



Town of The Blue Mountains Drainage Master Plan



Jacob Macdonald, B.A.Sc., P.Eng
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london.ca





Overview: Project Team

Town of The Blue Mountains

Manager, Development Engineering

Brian Worsley M.Sc, P.Eng., PMP, MICE



Manager, Capital Projects

Pruthvi Desai B.Eng., PMP, EIT



Tatham Engineering

Project Manager

Daniel Twigger B.Sc.Eng, P.Eng.



Water Resources Lead

Jacob Macdonald B.A.Sc, P.Eng.



Overview: Project Description

- TBM is located on the southern shores of Georgian Bay in Grey County, Ontario.
- Study area includes settlement areas within the Town (per figure)
- Broad level assessment detailing drainage deficiencies.
- Develops and evaluates alternative solutions to drainage deficiencies.
- Evaluates and selects preferred solutions.



Overview: Municipal Class EA

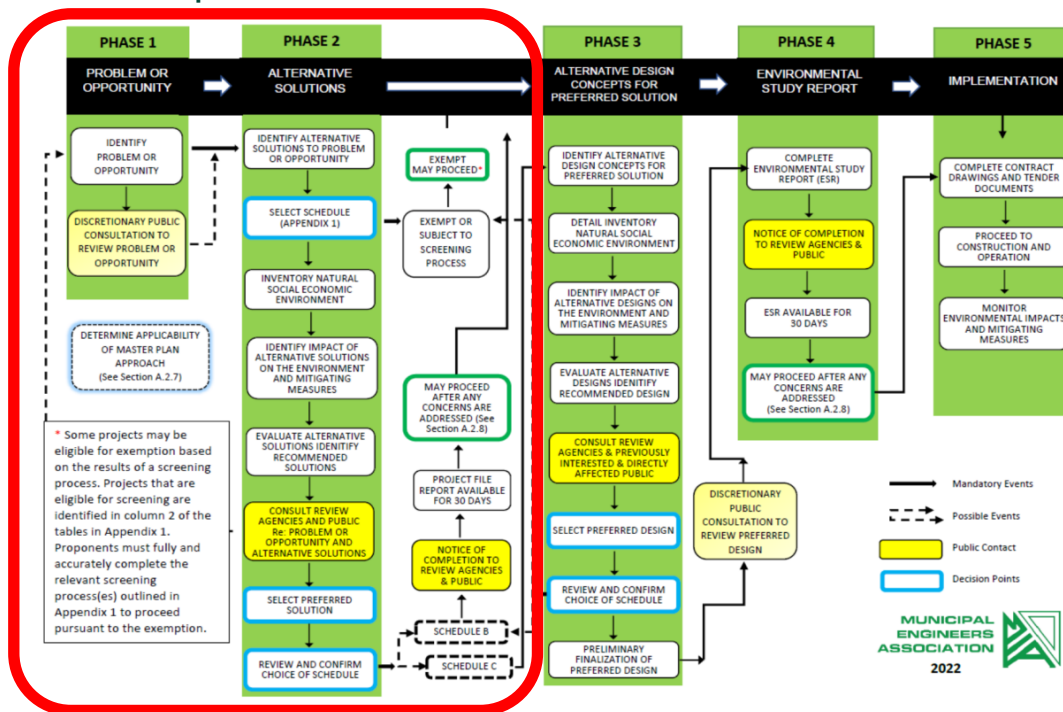
Project follows Approach #2 – Detailed Master Planning process outlined in the MCEA document:

Schedule A & A+: Exempt from MCEA planning requirements.

Schedule B: Completed MCEA process through Master Plan.

Schedule C: Phases 3 & 4 of MCEA process must be completed.

Municipal Class EA Process



Overview: Model Development (Phase 1)

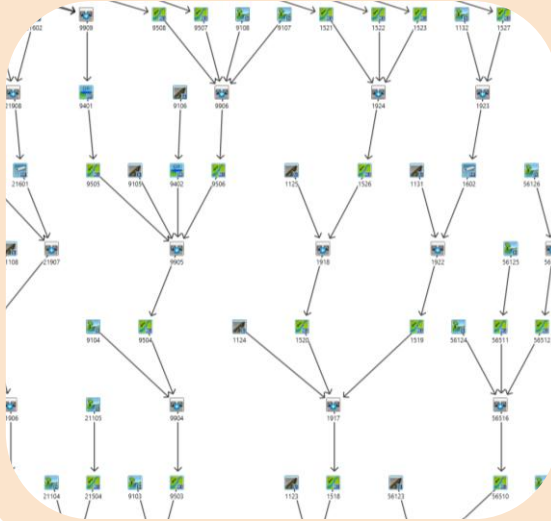
PCSWMM

- Hydrologic/Hydraulic Model
- Minor Drainage System



Visual OTTHYMO

- Hydrologic Model
- Major Drainage System



HEC-RAS

- Hydraulic Model
- Major Drainage System



Overview: Deficiency Assessment (Phase 1)

Drainage system deficiencies identified according to Town's Engineering Standards.

Minor Drainage Systems

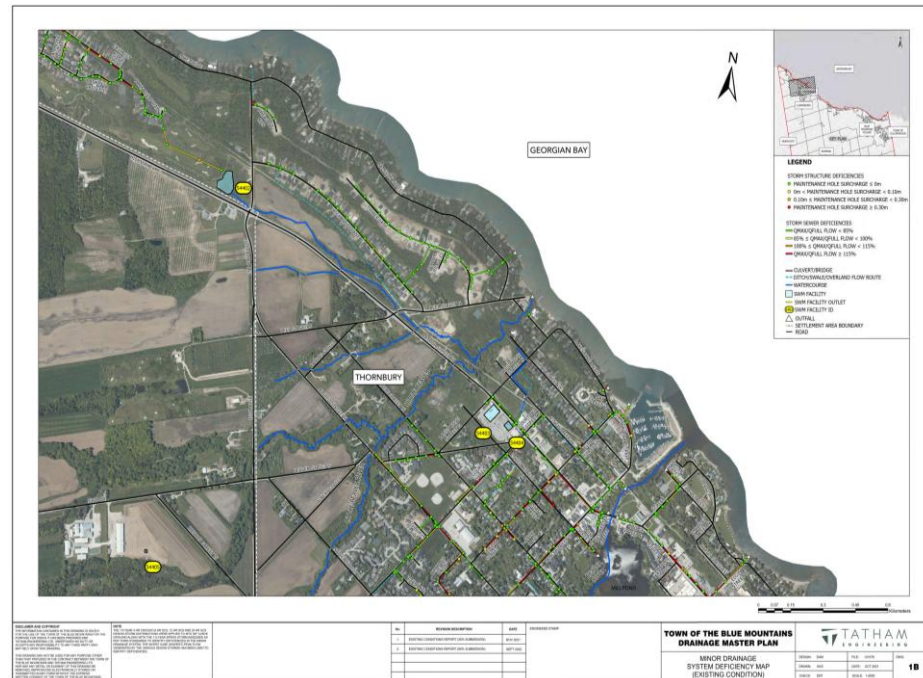
- Storm sewer capacity assessed through PCSWMM.
- Assessed for the 1:5-year design storms.

Major Drainage Conveyance Systems

- Culvert and overland flow deficiencies assessed through VO/ HEC-RAS and PCSWMM.
- Assessed for different design storms depending on road classification.
- Assessed culvert capacity, overland flow depth/velocity.

Stormwater Management Facilities

- SWM Facilities assessed through VO.
- Assessed for 1:2-year – 1:100-year design storms.
- Identified water quantity control and quality control deficiencies.





Overview: Public Consultation (Phase 1 & 2)

3 Public Information Centres (PICs) were held throughout the project (1 required by the Municipal Class EA process).

PIC #1

(Discretionary- Phase 1)

February 24, 2022

- Public (residents) in attendance.
- Presented deficiencies and alternative solutions.
- Public feedback regarding drainage deficiencies not identified in the study.
- Opportunity for public to ask questions, provide feedback on preliminary solutions.

PIC #2

(Mandatory – Phase 2)

March 29, 2023

- Public (residents) in attendance
Additional consultation w/
agencies/stakeholders.
- Present preliminary preferred solution(s).
- Opportunity for public questions and concerns.
- Provided comment sheets to identify preferred solutions and comment on recommended projects.

PIC #3

(Additional - Completion)

October 29, 2024

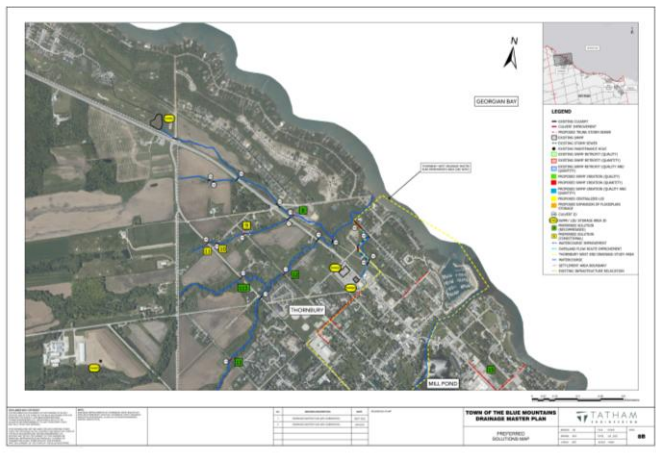
- Public (residents) in attendance.
- Presented final recommendations of DMP to public.
- Final opportunity for public to ask questions and interact with Tatham/Town staff on project.



Outcome: Preferred Solutions

General Recommendations

- **Minor Drainage System Improvements:** Upsizing storm sewer, relocating infrastructure onto municipal lands, and improving areas absent of minor drainage systems (sewers or ditches).
- **Water Quality Improvements:** Encourage residents to implement Lot Level LIDs, implement Linear LIDs (where feasible) and Mechanical Treatment Devices with future reconstruction projects.
- **Drainage System Operation and Maintenance:** Formalize procedure for the inspection, operation and maintenance, implement design criteria changes, and acquiring property or easements for drainage outlets.



Individual Drainage Projects

Alternative	No. Individual Projects Evaluated	No. Individual Projects Recommended
Retrofit/New Stormwater Management Facilities for Quantity Control	1	0
Retrofit/New Stormwater Management Facilities for Quality Control	7	1
Expansion of Existing Floodplain Storage Areas	5	0
Minor Drainage System Improvements	3	3
Culvert/Watercourse Major Drainage System Improvements	97	74
Trunk Storm Sewer/Overland Flow Route Major Drainage System Improvements	5	2
Total Preferred Solution	118	80



Outcome: Implementation Plan

Project Prioritization

Risk Assessment

- Individual projects prioritized through risk assessment considering:
 - Severity of the deficiency;
 - Probability of failure; and
 - Economic, social and environmental consequence of failure.
- The preliminary prioritization of the individual projects was established from the cumulative risk.

Other Considerations

- Identified replacement date (age of infrastructure).
- Planned works included in Capital Plans (road, sanitary, watermain improvements).
- Order of implementation required for the individual drainage projects.

PROBABILITY OF FAILURE	CONSEQUENCE OF FAILURE				
	None	Insignificant	Minor	Moderate	Major
Rare	No Risk	Low Risk	Low Risk	Moderate Risk	Moderate Risk
Occasional / Possible	No Risk	Low Risk	Moderate Risk	Moderate Risk	High Risk
Moderate / Likely	No Risk	Moderate Risk	Moderate Risk	High Risk	Extreme Risk
Certain / Very Likely	No Risk	Moderate Risk	High Risk	Extreme Risk	Extreme Risk

REPLACEMENT DATE	PROJECT NO.	IMPROVEMENT NAME/ID	LOCATION	COST
2026	79E	New Outlet to Georgian Bay	Watercourse 6	\$1,886,000
2026	73G	Culverts No. 69, 70, 71 and 72	Lakeshore Road East	\$1,158,000
2027	17A	Storm Sewer Relocation	Clark Street / Mary Street	\$1,295,000
2027	119A	Scenic Caves Road Ditch Improvement	Scenic Caves Road	\$99,000
2028	94	Monterra Road Drainage Improvements	Monterra Road	\$1,678,000
2029	20G	Culvert No. 147 / TOBM Asset ID CUL88	Lakeshore Road	\$2,063,000
2029	21G	Culvert No. 148	Georgian Trail	\$1,194,000
2030	18A	Decommission Historical Flume	Beaver River	\$716,000
2030	74H	Trunk Storm Sewer No. 6	Grey Road 19	\$3,246,000
2032	24A	Culvert No. 156	Clark Street	\$1,400,000
2033	15A	Trunk Storm Sewer No. 2	King Street East / Elgin Street North	\$2,625,000
2034	38E	Culvert No. 124 / TOBM Asset ID CUL93	Hoover Lane	\$1,410,000
2035	70A	Culvert No. 87 / TOBM Asset ID CUL118	Arrowhead Road	\$856,000
2035	71A	Culvert No. 88 / TOBM Asset ID CUL119	Arrowhead Road	\$568,000
Total				\$20,194,000

Outcome: Development Framework



A Development Framework was prepared describing the recommended approach and design criteria for drainage and stormwater management in the Town. The framework provides:

- A watershed-based methodology to establish **water quantity** control requirements;
- A means to identify **external improvements** to existing drainage infrastructure;
- **Water quality** control requirements;
- Area specific **infiltration** and **volume control** targets;
- Guidance on **erosion control** requirements; and
- Guidance on **LID** implementation.



Outcome: DC Eligibility & Funding

\$12M in DC eligible costs identified

Additional/alternative funding mechanisms to the general tax-based approach were reviewed:

- Stormwater utilities; and
- Federal and provincial funding opportunities (FHIMP, DMAF, Green Municipal Fund)

It appears a stormwater utility will be the only dedicated funding mechanism capable of covering the growing costs.

Municipalities with Stormwater Utilities



PROJECT	DC ELIGIBLE COST	PROJECT	DC ELIGIBLE COST
8	\$157,600	85	\$249,200
9	\$72,400	87	\$224,400
11	\$38,800	88	\$16,800
12	\$117,600	89	\$115,600
13	\$582,800	90	\$224,400
14	\$556,800	91	\$278,400
20	\$588,000	94	\$671,200
21	\$417,600	96	\$252,400
24	\$494,000	98	\$696,000
42	\$120,000	99	\$375,200
43	\$10,800	100	\$86,000
44	\$103,200	104	\$236,400
62	\$887,600	110	\$680,400
79	\$754,400	111	\$726,000
82	\$726,800	112	\$102,800
83	\$589,200	113	\$148,400
84	\$688,400	TOTAL	\$11,989,600

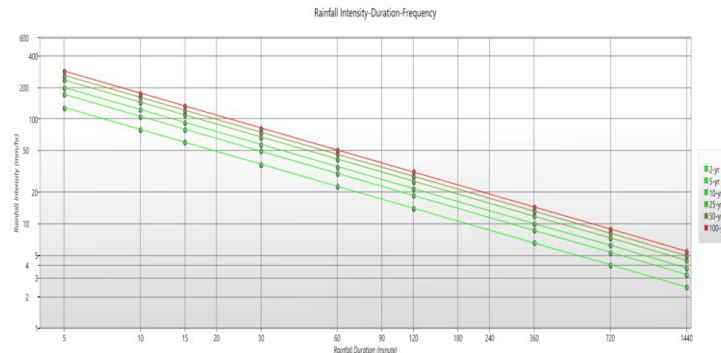
Outcome: General Considerations

Climate Change

- The Town currently applies a 10% increase to current rainfall intensity-duration-frequency data developed from historic rainfall data.
- It's recommended the Town reassess the climate change adjustment factor as part of future design standard updates.

Low-Impact Development Measures

- Encourage residents to implement **Lot Level LID** measures such as rain barrels and soakaway pits (no Town funding)
- Recommended the Town promote and accept the use of **Linear LID** measures within local roads where conditions are favorable.
- In general, not recommended to rely upon flow reduction from LID measures for infrastructure sizing (other than end-of-pipe **Centralized LID** SWMFs)



Lessons Learned: Model Calibration

- Discrepancies between the DMP hydrologic models and previous studies within the Town (DMP models produced higher flows).
- Model calibration recommended prior to developing solutions. Not undertaken at the time.
- After preliminary preferred solution was identified and cost estimates prepared, Town decided to complete model calibration for more accurate infrastructure sizing (aim to reduce costs).

Streamflow Monitoring Program

- 5 Gauges: Watercourses 6, 9, 19, 32, and Little Beaver River.
- Continuous water level monitoring devices installed.
- Manual streamflow and staff gauge measurements are collected during rain events.
- Rain gauge data sourced from GSCA rain gauge and other open-source weather gauges in the area.



Lessons Learned: Drainage Act

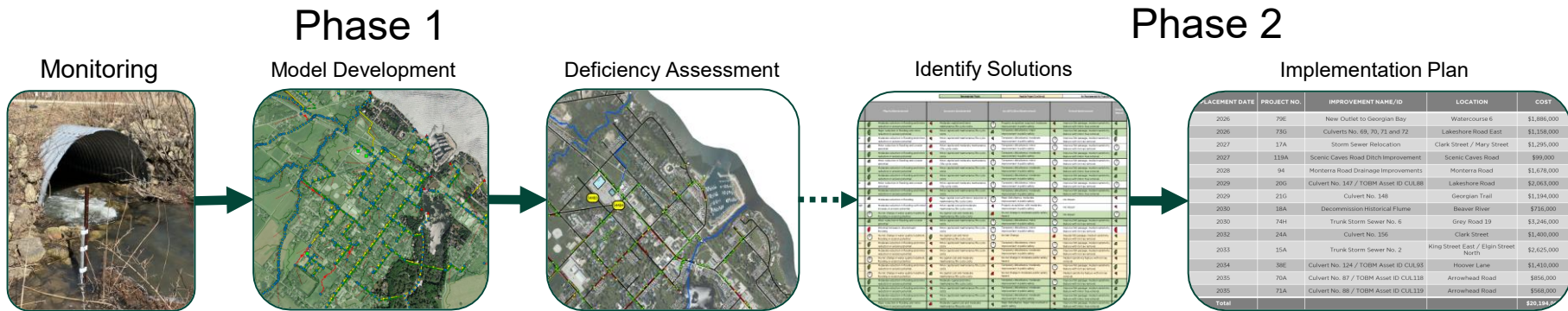
- Drainage deficiencies were identified in a 1993 Subwatershed Study on Watercourses 7, 8 & 9
- Improvements were made in 1994 through the Drainage Act on Watercourses 7 & 9, but 8 wasn't improved, and none of the watercourses had 1:100-year capacity to Georgian Bay, resulting in upstream flooding
- Analysis for 3 proposed developments (620 homes) draining to watercourses 7, 8 & 9 identified that while SWM controls could maintain existing conditions, downstream flooding would continue to occur in major events
- Discussions with the Consultant representing the 3 Developers resolved that their clients were interested in paying for downstream improvements to eliminate the pre-existing 1:100-year flooding
- Discussions with MTO resolved that their preferred method for getting new culvert under Highway 26 was the Drainage Act.
- Additional capacity has been created through the Drainage Act, but:
 - Initial discussions 2017, completion 2025.
 - Petition drain requires majority of owners, or owners of over 60% of land to be in favour, (3 sites were over 60% of water course 8), the 3 sites paying 100% of costs to mitigate opposition.
 - Engineering peer reviewed in triplicate, so technically sound but involvement of developers became contentious.
 - Drainage Act provides a mechanism to get drains constructed across private lands, who may not be in favour of the works, BUT because the Act is so powerful, there are a number of (free) protest mechanisms, Council meeting to consider the Engineers report, the Court of Revision, and the Drainage Tribunal, despite there being no levee (Developers paying all costs), and generous compensation for easement, this went through all.
 - Consultation & consensus with effected landowners essential, Act very much geared for getting things done with fairness.

Drainage Act Improvements



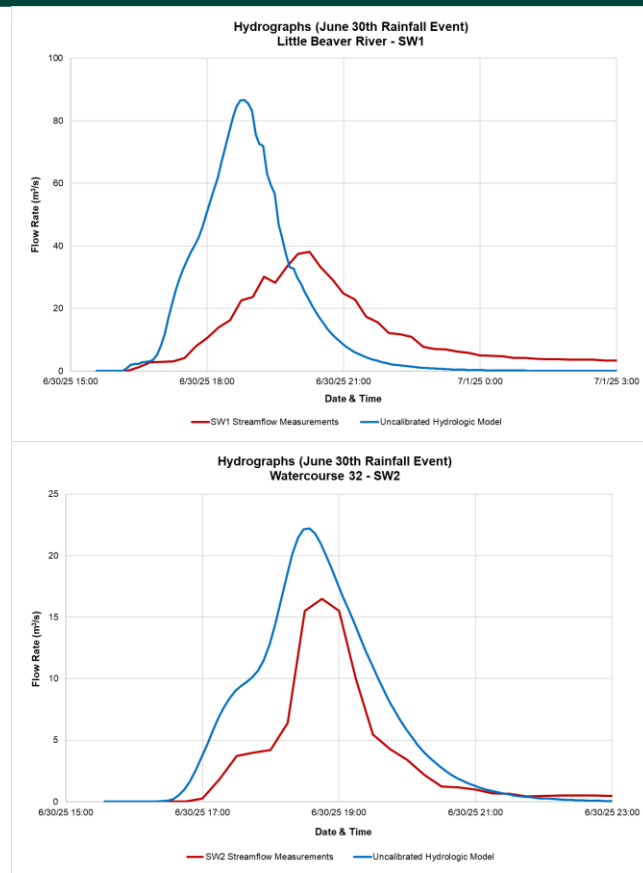
Lessons Learned: Project Scope/Timeline

- Combining the model development and Master Plan MCEA impacted the project timeline. Streamflow monitoring and model calibration should be completed early in the process.
- A phased approach would be more effective:
 - Rainfall & Streamflow monitoring first, (may take several years)
 - Model development/calibration and deficiency analysis ahead of EA process.
 - Then initiate the Master Plan MCEA process using calibrated, reliable data.
- Significant weather events impacted the overall timeline of the Master Plan development.
- By following a Schedule B EA rather than an extensive Schedule C, the Master Plan development fast-tracked the process shortening timelines while still ensuring a thorough and defensible outcome.



Next Steps: Model Update

- The streamflow monitoring program will continue through Spring 2026.
- Once the monitoring is complete, the DMP hydrologic model will be calibrated against the observed rainfall and streamflow data.
- Tatham and the Town will review the impacts to peak flows from calibration to determine if re-evaluation of the DMP recommendations is required and discuss next steps.



Next Steps: Schedule C Projects

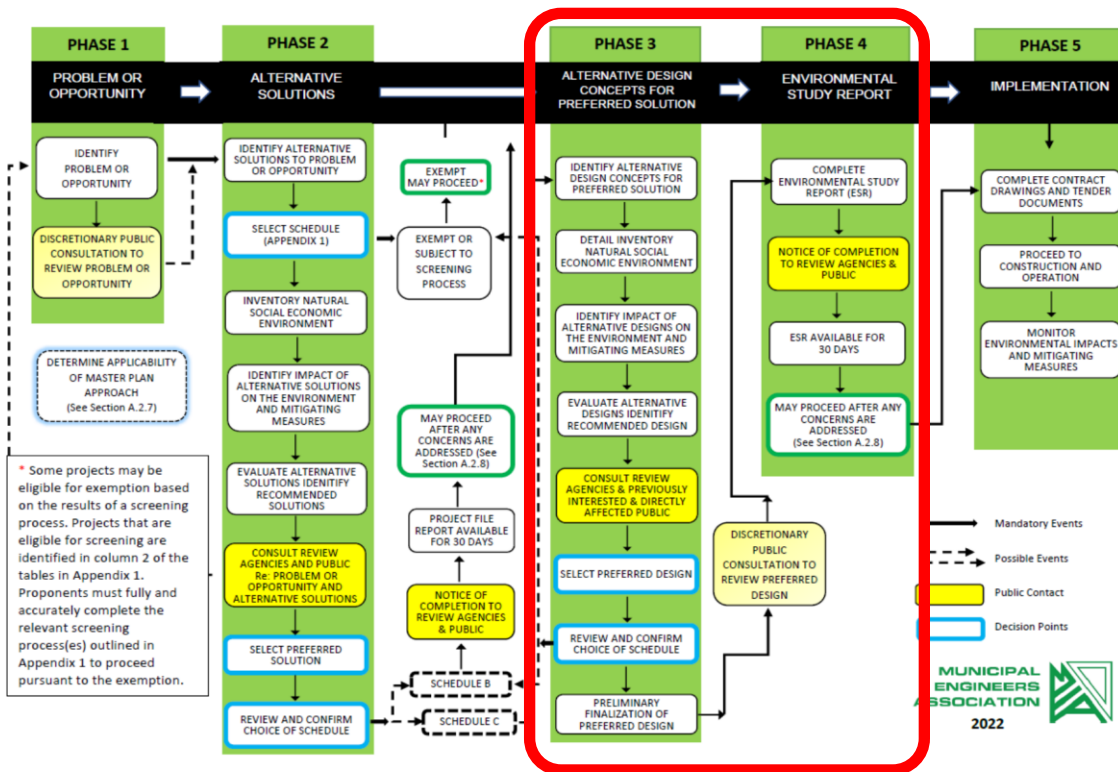
For **Schedule C** projects, proponents are required to complete Phases 3 and 4 of the MCEA process.

Project 74H:

- Culvert replacement.
- Trunk storm sewer diversion.

Project 79E/A:

- Construct new outlet to Georgian Bay (potential property acquisition).
- Potential to convey flow to existing outlet (no acquisition).



Next Steps: Post Calibration Review

It is anticipated that the hydrologic model calibration will reduce peak flows and hence the required size for the infrastructure upgrades recommended by the DMP.

Any projects implemented following model calibration will be reviewed against the updated peak flows to confirm sizing.

The Town may wish to complete a more fulsome review of the DMP recommendations to better understand budget implications.



Questions?

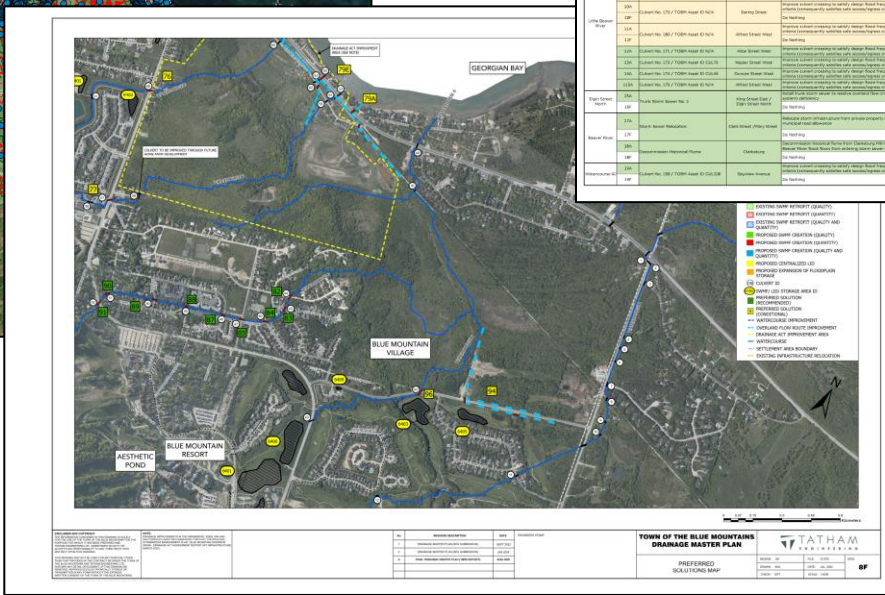


Table 26: Individual Project Evaluation Summary

Asset ID	Project Name	Project Description	Project Location	Project Status	Project Cost	Project Start	Project End	Project Duration	Project Complexity	Project Risk	Project Impact
13A	Culvert No. 128 / TOBM Asset ID NUL3	Storm Sewer	Georgetown	Proposed	\$1,886,000	2026	2026	1 Year	High	Medium	High
13B	Culvert No. 129 / TOBM Asset ID CUL2B	Storm Sewer	Georgetown	Proposed	\$2,063,000	2029	2029	1 Year	High	Medium	High
13C	Culvert No. 147 / TOBM Asset ID CUL17A	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13D	Culvert No. 148 / TOBM Asset ID CUL18	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13E	Culvert No. 149 / TOBM Asset ID CUL19	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13F	Culvert No. 150 / TOBM Asset ID CUL20	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13G	Culvert No. 151 / TOBM Asset ID CUL21	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13H	Culvert No. 152 / TOBM Asset ID CUL22	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13I	Culvert No. 153 / TOBM Asset ID CUL23	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13J	Culvert No. 154 / TOBM Asset ID CUL24	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13K	Culvert No. 155 / TOBM Asset ID CUL25	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13L	Culvert No. 156 / TOBM Asset ID CUL26	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13M	Culvert No. 157 / TOBM Asset ID CUL27	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13N	Culvert No. 158 / TOBM Asset ID CUL28	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13O	Culvert No. 159 / TOBM Asset ID CUL29	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13P	Culvert No. 160 / TOBM Asset ID CUL30	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13Q	Culvert No. 161 / TOBM Asset ID CUL31	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13R	Culvert No. 162 / TOBM Asset ID CUL32	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13S	Culvert No. 163 / TOBM Asset ID CUL33	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13T	Culvert No. 164 / TOBM Asset ID CUL34	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13U	Culvert No. 165 / TOBM Asset ID CUL35	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13V	Culvert No. 166 / TOBM Asset ID CUL36	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13W	Culvert No. 167 / TOBM Asset ID CUL37	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13X	Culvert No. 168 / TOBM Asset ID CUL38	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13Y	Culvert No. 169 / TOBM Asset ID CUL39	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13Z	Culvert No. 170 / TOBM Asset ID CUL40	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AA	Culvert No. 171 / TOBM Asset ID CUL41	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AB	Culvert No. 172 / TOBM Asset ID CUL42	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AC	Culvert No. 173 / TOBM Asset ID CUL43	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AD	Culvert No. 174 / TOBM Asset ID CUL44	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AE	Culvert No. 175 / TOBM Asset ID CUL45	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AF	Culvert No. 176 / TOBM Asset ID CUL46	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AG	Culvert No. 177 / TOBM Asset ID CUL47	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AH	Culvert No. 178 / TOBM Asset ID CUL48	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AI	Culvert No. 179 / TOBM Asset ID CUL49	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AJ	Culvert No. 180 / TOBM Asset ID CUL50	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AK	Culvert No. 181 / TOBM Asset ID CUL51	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AL	Culvert No. 182 / TOBM Asset ID CUL52	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AM	Culvert No. 183 / TOBM Asset ID CUL53	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AN	Culvert No. 184 / TOBM Asset ID CUL54	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AO	Culvert No. 185 / TOBM Asset ID CUL55	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AP	Culvert No. 186 / TOBM Asset ID CUL56	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AQ	Culvert No. 187 / TOBM Asset ID CUL57	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AR	Culvert No. 188 / TOBM Asset ID CUL58	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AS	Culvert No. 189 / TOBM Asset ID CUL59	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AT	Culvert No. 190 / TOBM Asset ID CUL60	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AU	Culvert No. 191 / TOBM Asset ID CUL61	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AV	Culvert No. 192 / TOBM Asset ID CUL62	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AW	Culvert No. 193 / TOBM Asset ID CUL63	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AX	Culvert No. 194 / TOBM Asset ID CUL64	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AY	Culvert No. 195 / TOBM Asset ID CUL65	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13AZ	Culvert No. 196 / TOBM Asset ID CUL66	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13BA	Culvert No. 197 / TOBM Asset ID CUL67	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13BB	Culvert No. 198 / TOBM Asset ID CUL68	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13BC	Culvert No. 199 / TOBM Asset ID CUL69	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High
13BD	Culvert No. 200 / TOBM Asset ID CUL70	Storm Sewer	Georgetown	Proposed	\$1,194,000	2029	2029	1 Year	High	Medium	High

Table 27: 10-Year Implementation Program

YEAR	PROJECT NO.	IMPROVEMENT NAME/ID	COST
2026	79E	New Outlet to Georgian Bay	\$1,886,000
2026	73G	Culverts No. 69, 70, 71 and 72	\$1,158,000
2027	17A	Storm Sewer Relocation	\$1,295,000
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