



INTEGRATED
SUSTAINABILITY

WATER | WASTE | ENERGY

An Integrated Approach to Managing Wastewater Drainage in Urban Catchments and Waterways

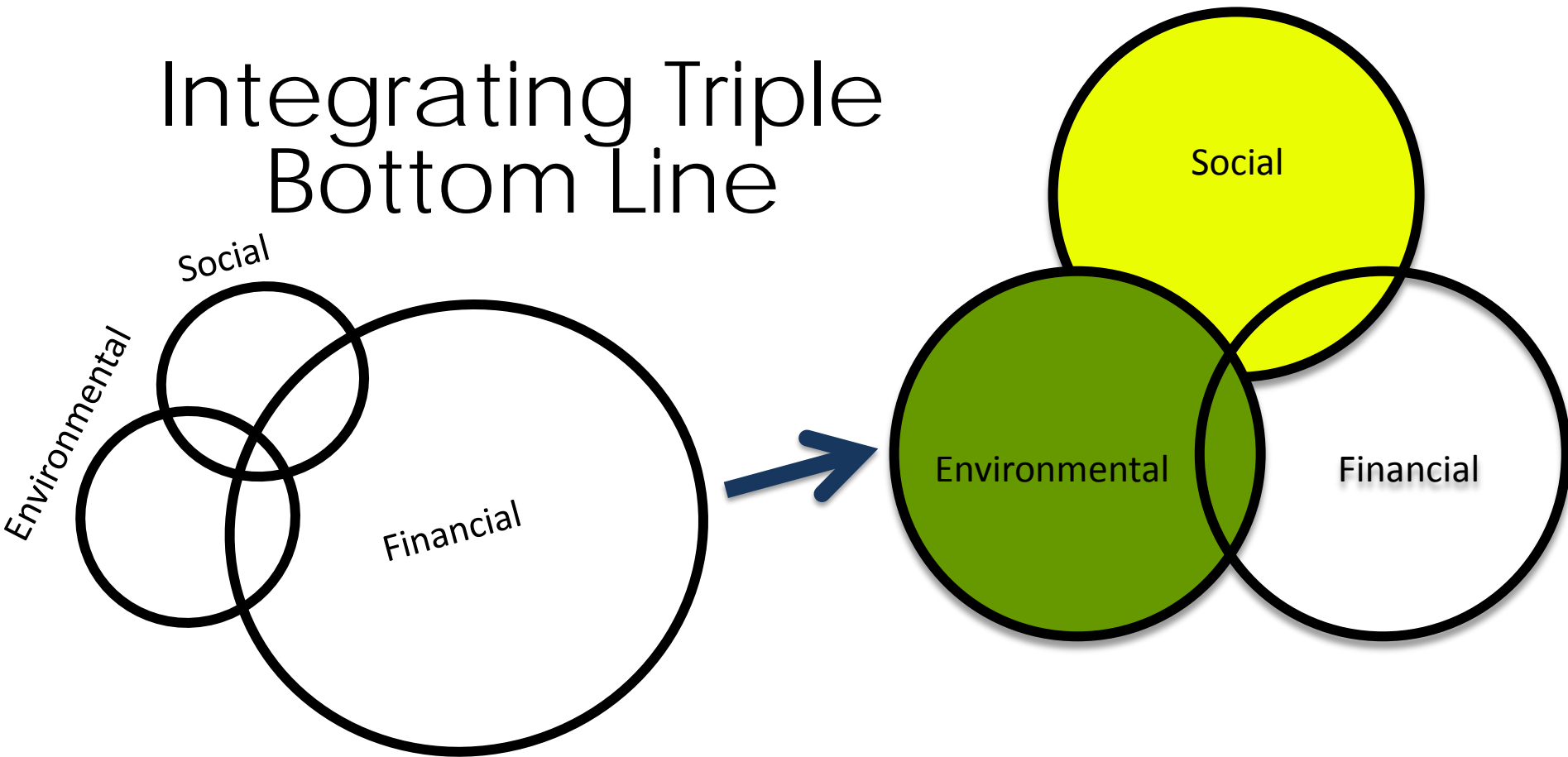
**Nic Keast P.Eng and
Ryan Cant B.Sc.**



**Presented on
April 11, 2014**

Shifting Decision Making

Integrating Triple Bottom Line



Background

Project Basis:

- The likely future direction of the management of urban drainage

Design Basis

- Effects of upstream inflows
- Combined sewer overflows (CSO).
- Rainfall
- Water treatment
- Water quality

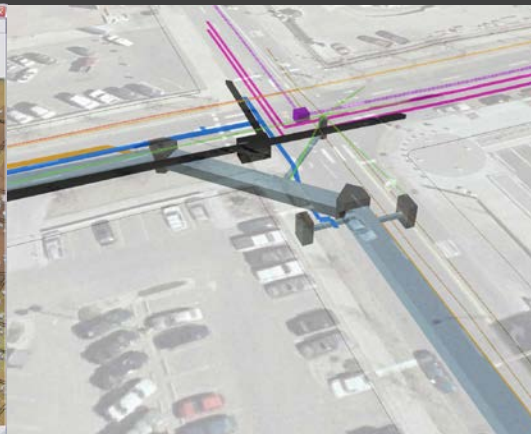
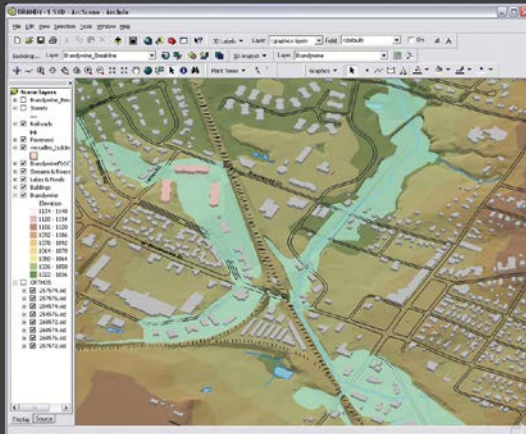
Goal:

- Cost effective solutions
- Limit environment impact

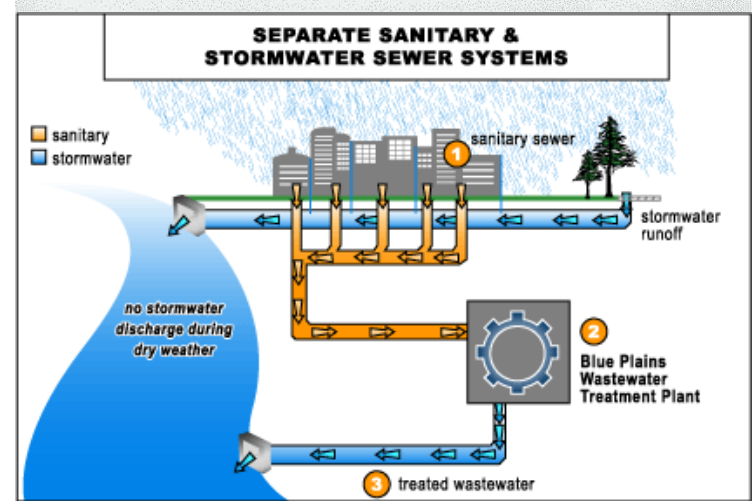
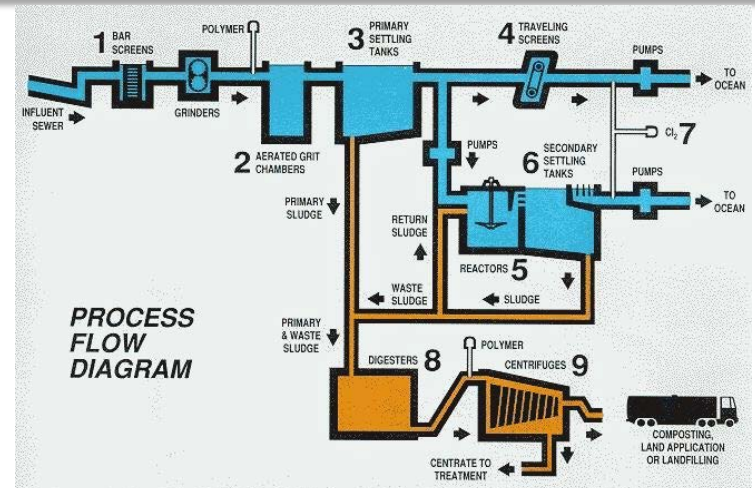
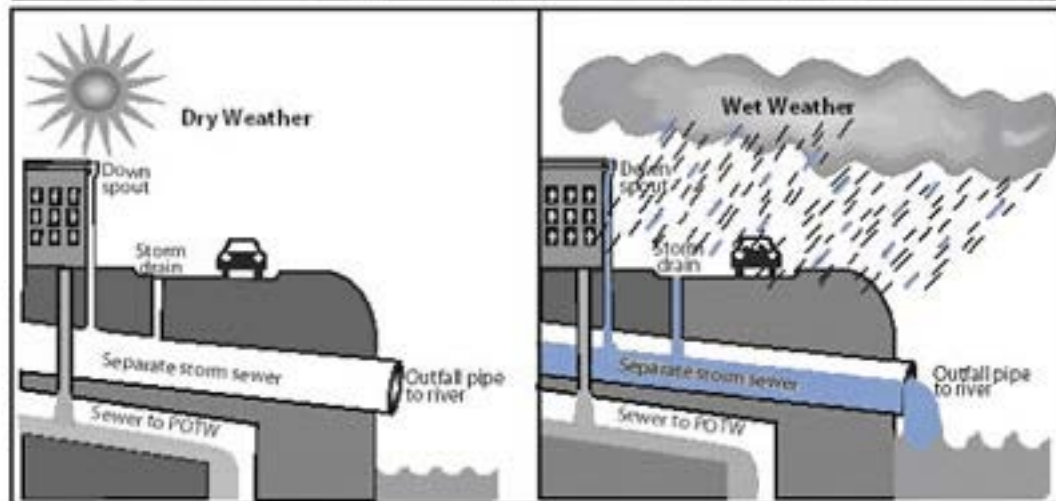
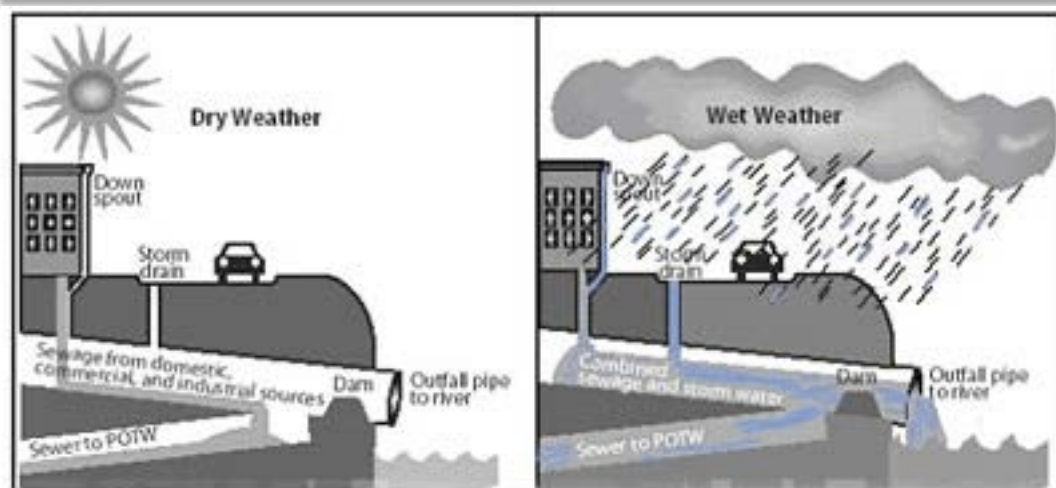


Background

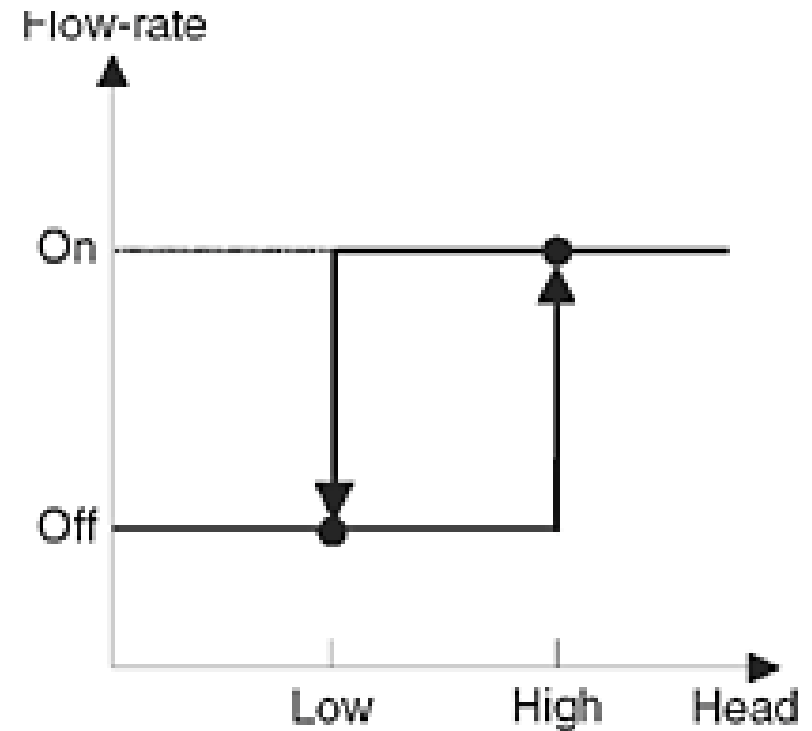
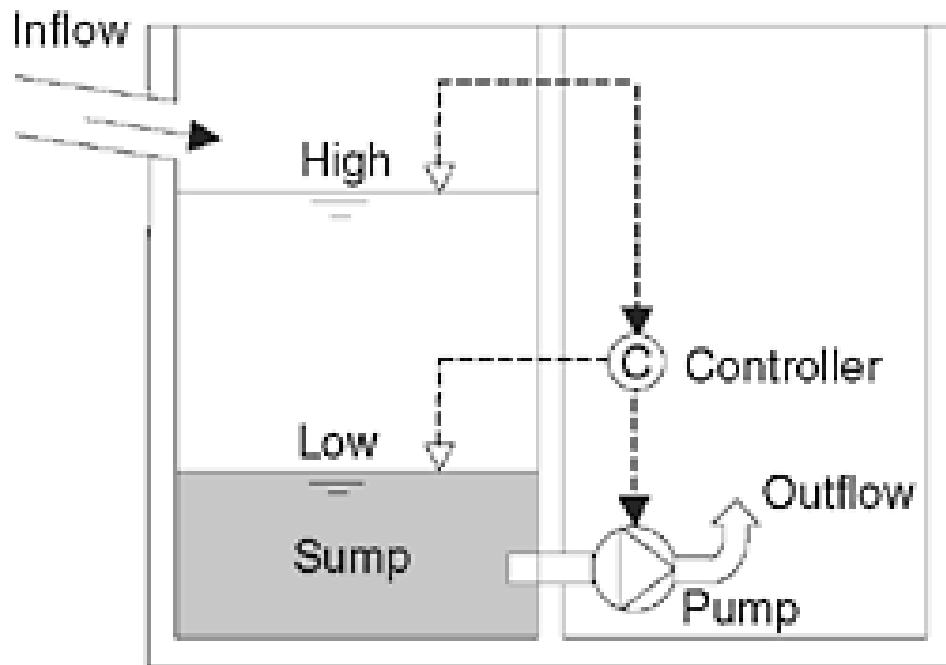
Coupling **deterministic models** of each element into an **integrated model** of the system as a whole.



Urban Wastewater Management



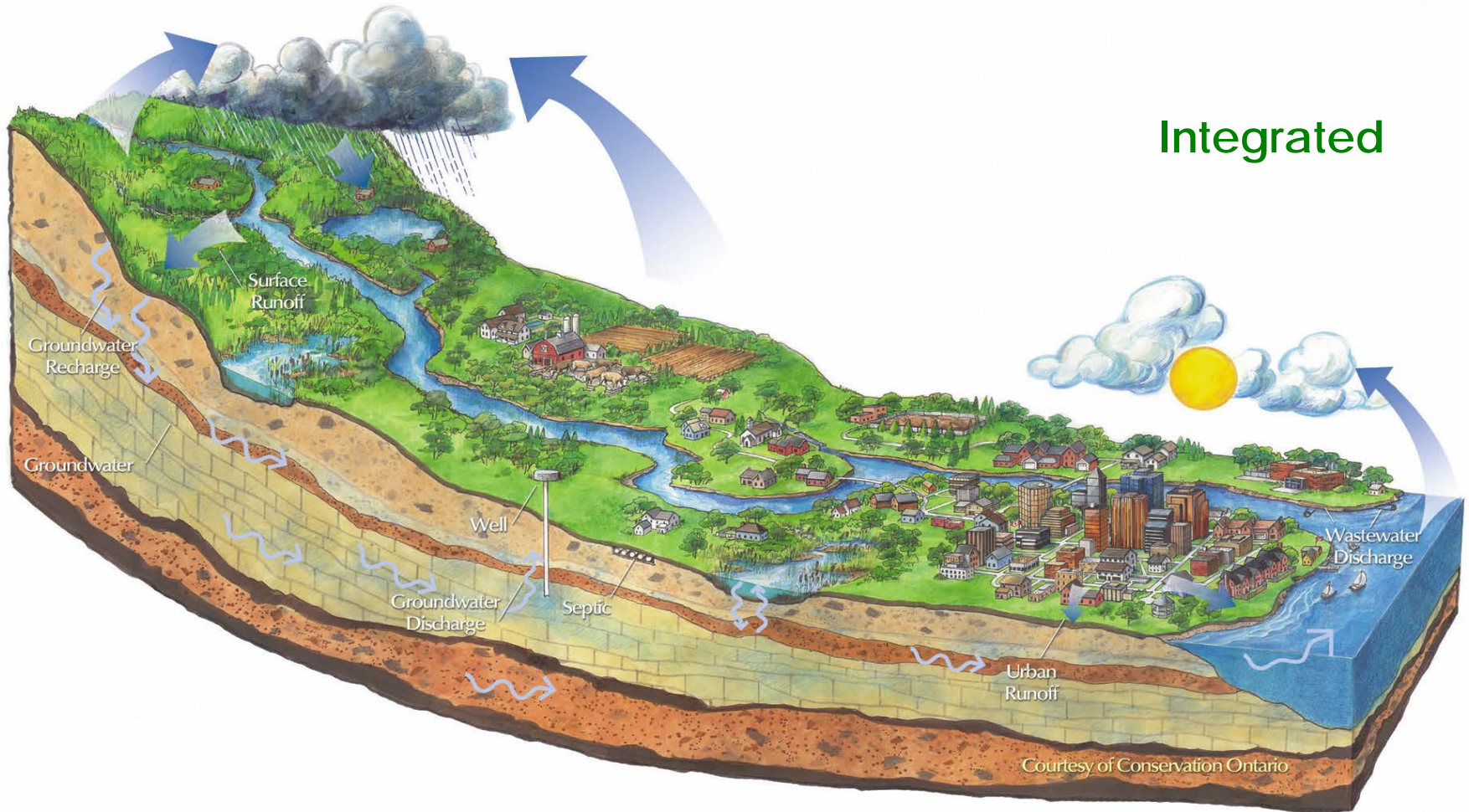
Real-time Control



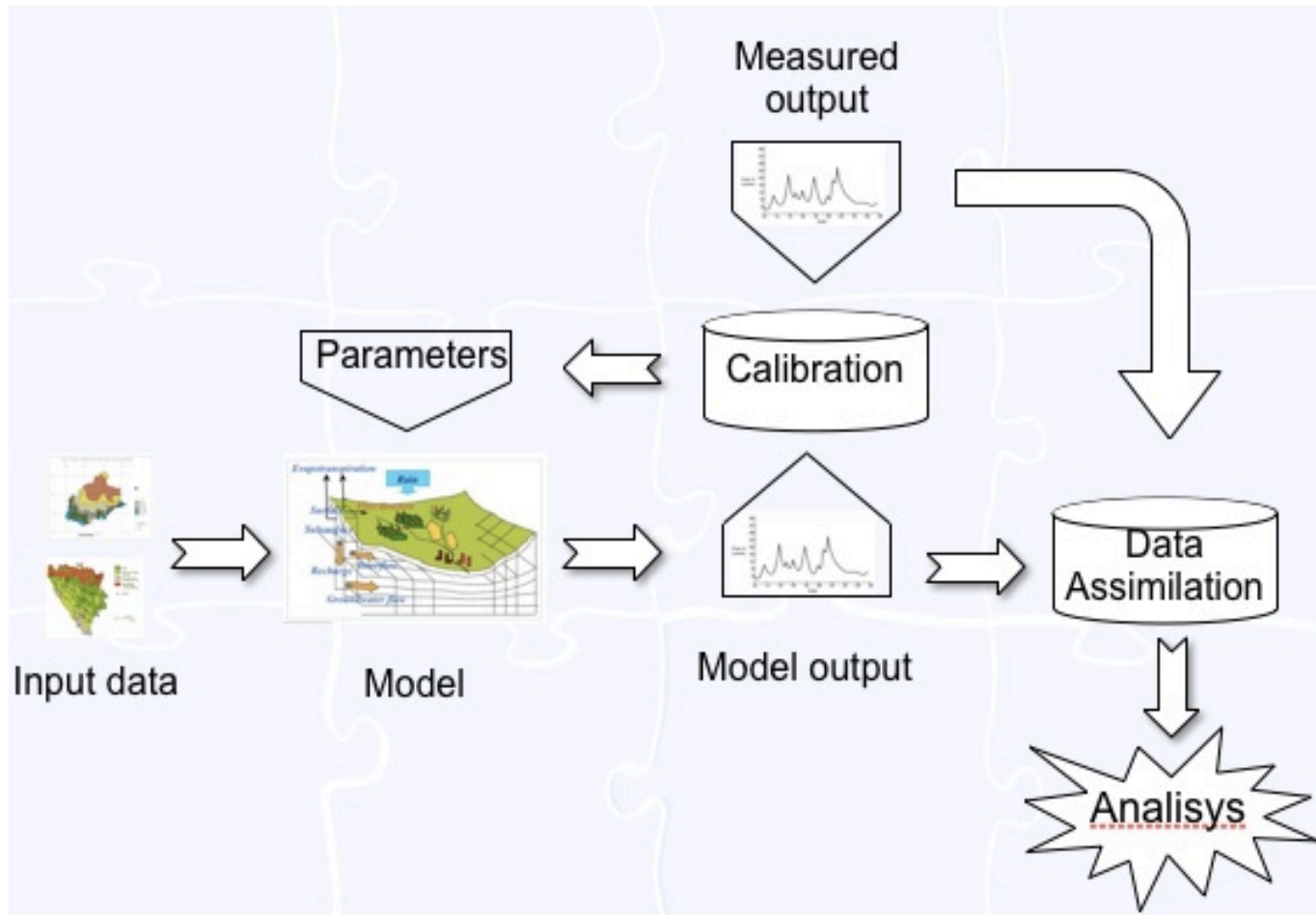
Equipment

- Sensors;
- Regulators;
- Controllers; and
- Data transmission systems.

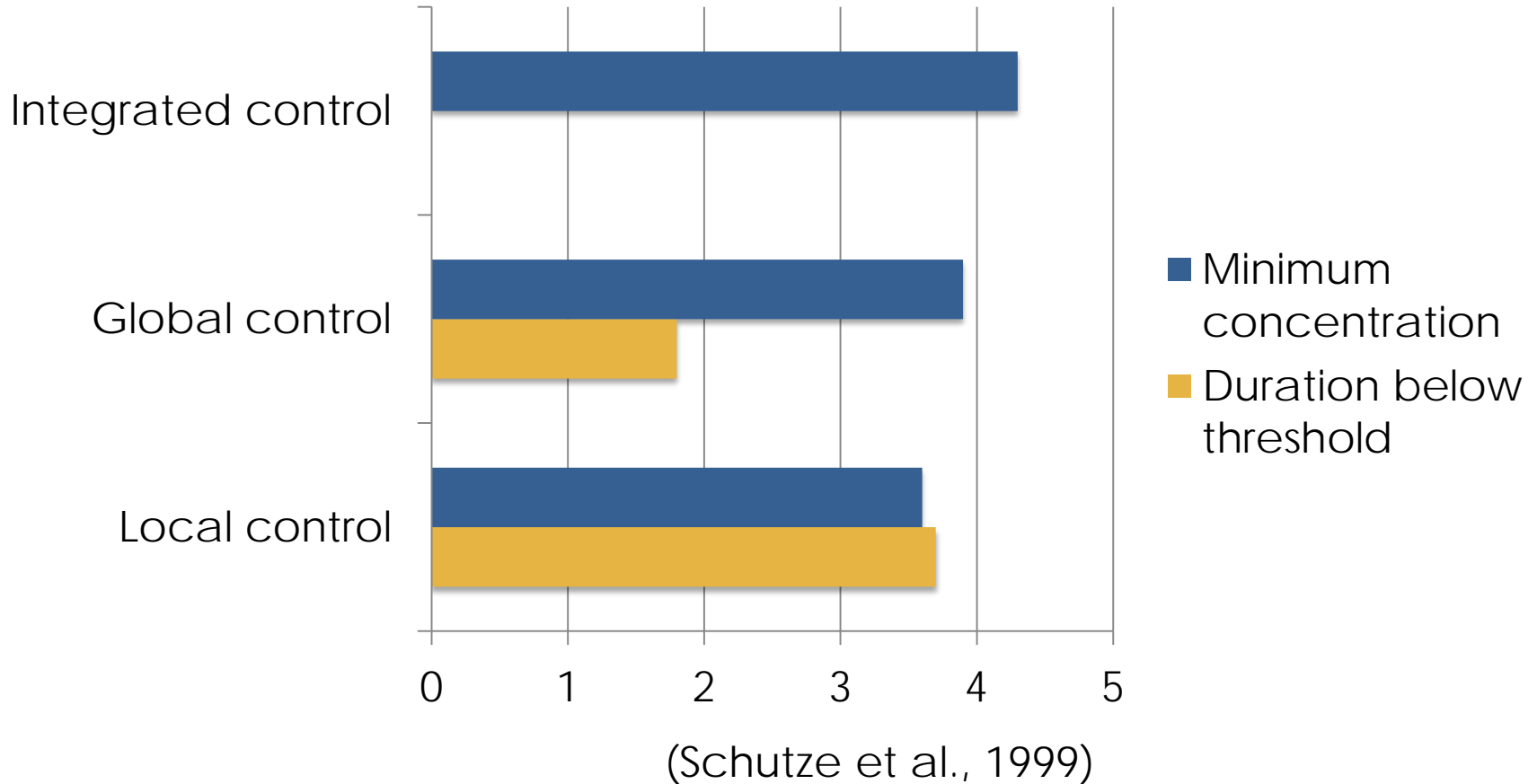
Real-time Control Options



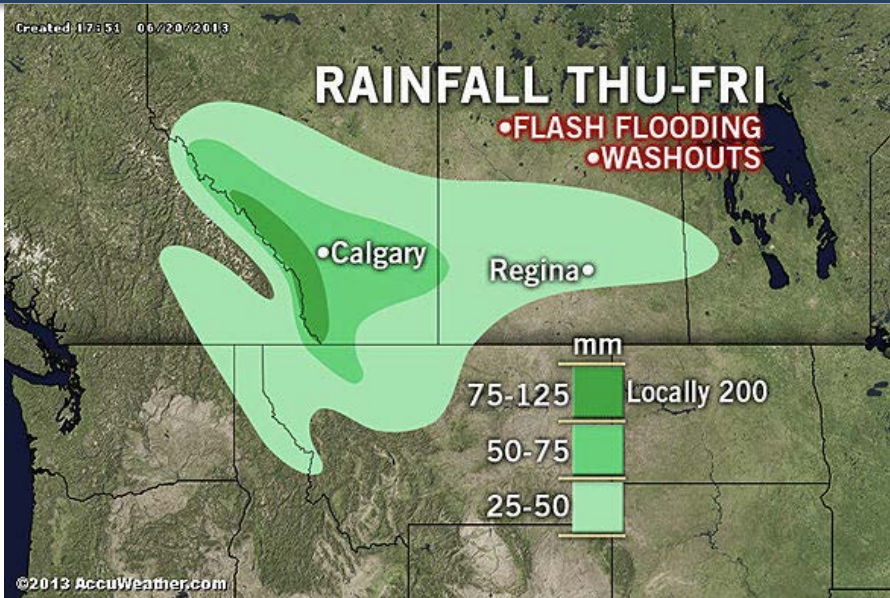
Integrated Control



Integrated Models

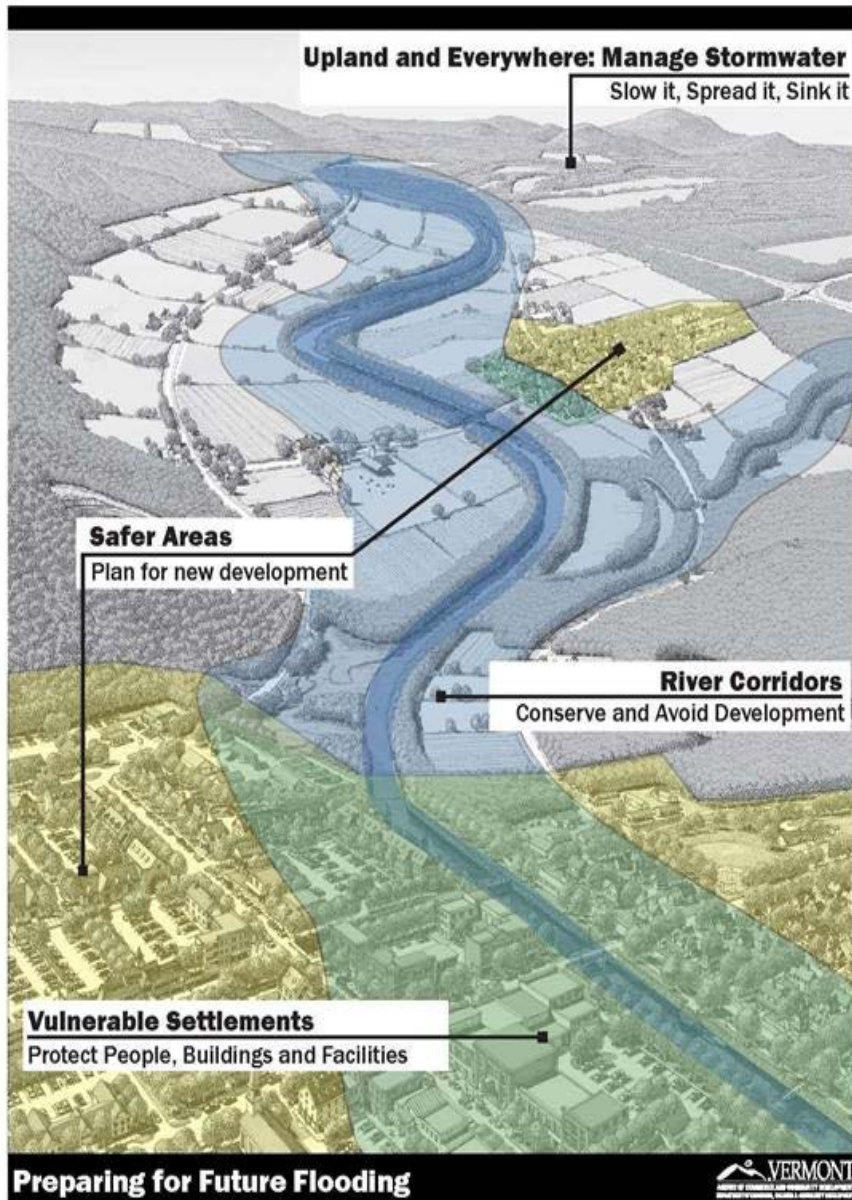


Real-time Control Strategy



1. Flow, level and quality measurements in upstream sewers:
 - System reaction must be within the time of flow.
2. Rainfall measurements and results from rainfall/runoff models:
 - Available reaction time is extended to the time of concentration of the catchment.
3. Rainfall forecasts:
 - Dependent on the forecast time horizon.

Real-time Control Strategy



- Preferential upstream storage.
- Preferential downstream storage.
- Balance storage.

Software

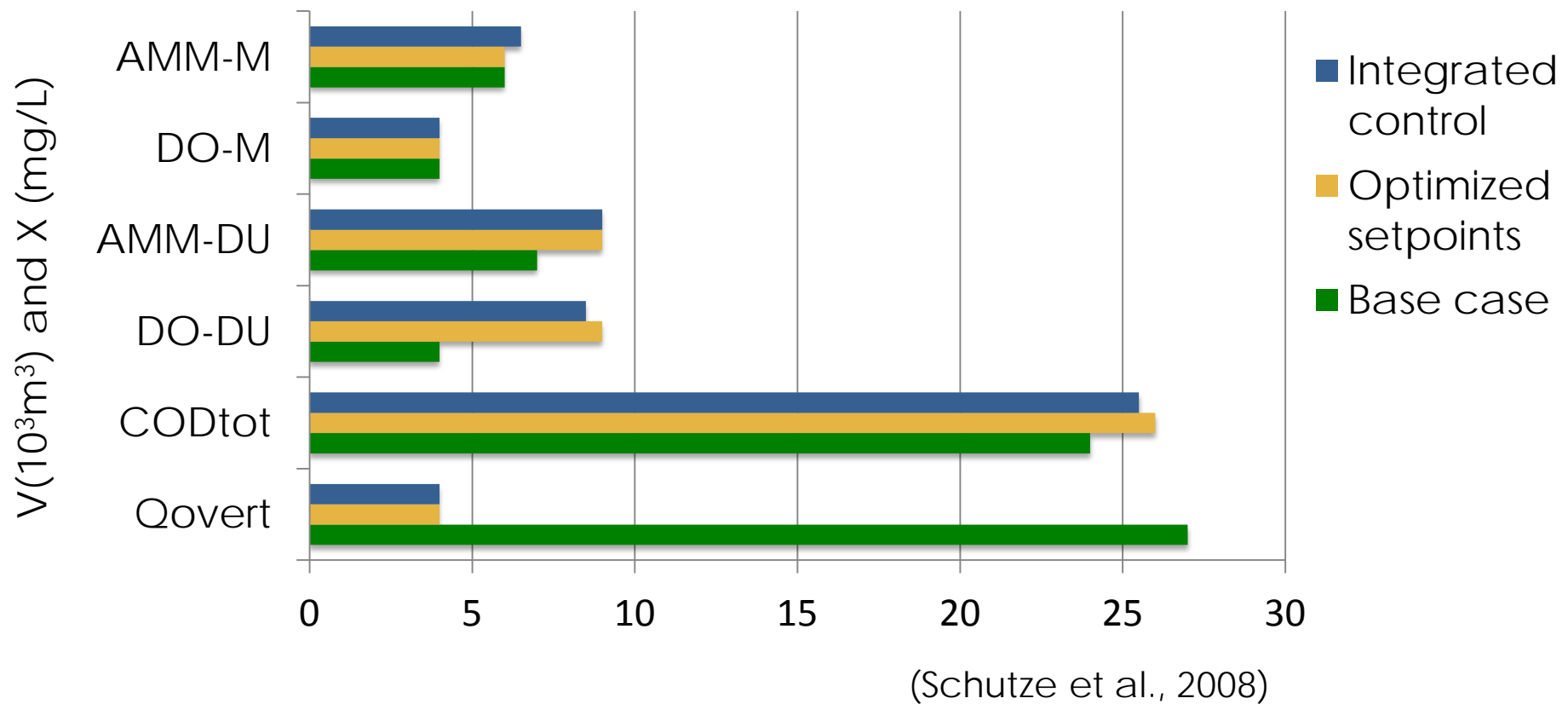


Integrated Controls

Subsystems	Devices	Objectives	Decision-finding Methods
Sewer System	<ul style="list-style-type: none"> • Pumps • Weirs • Gates 	<ul style="list-style-type: none"> • Prevention of flooding CSO reduction (frequency, volumes, loads) 	<ul style="list-style-type: none"> • Heuristics, intuition • Self-learning expert system • Off-line optimization
Treatment Plant	<ul style="list-style-type: none"> • Weirs, gates • Return sludge rate • Waste sludge Rate • Aeration 	<ul style="list-style-type: none"> • Equalization of flows • Maintenance of effluent standards 	<ul style="list-style-type: none"> • On-line Optimization • Model-based control
Receiving River	<ul style="list-style-type: none"> • Weir • Gates 	<ul style="list-style-type: none"> • Process Maintenance • Improve water quality • Flood protection 	<ul style="list-style-type: none"> • Application of control theory

(Schutze et al., 1999)

Integrated Models



Real-time Control Applicability

Other network characteristics that favor the RTC applications are:

- Spatially distributed inputs
- Spatially distributed storage
- Larger, flatter, more looped sewer networks
- Many controllable elements (e.g. storage tanks, pumps, overflows).



Real-time Control Applicability

Benefits

- Reduction in the risk of flooding.
- Reduction in wastewater bypass events.
- Reduction in new element capital costs.
- Reduction in operating costs.
- Enhancement of WWTP performance.

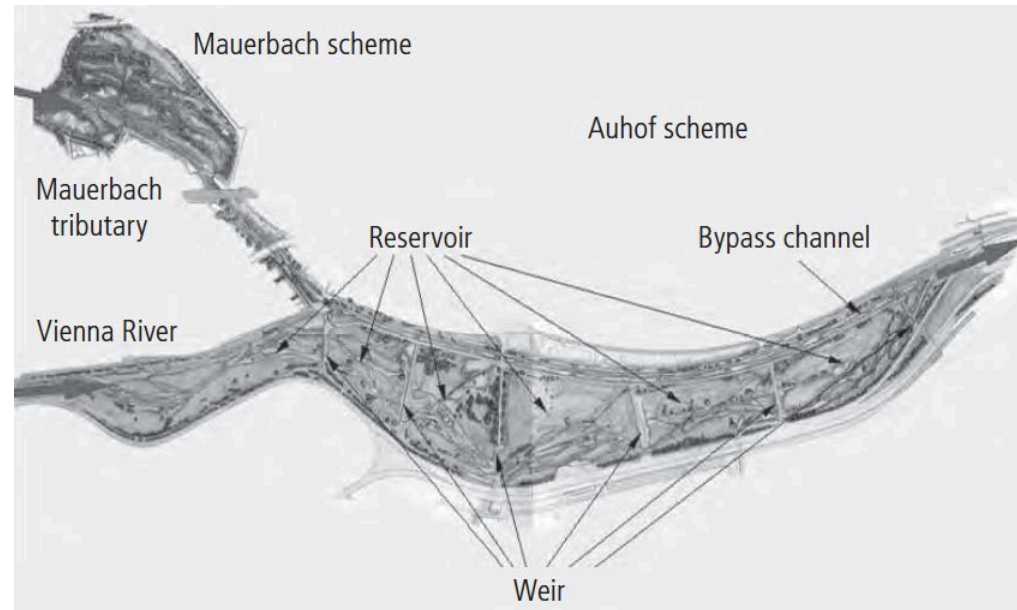
Drawbacks

- The construction and implementation time-lines.
- High retrofit capital costs.

Vienna, Austria

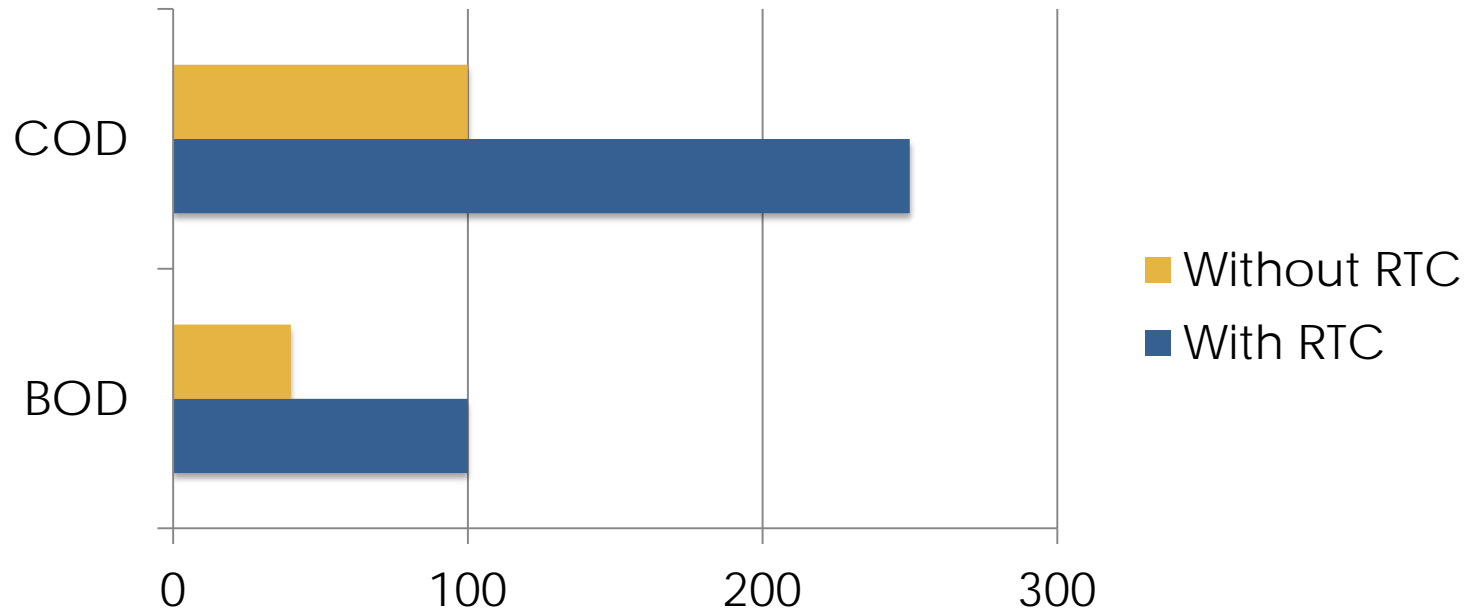
Population of 1.8 million spread over 260km² and served by 2200km of sewer system.

- Control devices to regulate water level & flow.
- Measurement devices for water level, flow, & rainfall.
- A SCADA system to collect the measurement data, transmit set points and display information about the system.
- A central point strategy to generate a control decision based on measured and forecasted data.



The system contains 25 rain gauges, 40 in-sewer flow measurement devices and 20 water level measurement units installed at 25 sites.

Integrated Models



(Nowak, 2007)

In-sewer Treatment

Transformations

A sewer acts as a plug flow reactor with a system retention time that may be equal to or exceed that of only the WWTP. A number of transformation processes occur, even without being specifically engineered.

Physical

- Particle degradation
- Dissolution,
- Mixing
- Agglomeration and flocculation
- Turbulent buffering

Biochemical

- Precipitation
- Hydrolysis
- Suspended biomass; and
- Biofilms

In-sewer Treatment



Treatment Methods

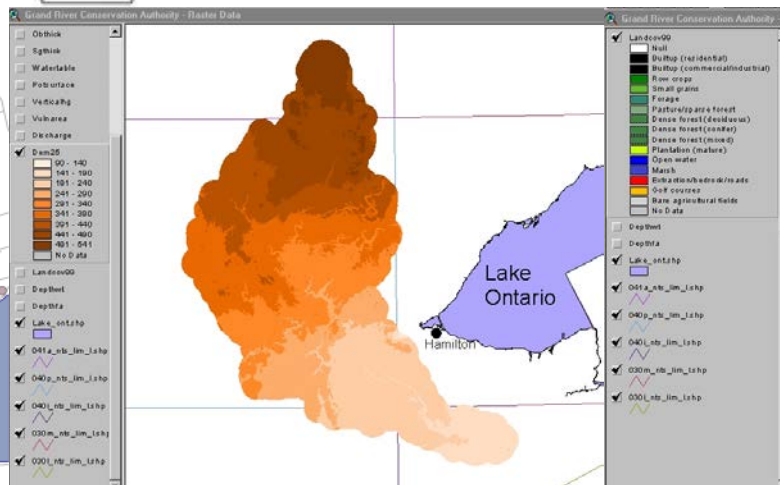
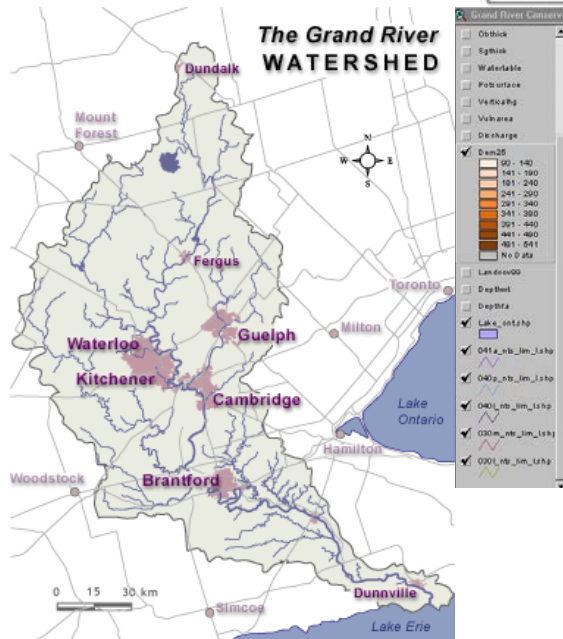
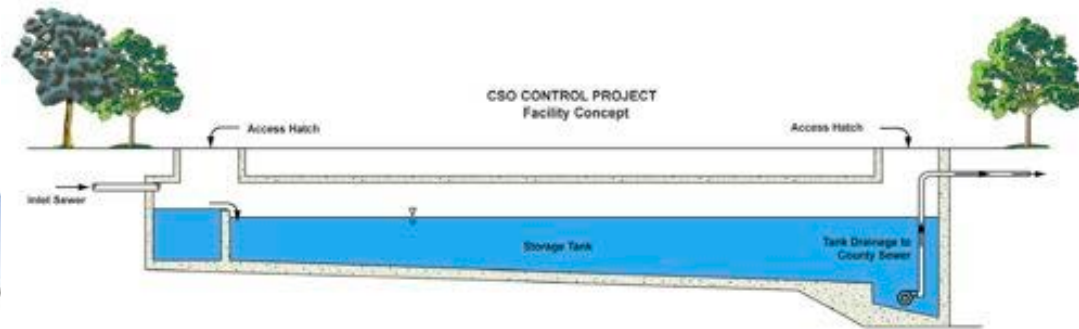
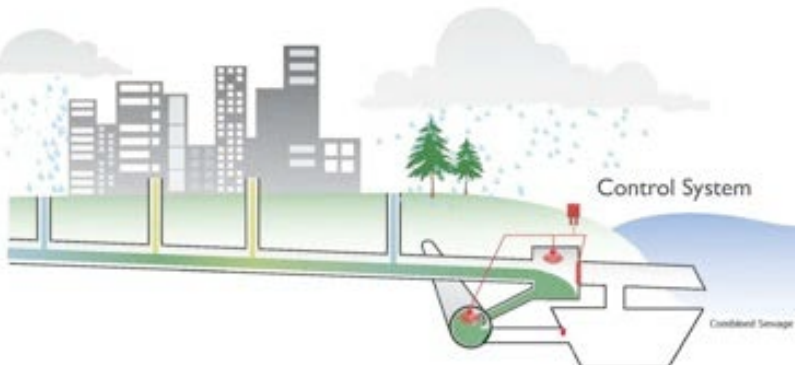
Biofilm seeding



Steps in the Right Direction

Future

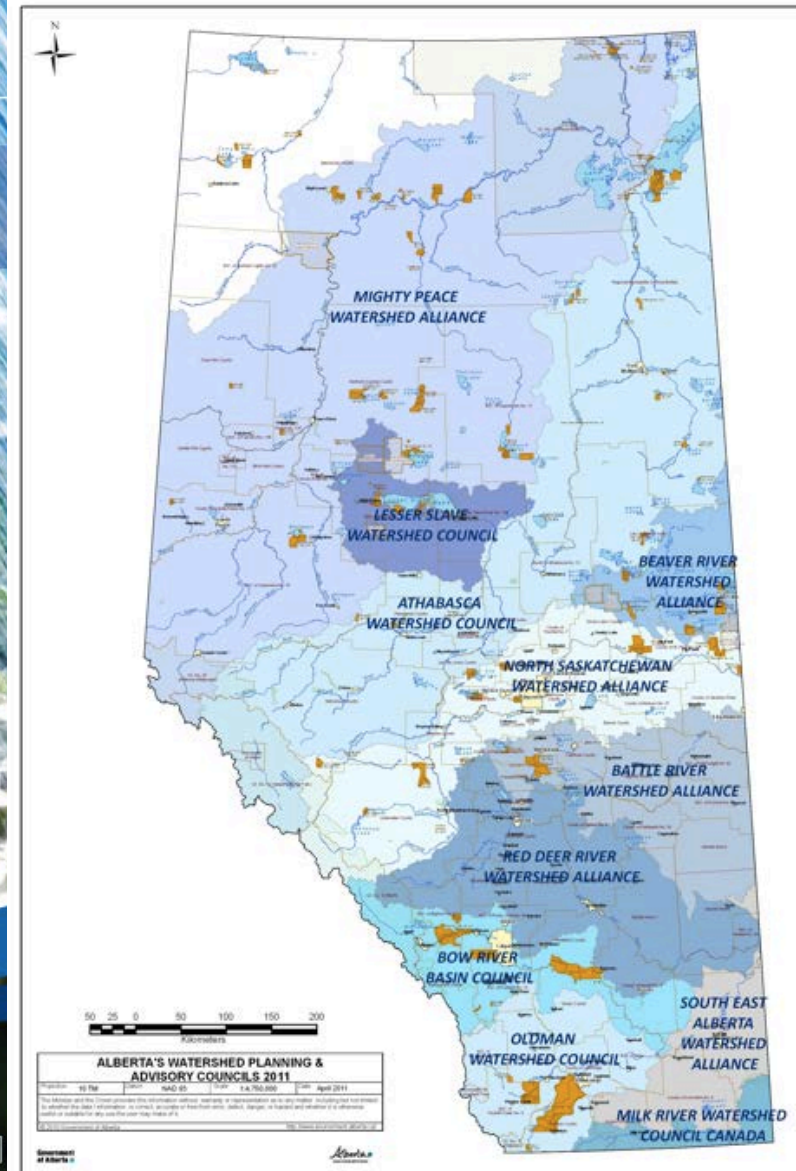
Combined Sewage Storage - Soon to be commissioned (2014)



Steps in the Right Direction

water for life

a renewal



Alberta

water for life

Towards Sustainable Water Management



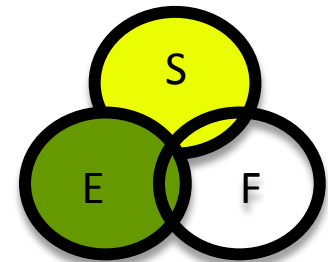
Sustainability in Design

#1

Helping to develop municipalities' sustainability policies and objectives into Project Reality.

#2

Aim to embed environmental, social and financial costs across the project life-cycle.





INTEGRATED
SUSTAINABILITY

WATER | WASTE | ENERGY

Contact Us:

Nicholas Keast, P.Eng.

Water Resources Engineer

Integrated Sustainability Consultants Ltd.

Telephone: (403) 688-7033

E: nic.keast@integratedsustainability.ca


Ryan Cant, BSc.

Environmental Scientist

Integrated Sustainability Consultants Ltd.

Telephone: (403) 471-7871

E: ryan.cant@integratedsustainability.ca



Integrated Sustainability Consultants Ltd. is an employee-owned engineering and consulting company specializing in water and wastewater treatment, water management, waste management and energy solutions.