Agenda

- Climate Change Forum on September 28 and 29
  - Agenda posted on 4771 site
  - Perhaps ideas for research topics for Seminar 2?
  - How many can attend on Thursday - Friday?
- Seminar 1 Presentations (2017):
  - October 20 and 27
- CILU
- Lecture 5: Sustainable Water and Wastewater Management

CLIMATE CHANGE FORUM

Day 1:
Sept. 28
(Thursday)

Venue:
The Study, LU

1:00 – 1:15 pm Coffee

1:15 – 2:15 pm What Is Climate Change Anyway?

2:15 – 2:45 pm Picturing Climate Change in Thunder Bay: Photovoice Exhibit

2:45 – 3:45 pm Student/Faculty Debate
Be it resolved that "*Humans are rising to the challenge and tackling the climate change crisis*"

4:00 – 5:00 pm Lecture: "Climate change impacts on Indigenous peoples' health: Stories from around the world" -Sherilee Harper

5:00 – 6:00 pm Dinner (Free for registered)

6:00 – 7:30 pm Boreal Heartbeat: Emotional Impacts of Climate Change in Northwestern Ontario.
-Kelsey Jones-Casey, Fulbright Scholar

CLIMATE CHANGE FORUM

Day 2:
Sept. 29
(Friday)

Venue:
The Bartley Residence, Conference Room, LU

8:30 – 9:00 am Coffee and greetings

ALL FOLLOWING ARE PANEL DISCUSSIONS:
5 mins presentations per panelist.

9:00 - 10:30 am
Panel 1 : Climate Change Impacts on the Lake Superior/watersheds

Panelists:

- **Robert Stewart (Moderator)**
- **Carl Lindquist – Superior Watershed Partnership**
- **Tom Berry – Minnesota Sea Grant**
- **EJ Isaac – Grand Portage Band of Lake Superior Chippewa**
- **Alyssa Ray – Red Rock Indian Band**

CLIMATE CHANGE FORUM

Day 2:
Continued

Sept. 29
(Friday)

Venue:
The Bartley Residence, Conference Room, LU

10.45 - 12.15 am

Panel 2: Climate Modelling and Data Use

Panelists:

- Adam Cornwell (Moderator)
- Al Douglas
- Edmundo Fausto
- Graham Saunders
- Tammy Cook (LRCA)

12:15 - 1:00 pm Lunch

1:00 - 2:30 pm

Panel 3: The Bio-economy and Climate Mitigation

Panelists:

- Sudip Rakshit (Moderator)
- Warren Mabee (Queens)
- Colin Kelly (Confederation College)
- David Johnson

CLIMATE CHANGE FORUM

Day 2:
Continued

Sept. 29 (Friday)

Venue:
The Bartley Residence, Conference Room, LU

2:30 - 3:00 pm Tea

3:00 - 3:15 pm
Lecture: Ontario's Aboriginal Communities: On the frontline of the fight against Climate change - First Nation Technical Services (TBC)

3:15 - 4:45 pm
Panel 4: Community Awareness Perspectives
Panelists:

- **Paul Berger (Moderator)**
- **Rena Viehbeck (EarthCare ,Thunder Bay)**
- **Lindsay Galway (Asst Professor - LU Health Sciences)**
- **Charles Levkoe**

Sustainable Water and Wastewater Management

Geog 4771 – Sept. 27, 2017

Graham Saunders

Lakehead University

Overview – Water / Wastewater

- Pollution and Availability
- Water Use and Misuse
- Water Balance of the Home
- Conservation Alternatives
- Wastewater Treatment: Traditional: Thunder Bay

Seminar Presentations SESSION 1

- Speaker/Présenteur: Brian French Time/Heure: 08:31
  Minimizing our reliance on California
- Speaker/Présenteur: Melissa MacPhail Time/Heure: 08:43
  Eco Cemeteries
- Speaker/Présenteur: Kelsey Agnew Time/Heure: 08:55
  "Flash Flooding"
- Speaker/Présenteur: Curtis Towle Time/Heure: 09:07
  Sustainable automobile traffic networks in urban areas
- Speaker/Présenteur: Yifu Yu Time/Heure: 09:19
  Pricing and taxing carbon
- Speaker/Présenteur: Sabrina Bloedorn Time/Heure: 09:31
  Fire and Flood in Kelowna BC summer of 2017,
  what the city did to help control these natural disasters?
- Speaker/Présenteur: Brodie Fischer Time/Heure: 09:43
  Regulations that have proven more harmful than good

Seminar Presentations SESSION 2

- Speaker/Présenteur: Brendan Faykes Time/Heure: 08:31
  Walkability in Thunder Bay
- Speaker/Présenteur: Rylie Nellis Time/Heure: 08:43
  Sustainable approaches to living in northern communities
- Speaker/Présenteur: AyshaLiisa McNally Time/Heure: 08:55
- **Initiating grey water recycling projects in Thunder Bay**
- Speaker/Présenteur: Ethan DInverno Time/Heure: 09:07
  How countries of different wealth can best prepare based on their circumstances
- Speaker/Présenteur: Alexandru Todosia Time/Heure: 09:19
  European eco-villages and how relevant are they in the modern world?
- Speaker/Présenteur: Cliff Hartono Time/Heure: 09:31
  Futures of Vehicles: Pros and Cons of Hydrogen, Electric, and Diesel
- Speaker/Présenteur: Erin Knight Time/Heure: 09:43
  Forest harvesting practices relating to fire management (i.e. recent BC and AB wildfires)

Canada: the Land of Plenty

- **Urban Myth:** *The Globe and Mail* and other media report that most Canadians believed we have an over-abundance of water in Canada ("20 to 40% of Earth's store")

- **Fact:** 5th in renewable supply (World Resources Institute)
  - Brazil (12.7%)
  - Russia (10.2%)
  - China (8.3%)
  - Indonesia (6.7%)
  - **Canada (6.4%)**
  - India (6.0%)
  - United States (5.8%)

Water Shortages in Canada?

- Great Lakes
- First Nations

"Tofino water shortage brings closure order"

Other situations?

Pollution and Availability

- **Untreated sewage**
  - Victoria
  - Status of Halifax, St. John's
- **Aquifer troubles**
  - Abbotsford, Walkerton, Oak Ridges Moraine
- **Water shortages**
  - China: Yangtze (Yellow River) dry 200+ days per year - Diamond, 2005)

Photo courtesy of NOAA

Photo credit: J.Ryder

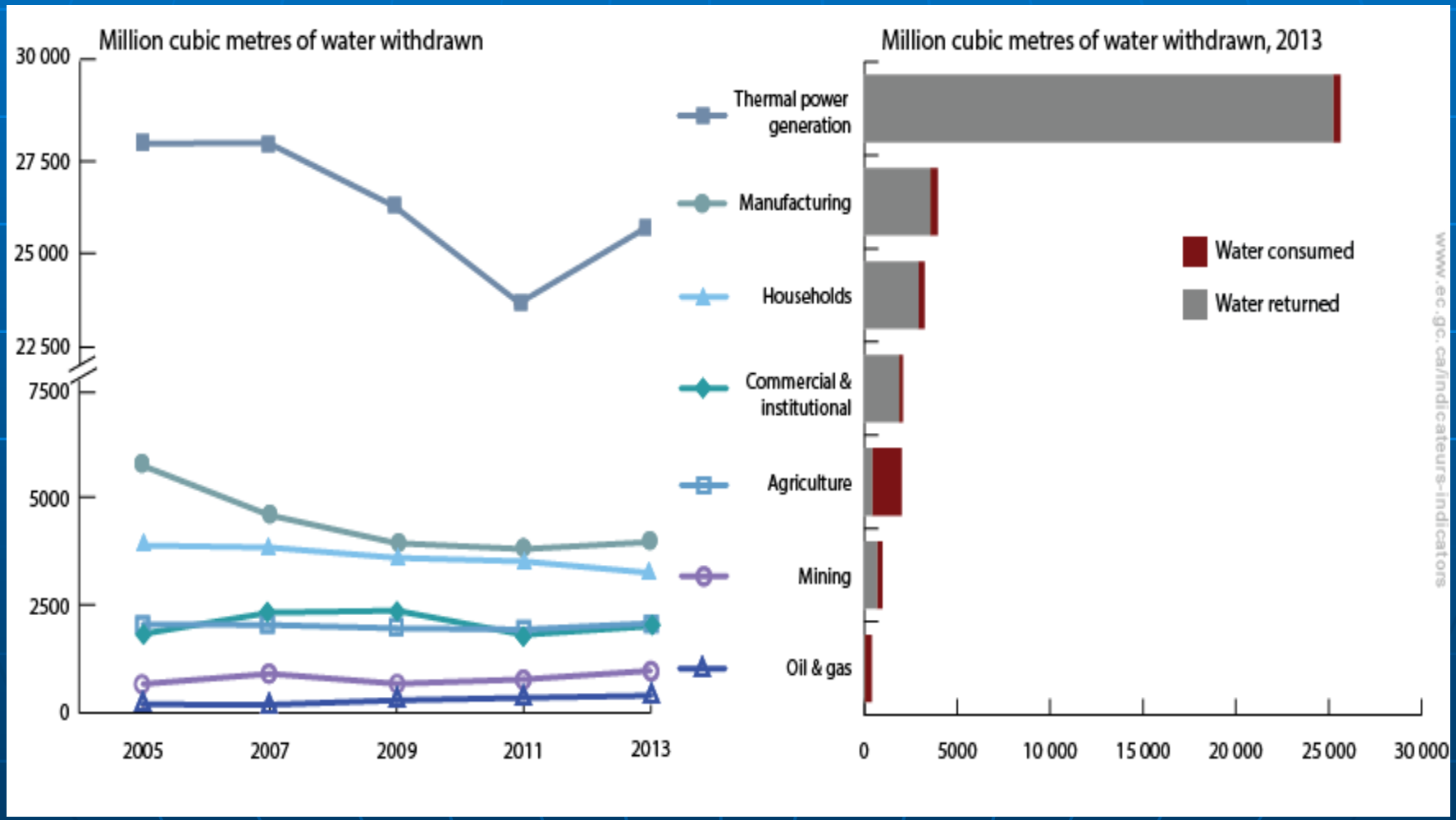
Water Use (brief)

- *By Sector* (2013 data, Env. Canada):
  - Thermal Power Generation* 64%
  - Manufacturing 14%
  - **Municipal** **10%**
  - Rural 2%
  - Agriculture 9%
  - Mining 1%

- ** 80% of this in Ontario, 7% in Atlantic Canada and Prairies; minimal in QC, BC*

Water withdrawal by sector, Canada, 2005 to 2013

(**Source:** Environment and Climate Change Canada)

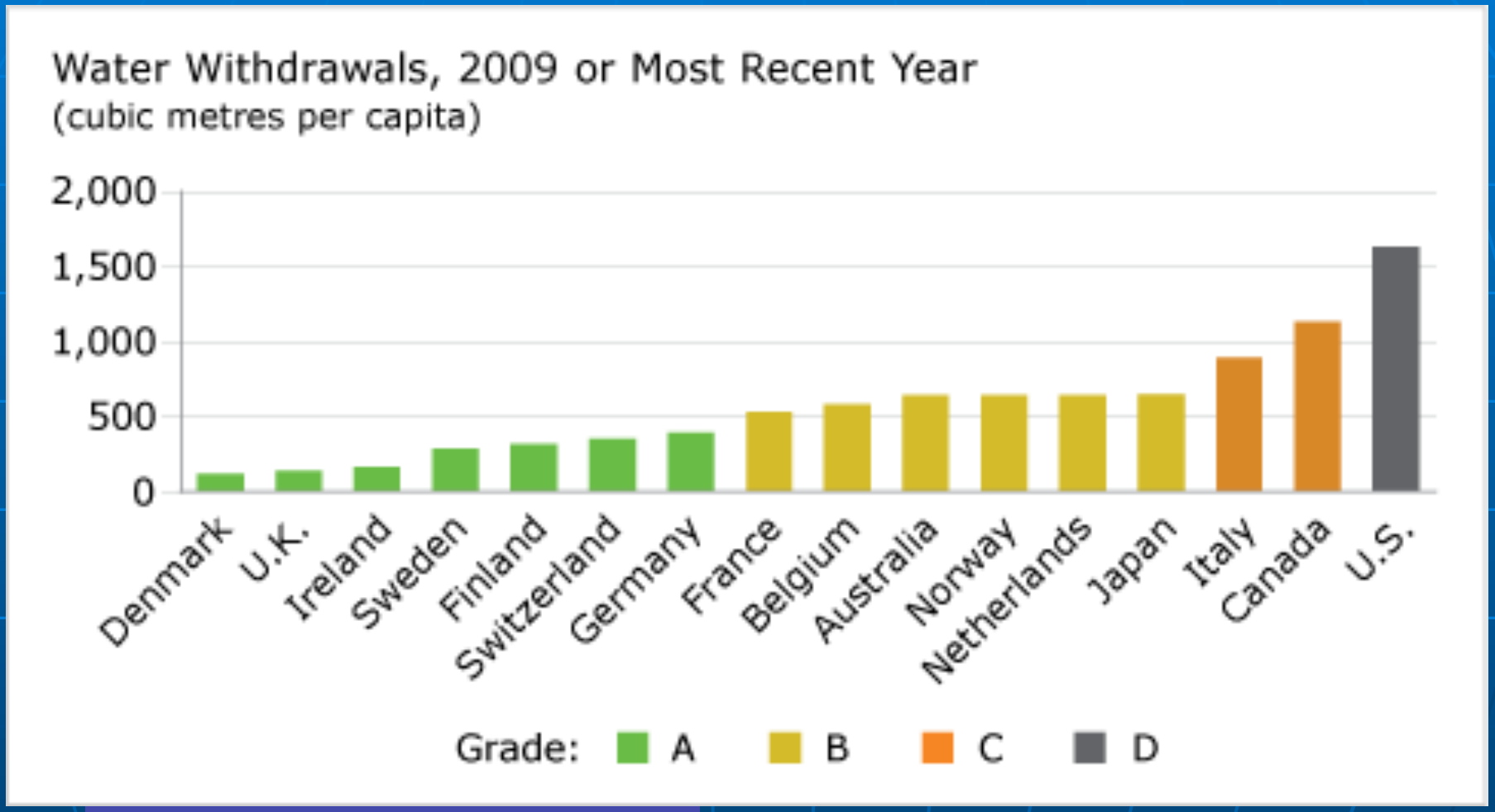


Per Capita Water Use (intro)

Comparison of per capita residential water consumption (from Conference Board of Canada, 2009) and costs (from Canada West Foundation, 2006).

jurisdiction	water consumption (L/c/d)	water prices (1989 $US/m^3)
USA	1632	1.25
Canada	1,131	***0.36***
Denmark	125	6.70
Germany	150	2.15
France	150	3.74
Australia	932	2.44

Notes: L/c/d = Litres per capita per day; 1000 L = 1 m^3.



Conservation

Source: Canada West Foundation

Water Balance of a home

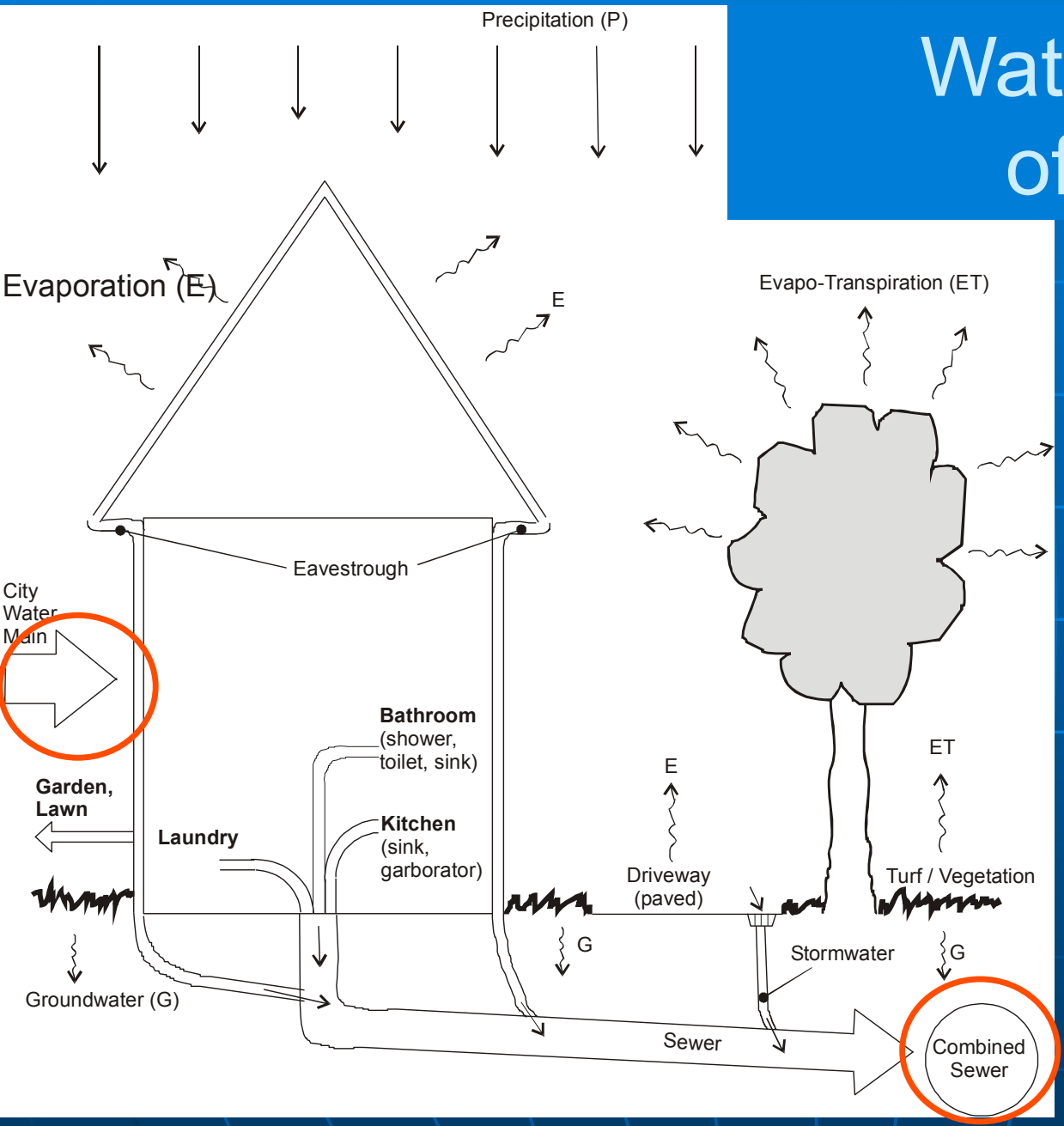


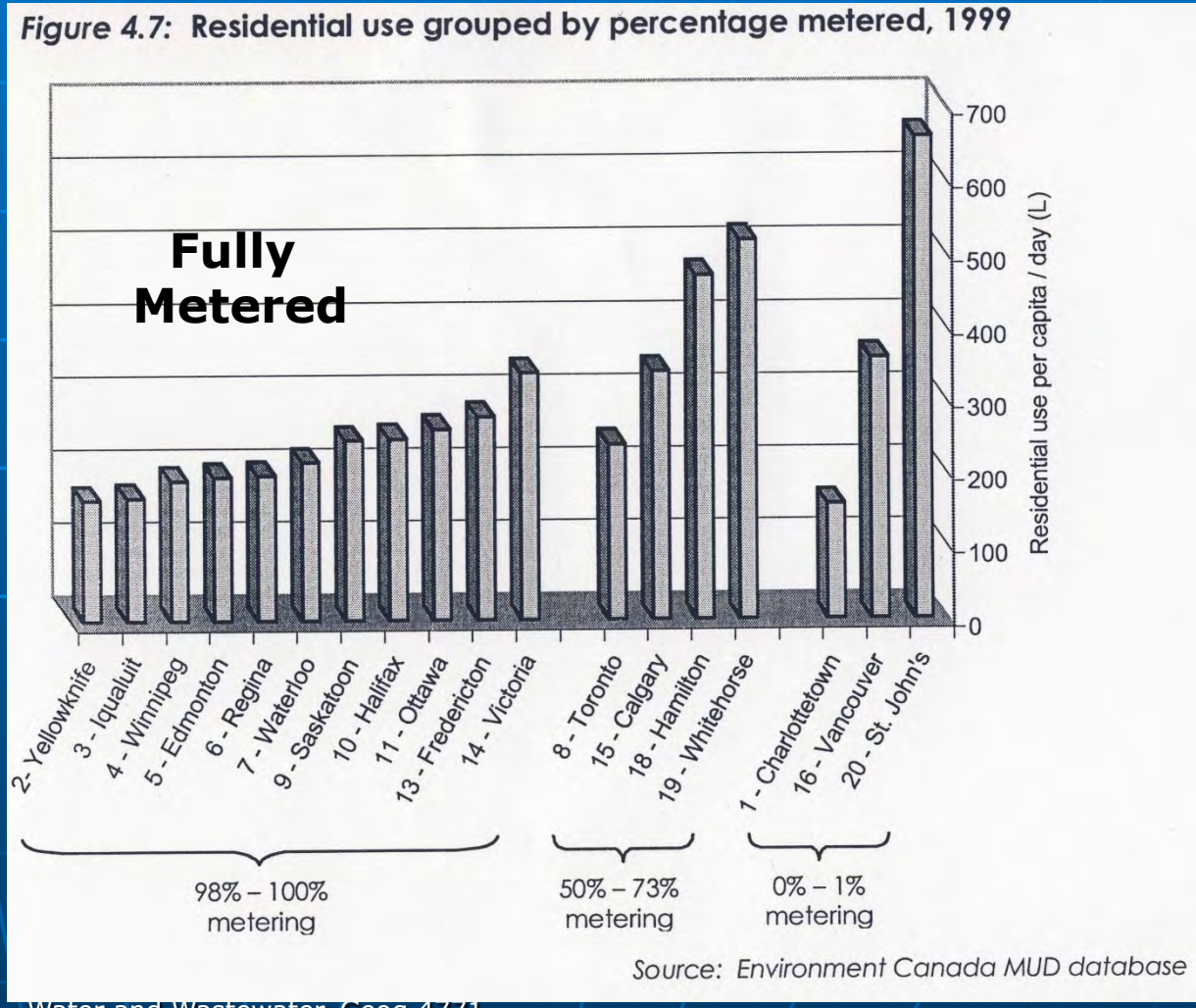
Figure by T. Randall (2002)

- Combined Sewer (storm + septic)
- City Water
- Greywater Sources
- Blackwater Sources

- Conservation Alternatives
  - Water Metering / Pricing
  - Separate vs Combined Sewers
  - Greywater Recycling; Blackwater?
  - Cisterns / Rainwater Collection

Water Metering / Pricing

- Residential Use seems to be reduced by metering and restrictions (e.g., Vancouver)



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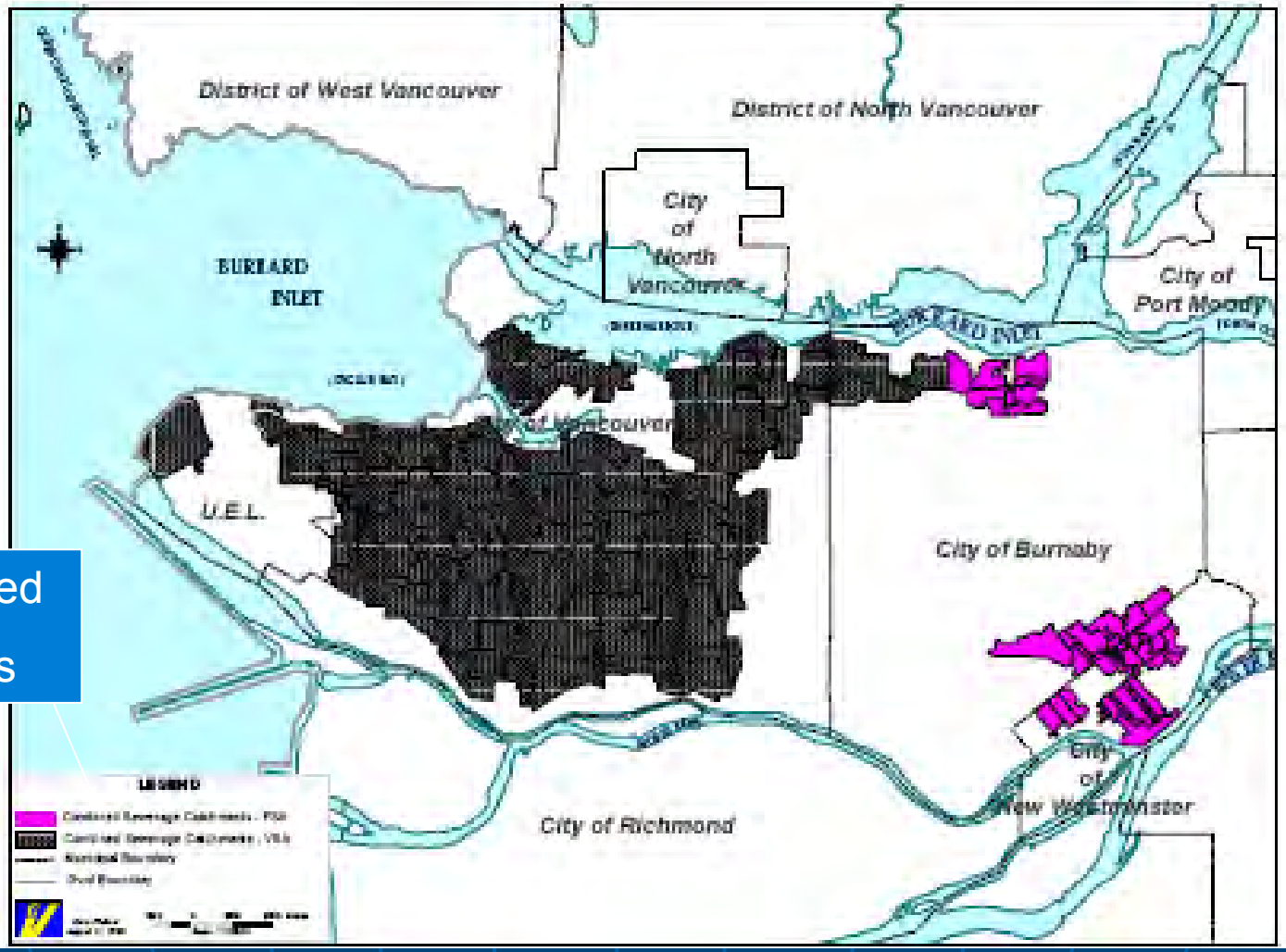
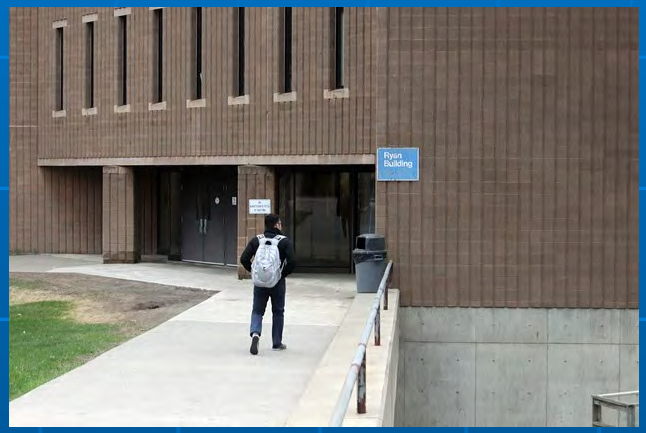
Combined Sewers

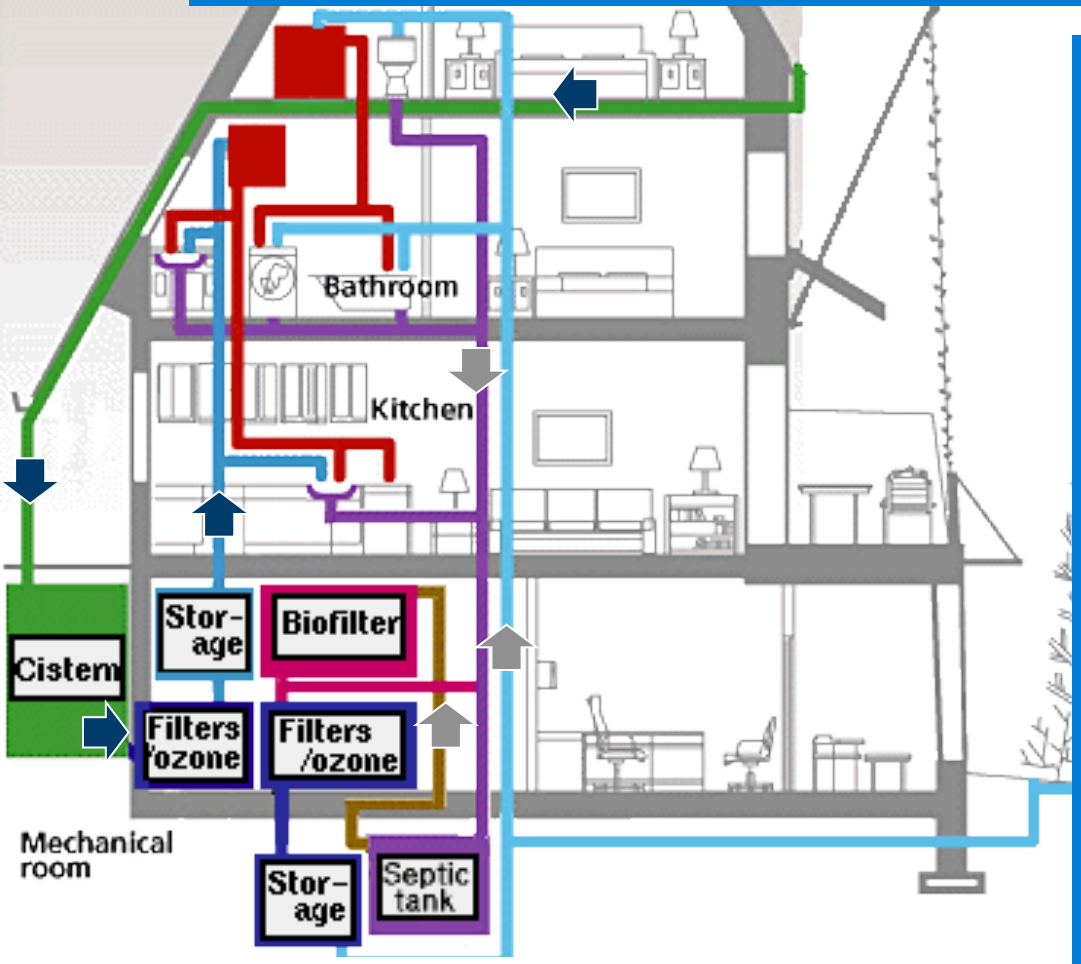
Figure 5-2: Combined and Separate Sewer Systems for Stormwater within the GVS&DD



Combined sewers in older portions of GVRD (Vancouver Proper, portions of Burnaby and New Westminster). *Source:* GVRD (Oct. 1999) Stormwater Management Plan


Ryan
Building

Alternative Water Collection and Wastewater Treatment



- Rainwater collection via cistern and then **potable uses** (1st blue line) – blue arrows
- "greywater recycling" system filters and returns for **non-potable uses** (toilets) – grey arrows
- "Blackwater" treatment, with effluent treated on site

Toronto's Healthy House, Water & Wastewater Systems

Conventional Wastewater Treatment WWTP, (biological treatment)

- **Primary** (settling of bio-solids)
- *Secondary (aeration, digestion)*
- *Tertiary (effluent polishing)*

Conventional WWTP (biological treatment)

- *Primary (settling of bio-solids)*
- **Secondary** (aeration, anaerobic digestion of sludge)
- **Tertiary** (effluent polishing)

Thunder Bay – Extreme Precipitation (May 28, 2012)

The total estimated cost of the Flood Disaster Event is $100 million CAD

- A rainstorm on May 28, 2012 **caused flash flooding** in and around the city of Thunder Bay.
- Rain showers associated with a thunderstorm began around **midnight on May 28, 2012**.
- Thunder and heavy/moderate rain showers occurred **for two hours**, with **70 mm recorded at the Airport** and **77 mm at the LRCA station** next to the Neebing River.
- The heavy rains and flooding of May 28 **closely followed another heavy rain event** on May 24 of 51.5 mm.
  - The **landscape in and around the City was saturated** and subsequent days with more rain continued very wet ground conditions with **a high water table**.
- Available records suggest that the May 28 situation **reached 100-year status more quickly than any other historical storm.**

G. Saunders (2012)

THUNDER BAY: ATLANTIC AVENUE WATER POLLUTION CONTROL PLANT (WPCP)

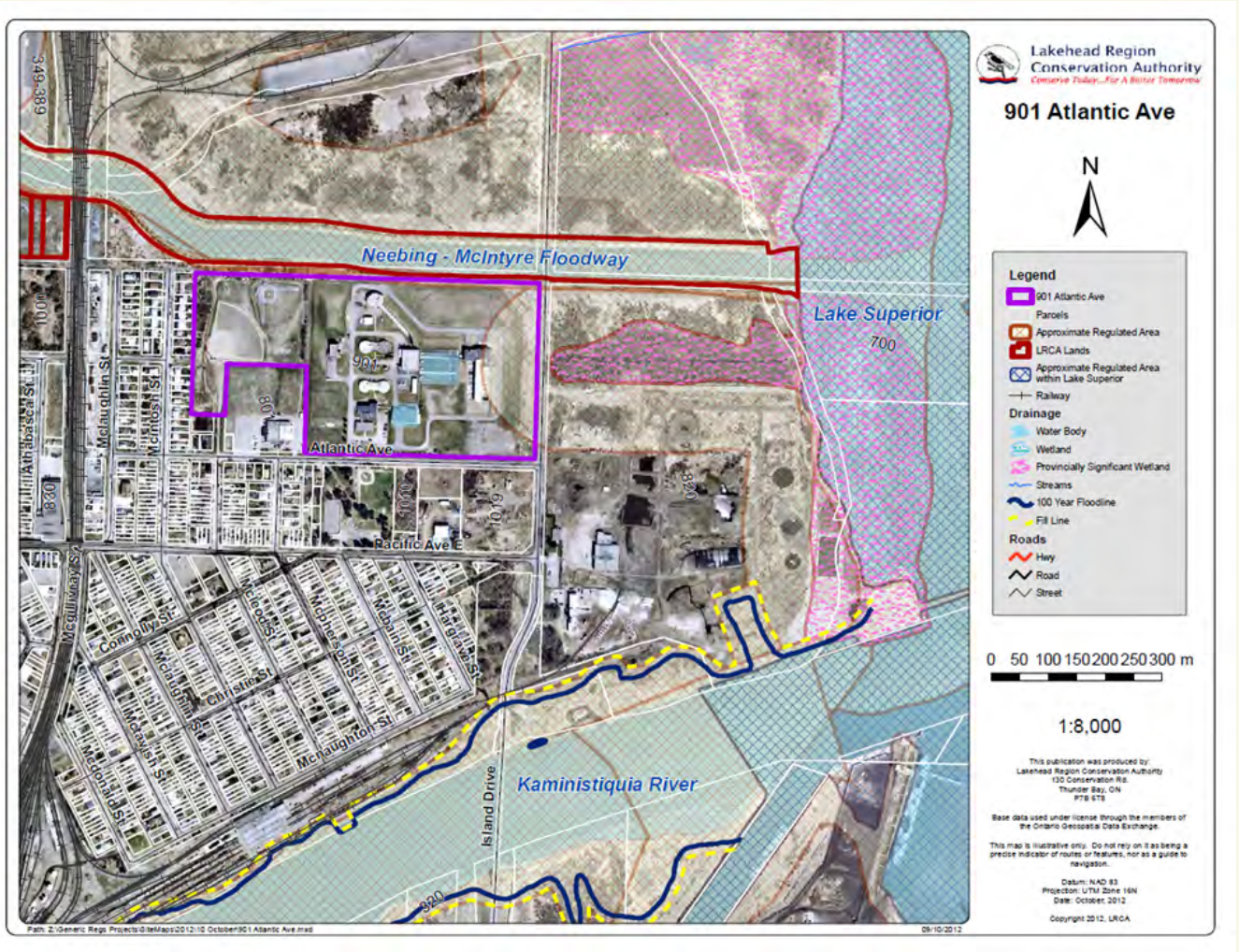
REVIEW OF DAMAGE RESULTING FROM MAY 28, 2012 FLOOD

Plant Configuration

- Located in a low-lying area of the system, but outside of the Flood Plain
  - Typical of most facilities to maximize gravity flow
- Plant configuration typical of most facilities
  - Raw wastewater pumping
  - Preliminary treatment (screening/grit removal)
  - Primary treatment
  - Secondary treatment
  - Disinfection

Flood Plain Mapping

Plant is outside of Flood Plain. As a result, this did **NOT** contribute to plant flooding



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Design Capacity

- Normal flow to the plant is currently is 75 ML/d. Pump station is designed to handle peak flow of 766 ML/d
- There is **no*** provision for emergency bypassing at:
  - Pump station
    - All flow must be pumped due to depth of sewers
  - Downstream of pumping station or around preliminary treatment (i.e., screens)
- There **is** provision for emergency bypassing at:
  - Primary treatment
  - Secondary treatment

* Comments

Plant Monitoring and Controls

- All critical plant systems are fully automated and alarmed to alert staff and call in an operator if alarm is after normal working hours*
  - Tunnel sump alarms
  - Process equipment failures
  - High level in preliminary treatment
- This level of monitoring and control is typical of most modern facilities
  - Numerous plants of similar size to Atlantic Ave. WPCP utilize these control systems to allow unattended night-time operation*

*Comment

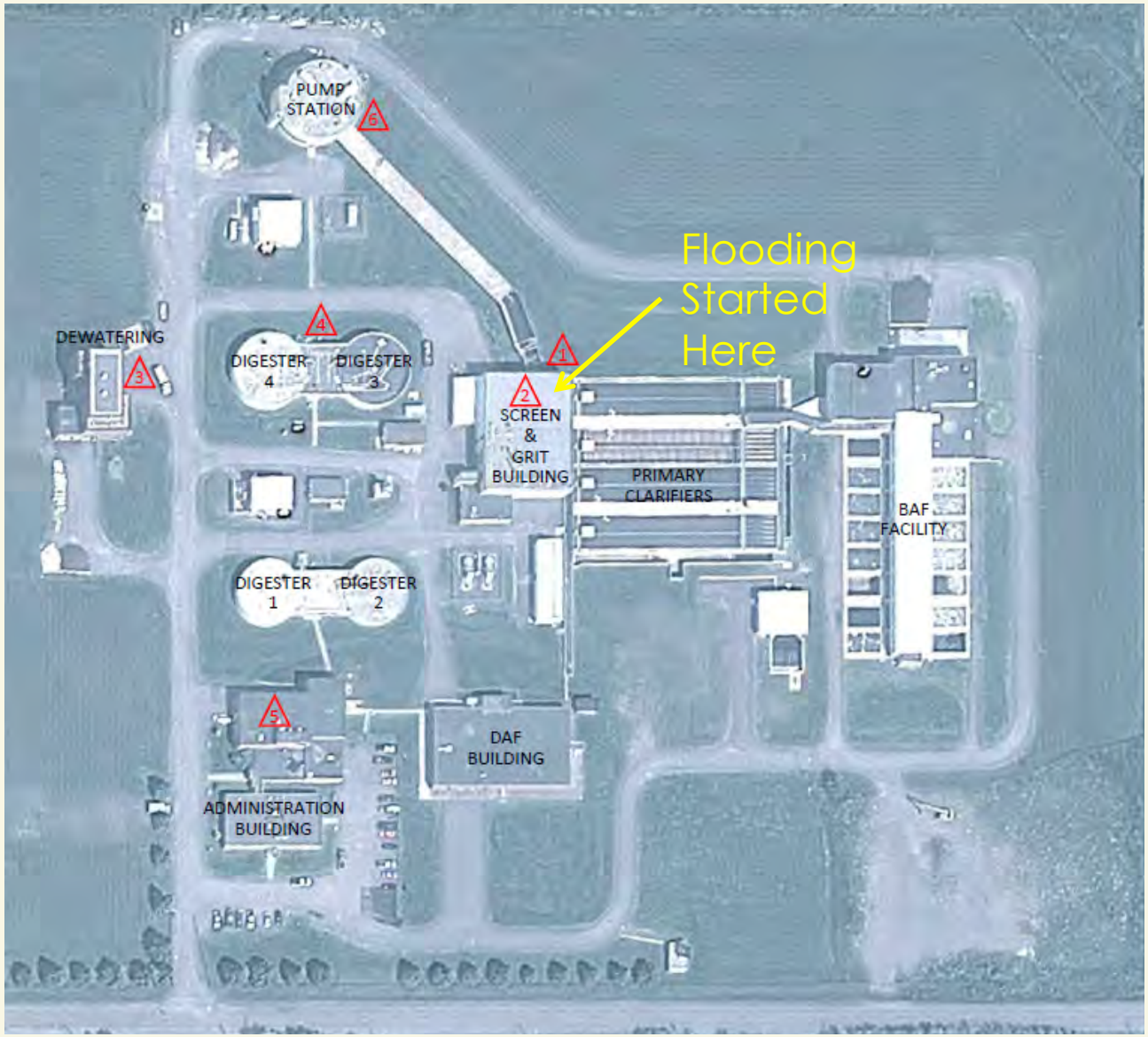
Source of Flooding

- Plant control system logs all critical alarms and events
  - Provided timeline for flooding of the plant tunnels

Time	Alarm
01:09:28	Screen Channel Hi-Hi Level
01:35:04	Wet Well No 2 Hi Level
01:38:04	Wet Well No 1 Hi Level
01:39:02	PS Inlet Chamber Hi Level
01:44:28	Screen & Grit Sump Hi Level (El. 181.97)
01:49:44	Dewatering Building Sump Hi Level
01:53:02	Digester 3&4 Sump Hi Level (El. 181.05)
02:05:54	Old Side Sump Hi Level (El. 180.75)
02:35:52	Pump Station Dry Well Hi Level (El. 168.25)
03:44:05	All Pumps off in PS

  - Operator on-site at 1:33 am to respond to initial screen channel hi-hi alarm

Source of Flooding



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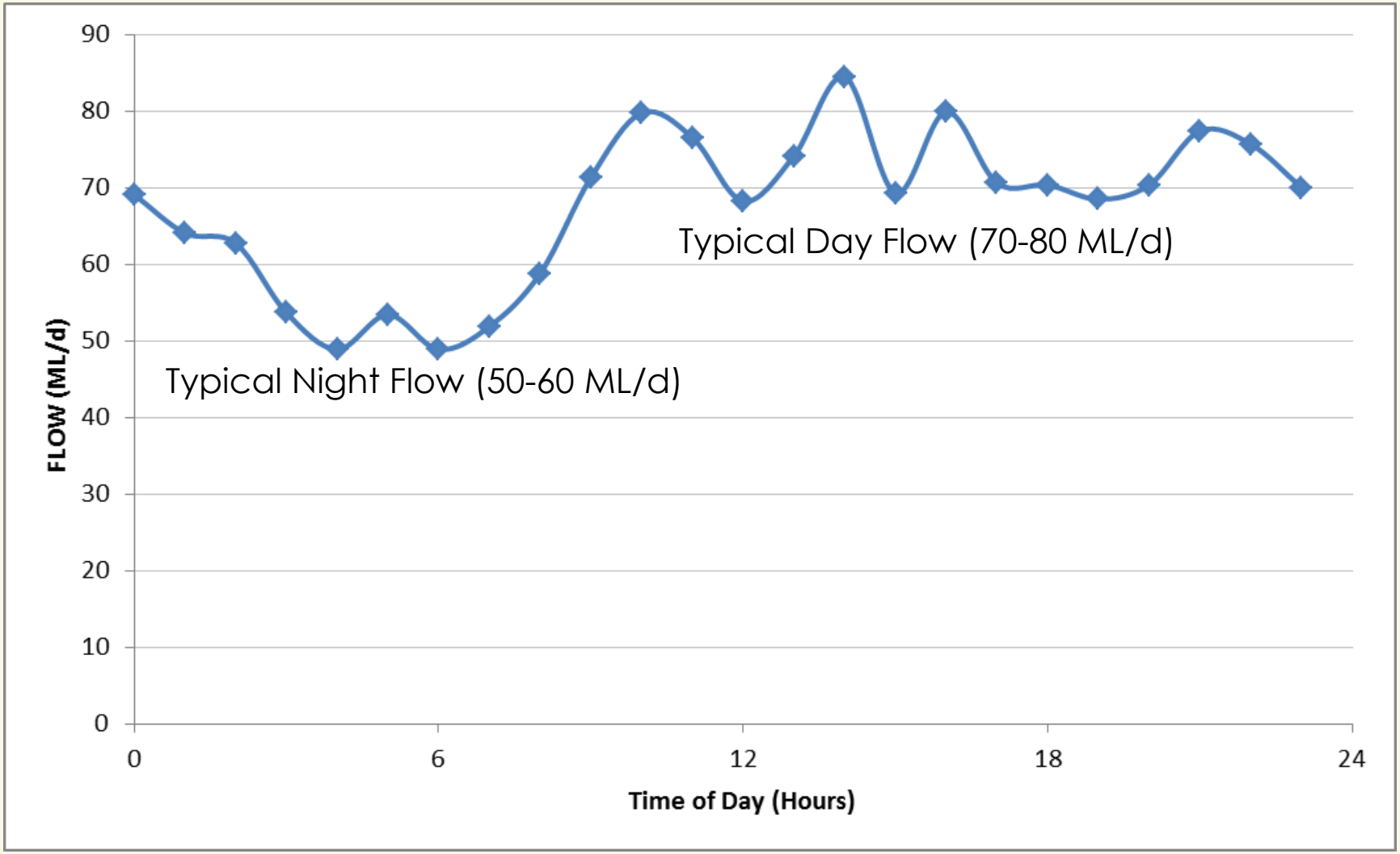
Source of Flooding

- Flooding started in Preliminary Treatment Building and progressed to all other tunnels around the plant including ultimately pump station dry well
  - Suggests excessive plugging and headloss across influent screens
  - Direction of door buckling confirms flooding from main level in Headworks down into tunnel

Estimated Plant Flows

- All flow to plant is through an on-site pumping station
  - Design capacity 766 ML/d
  - Equipped with 5 pumps (4 duty)
- Plant flow meter is calibrated to a maximum of 668 ML/d
- Applied first principles engineering approach using wet well level and manufacturer pump data to estimate flow from station

Normal Dry Weather Plant Flow



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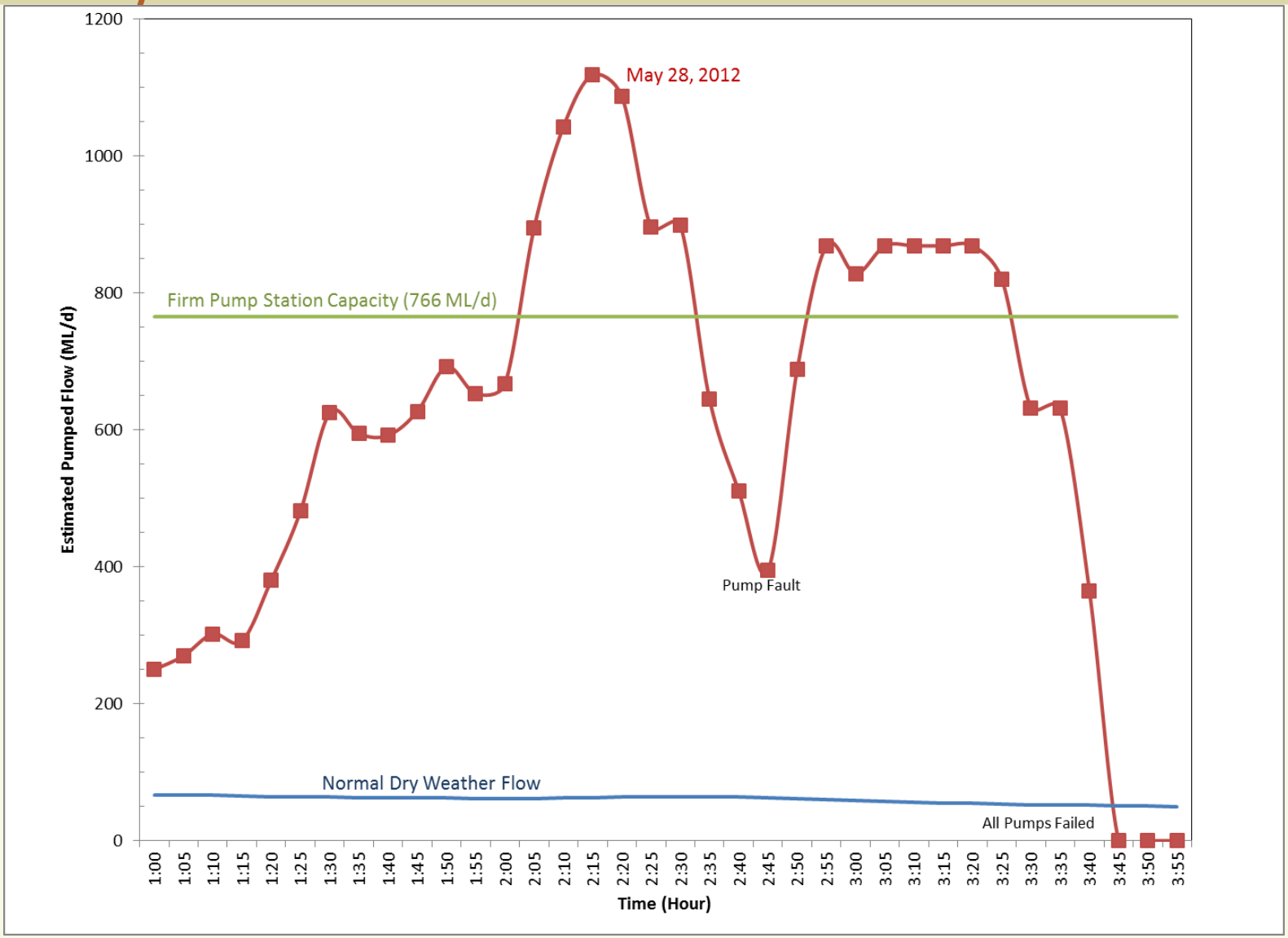
Plant Flow During Flooding (May 28, 2012)



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May 28th Plant Flow

- Estimated flow to the plant exceeded 1000 ML/d (more than 30% greater than station firm capacity)
- Average pump station output from 2 am to 3:30 am (before drywell flooding) approximately 800 ML/d
  - Greater than station design capacity
  - Unable to maintain normal pump station operating level due to incoming flow exceeding station capacity

Summary of Findings

- Flow to the plant exceeded its design capacity
  - Estimated >1000 ML/d compared to design rating of 766 ML/d
- Flooding started at Preliminary Treatment (screens) and proceeded throughout plant
  - Flooding due to hydraulic overloading and not equipment failure

Thunder Bay: Secondary Sewage Treatment Plant on Atlantic Avenue.

“The Plant's modern wastewater treatment protocol provides secondary treatment, phosphorous removal, sludge digestion from the City's wastewater. The plant also uses a nitrification process to eliminate ammonia in the wastewater.”

-)