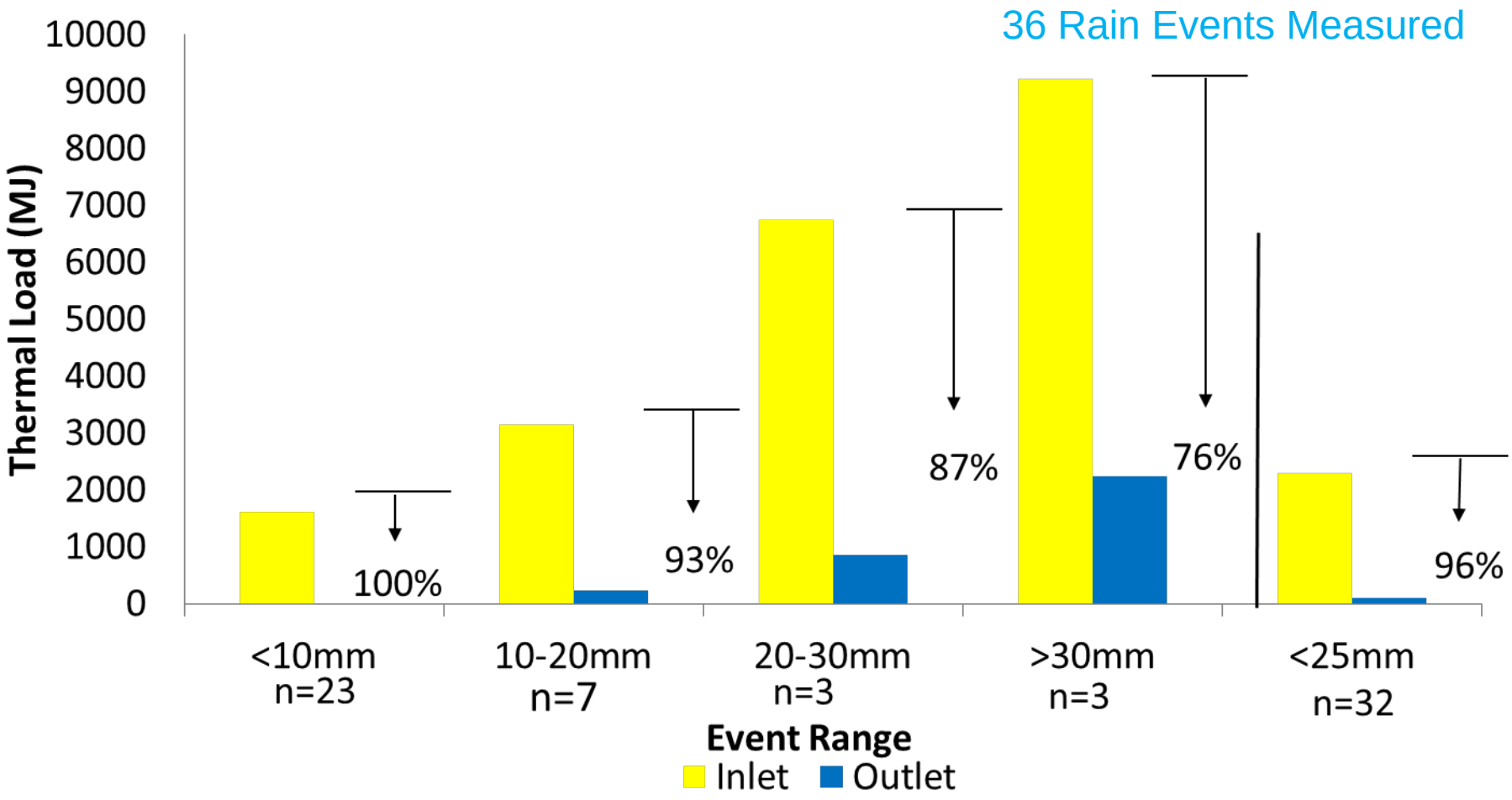
Demonstrate the degree to which LID mitigates urban thermal impacts on receiving waters

Air Temp 26.23°C





Thermal Load Reduction: 2014 Rain Events



Monitoring Challenges

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Monitoring Challenges

Lessons Learned: CVC Stormwater Management and LID Monitoring and Performance Assessment Guide

http://www.creditvalleyca.ca/wp-content/uploads/2015/08/Monitoring-Guide_DRAFT.pdf

Lessons Learned: CVC Stormwater Management and LID Monitoring and Performance Assessment Guide

Purpose

- To help develop stormwater monitoring plans to demonstrate due diligence, reduce risk and liability, and inform asset management decisions

How

- Presents the general steps, experiences, and valuable lessons learned from monitoring

Key topics

- How to set up a monitoring program
  - importance of goals and stakeholder involvement
- How monitoring can build consensus for implementing LID on a broad scale
- Importance of monitoring in the design, construction, assumption, operation and maintenance of stormwater infrastructure

- Tips for budgeting and securing funding, potential permits and permissions required
- An overview of the various types of equipment and installation practices available
- The importance of quality control and assurance in data and sample collection

Questions

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Together, it's our nature to conserve and our future to shape.