6. Drainage Infrastructure Screening Tool

The Regional Adaptation Collaboratives (RAC), a federal-provincial program, supports coordinated action towards advancing regional climate change adaptation decision-making by local government. RAC funded development of the *Drainage Infrastructure Screening Tool*. The tool is web-based and can be accessed only from the Water Balance Model website. The Hastings Creek Blueprint is the first validation application.

How We Look At Drainage Systems

"A typical situation faced by local governments is this: an existing storm sewer system; some problem areas; limited funding available for system upgrades; and the need to provide flood protection while being fiscally responsible," observes Ted van der Gulik. "Experience shows that many systems operate without serious problems for many years. Also, the vast majority of the time, the system capacity is only partially utilized for drainage conveyance."

"Yet many engineering studies recommend plans for pipe replacement and upsizing that would cost tens of millions of dollars, money that local governments do not have; while providing no offsetting stream health benefits. Unaffordable infrastructure plans that cannot be implemented paralyze municipal decision-making. When plans go on a shelf to gather dust, what has been accomplished? And why is this happening?"

"Is an apt analogy that modellers are missing the forest for the trees? Is it time local governments hit the re-set button regarding the way drainage infrastructure is evaluated? The need by our Partners for a new tool spurred development of the Drainage Infrastructure Screening Tool. Now, local governments can focus on what is most important AND save money."

Focus on what is Most Important: Figure 5 introduced the paradigm-shift from a *model-centric* ISMP to a *landscape-based* Watershed Blueprint. The Drainage Infrastructure Screening Tool is at the heart of the paradigm-shift:

- Take a step back.
- Look at the system as a whole.
- Eliminate unnecessary complexity.

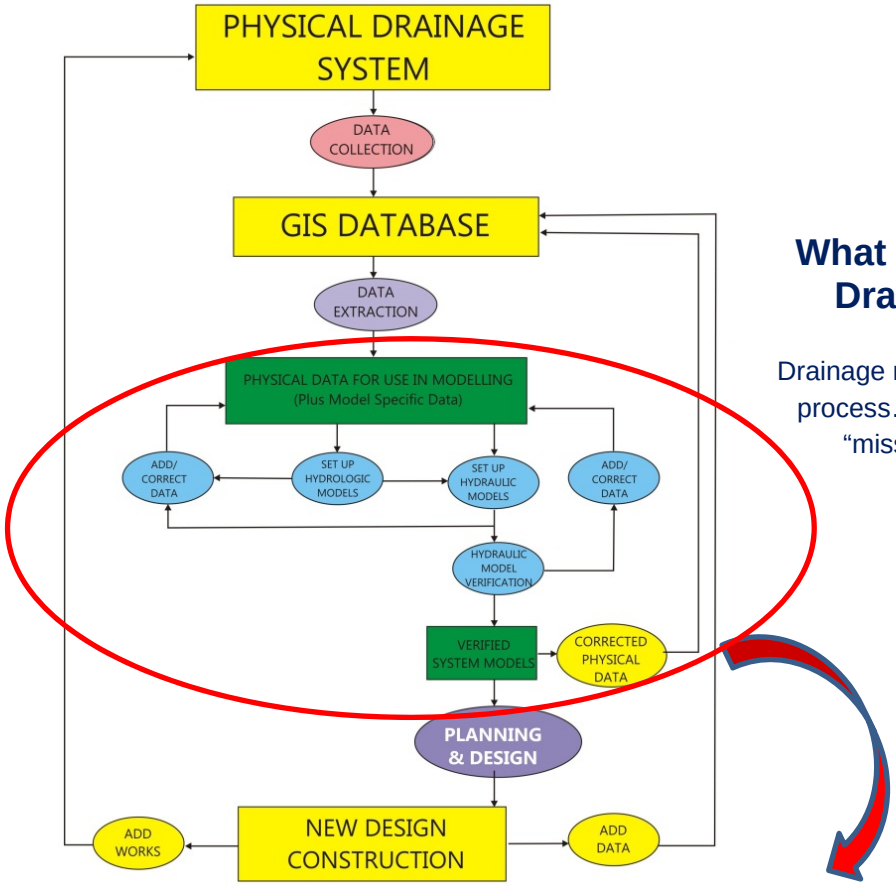
Figure 11 synthesizes, on one page, the thought process that is driving the paradigm-shift. Pipe-by-pipe computer simulation of storm sewer performance is expensive. Note the steps in the flow chart that the screening tool eliminates.

Hastings Creek Validation: The District has demonstrated how to integrate GIS input, apply the level-of-service methodology (that is embedded in the tool), inexpensively and quickly assess system performance, pinpoint problem areas, and generate relevant information for capital planning:

"Based on detailed modelling experience, we know that 'problems' fall within a narrow range. The lesson learned is that one need not model every section of pipe. The level-of-service approach is inexpensive and provides relevant information. It does this without the detailed and expensive simulation of the drainage system," explains Jim Dumont, Engineering Applications Authority for the Water Balance Model Partnership, and technical advisor to the District. He developed the level-of-service methodology for the screening tool.

A guiding principle for the Drainage Infrastructure Screening Tool is to ....

"Provide an equal **Level-of-Service** or access to the drainage system for all properties within a drainage catchment or watershed"



What is a 'Model-Centric' Drainage Approach?

Drainage modelling is an *output*-oriented process… such that it is fairly easy to "miss the forest for the trees"!

Screening tool eliminates unnecessary complexity!

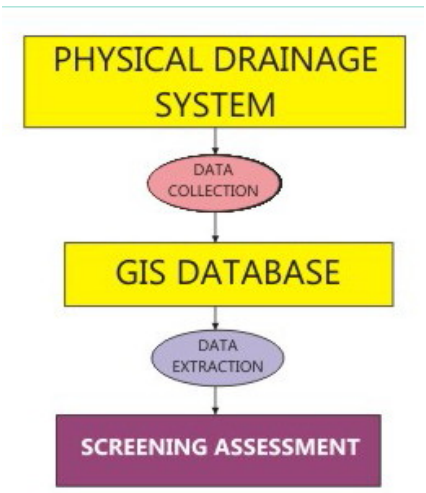
The "paradigm-shift" starts with how we look at drainage systems

THE ISSUE: A "model-centric" approach spends a disproportionate share of scarce resources in time-intensive and hence costly computer modelling that is frequently unnecessary

AN UNINTENDED CONSEQUENCE: Unaffordable capital plans that cannot be implemented are "unfunded liabilities"

THE NEED: An inexpensive screening tool for prioritization and budgeting that results in affordable solutions

A BENEFIT: Can reallocate scarce resources to tackle pressing environmental concerns and needs



Paradigm-Shift from 'Model-Centric' to 'Landscape-Based'

Figure 11

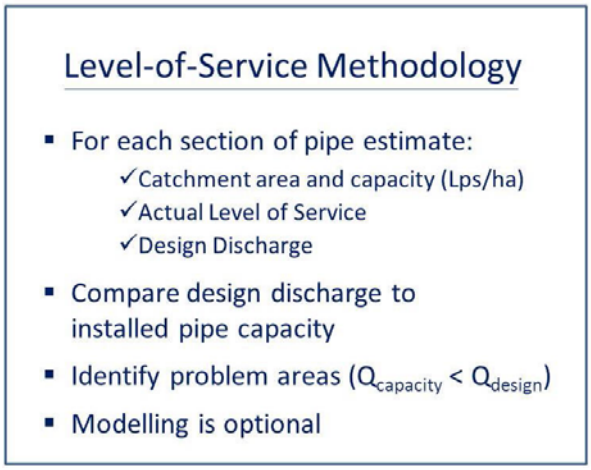
Ask Four Questions

Four questions provided the decision framework for application of the *Drainage Infrastructure Screening Tool* to evaluate the adequacy of storm sewer systems draining into Hastings Creek:

1. What is the existing level of drainage service within each tributary catchment?
2. What will be the effect of climate change?
3. What will be the effect of redevelopment?
4. How will climate change affect redevelopment?

Level-of-Service: "Good engineering is all about knowing when and how to ask the right questions before diving into technical analyses," reflects Ariel Estrada. "Having a clear decision framework got us off to a good start and kept us on track. Because a level-of-service approach is actually common-sense engineering, everything fell into place."

"A guiding principle in applying the screening tool is to examine the pipe system that is tributary to each drainage outlet or creek outfall (Figure 12). We examined every catchment. We evaluated every pipe in each catchment. We compared **installed capacities** to unit runoff discharges. We defined uniform levels-of-service. We identified potential weak links under different scenarios."



Extract and Integrate GIS Output: "One of the keys to carrying out the analysis efficiently and cost-effectively was the valuable supporting role played by the GIS department," continues Ariel Estrada. "A critical input to the analysis is pipe data – identity, diameter, length and grade. This requires data extraction from GIS and creation of a spreadsheet for each and every catchment. Then the file is imported into the Screening Tool."

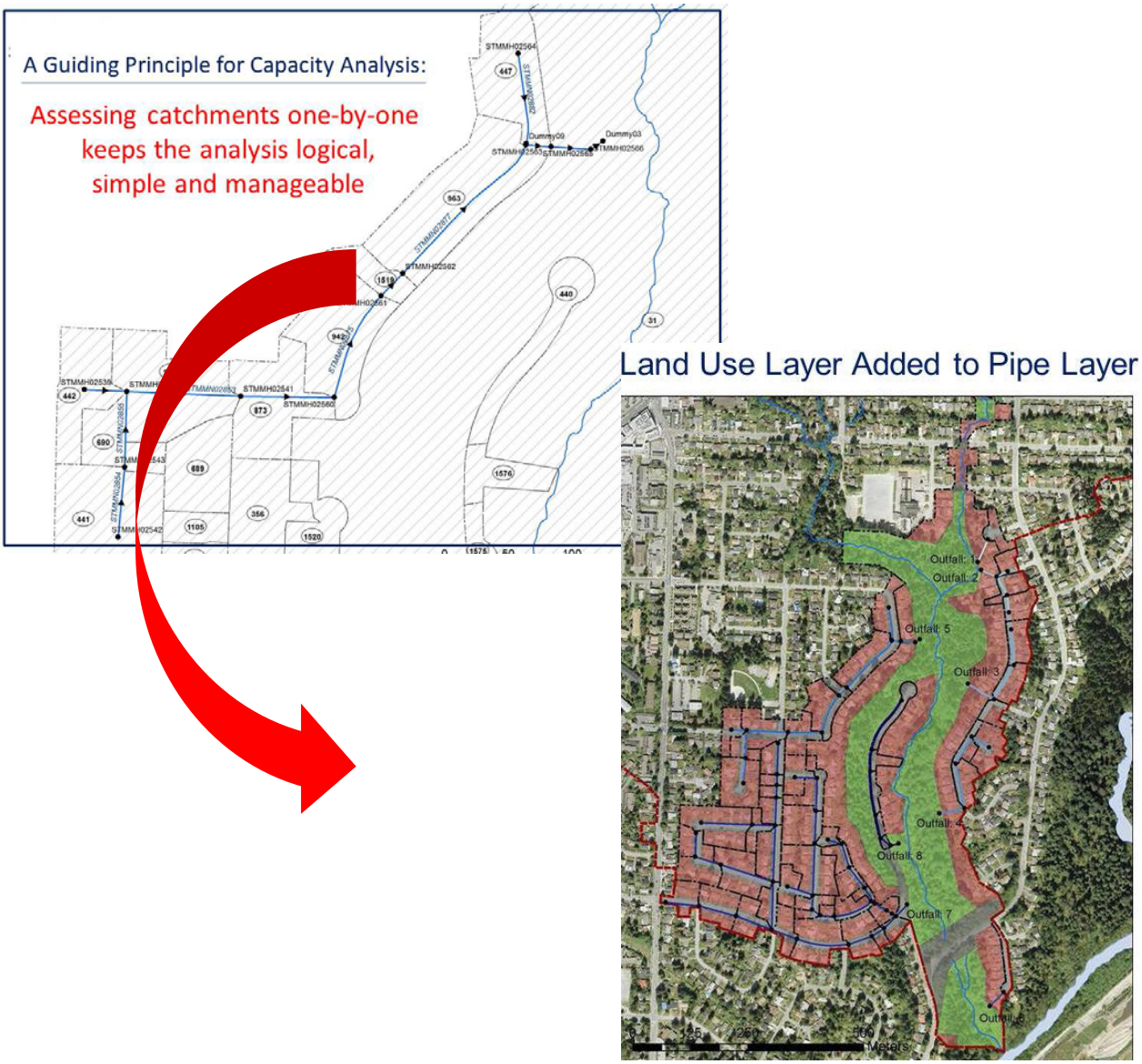
"This is a labour intensive and time consuming process. With project schedule and cost constraints, it was not an option to hire a consultant. Our in-house solution was to hire Raymond Lee, a graduating student from BCIT. He has done great work."

"Because Hastings Creek is a success, we have had Raymond carry on with data extraction for the rest of the District storm sewer system. As the need arises, we are now positioned to apply the Screening Tool District-wide."

Assess the Impacts of Land Use Densification and Climate Change Using a Single Tool: "We imported the spreadsheets prepared by Raymond into the Screening Tool and carried out level-of-service scenario comparisons. We assessed climate change and land use change at the same time. Think about what that means – one tool does both! Having that capability is invaluable."

"The climate change scenarios were developed at by the Pacific Institute for Climate Solutions (PICS) at the University of Victoria for use in the Water Balance Model. It is quick and easy to check and verify the relative impact of a changing climate on conveyance capacity throughout the Hastings Creek storm sewer system."

"The tool has made it possible to quantify the resiliency of each catchment. A key finding is that there is no reason to be alarmed by climate change. The Screening Tool also made it easy to assess the relative significance of densification in the Town Centre area." (Refer to next page)



Screening Tool Integrates Land Use Information

Figure 12

Application to Town Centre

Figure 13 presents a plan and sample output to illustrate the results of the screening tool analysis for the storm sewer system in the Lynn Valley core. Four notes on the bottom image highlight relevant information that became timely input to inform the District's decision process.

Timely Evaluation and Response: "A developer submitted a redevelopment proposal for one of the parcels in the Town Centre. A quick response on the part of the District was necessary to assess the potential impact on the existing storm sewer system," reports Richard Boase.

"We applied the Screening Tool, quickly identified that there was a 'weak link' on East 27th Street, and determined that the capacity shortfall would be addressed as conditions of approval for the land redevelopment process. Staff then informed the proponents that they would be responsible for assessing options for infrastructure renewal and doing the detailed design," adds Ariel Estrada.

Validation of Level-of-Service Methodology: "There is no history of operational problems in the Hastings Creek storm sewer system. Manholes do not surge and overflow during storm events. In a sense, application of the Screening Tool has confirmed the obvious. And that is precisely the point. We did not get sidetracked by a computer modelling exercise," reflects Richard Boase.

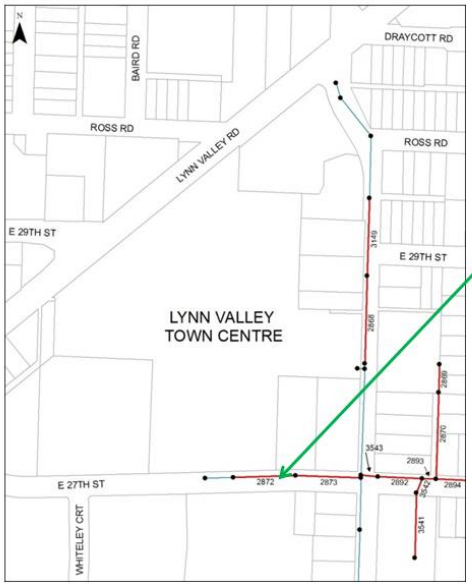
"Because we were hands-on, we learned a lot and understand how pipes in the Hastings Creek drainage area perform," continues Ariel Estrada. "This outcome contrasts with the typical situation when a municipality hires a consultant to build a detailed and expensive computer model. After a period of time, we will receive a report. The model is a black box. From our municipal perspective, we often have little feel for what has been done."

"The Hastings Creek process has demonstrated the immediate payback of a small investment in applying the Screening Tool. The District has saved money, both now and in the future, and avoided the pitfalls that other municipalities have experienced," concludes Richard Boase.

Drainage Infrastructure Screening Tool

Hastings Creek demonstration application has validated the level-of-service methodology

- **KEY FINDING** is that the "90-10 Rule" applies:
  - ✓ "Do Nothing" in the 90% of system that is adequate
  - ✓ Investigate possible "Weak Links" in the other 10%
- **AND FURTHERMORE**, municipality can now:
  - ✓ Do analyses in-house
  - ✓ Generate immediate answers
  - ✓ Establish capital budgets quickly
  - ✓ Assign financial responsibilities
  - ✓ AND ➔ *Focus effort on environmental opportunities!*



East 27th Street

Use of the screening tool quickly identified 'weak link' in existing system.

DNV was then able to promptly request that the affected developer assess options and undertake detailed design for infrastructure renewal

Drainage Infrastructure Screening Tool

Making Decisions in the Lynn Valley Town Centre

4. Size and length allows estimation of costs and allows budgets and priorities to be established for future implementation

1. Scenario comparison of system performance under existing versus two future conditions

Asset ID	From Manhole	To Manhole	Diameter (mm)	Length (m)	Contributing Area (ha)	Design Flow / Capacity Existing	Climate Change	Climate Change and Land use
STMMN02894	STMMH02556	STMMH02578	300	41.3	0.14	0.26	0.22	0.22
STMMN02895	STMMH02578	STMMH02577	375	107.2	0.86	0.26	0.22	0.22
STMMN02866	STMMH02550	STMMH02551	450	2.4	0	1.14	0.99	0.99
STMMN02849	STMMH02536	STMMH02537	900	54.6	1.76	0.83	0.72	0.72
STMMN02901	DUMMH016	DUMMH100	900	22.9	0	1.09	0.95	0.92
STMMN02902	STMMH02582	DUMMH016	900	2.5	0.32	1.03	0.9	0.88
STMMN02898	STMMH02583	DUMMH186	1050	20.9	0	0.79	0.69	0.62
STMMN02904	DUMMH015	STMMH02581	1200	40.8	0	1.1	0.96	0.93

3. These three pipe lengths are the only ones in the Town Centre drainage system that would become of concern under future operating conditions

2. A ratio of less than 1.0 indicates a possible capacity problem

Application of Screening Tool to Make Decisions

Figure 13