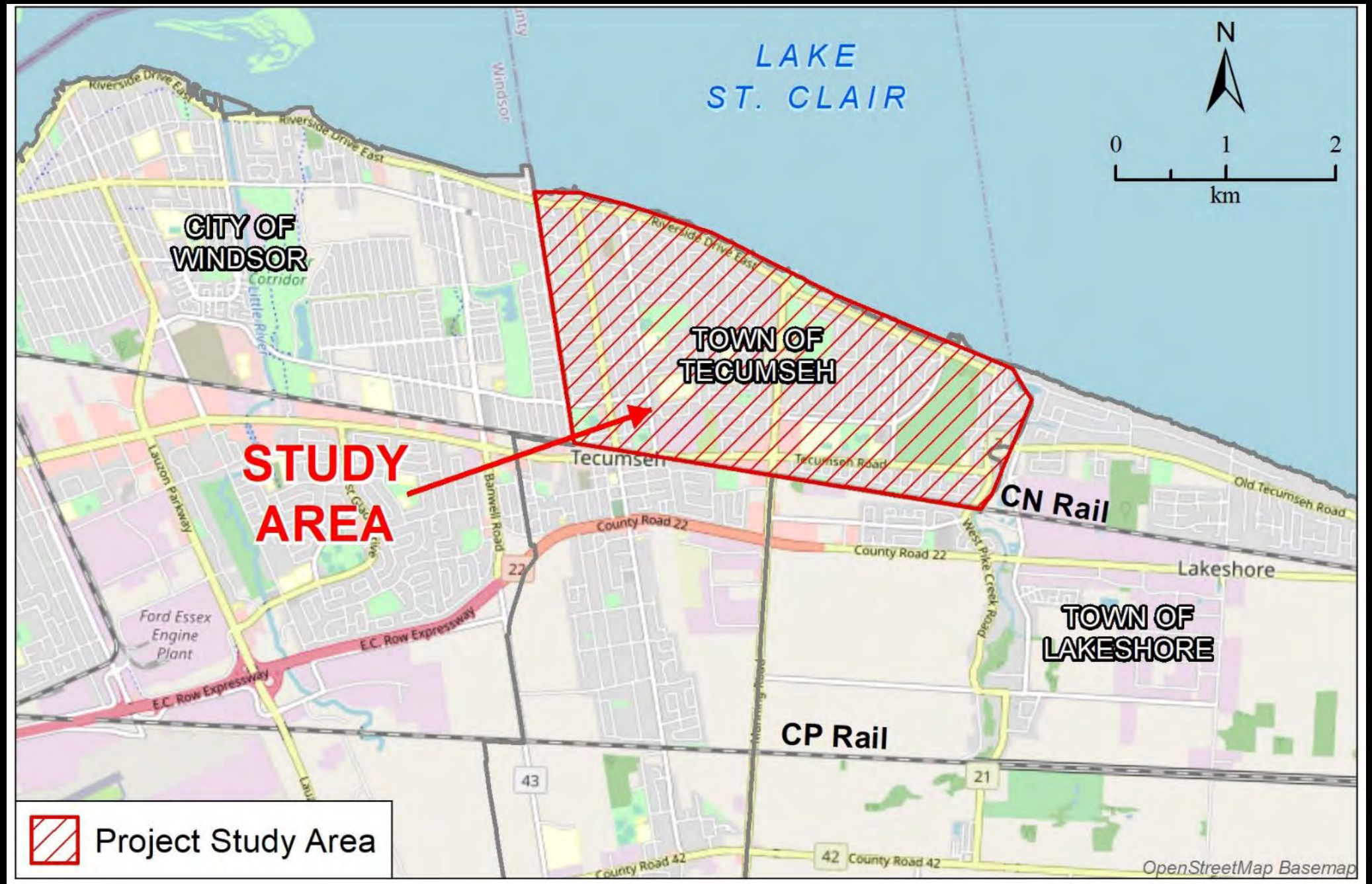
Town of Tecumseh
Shoreline Management Plan Update
Coastal Flood Risk Assessment

Public Information Centre #3

August 18, 2021

Study Area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Tecumseh
Riverside Drive East
Tecumseh Road
County Road 22
E.C. Row Expressway
Ford Essex
Engine
Plant
Lauzon Parkway
Barnwell Road
West Pike Creek Road
Old Tecumseh Road
Little River
Corridor
43
21
42
County Road 42
Project Study Area
OpenStreetMap Basemap

AGENDA FOR PIC#3

- Meeting guidelines, goals, and final steps
- Flood risk factors in Tecumseh
- Flood mapping and potential economic damages
- Adaptation concepts to reduce flood risk
- Question and answer on the presentation
- Interactive poll questions with the participants
- Closing remarks

Public Information Centre Guidelines

- All participants are muted and off video
- The panelists will present the webinar and have their video on
- During the feedback portion you can use the '**Question and Answer**' button found at the bottom of your screen
  - Open the 'Question and Answer' window
  - Type your question or comment in the window. Click send
  - Your question will be read to all participants by the facilitator and one of the panelists will respond to the comment or question
- Note: Check **Send Anonymously** if you don't want your name attached

Public Information Centre (PIC) #3 GOALS

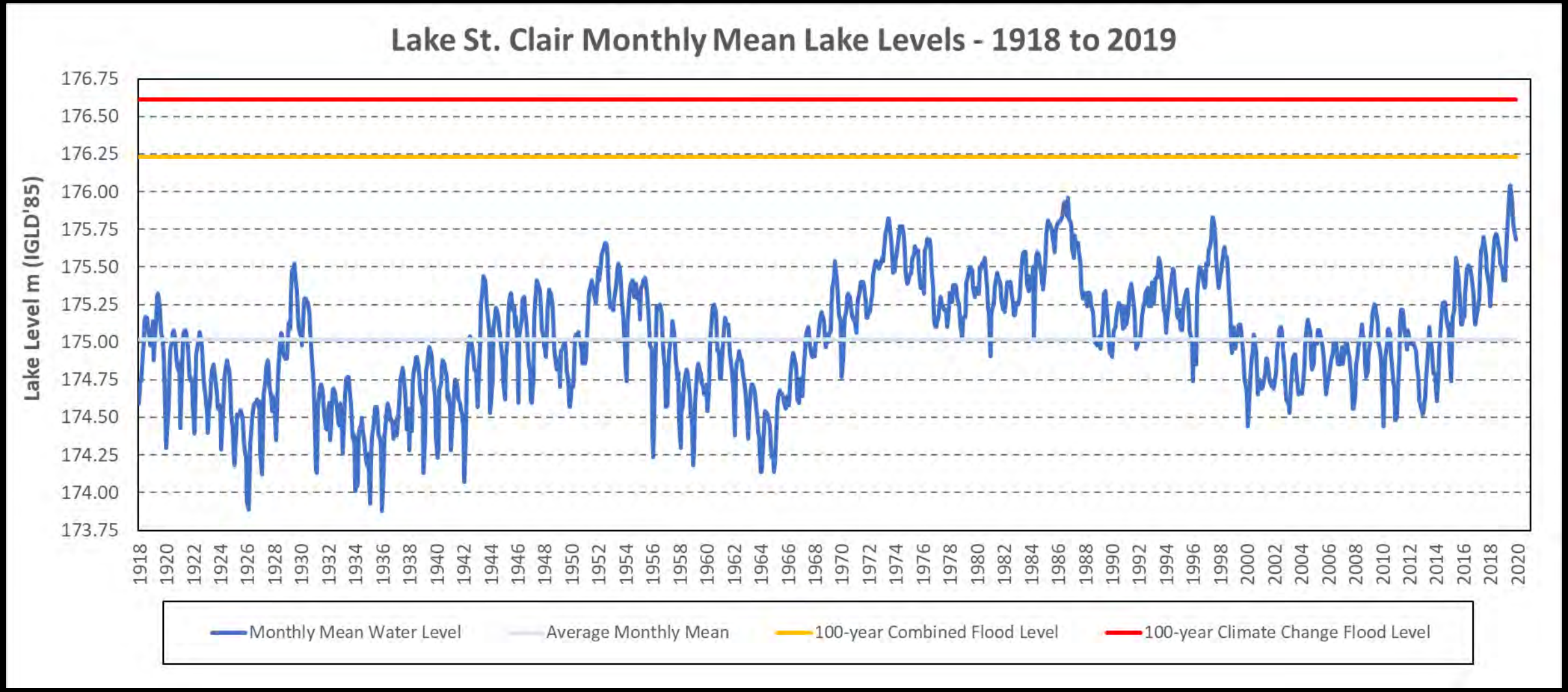
- Provide an update on the project and workplan
- Share findings of the flood risk assessment and potential economic damages
- Present flood mitigation strategies and benefit-cost ratios
- Get feedback from the attendees on the flood mitigation strategies

FINAL STEPS FOR THE STUDY

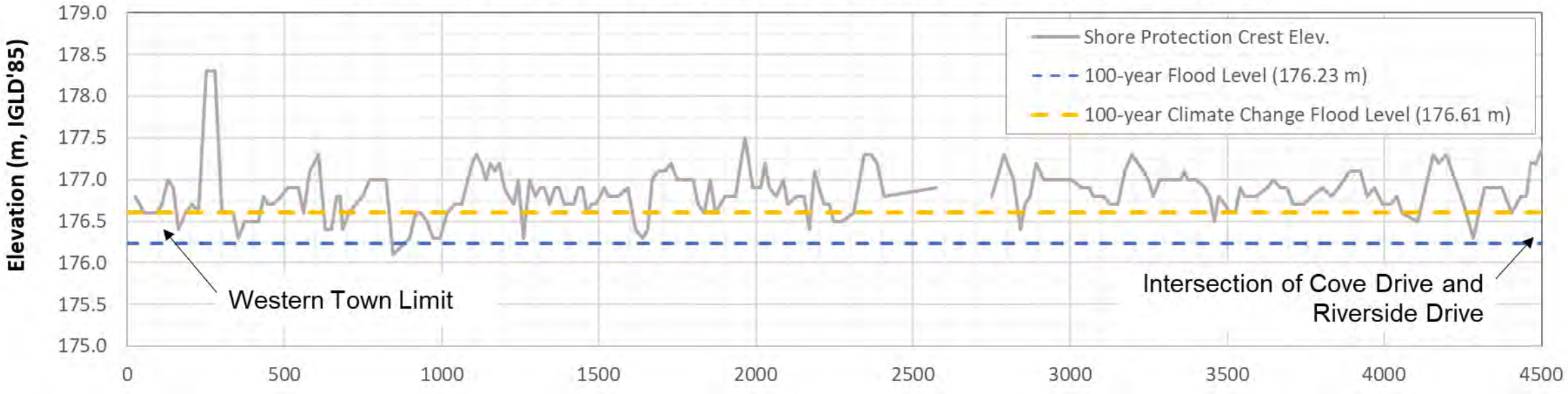
- Evaluate feedback from PIC#3 and integrate into the study
- Draft Report
- Present to the Town of Tecumseh
- Finalize Report

FLOOD RISK FACTORS IN TECUMSEH

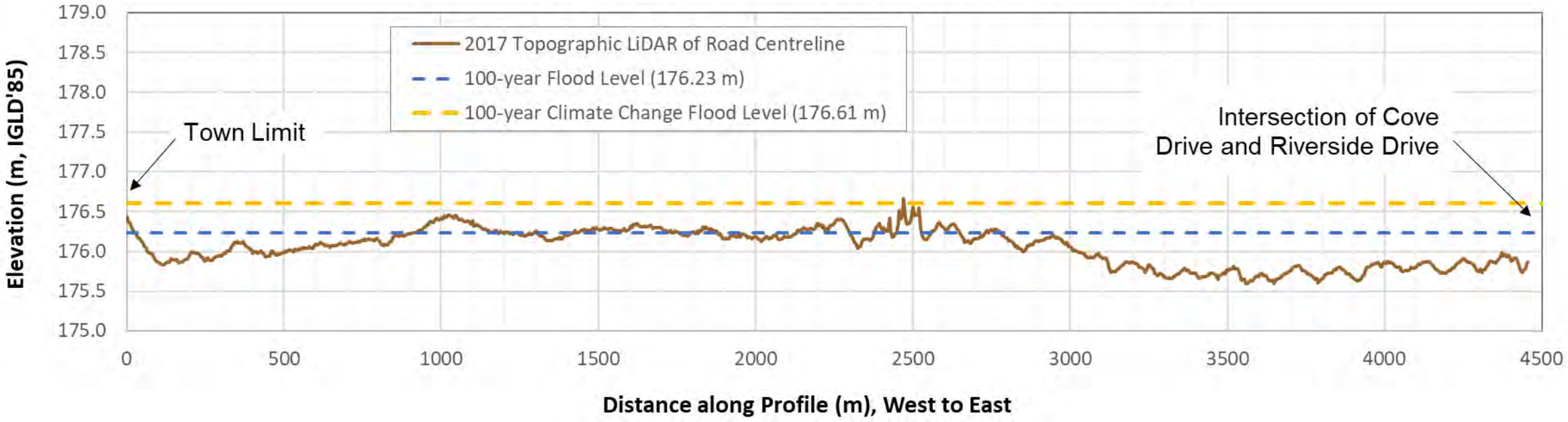
Historical Water Levels, 100-year Combined Flood Level, and 100-year Climate Change Flood Level



Shore Protection Crest Elevation vs Flood Level (west to east)



Riverside Drive Elevation vs Flood Level (west to east)



FLOOD PATHWAYS

Legend

- Parcels
- 100-year Combined Flood Level

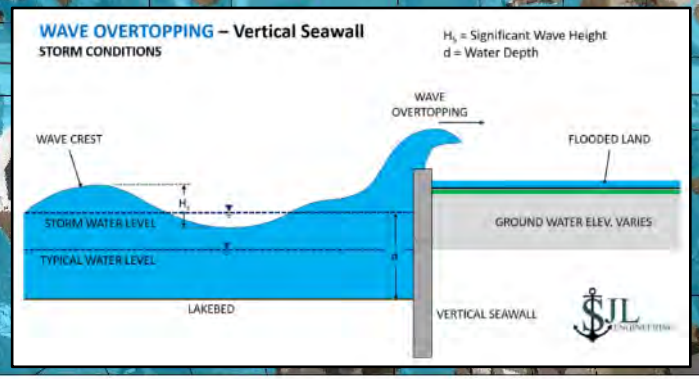
JD Barnes Survey - CAD Points

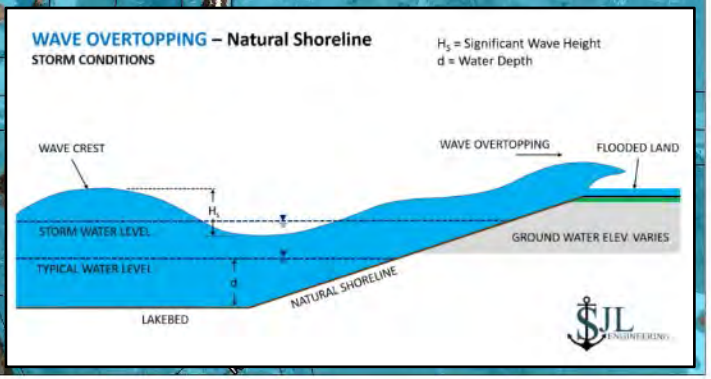
- Other
- Survey Nodes
- Lake Bed Points

JD Barnes Survey - CAD Lines

- Other
- BLOCKS
- Crest - Wall
- G-DIMARR
- T-PAVC
- Waters Edge

In 2020 berms constructed in known flood prone areas





TOWN OF TECUMSEH
FLOOD RISK STUDY

Flood Pathway for 100-year Combined Flood Level

Notes:
JD Barnes survey elevations in CGVD'28, m.
For Tecumseh, IGLD'85 - CGVD'28 = -0 m.

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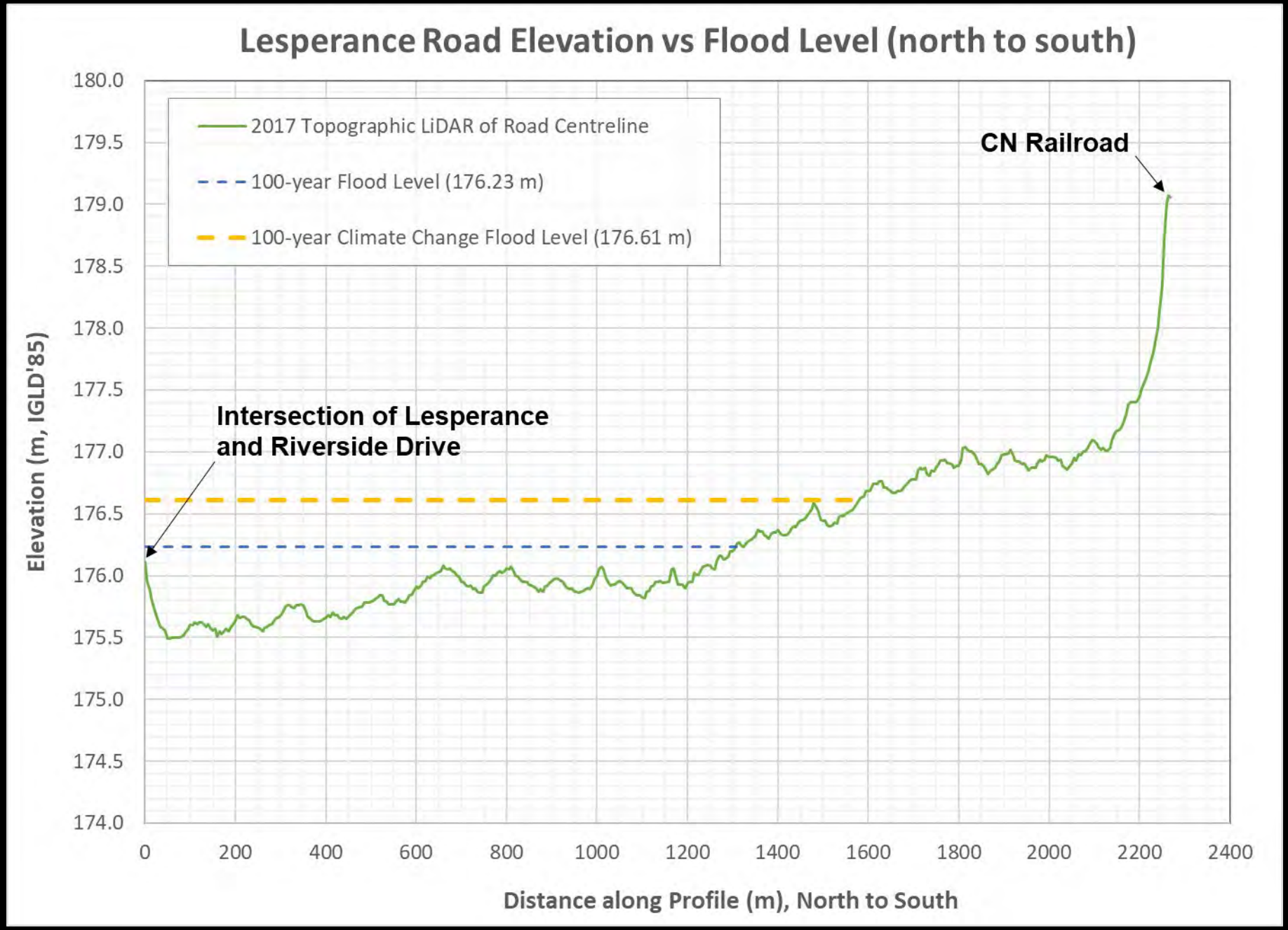
Lesperance Road

Road is lower than coastal flood elevations



It has happened before …
Saint Patrick's Day Storm of 1973

- Major coastal storm on March 17, 1973
- Peak water level at Belle River reached +176.19 m IGLD85'
  - 4 cm below predicted 100-year combined flood level
  - Mean Lake Level = +175.83 (50-year for March)
  - Storm Surge = 0.36 m (25-year)
  - Significant wave height event


St. Clair Beach Police Station

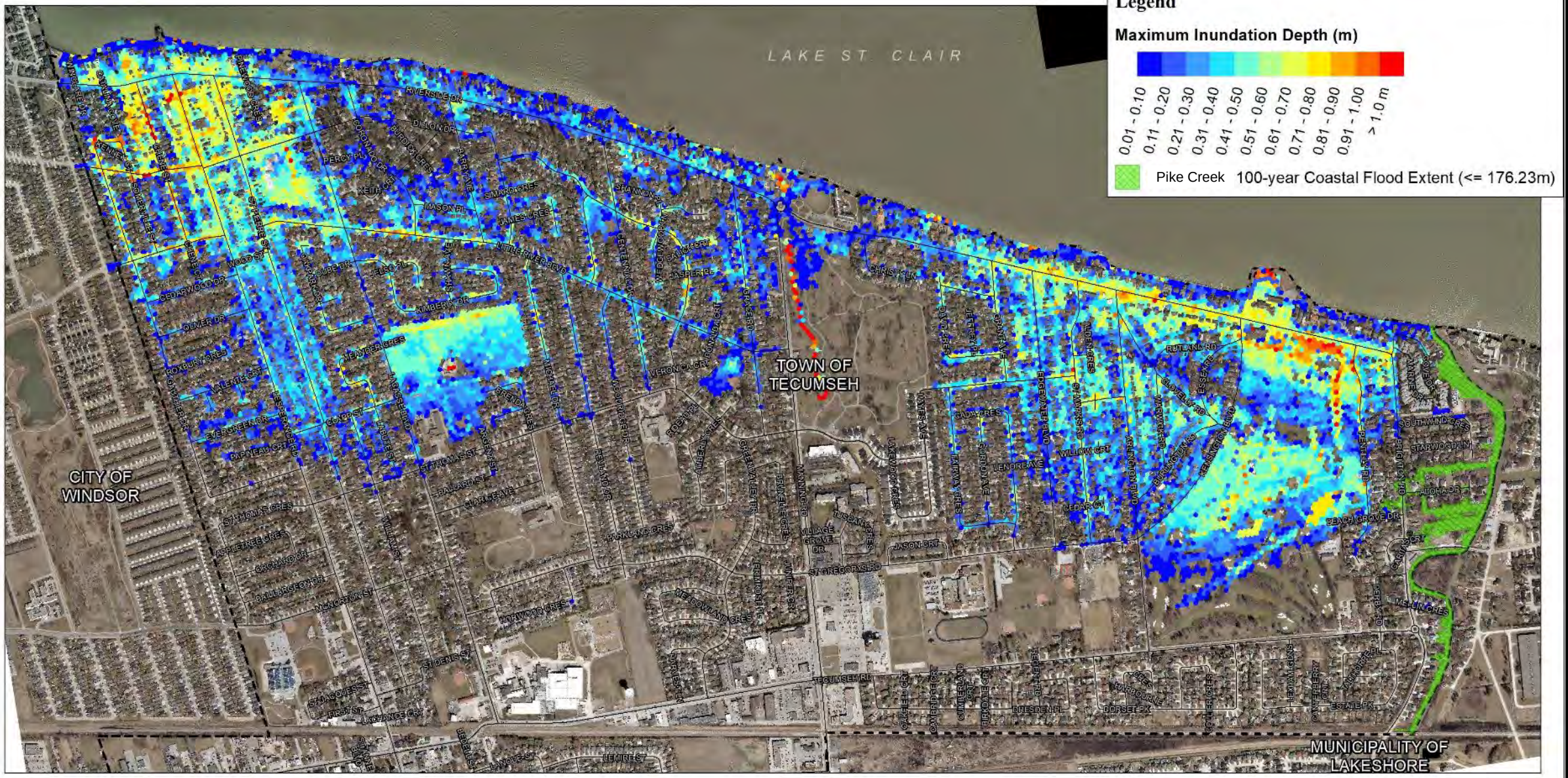

Riverside Drive


Tecumseh Road


Arlington Blvd.

FLOOD MAPPING AND POTENTIAL ECONOMIC DAMAGES

SCENARIO A FLOOD ANIMATION (30 hours)



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Scenario A
100-year Coastal Flood with No Rain

Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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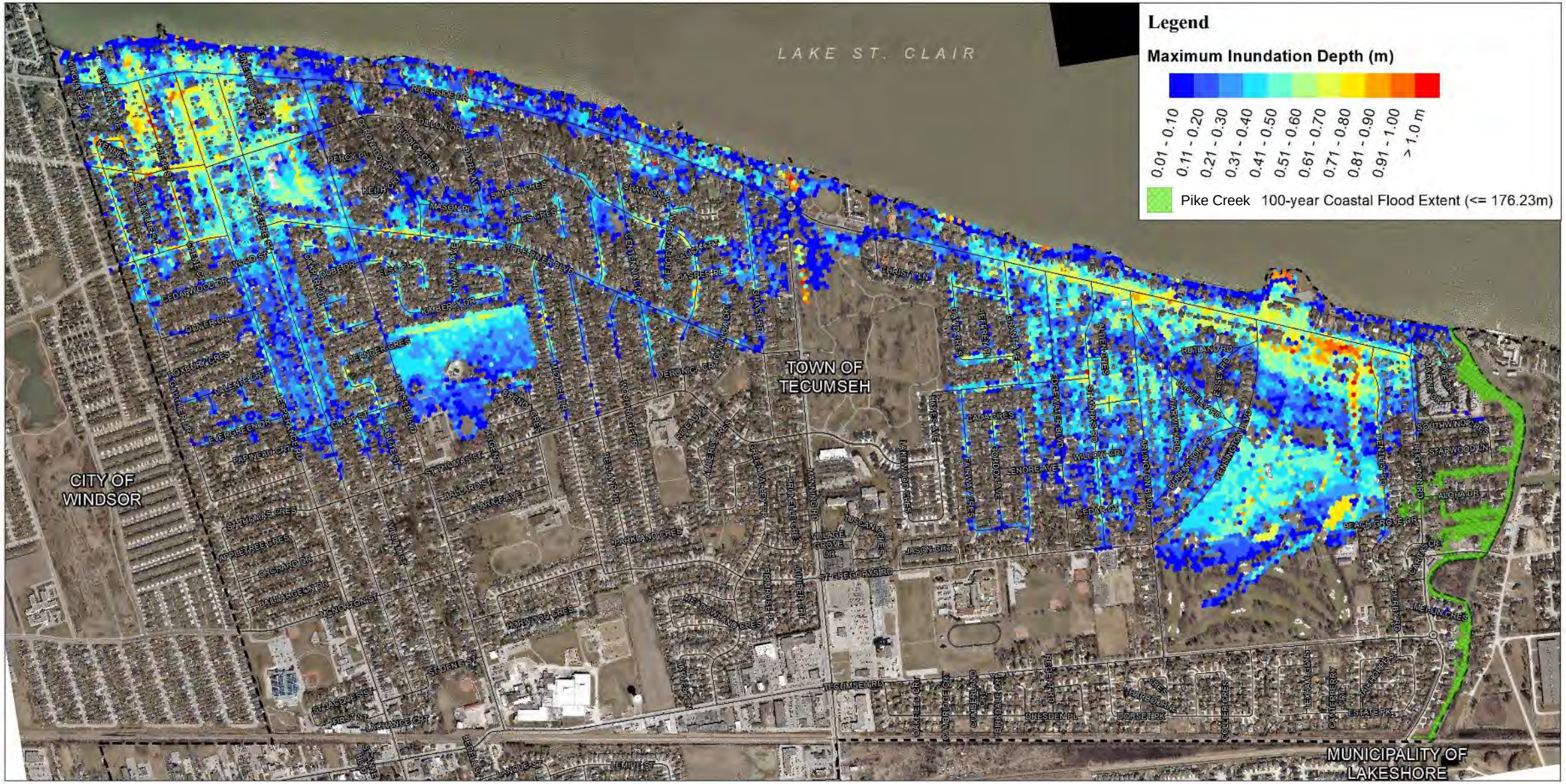

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Scenario H
100-year Coastal Flood with No Rain
Shore Protection Upgraded to Limit Overtopping to 50 L/s/m
Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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Scenario G
100-year Coastal Flood with No Rain
Shore Protection Upgraded to Limit Overtopping to 10 L/s/m
Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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Scenario L
100-year Coastal Flood with No Rain
Hypothetical Riverside Drive Flood Barrier
Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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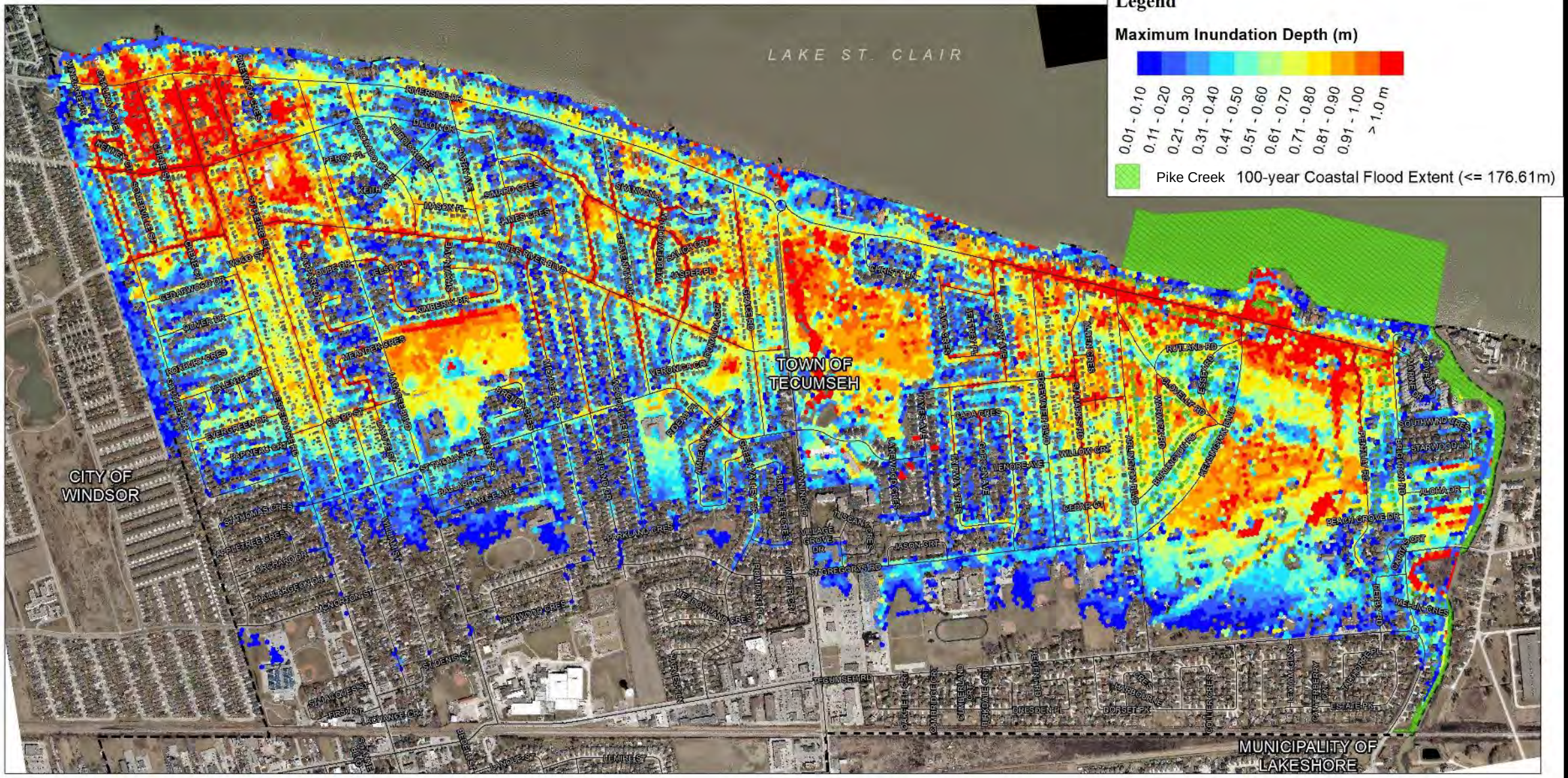
SCENARIO C FLOOD ANIMATION (30 hours)



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Scenario C
100-year Climate Change Coastal Flood with No Rain

Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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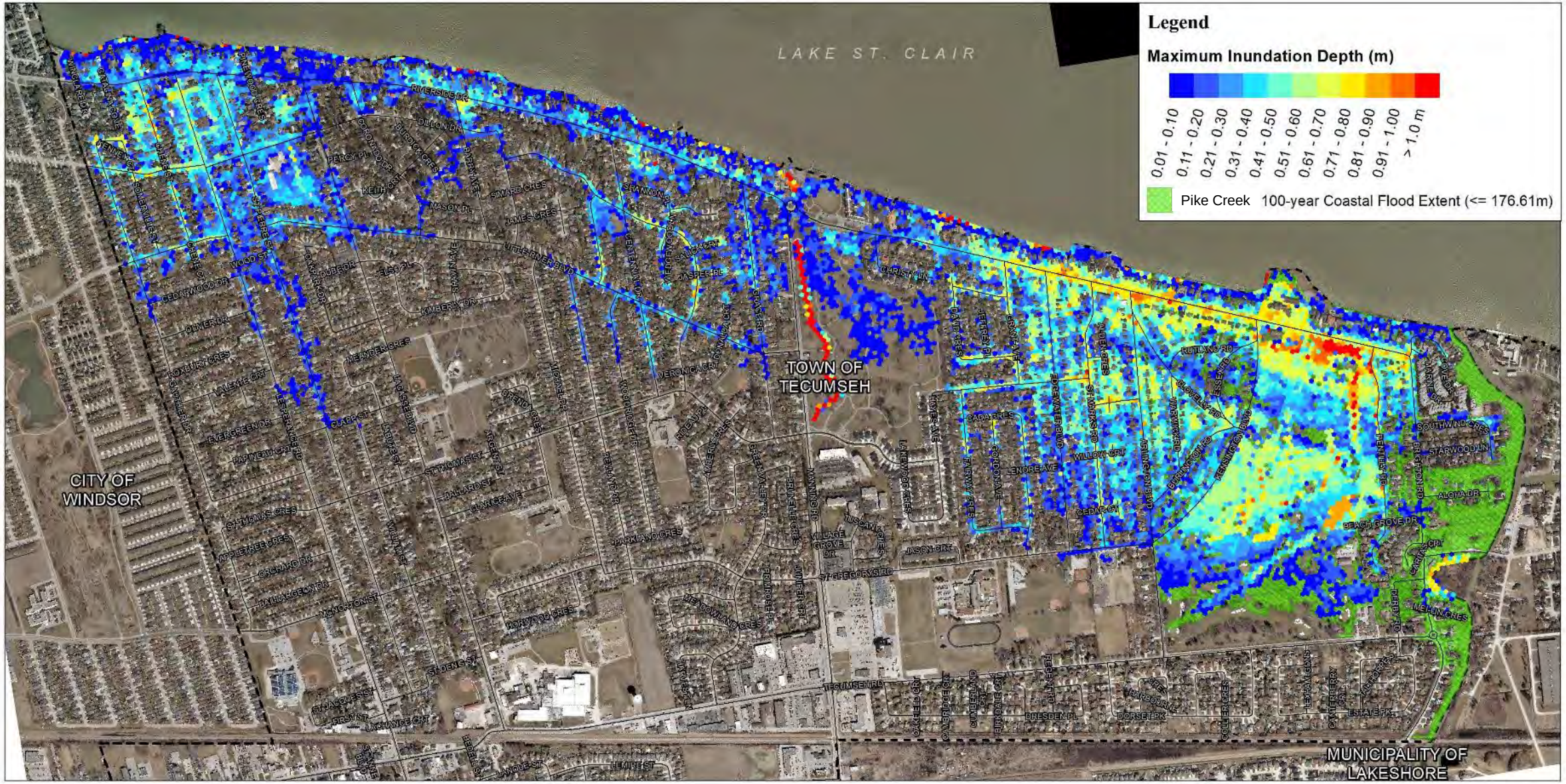

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Scenario J
100-year Climate Change Coastal Flood with No Rain
Shore Protection Upgraded to Limit Overtopping to 10 L/s/m
Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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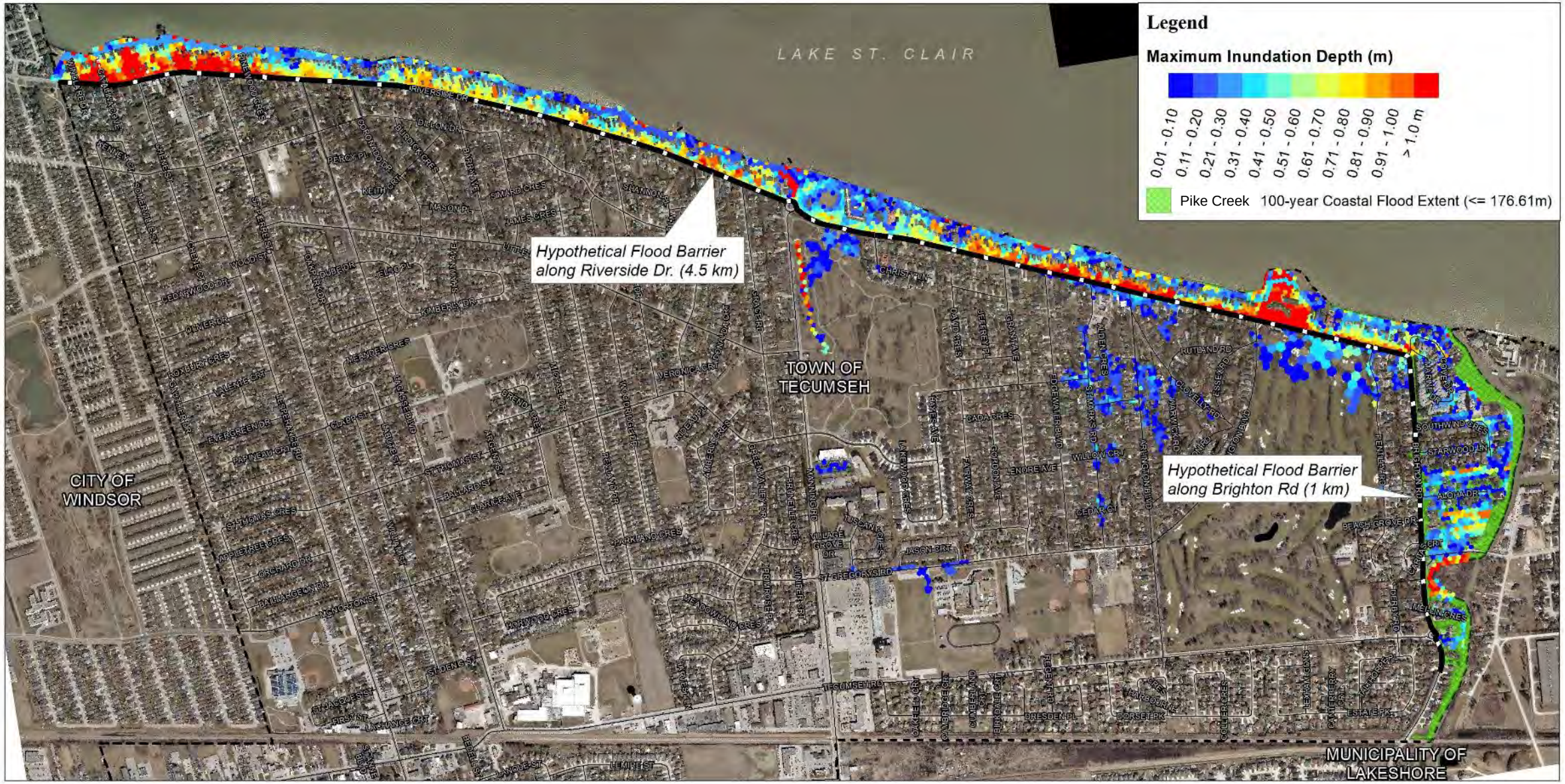

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Scenario M
100-year Climate Change Coastal Flood with No Rain
Hypothetical Riverside Drive Flood Barrier
Town of Tecumseh

Notes:
1) Wave overlopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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PROPERTY PARCEL DATABASE

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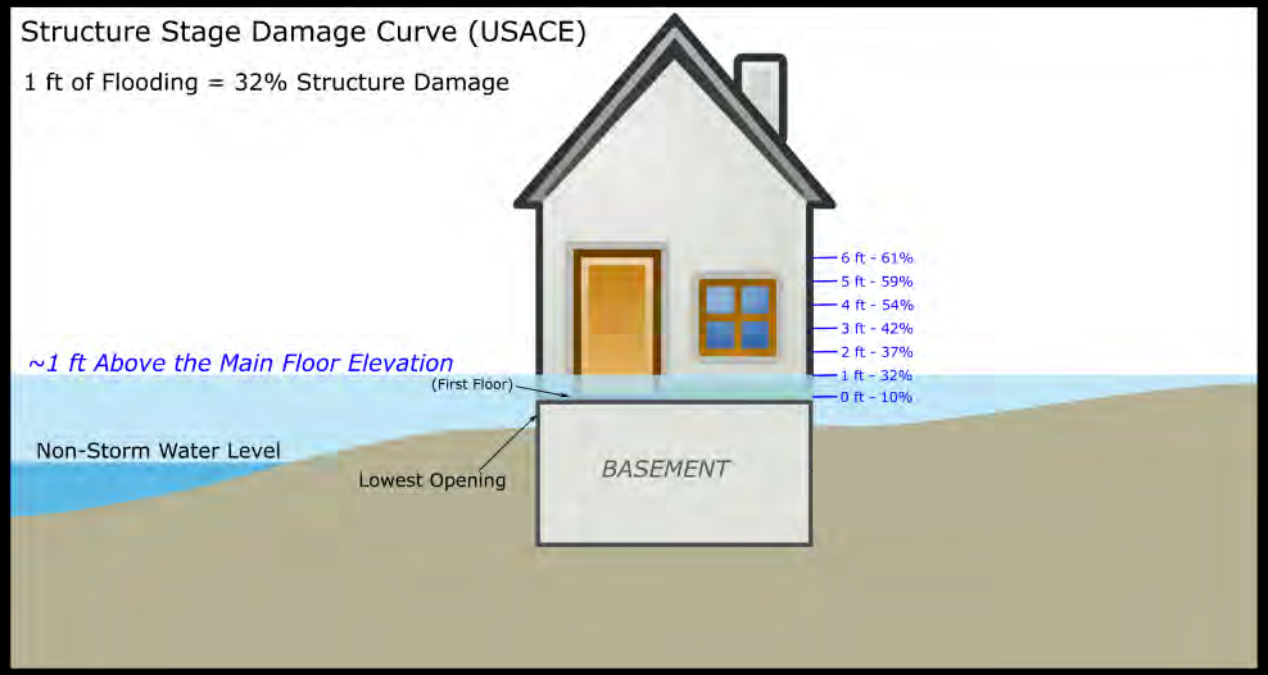
Parcel Database
Collection of Estimated First Floor Elevations

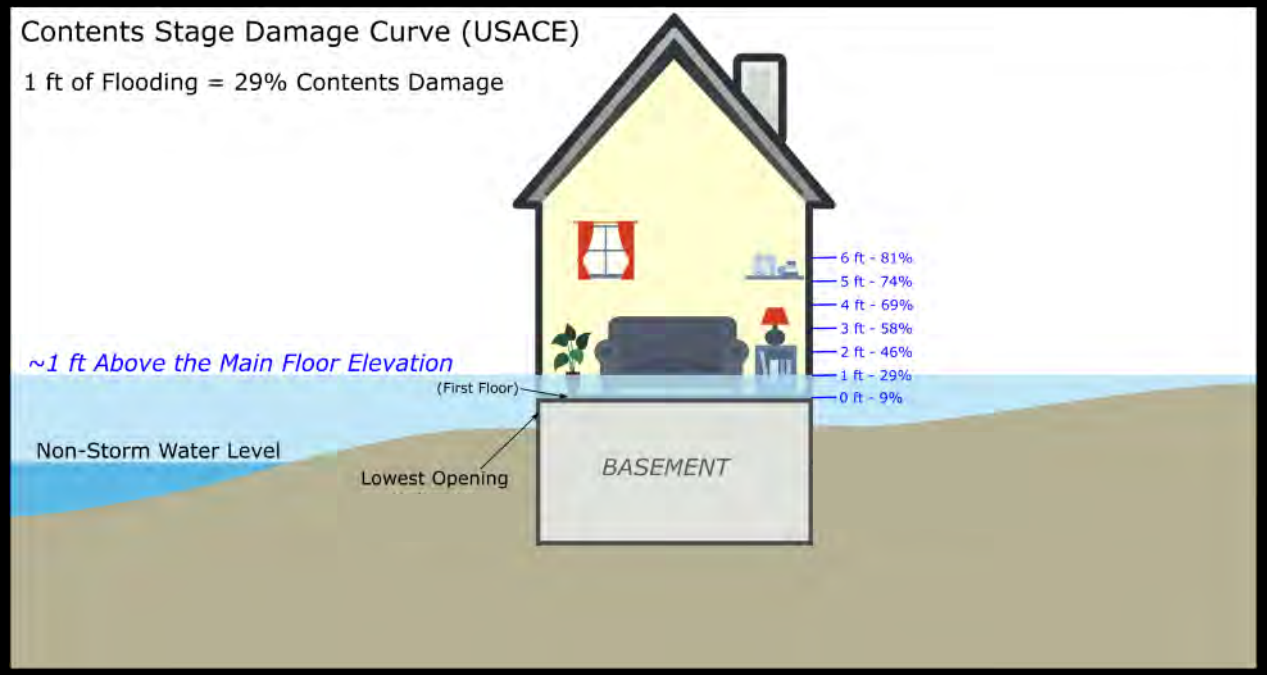
Town of Tecumseh

Data Sources:
1) 2019 ortho provided by the Cou
Essex.

Flood Damage Methodology

- Property value based on current assessment value (not market value)
- Building and content damages increase with the depth of flooding above the first floor (USACE methodology in graphics below)

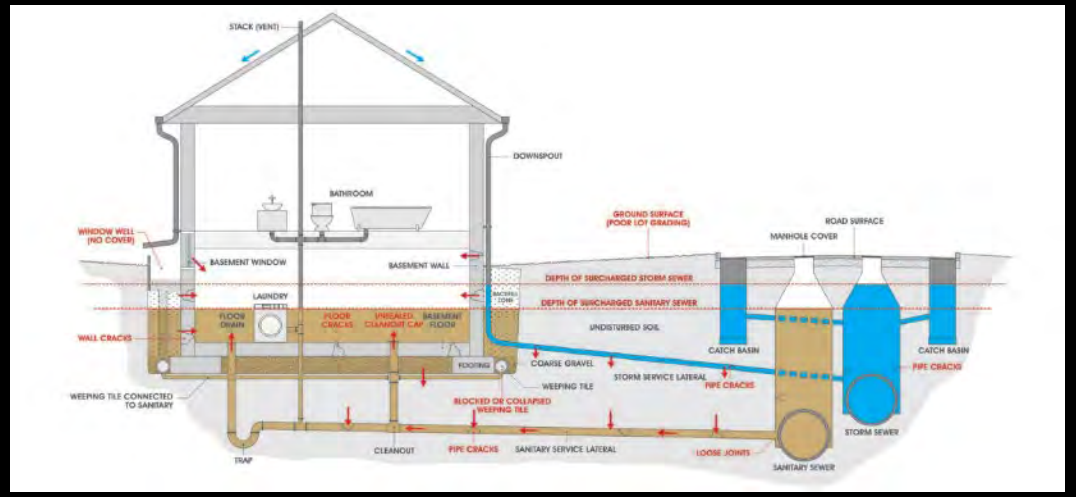


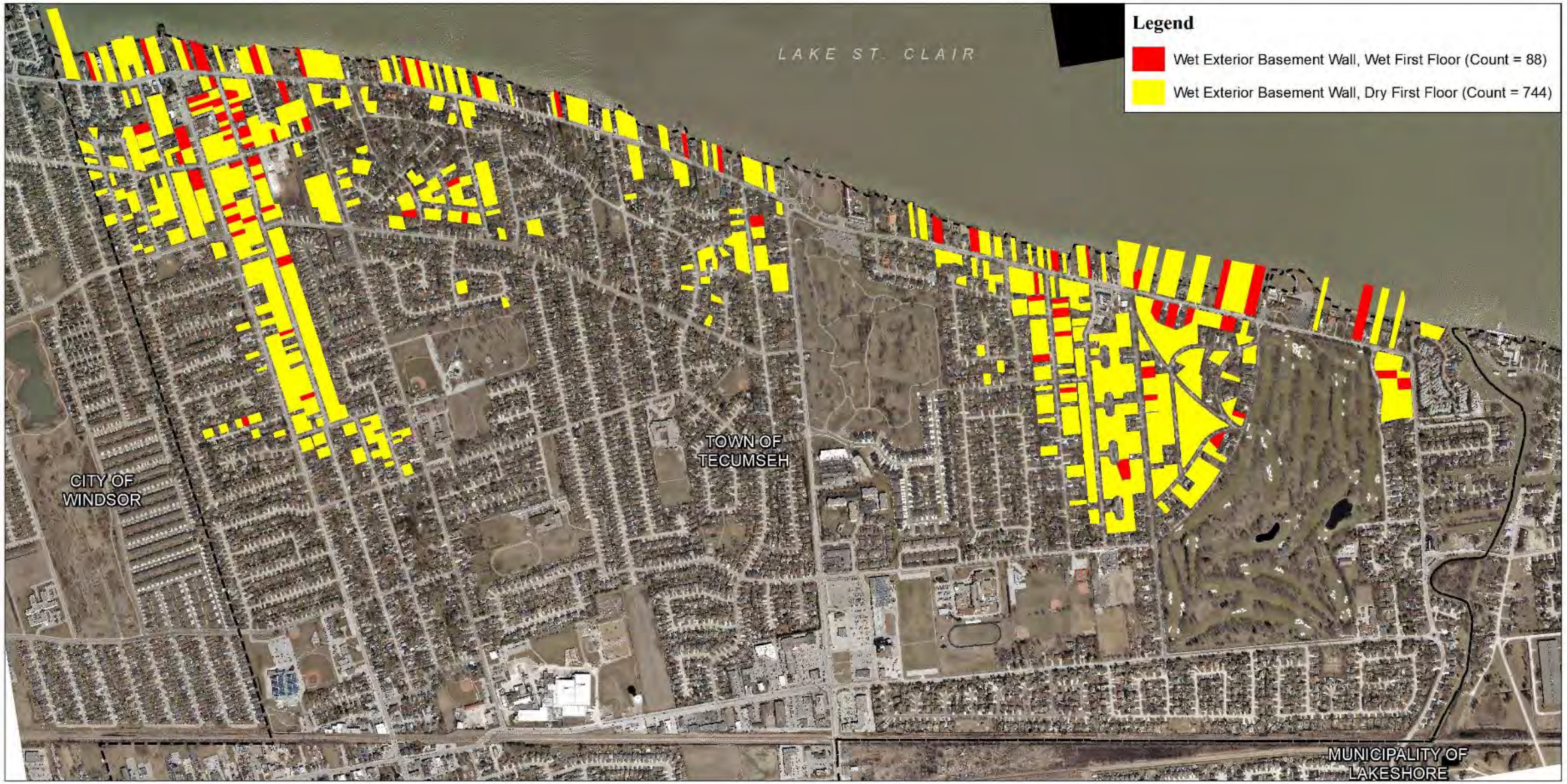


Basement Flooding During a Coastal Flood from Sanitary Sewer Surcharging

- Homes constructed prior to 1980 may have foundation drains connected to the sanitary sewer system, which could contribute to sanitary sewer surcharging, causing backflow and basement flooding during a coastal flood

- During a coastal flood, the Hydraulic Grade Line (HGL) elevations (water levels) in some sanitary sewers may be above the basement floor level, which could lead to backflow and basement flooding





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Potential Flooding of Basement and First Floor for Residential Properties
Scenario A

Town of Tecumseh

Notes:
*indicates that flood elevation is less than the ground elevation adjacent to the house; or a basement may not be present or identifiable; or the parcel is classified as non-residential.

2019 aerial provided by the County of Essex

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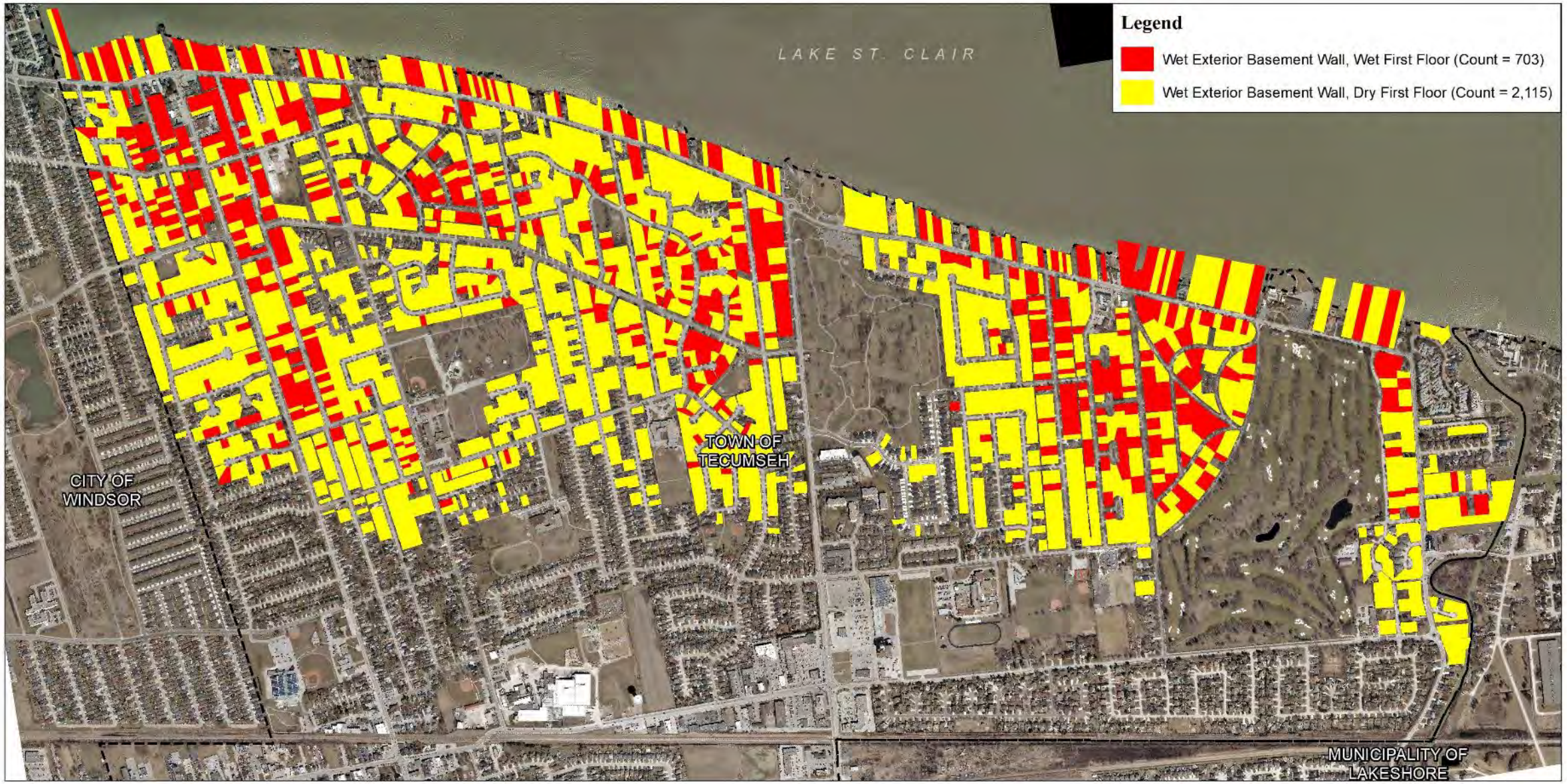

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Potential Flooding of Basement and First Floor for Residential Properties
Scenario C

Town of Tecumseh

Notes:
*indicates that flood elevation is less than the ground elevation adjacent to the house; or a basement may not be present or identifiable; or the parcel is classified as non-residential.

2019 aerial provided by the County of Essex

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Zone of Potential Basement Flooding from Sewer Surcharging during a Coastal Flood

Town of Tecumseh

Notes:
*indicates that flood elevation is less than the ground elevation adjacent to the house; or a basement may not be present or identifiable; or the parcel is classified as non-residential.

2019 aerial provided by the County of Essex

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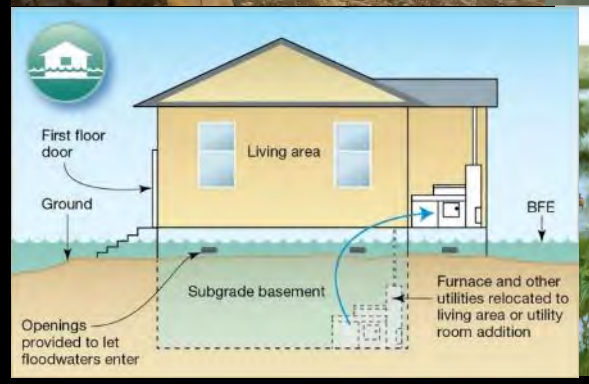
Estimated Economic Damages for Overland Flood Scenarios (structure and contents)

Flood Scenario	Wet Exterior Basement Foundation	# with First Floor Flooding	Flooding Damage to Structures and Contents	Sanitary Sewer Surcharging
A – 100-year Coastal Flood	850	110	$24 to $37 million	*High risk during a coastal flood* *Could lead to basement flooding* *Not included in the economic damage calculations*
H – 100-year Coastal Flood with minor shore protection upgrades (50 L/s/m)	670	80	$19 to $30 million	
G – 100-year Coastal Flood with moderate shore protection upgrades (10 L/s/m)	190	10	$3 to $5 million	
L – 100-year Coastal Flood with continuous Riverside Drive barrier	126	33	$9 to $13 million	
C – 100-year Climate Change Coastal Flood	2,840	730	$124 to $188 million	
J – 100-year Climate Change Coastal Flood with major shore protection upgrades	620	90	$23 to $35 million	
M – 100-year Climate Change Coastal Flood with continuous Riverside Drive barrier	210	90	$31 to $45 million	

ADAPTATION CONCEPTS TO REDUCE FLOOD RISK



BENEFIT COST RATIO

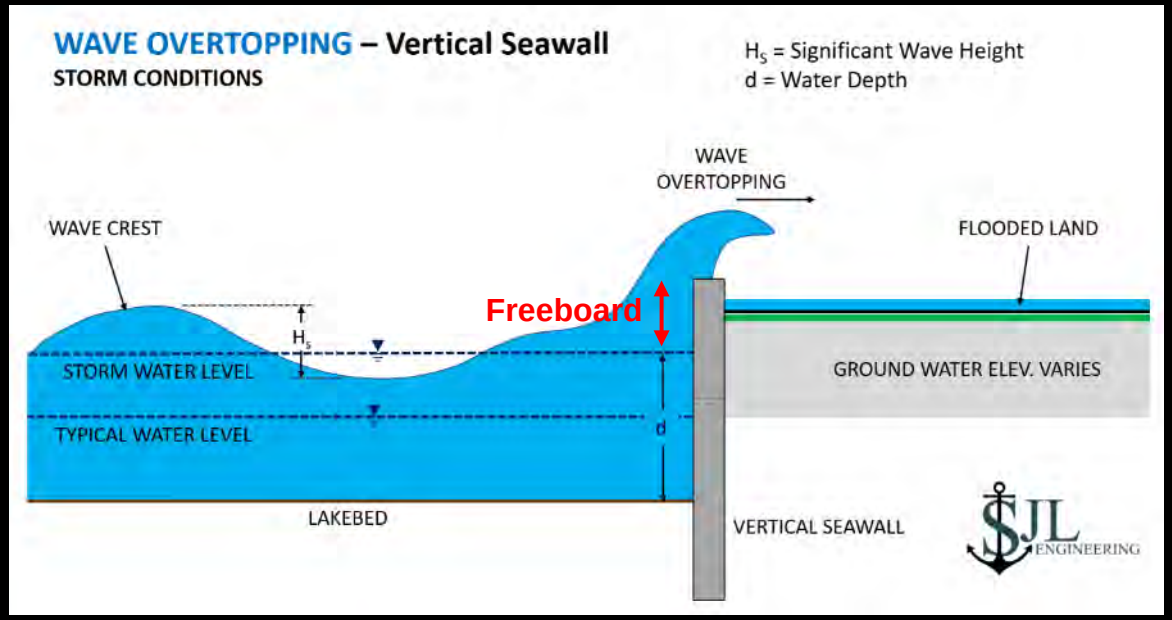
- Systematic process to evaluate the cost-effectiveness of hazard mitigation concepts, such as shore protection, that reduce potential flooding damages

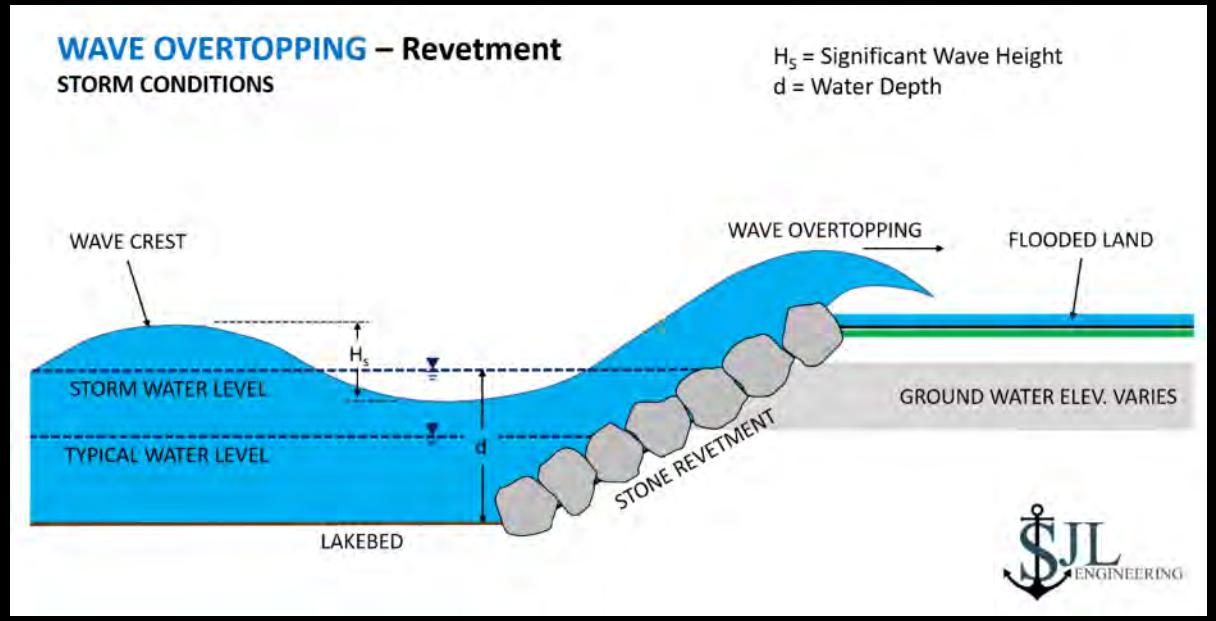
- Benefits: calculate potential benefits of protection (e.g., avoided flood damages)
- Costs: capital cost of implementing the shore protection
  - Example: Avoided Damages ($10M) requires investment in shore protection ($5M)
  - Benefits ($10M) / Costs ($5M) = Ratio of 2.0
- In general, ratios > 1.0 will result in positive economic benefits for a community

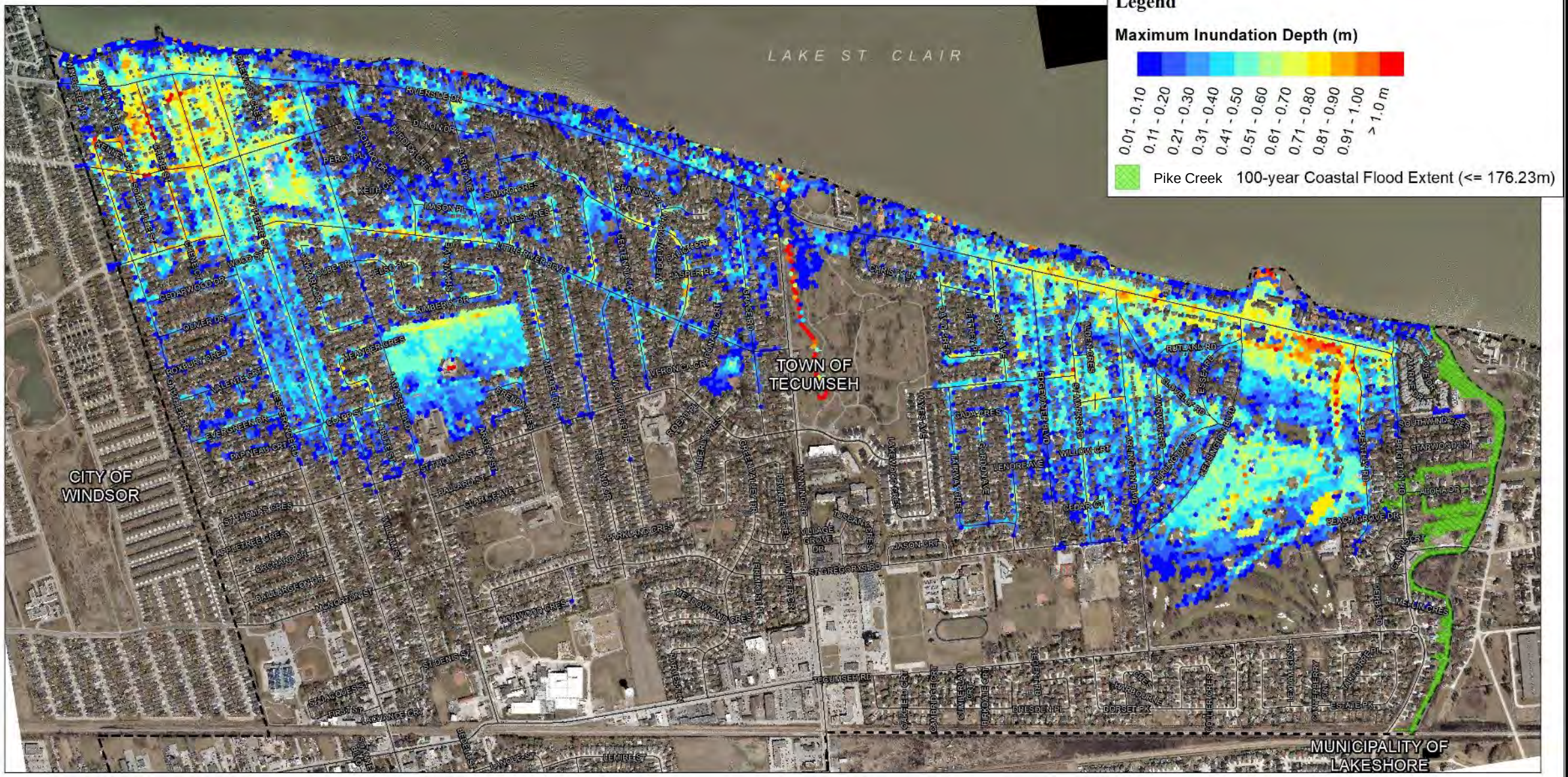
- Complex benefit-cost ratios include a temporal component (e.g., 25 years) and discounting is used to compare future avoided damages to initial capital costs

PROTECT

- Improve shoreline infrastructure to reduce the volume and rate of wave overtopping during the 100-year storm
  - Wave overtopping is typically measured in litres of water, per second, per metre of shoreline (l/s/m)
  - Simplest way to mitigate overtopping is to raise structures







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Scenario A
100-year Coastal Flood with No Rain

Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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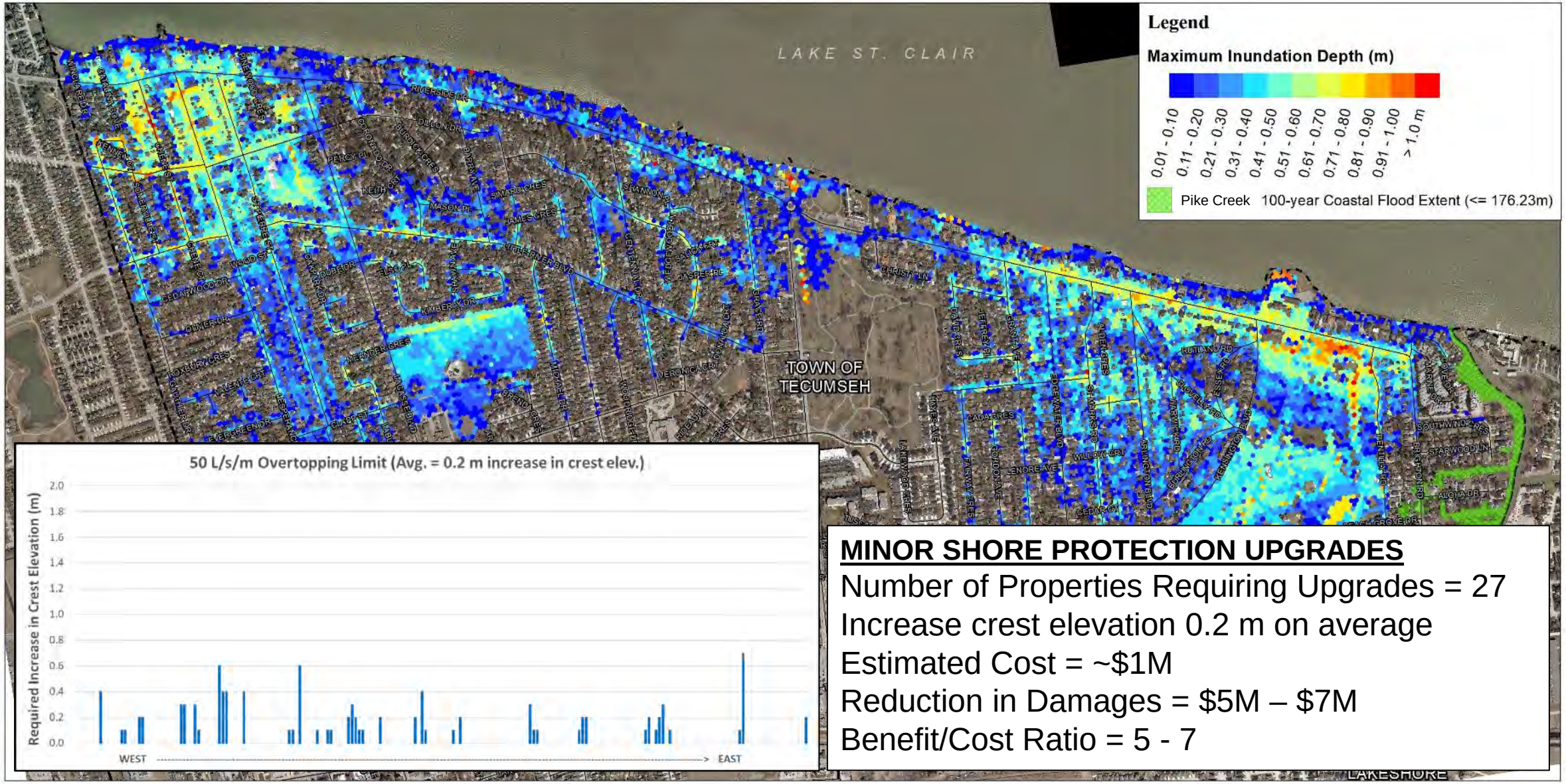

MINOR SHORE PROTECTION UPGRADES

Number of Properties Requiring Upgrades = 27
Increase crest elevation 0.2 m on average
Estimated Cost = ~$1M
Reduction in Damages = $5M – $7M
Benefit/Cost Ratio = 5 - 7

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Scenario H
100-year Coastal Flood with No Rain
Shore Protection Upgraded to Limit Overtopping to 50 L/s/m
Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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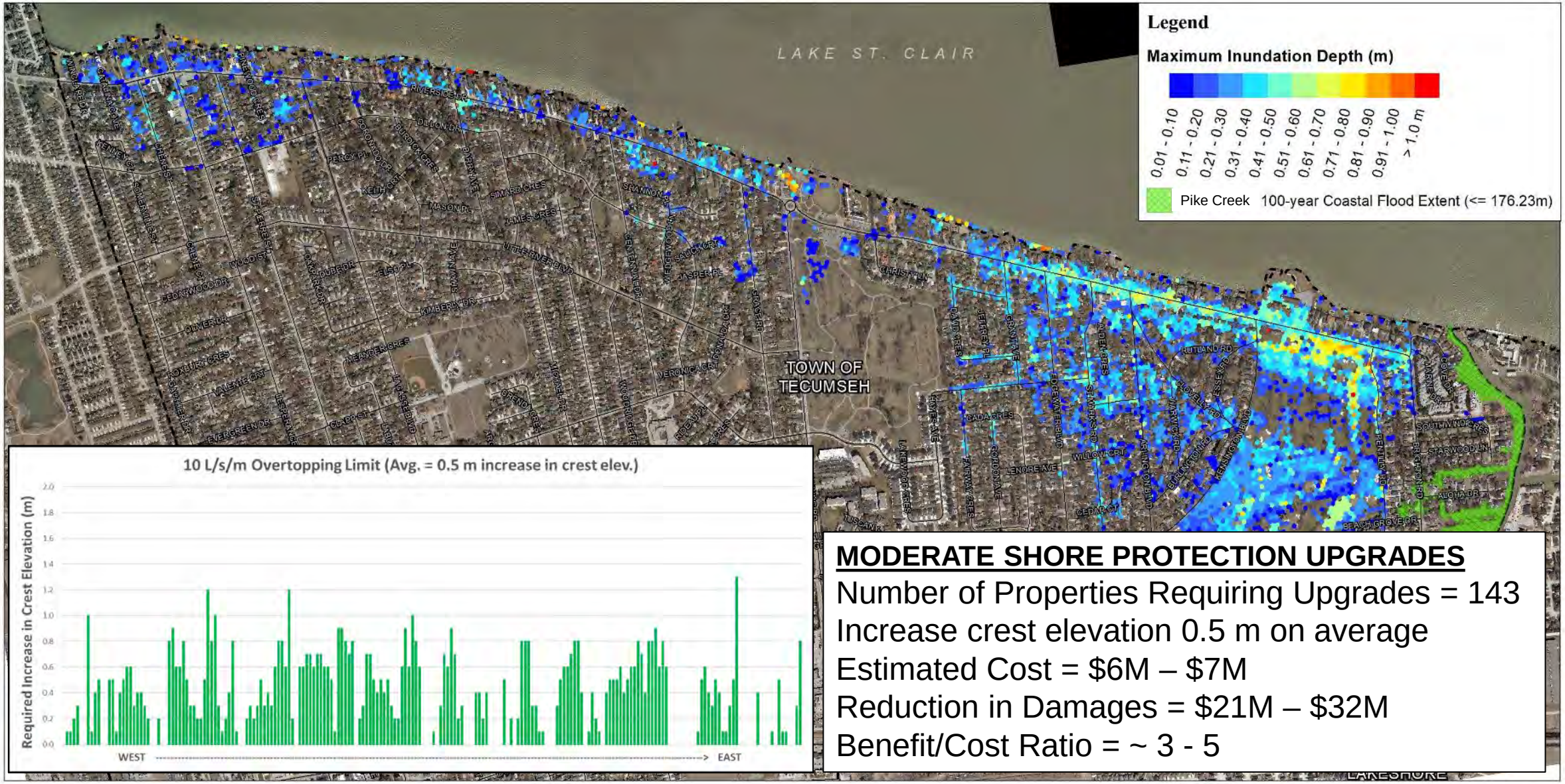

MODERATE SHORE PROTECTION UPGRADES

Number of Properties Requiring Upgrades = 143
Increase crest elevation 0.5 m on average
Estimated Cost = $6M – $7M
Reduction in Damages = $21M – $32M
Benefit/Cost Ratio = ~ 3 - 5

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Scenario G
100-year Coastal Flood with No Rain
Shore Protection Upgraded to Limit Overtopping to 10 L/s/m
Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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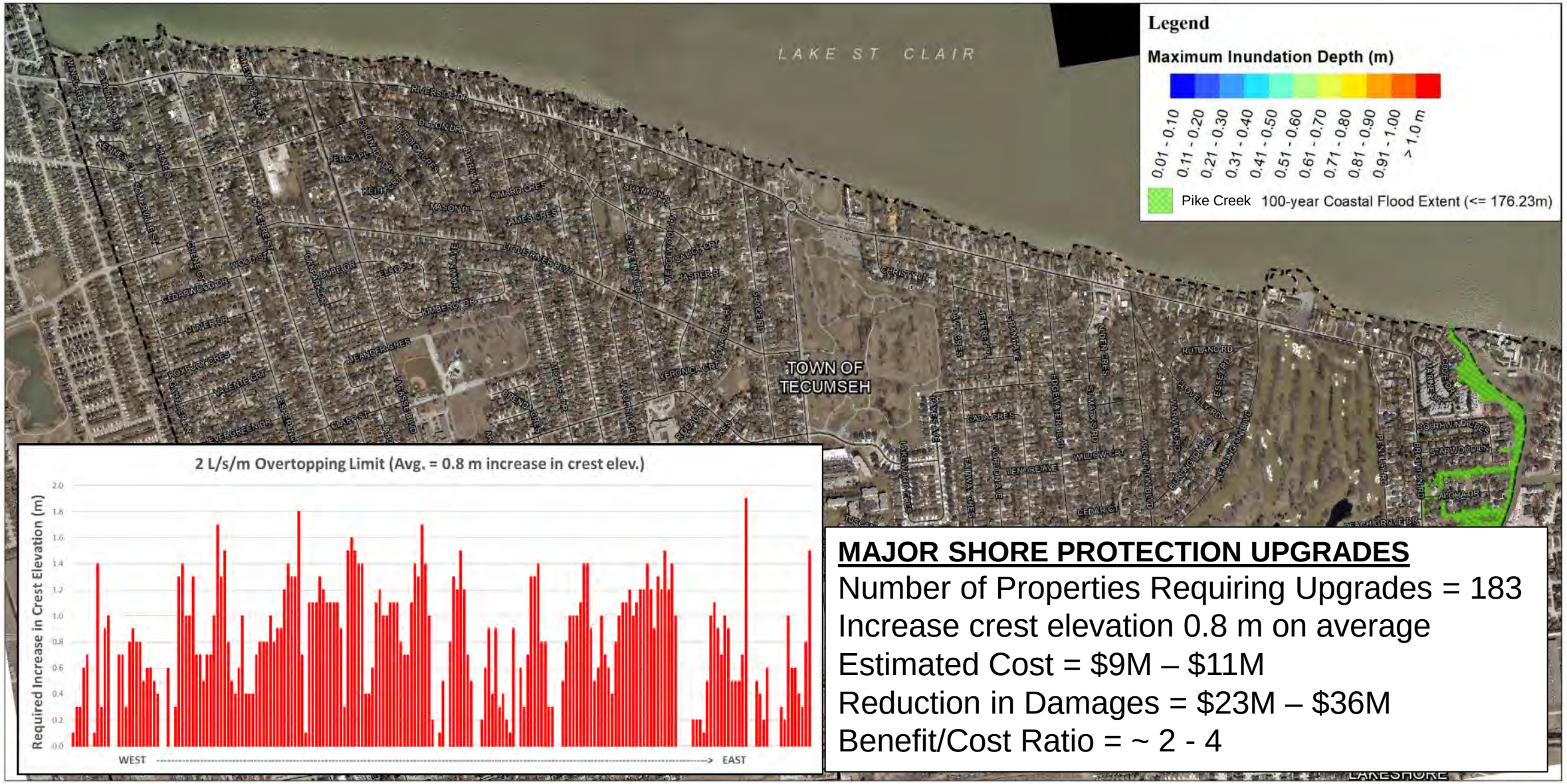

MAJOR SHORE PROTECTION UPGRADES

Number of Properties Requiring Upgrades = 183
Increase crest elevation 0.8 m on average
Estimated Cost = $9M – $11M
Reduction in Damages = $23M – $36M
Benefit/Cost Ratio = ~ 2 - 4

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Scenario F
100-year Coastal Flood
Shore Protection Upgraded to Limit Overtopping to 2 L/s/m
Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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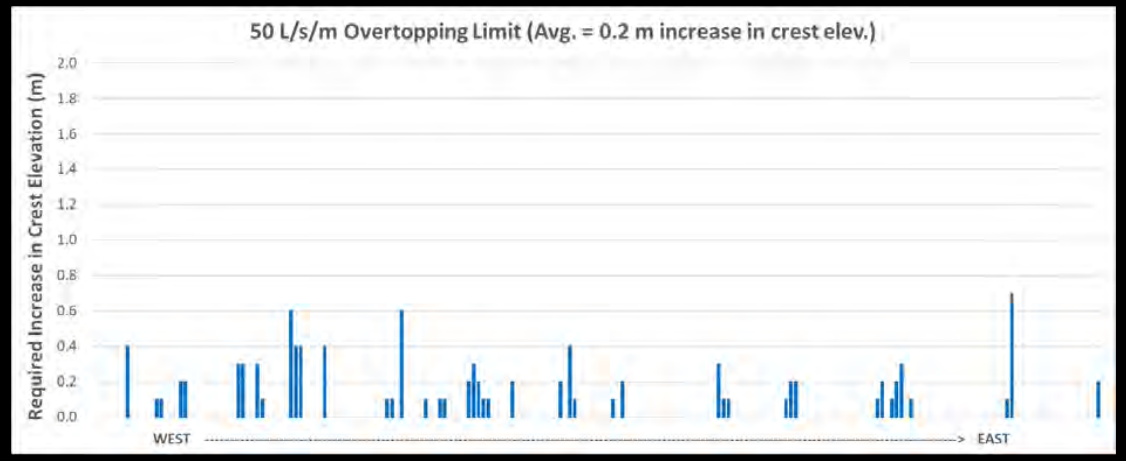
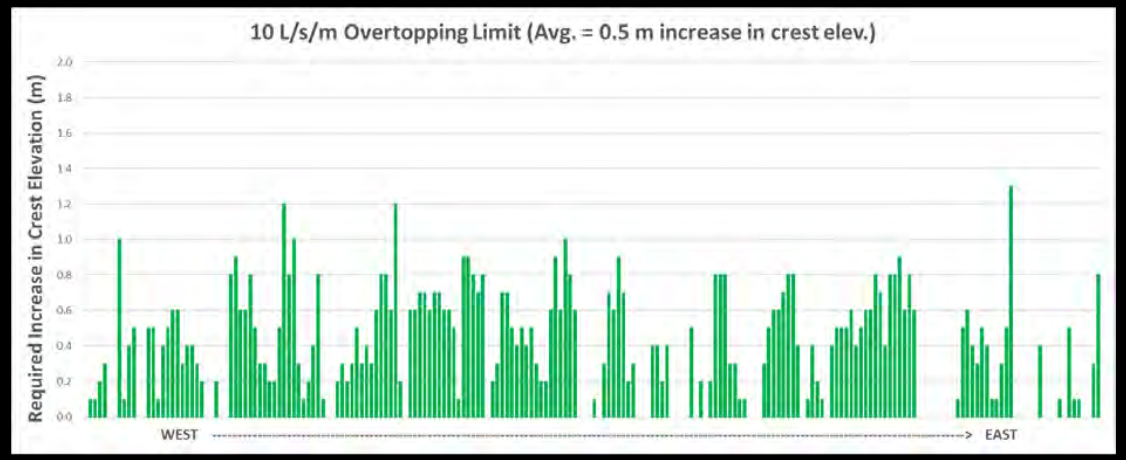
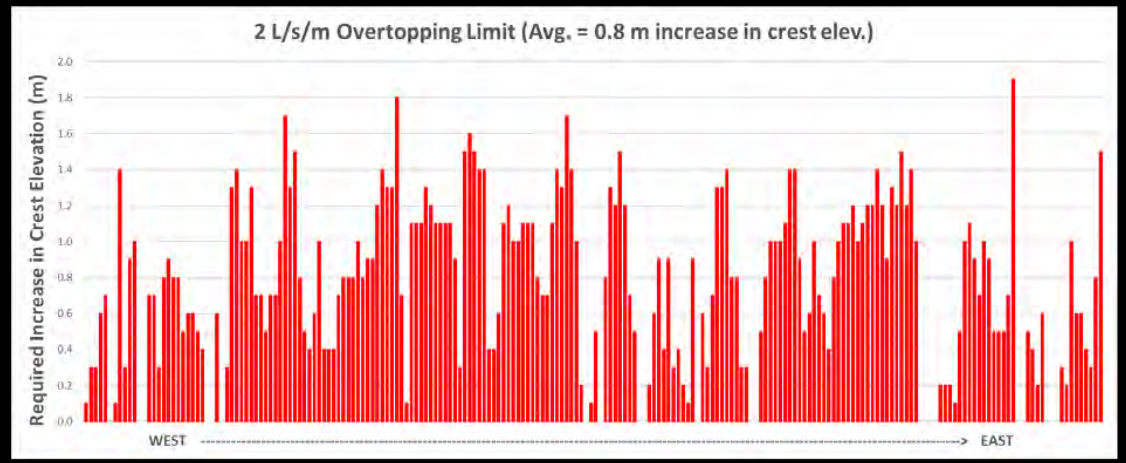
SUMMARY (100-YEAR EVENT)







Minor Shore Protection Upgrades

Number of Properties Requiring Upgrades = 27
Increase crest elevation 0.2 m on average
Estimated Cost = ~1M
Reduction in Damages = $5M – $7M
Benefit/Cost Ratio = 5 - 7

Moderate Shore Protection Upgrades

Number of Properties Requiring Upgrades = 143
Increase crest elevation 0.5 m on average
Estimated Cost = $6M – $7M
Reduction in Damages = $21M – $32M
Benefit/Cost Ratio = ~ 3 - 5

Major Shore Protection Upgrades

Number of Properties Requiring Upgrades = 183
Increase crest elevation 0.8 m on average
Estimated Cost = $9M – $11M
Reduction in Damages = $23M – $36M
Benefit/Cost Ratio = ~ 2 - 4

FLOOD BARRIER FOR RIVERSIDE DRIVE AND A SMALL PORTION OF BRIGHTON ROAD

Continuous barrier along Riverside Drive and a portion of Brighton Road
Estimated Cost = not calculated
Reduction in Damages = $15M – $24M
Benefit/Cost Ratio = no calculated

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Scenario L
100-year Coastal Flood with No Rain
Hypothetical Riverside Drive Flood Barrier
Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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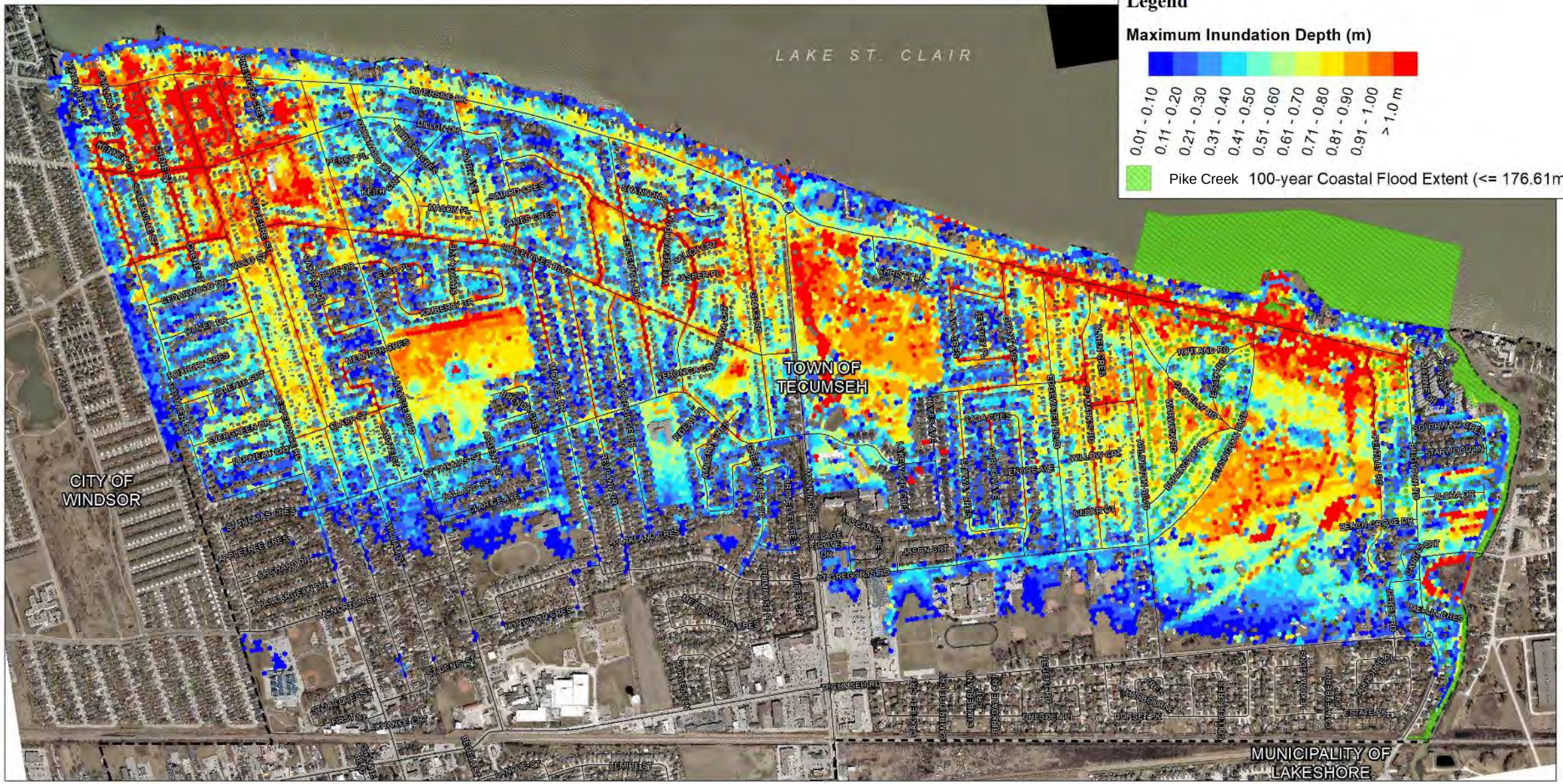

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Scenario C
100-year Climate Change Coastal Flood with No Rain

Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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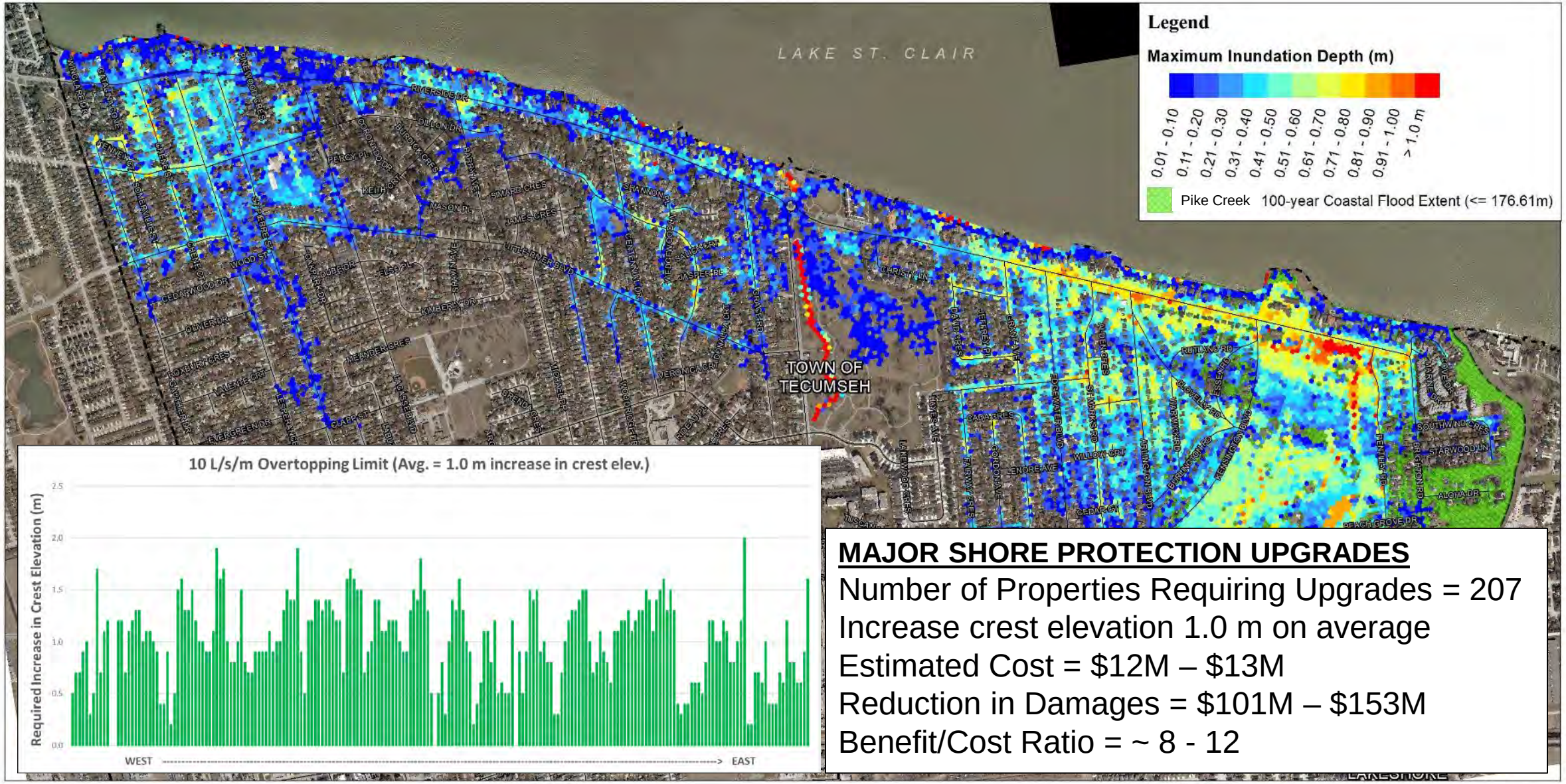

MAJOR SHORE PROTECTION UPGRADES

Number of Properties Requiring Upgrades = 207
Increase crest elevation 1.0 m on average
Estimated Cost = $12M – $13M
Reduction in Damages = $101M – $153M
Benefit/Cost Ratio = ~ 8 - 12

Zuzek inc.
ONE WORLD
www.zuzekinc.com

Scenario J
100-year Climate Change Coastal Flood with No Rain
Shore Protection Upgraded to Limit Overtopping to 10 L/s/m
Town of Tecumseh

Notes:
1) Wave overtopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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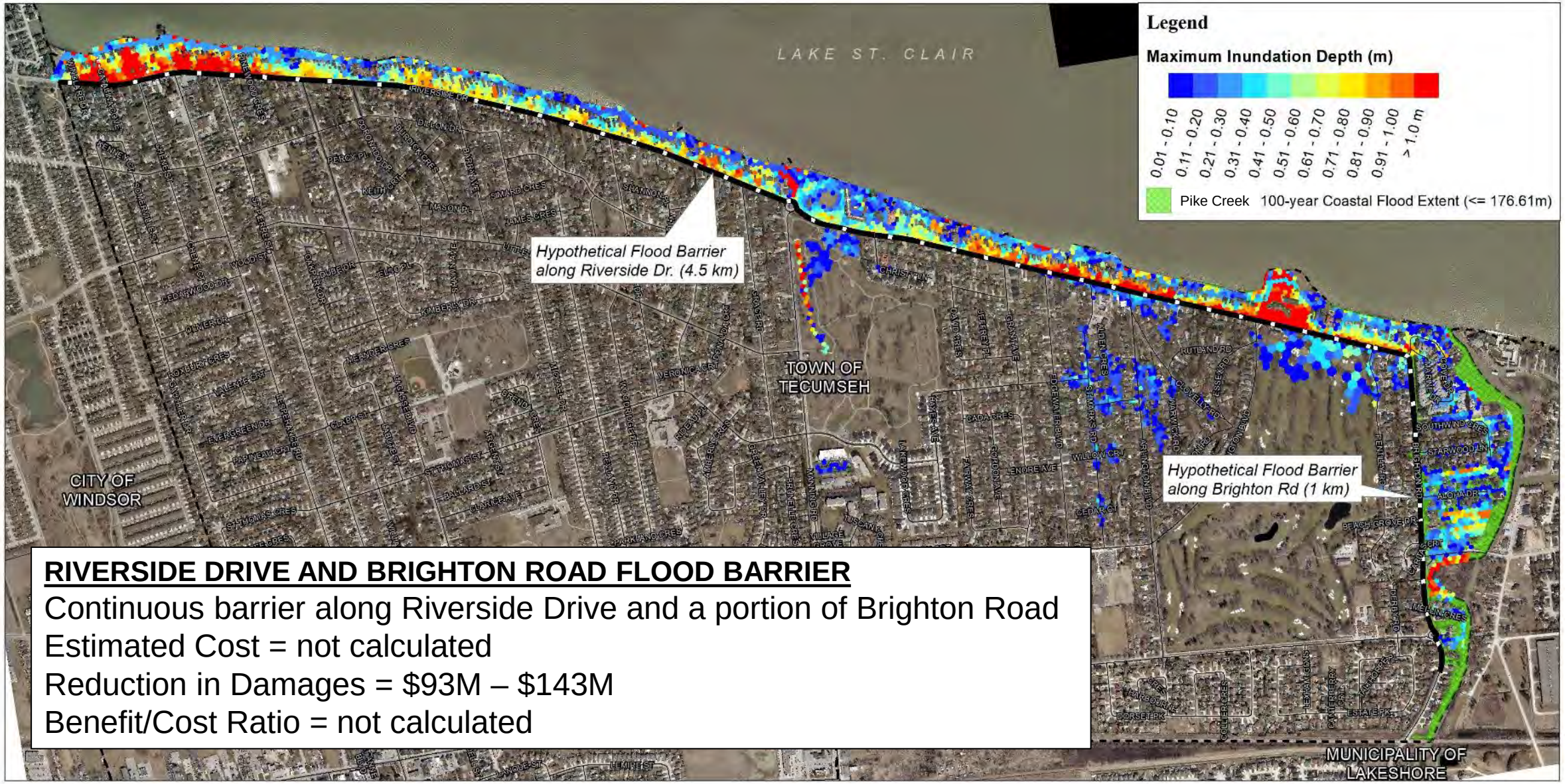

RIVERSIDE DRIVE AND BRIGHTON ROAD FLOOD BARRIER

Continuous barrier along Riverside Drive and a portion of Brighton Road
Estimated Cost = not calculated
Reduction in Damages = $93M – $143M
Benefit/Cost Ratio = not calculated

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Scenario M
100-year Climate Change Coastal Flood with No Rain
Hypothetical Riverside Drive Flood Barrier
Town of Tecumseh

Notes:
1) Wave overlopping calculations by SJL Engineering
2) Pike River flood analysis by Zuzek Inc.
3) Interior flood modelling by Dillon Consulting
4) 2019 aerial provided by the County of Essex

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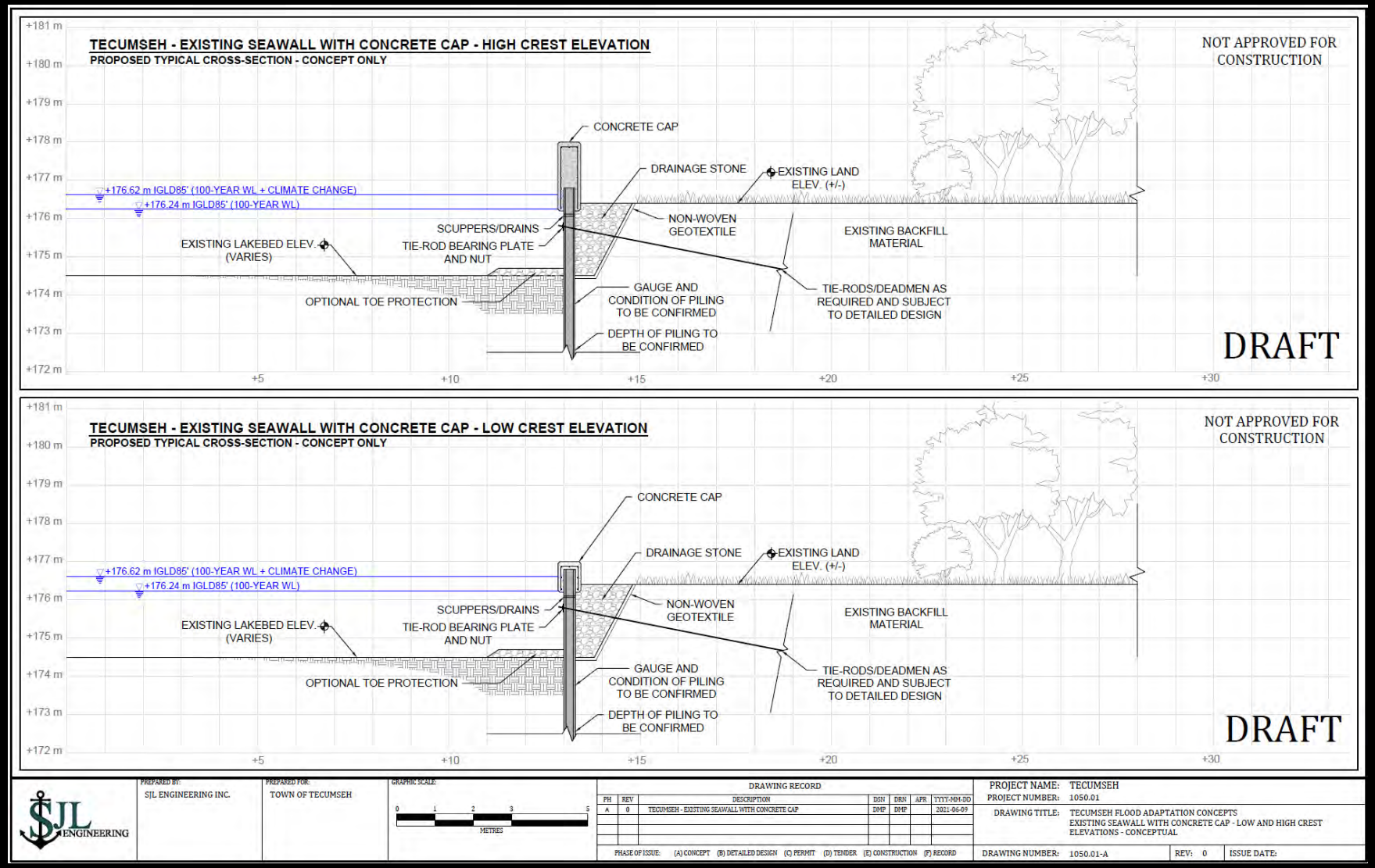
COMPARISON OF SHORE PROTECTION REQUIREMENTS FOR 100-year STORM WITH AND WTHOUT CC

To achieve 10 L/s/m overtopping target:	100-year Coastal Storm (Scenario A)	100-year Climate Change Coastal Storm (Scenario C)
Number of properties requiring upgrades	143	207
Average increase in crest elevation required	0.5 m	1.0 m
Estimated construction cost	$6M - $7M	$12M - $13M
Reduction in overland flooding damages	$21M - $32M	$101M - $153M
Benefit/Cost ratio	~ 3 - 5	~ 8 - 12

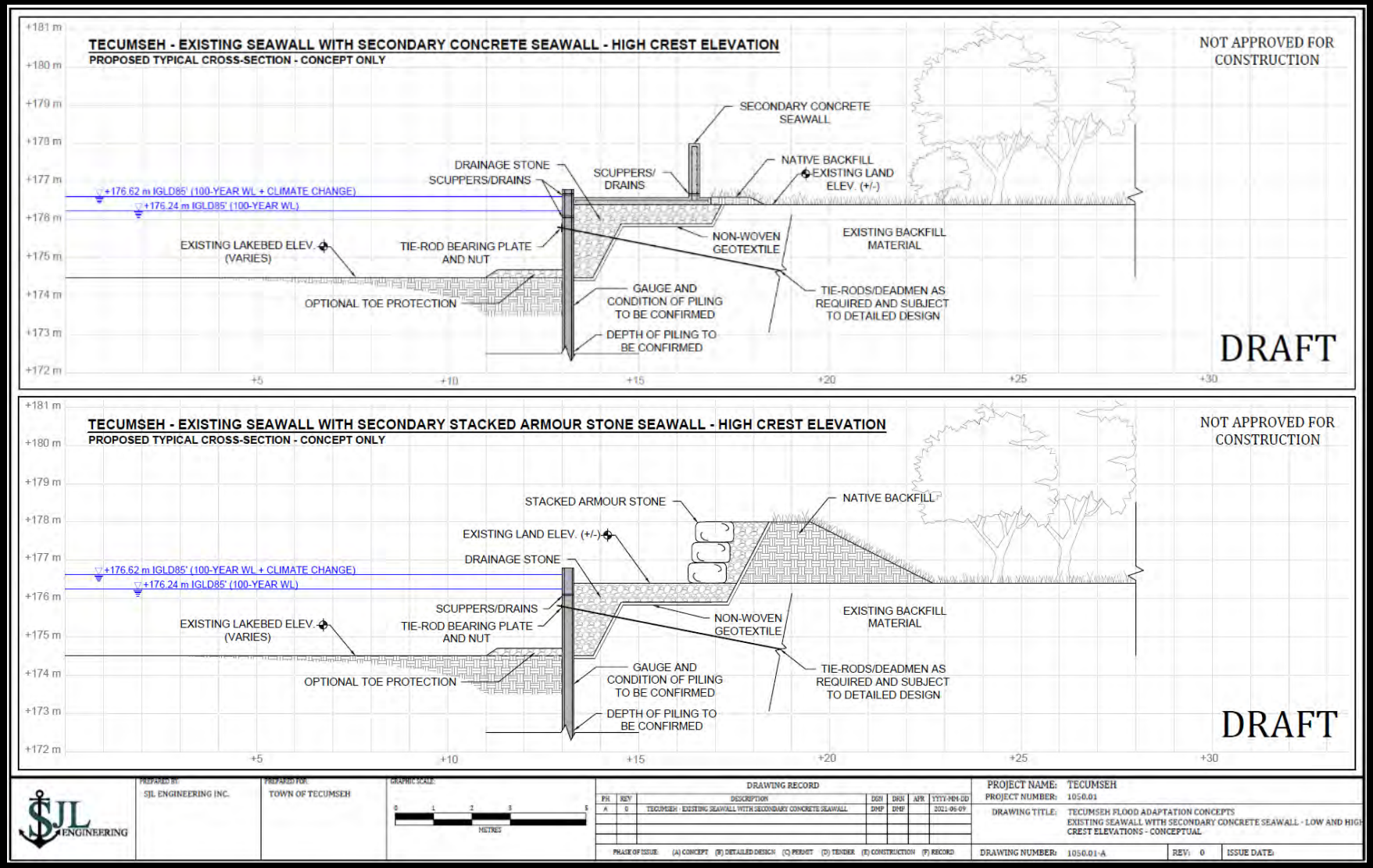
PROTECTION STRATEGIES ASSUMED IN COSTING

Increase crest elevation of vertical wall:



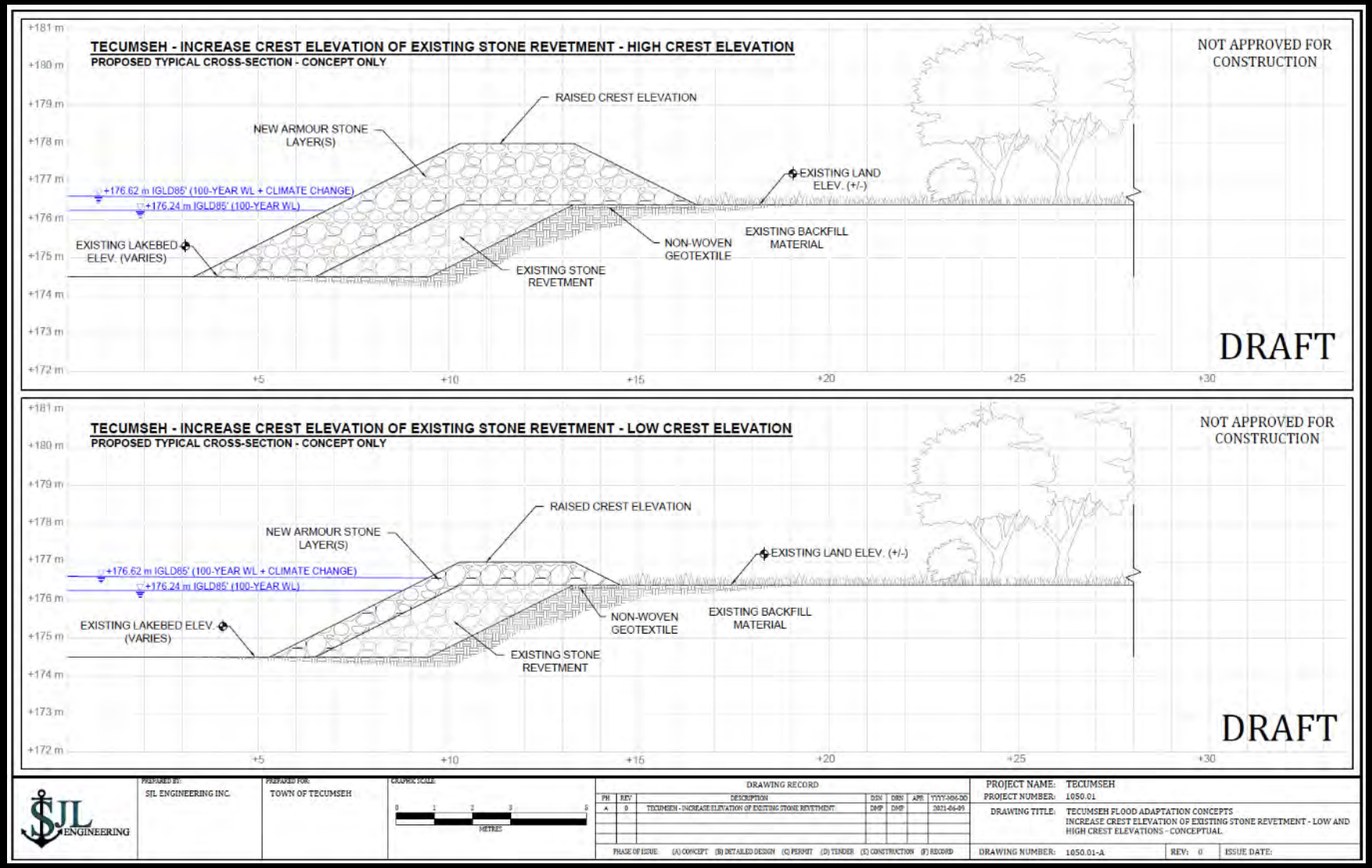
PROTECTION STRATEGIES ASSUMED IN COSTING

Increase crest elevation of vertical wall:



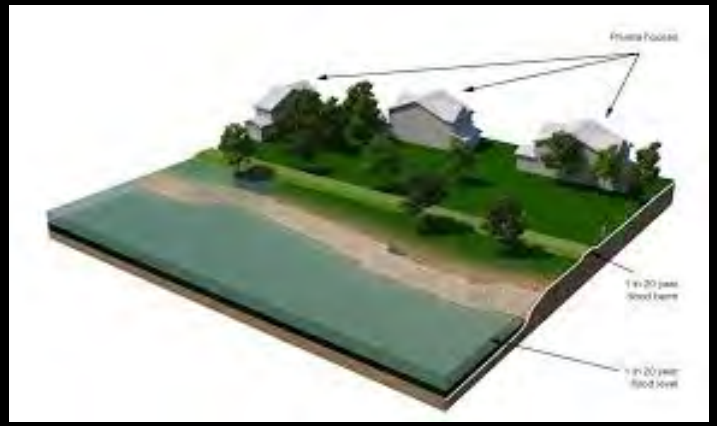
PROTECTION STRATEGIES ASSUMED IN COSTING

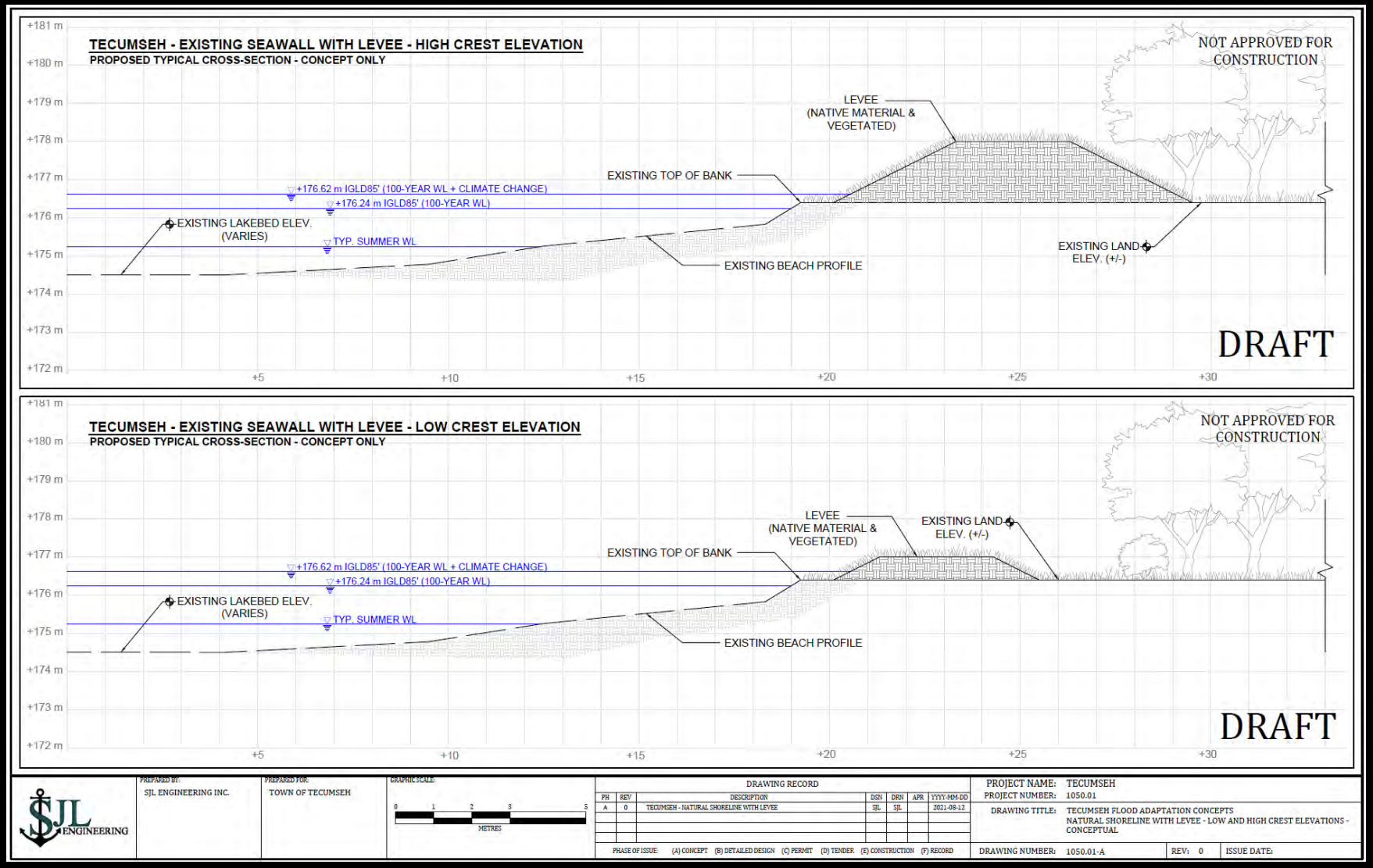
Increase crest elevation of sloping stone revetment:



PROTECTION STRATEGIES ASSUMED IN COSTING

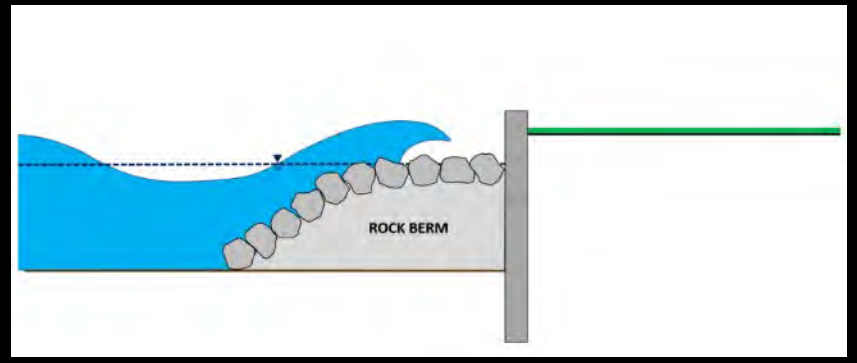
Increase crest elevation of natural shoreline:



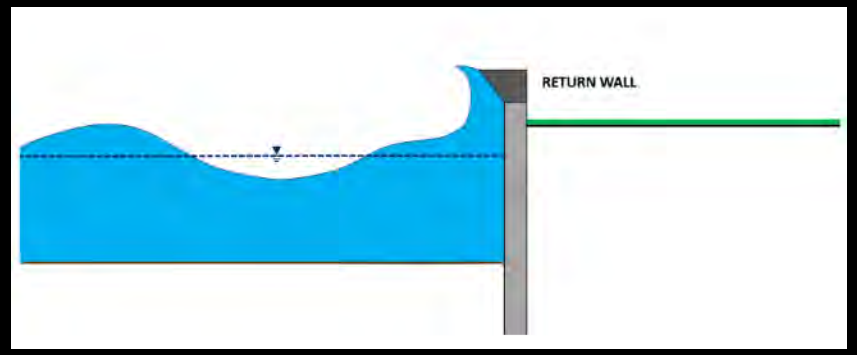


OTHER WAYS TO REDUCE OVERTOPPING

- Shore protection upgrades to mitigate overtopping / flooding should be evaluated on a site-specific basis by a qualified professional
- Other strategies may be possible to mitigate overtopping beyond simply raising crest elevations:

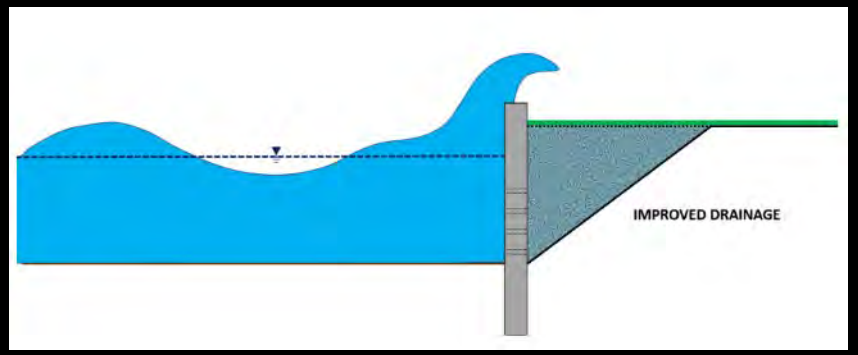


Rock berm / cobble beach

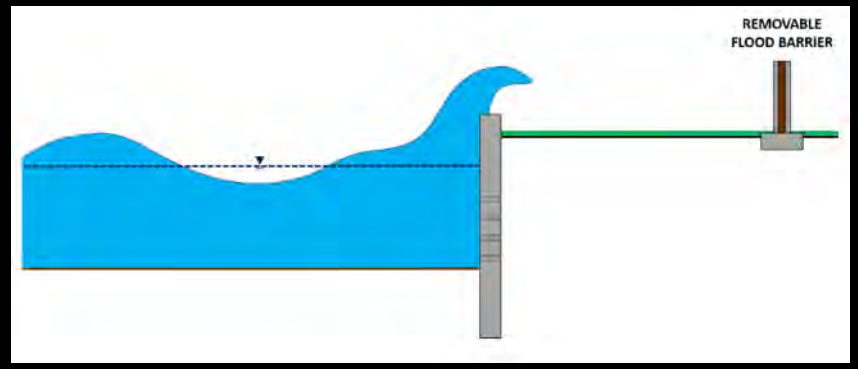


Return / re-curved / parapet walls

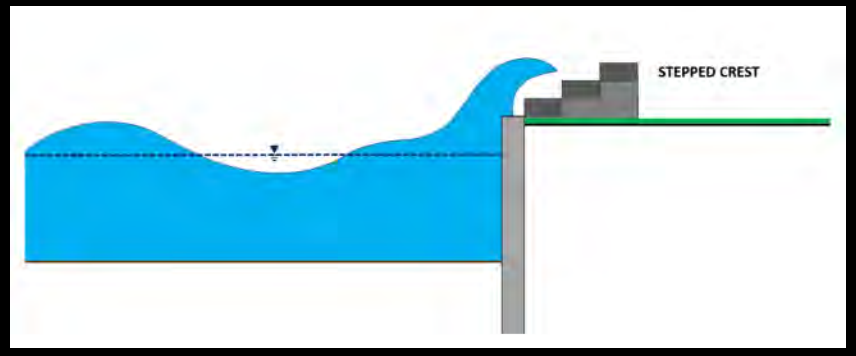
OTHER WAYS TO REDUCE OVERTOPPING



Improved drainage



Removable flood barriers



Stepped Wall

Summary of Damages, Mitigation Strategies and Benefit-Cost Analysis

- There is extensive coastal flooding risk in Tecumseh due to overland flow, basement flooding due to sewer surcharge, and emergency access limitations
- Reducing wave overtopping by raising the crest elevation of existing shoreline protection is the easiest way to reduce coastal flood risk and potential economic damages
- Other engineering solutions to reduce overtopping exist (e.g. rock berm), but should be evaluated on a site specific basis

- The benefit-cost ratios generated for the alternatives were all significantly greater than 1.0, even without including potential basement flooding damage from sewer surcharging (>1.0 is the cut-off for an economically viable mitigation project)
- Further studies are warranted

QUESTION AND ANSWER PERIOD ON THE PRESENTATION

INTERACTIVE DISCUSSION WITH THE PARTICIPANTS

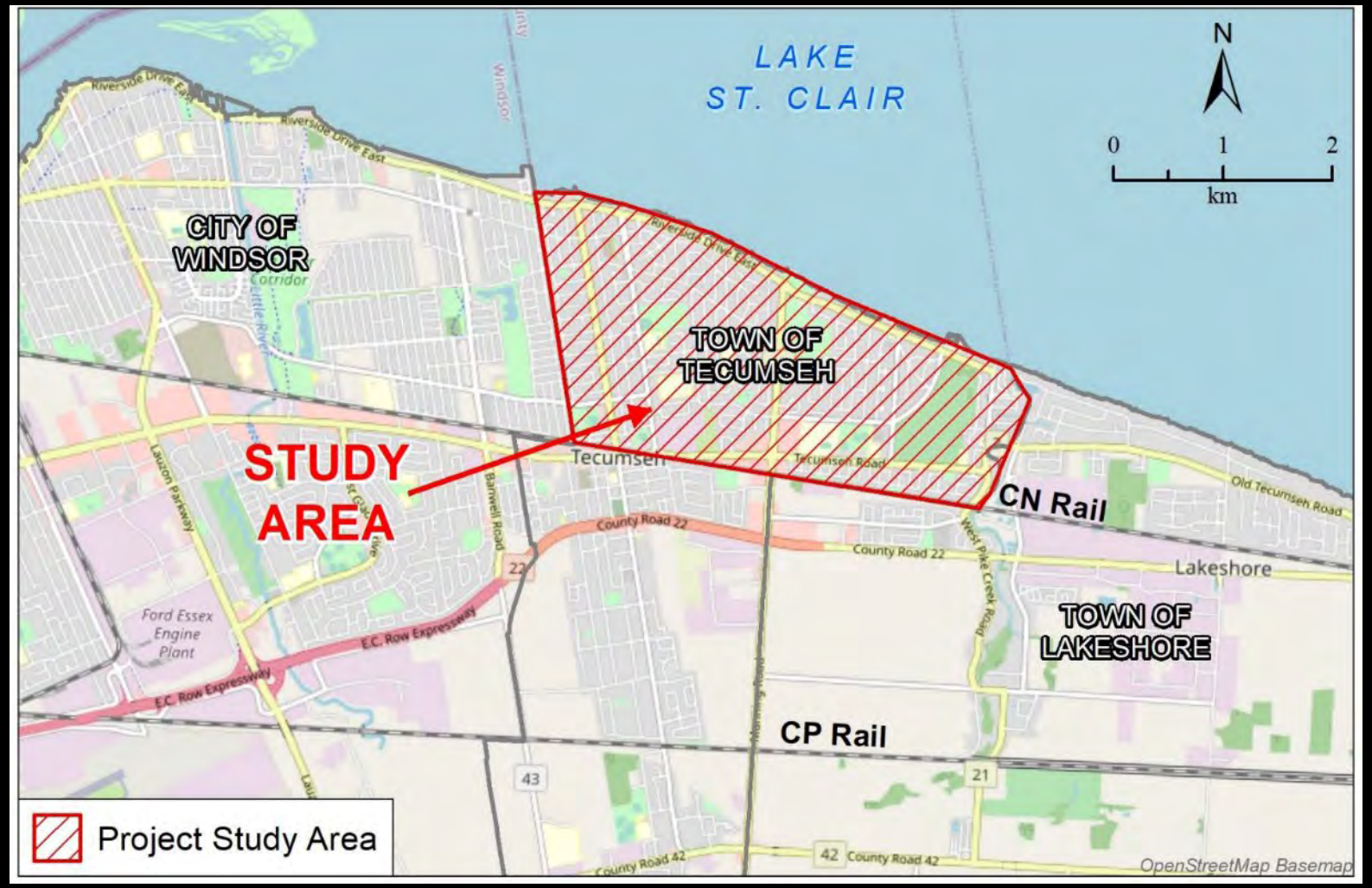
POLL QUESTION #1

Where do you live?

a) Own or rent north of Riverside Drive

b) Own or rent south of Riverside Drive

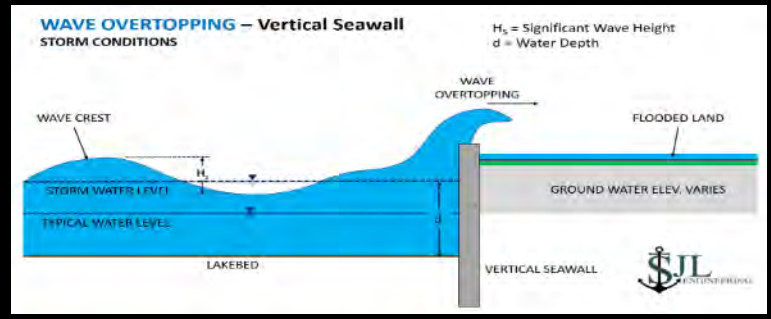
c) Other



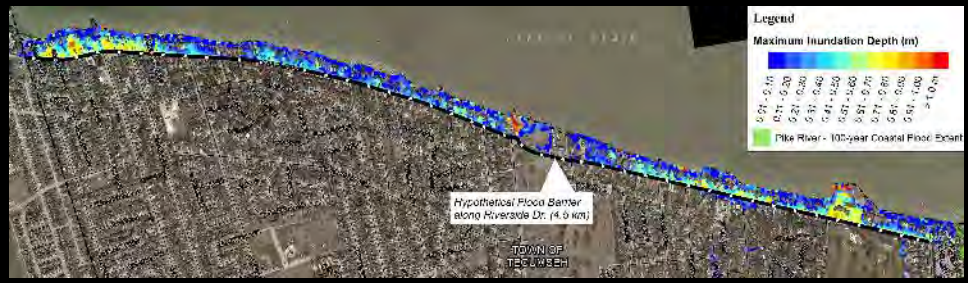
POLL QUESTION #2

What is your preferred long-term approach to reduce the coastal flood risk in Tecumseh?

a) A community scale program to upgrade the existing shoreline protection



b) A flood barrier along Riverside Drive and Brighton Road



c) Other

POLL QUESTION #3

Should the Town of Tecumseh and the Residents continue with further studies to select, design, and implement a community scale long-term coastal flood mitigation strategy?

a) Yes
b) No
c) Unsure

POLL QUESTION #4

For the Lakefront landowners, would you be willing to participate in a shoreline protection upgrade program that standardizes criteria and approaches to reduce coastal flooding for the Tecumseh lakefront?

a) Yes
b) No
c) Unsure

NEXT STEPS

- Receive and integrate feedback from PIC#3
- Complete draft flood risk assessment report
- Presentation to Tecumseh Council
- Final Report

COMMENT SHEET

www.tecumseh.ca\shorelinemanagementplan