WELCOME

EAST RIVERSIDE FLOOD RISK ASSESSMENT

Open House Information

- Information presented here today will also be available online for public review on the City of Windsor's Website (www.citywindsor.ca)
- The Project Team members present will be pleased to discuss any questions you may have.
- Public input is welcome. Comment sheets are available if you wish to provide feedback on the project.

Project Team

This project has been initiated by the City of Windsor. Landmark Engineers Inc. has been retained by the City to serve as the Lead Consultant on the project.

Any comments, questions or suggestions relevant to this study should be directed to the following primary members of the Project Team:

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Location Map

West of Little River

East of Little River

BACKGROUND INFORMATION

Project Background

The City of Windsor recently received funding approval to undertake a flood risk assessment for the study area along Riverside Drive East and inland, from St. Rose Beach easterly to the City limit with the Town of Tecumseh. This area of Riverside and East Riverside has historically been protected by a dike system that was constructed along the Ganatchio Trail in the 1980s. The flood risk assessment is intended to evaluate the integrity of the existing dike system and to determine whether the original design criteria apply to current and future flood levels.

The City of Windsor retained Landmark Engineers Inc. in the fall of 2018 to undertake a flood risk assessment study for the East Riverside area.

HIGH WATER LEVELS ALONG LITTLE RIVER (LOOKING NORTH)

Project Objectives

This flood risk assessment is aimed at achieving the following objectives:

- Documenting the extents and the condition of the existing dike system along Riverside Drive and inland;
- Assessing the integrity of the dike system (both above and below ground) along its entire length;
- Identifying and assessing the flood risk within the study area under various scenarios, and;
- Identifying alternative solutions for the restoration and / or enhancement of the existing flood protection measures within the study area.

This study does not include any review of the existing dike system along Little River, nor does it include the study of the stormwater drainage system for the area. These items are being studied separately, but in coordination with each other.

GANATCHIO TRAIL BERM (LOOKING EAST)

TYPICAL EXISTING EARTH BERM (LOOKING EAST)

Purpose of the Open House

The purpose of this Open House is to present the findings of the study to the Public. This study is not intended to present detailed design solutions for each property, but rather to identify the areas of the dike system that need improvements. Typical solutions, illustrating what may be implemented for each area are also presented.

Residents of the study area are encouraged to locate their homes and / or business on the proceeding maps in order to assess how the proposed alternatives may impact their property.

EXISTING EARTH BERM AT ST. ROSE BEACH (LOOKING WEST)

THE CITY OF WINDSOR ONTARIO, CANADA

Landmark Engineers Inc.

1:100 Year Instantaneous Water Level Analysis

The criteria for the design of flood protection along Riverside Drive and the Ganatchio Trail is based primarily on the 1:100-year instantaneous water level on Lake St. Clair.

When the existing diking system was originally established in the 1980s, the 1:100-year instantaneous water level was calculated to be at an elevation of 176.4m based on a statistical analysis of the historical water levels recorded on Lake St. Clair.

Since more than 30 years have passed since the completion of the original study, Landmark retained the climate and environmental consulting firm RWDI to re-evaluate the 1:100-year instantaneous water level, based on the expanded data set. RWDI also reviewed the available climate change projections for the Great Lakes Region and their effect on the 1:100-year instantaneous water level elevations for the years 2030 and 2050.

A copy of the RWDI report is available for review upon request.

RWDI's Findings for the 1:100-Year Instantaneous Water Level Elevations:

Timeline	Elevation	Difference
Original Dike Design (1986)	176.4m	---
Current Conditions (2019)	176.5m	0.1m (4")
2030 (Projected based on Climate Change model)	176.6m	0.2m (8")
2050 (Projected based on Climate Change model)	176.8m	0.4m (16")

Based on the updated water level elevations determined by RWDI, the projected future 1:100-year instantaneous water levels will be up to 0.4m (approx. 16") higher that the currently used elevation of 176.4m.

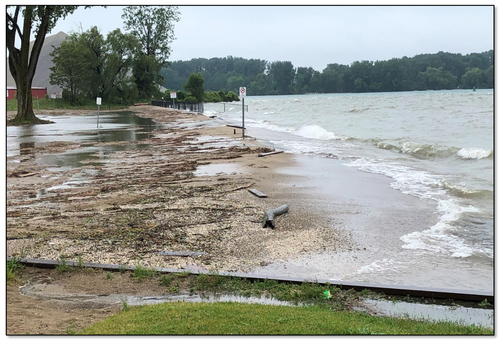
Existing Dike Conditions

Landmark Engineers has surveyed and assessed the top elevation / condition of the existing dike system along Riverside Drive and the Ganatchio Trail. Our findings are presented in the Table below:

Design Criteria	Designated Elevations	Percentage of Existing Dike System Above Designated Elevation	
		West of Little River	East of Little River
Original Dike Design (1986)	176.4m (Flood Level)	39.2%	99.1%
	176.7m (Flood Level plus 0.3m freeboard)	15.4%	52.5%
Current Conditions (2019)	176.5m (Flood Level)	31.9%	98.6%
	176.8m (Flood Level plus 0.3m freeboard)	12.7%	37.1%
Projected Future Conditions (2050)	176.8m (Flood Level)	12.7%	37.1%
	177.1m (Flood Level plus 0.3m freeboard)	0.8%	3.4%

Based on the above, it is clear that significant upgrades to the existing dike system are needed.

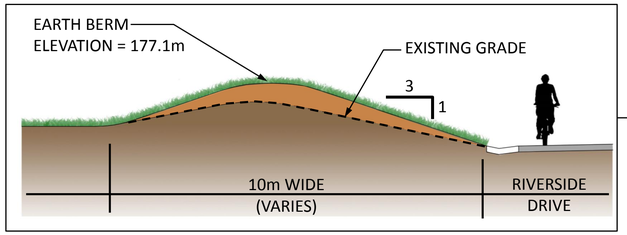
LAKEVIEW MARINA (20 JUNE 2019)



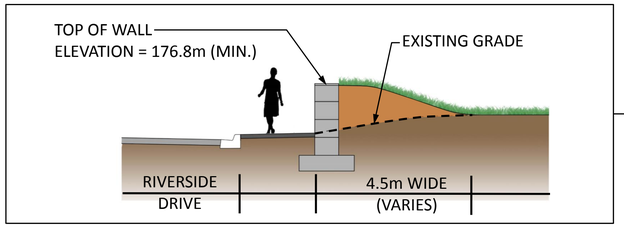
SAND POINT BEACH (16 JUNE 2019)

SHANFIELD SHORES PARK (16 JUNE 2019)

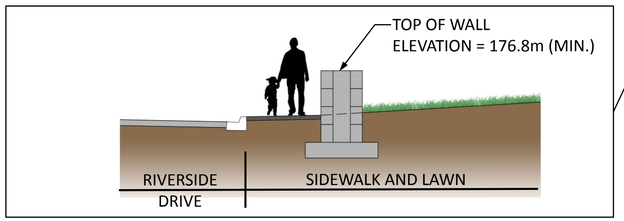
ALTERNATIVES – TYPICAL SECTIONS



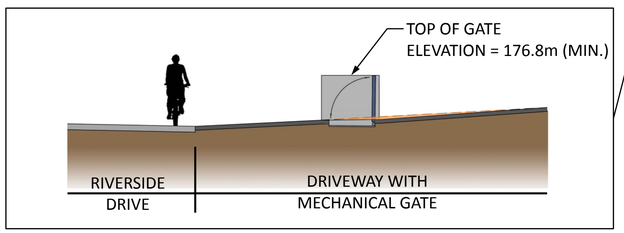
ALTERNATIVE 1 - EARTH BERM



ALTERNATIVE 2 - WALL WITH EARTH BERM

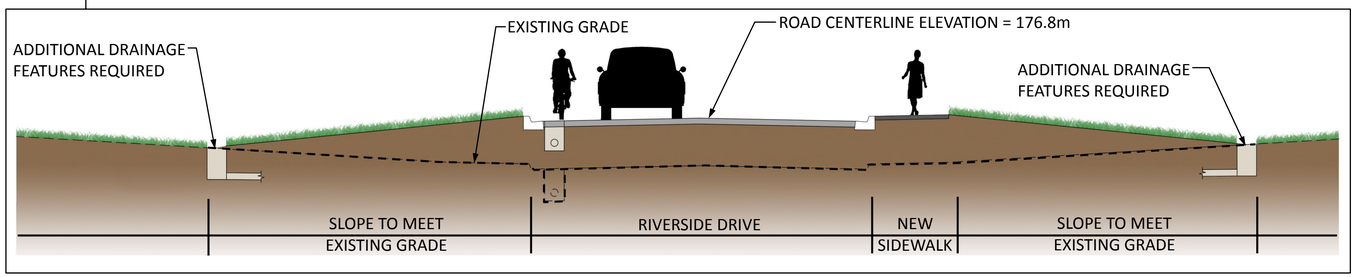


ALTERNATIVE 3 - WALL



ALTERNATIVE 4 - MECHANICAL GATE

Alternative	Opportunities / Advantages	Constraints / Disadvantages
1 **Earth Berm**	• Permanent feature • Low maintenance / low construction cost • Existing berm already in place along substantial portions of the dike system – requiring only minor upgrades • Opportunity to enhance features along the Ganatchio Trail (landscaping, benches, etc.)	• Requires substantial encroachment onto private properties • Will disrupt existing landscaping, trees and fences • May require property acquisition and / or landowner agreements • Steep slope for mowing (max at 3H:1V)
2 **Wall with Earth Berm**	• Permanent structure • Low maintenance / moderate construction cost • Reduced footprint compared to Earth Berm • Increased privacy for property owners (from pedestrians and road) • Wall facing could incorporate designs / features to improve aesthetics	• Needs to be used in conjunction with mechanical gates at driveways • Installation may disrupt underground utilities • Steep slope for mowing (max at 3H:1V) • May require property acquisition and / or landowner agreements
3 **Wall**	• Permanent structure • Low maintenance / moderate construction costs • Potential to substitute for existing fence at property line • Minimal space required for installation • Wall facing could incorporate designs / features to improve aesthetics	• Needs to be used in conjunction with mechanical gates at driveways • High construction cost • Installation may disrupt underground utilities • May disrupt existing landscaping
4 **Mechanical Gate**	• Can be installed in areas constrained for space • Maintains accessibility to protected properties	• Not a permanent fixed structure / potential for failure if not maintained • High construction and maintenance costs • Installation may disrupt underground utilities • Can only be used for short opening such as driveways • When gate is deployed, vehicle access to property is not available • Regular inspections and maintenance required
5 **Raise Riverside Drive**	• Permanent structure • Less impact on adjacent properties and landscaping • Could be reconstructed within road allowance (in some areas) • Reduced need for property acquisition and landowner agreements	• Highest associated cost • Utilities and drainage within the right-of-way will be affected • This option is not feasible where homes are close to the roadway • Will require alterations to front yards and driveways • Additional front yard drainage will be required



ALTERNATIVE 5 - RAISE RIVERSIDE DRIVE

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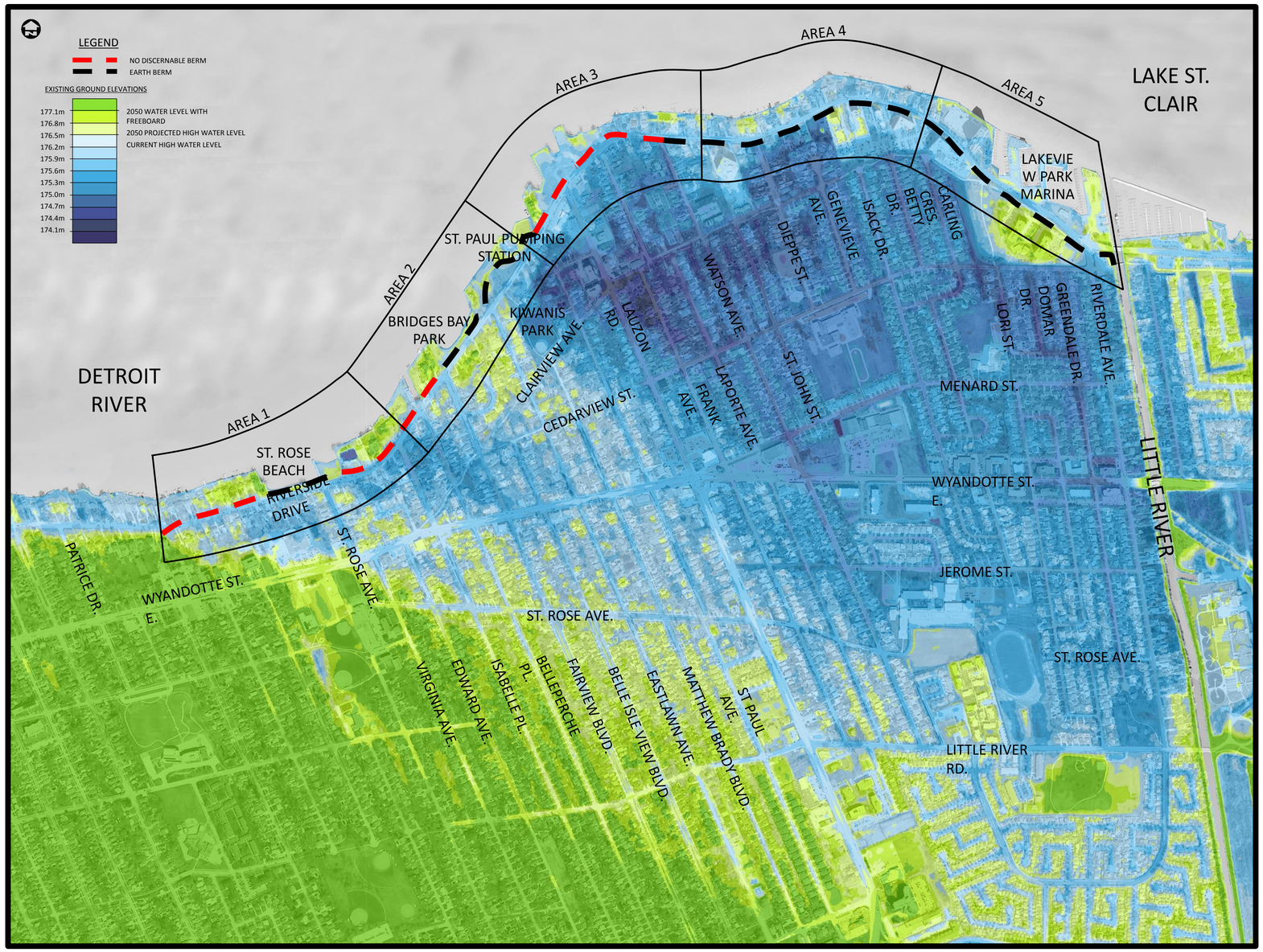
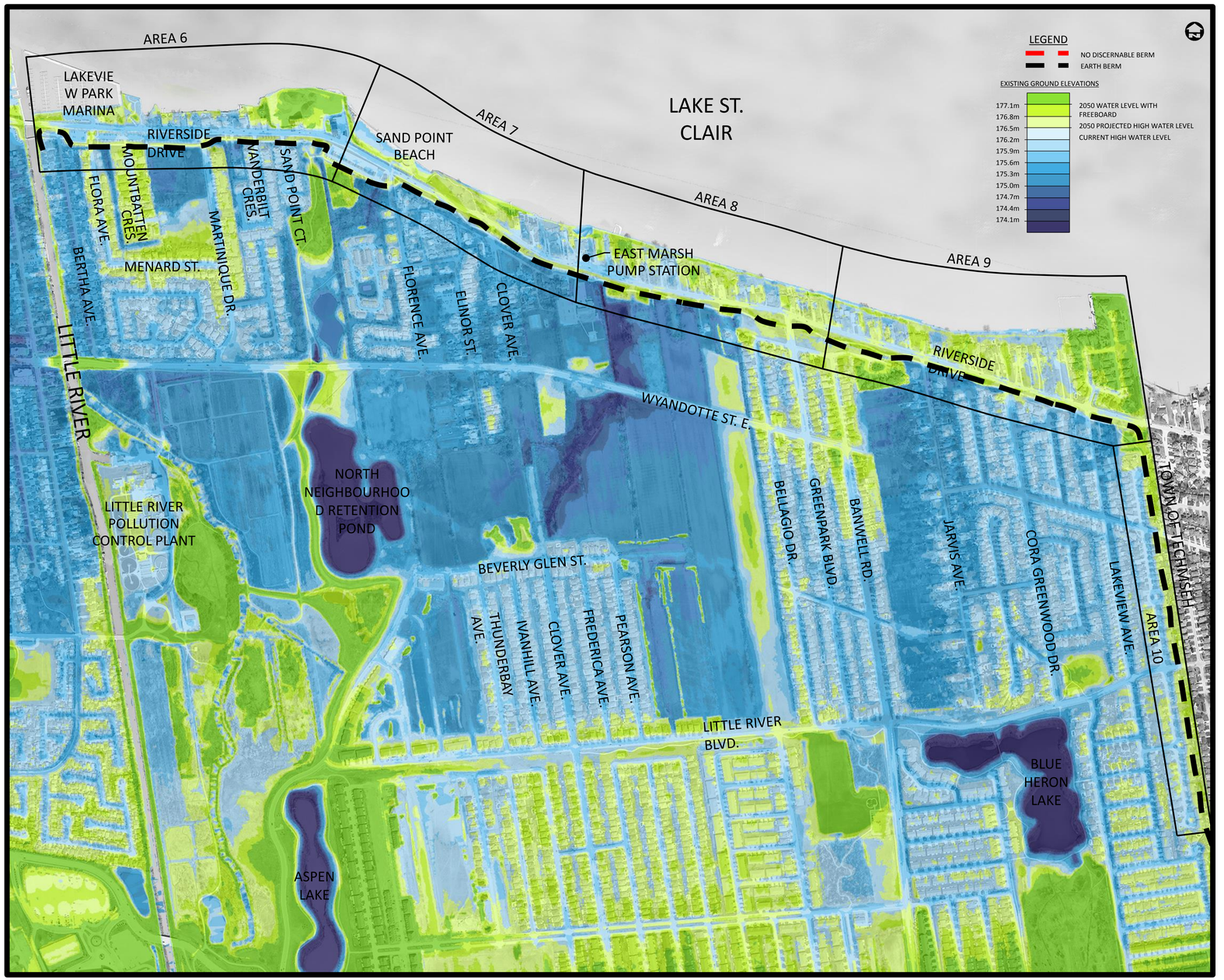
Landmark Engineers Inc.

EXISTING CONDITIONS – WEST OF LITTLE RIVER

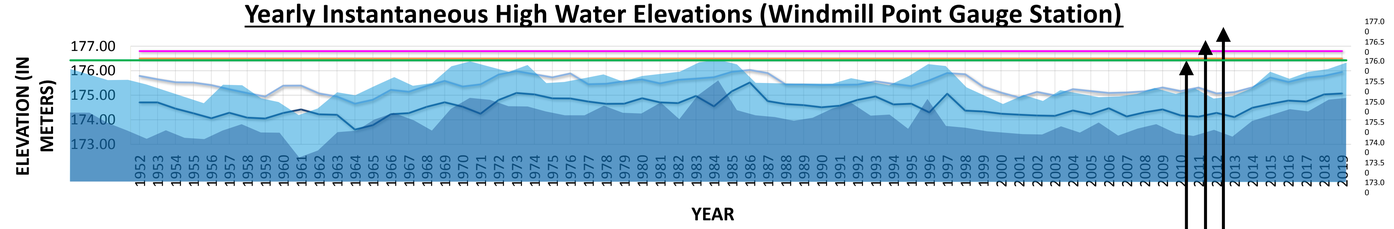


EXISTING CONDITIONS – EAST OF LITTLE RIVER



ANALYSIS – AREAS AFFECTED AT FLOOD LEVELS

The graph below presents the historical yearly instantaneous high and low water levels from 1952 – Present day.



LEGEND

- 176.8m (2050 1:100-YEAR INSTANTANEOUS WATER LEVEL)
- 176.5m (CURRENT 1:100-YEAR INSTANTANEOUS WATER LEVEL)
- CURRENT HIGH WATER LEVEL (176.0m)
- HISTORICAL YEARLY INSTANTANEOUS HIGH WATER LEVELS
- HISTORICAL YEARLY INSTANTANEOUS LOW WATER LEVELS

LEGEND

- AREA BELOW 176.0m
- AREA ABOVE 176.0m

The blue area represents the area of land that is below the current existing water level of 176.0m.

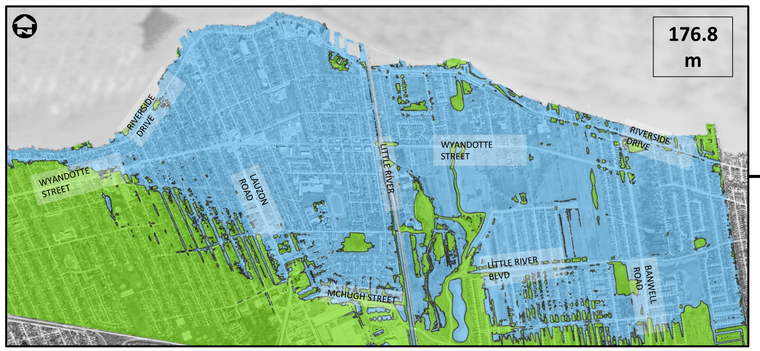
LEGEND

- AREA BELOW 176.5m
- AREA ABOVE 176.5m

The blue area represents the area of land that is below the current 1:100-year instantaneous water level of 176.5m.

LEGEND

- AREA BELOW 176.8m
- AREA ABOVE 176.8m



The blue area represents the area of land that is below the future 2050 1:100-year instantaneous water level of 176.8m.

THE CITY OF WINDSOR
ONTARIO, CANADA

Landmark Engineers Inc.

AREA 1

ST. ROSE BEACH AREA

EAST RIVERSIDE FLOOD RISK ASSESSMENT

- Residential area on both sides of Riverside Drive
- Generally low lying with some individual properties at higher elevations
- No discernable berm
- Modify berm with Alternatives 1, 3, 4, or 5

- St. Rose Park area north of Riverside Drive; Residential area south of Riverside Drive
- Outfall for drainage from St. Rose area
- Earth berm with discontinuity at pedestrian walkway crossing
- Modify berm with Alternatives 1 and 4

- Residential on both sides of Riverside Drive
- Generally low lying area
- Berm is non-discernable
- Modify berm with Alternatives 1, 3, 4, or 5

LEGEND

EXISTING BERM ALIGNMENT

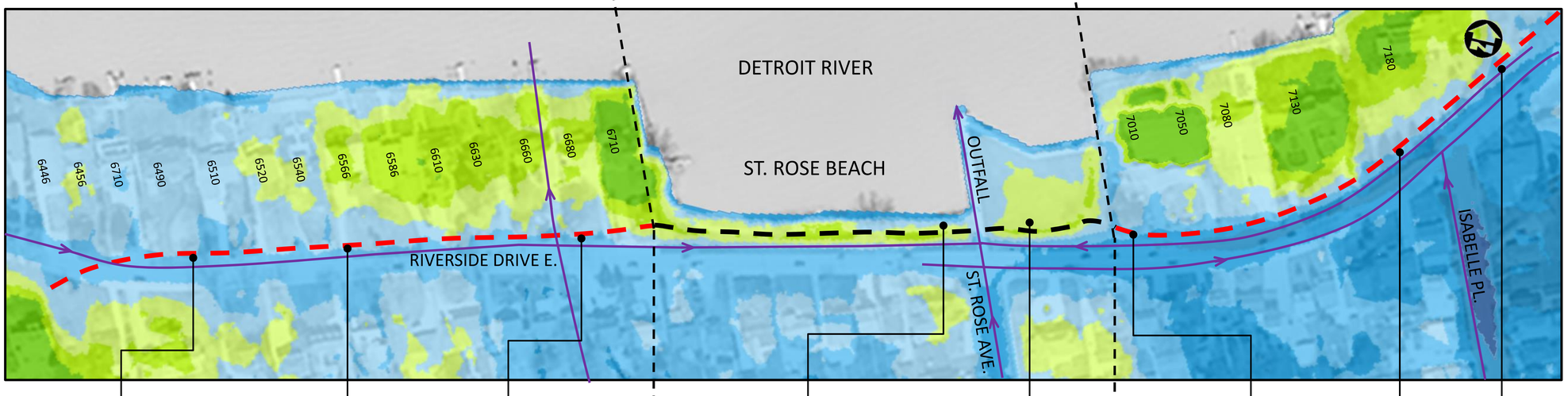
- NO DISCERNABLE BERM
- EARTH BERM

EXISTING DRAINAGE

- STORM SEWER
- CATCH BASIN

EXISTING GROUND ELEVATIONS

- 177.1m — 2050 WATER LEVEL WITH FREEBOARD
- 176.8m — 2050 PROJECTED HIGH WATER LEVEL
- 176.5m — CURRENT HIGH WATER LEVEL
- 176.2m
- 175.9m
- 175.6m
- 175.3m
- 175.0m
- 174.7m
- 174.4m
- 174.1m



LOOKING WEST

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AREA 2

BRIDGES BAY AREA

EAST RIVERSIDE FLOOD RISK ASSESSMENT

- Residential area on both sides of Riverside Drive
- Generally low lying with some individual properties at higher elevations
- No discernable berm
- Modify berm with Alternatives 1, 3, 4, or 5

- Bridges Bay Public park area north of Riverside Drive; Residential area south of Riverside Drive
- Continuous earth berm meets existing criteria
- Modify existing berm with Alternative 1

- Residential areas on both sides of Riverside Drive
- Generally low lying
- No discernable berm
- Modify berm with Alternatives 1, 3, 4, or 5

- St. Paul Pumping Station and Kiwanis Park area north of Riverside Drive; Residential area south of Riverside Drive
- Existing earth berm, generally continuous but with narrow / low points
- Modify existing berm with Alternative 1

LEGEND

EXISTING BERM ALIGNMENT

- NO DISCERNABLE BERM
- EARTH BERM

EXISTING DRAINAGE

- STORM SEWER
- CATCH BASIN

EXISTING GROUND ELEVATIONS

- 177.1m — 2050 WATER LEVEL WITH FREEBOARD
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- 176.2m
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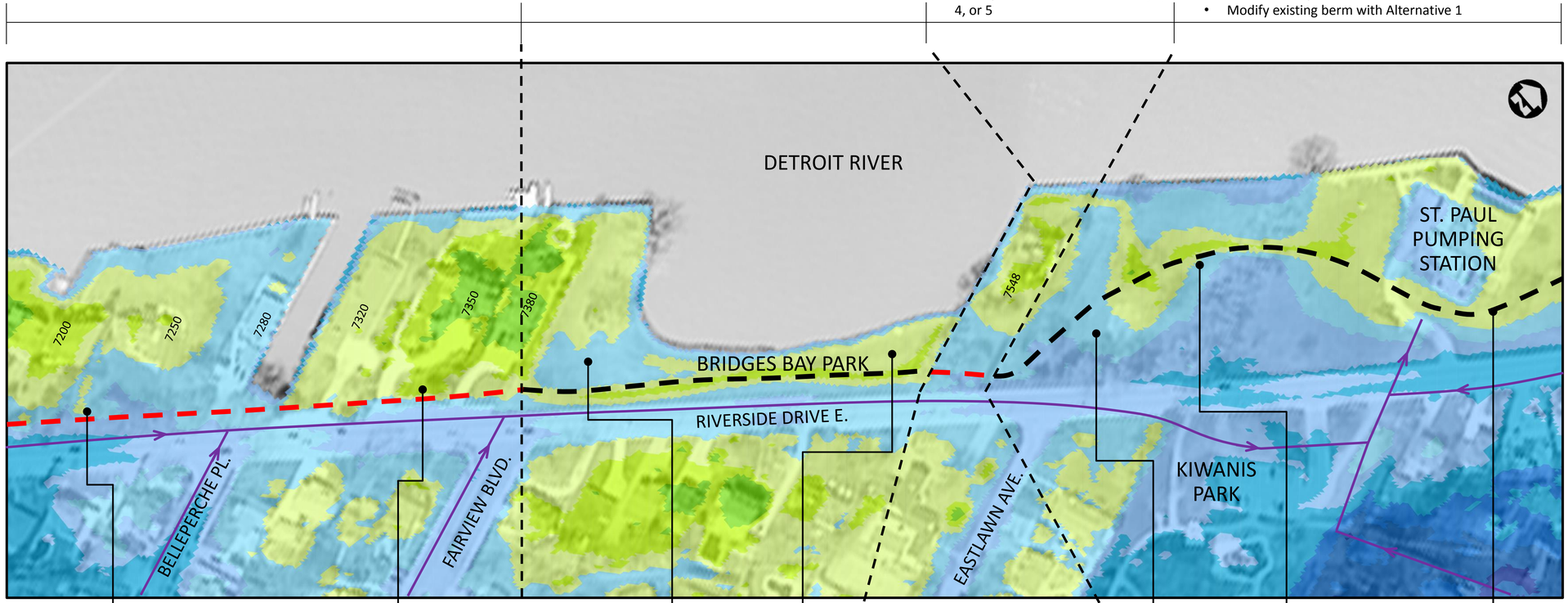
- 175.6m
- 175.3m
- 175.0m
- 174.7m
- 174.4m
- 174.1m




LOOKING EAST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LOOKING NORTH


LOOKING WEST

THE CITY OF WINDSOR ONTARIO, CANADA

Landmark Engineers Inc.

AREA 3

LAUZON AREA

EAST RIVERSIDE FLOOD RISK ASSESSMENT

- Kiwanis Park north of Riverside Drive
- Existing earth berm, generally continuous, but with narrow / low points
- Modify existing berm with Alternative 1

- Undeveloped area north of Riverside Drive; commercial and residential area south of Riverside Drive
- Generally low lying area with no discernable berm
- Modify berm with Alternatives 1, 3, 4, or 5

- Undeveloped area north of Riverside Drive; residential areas on both sides of Riverside Drive
- Generally low lying with no discernable berm
- Possible location for berm to cross Riverside Drive to maintain continuity
- Site-specific design solution required

- Residential area both sides of Riverside Drive
- Generally low lying with discontinuous berm
- Connected storm sewer on Watson - modify with sluice gate alternative
- Modify berm with Alternatives 1, 2, 3, 4

LEGEND

EXISTING BERM ALIGNMENT

- NO DISCERNABLE BERM
- EARTH BERM

EXISTING DRAINAGE

- STORM SEWER
- CATCH BASIN

EXISTING GROUND ELEVATIONS

- 177.1m — 2050 WATER LEVEL WITH FREEBOARD
- 176.8m — 2050 PROJECTED HIGH WATER LEVEL
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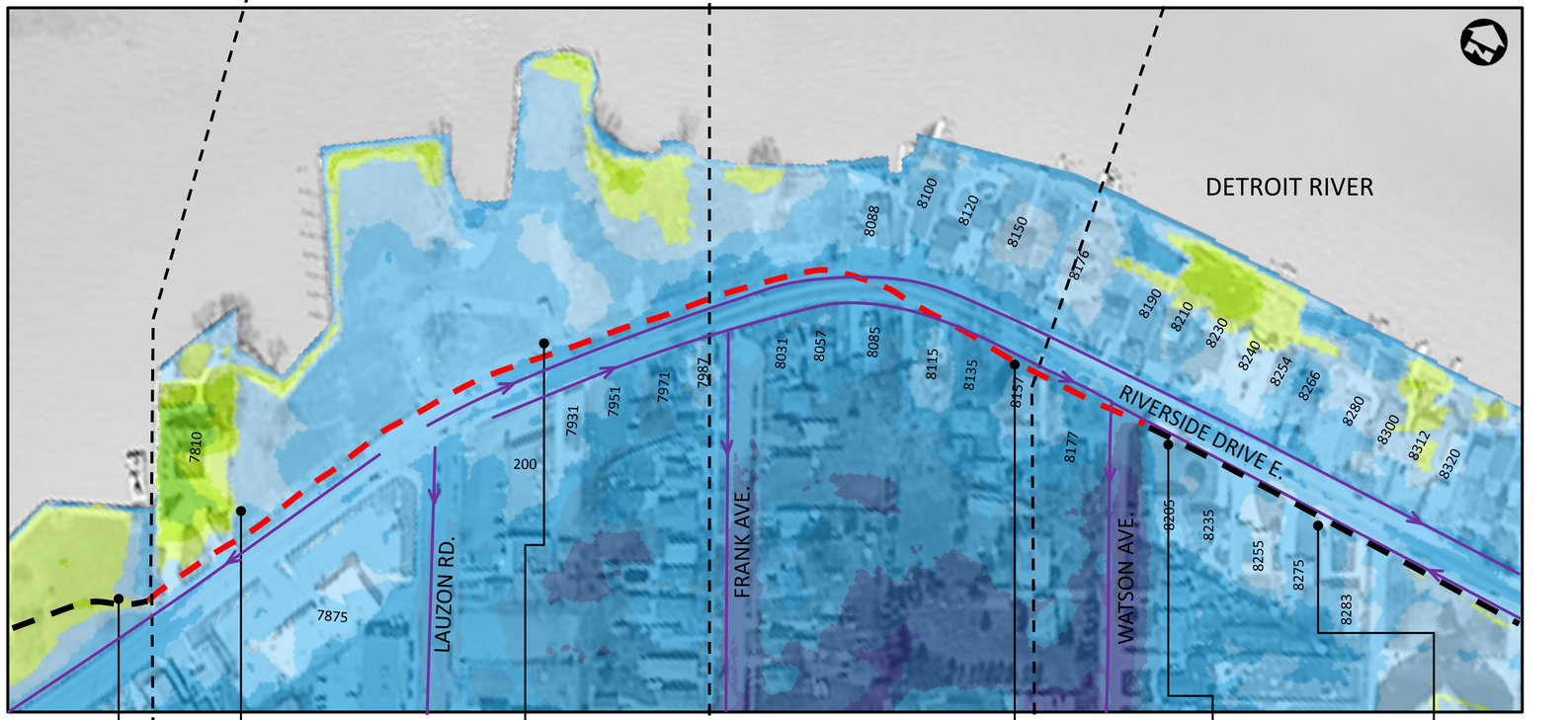
- 176.2m
- 175.9m
- 175.6m
- 175.3m
- 175.0m
- 174.7m
- 174.4m
- 174.1m



LOOKING NORTH

LOOKING NORTH

LOOKING WEST

LOOKING WEST

LOOKING WEST

LOOKING EAST

THE CITY OF WINDSOR ONTARIO, CANADA

Landmark Engineers Inc.

AREA 4

DIEPPE STREET AREA

EAST RIVERSIDE FLOOD RISK ASSESSMENT

- Residential area on both sides of Riverside Drive
- Generally low lying with some properties at higher elevations
- Existing discontinuous berm on south side of Riverside Drive
- Connected storm sewer on Dieppe - modify with sluice gate alternative
- Modify berm with Alternatives 1, 2, 3, 4

- Residential area north of Riverside Drive; Apartment complexes south of Riverside Drive with below-grade parking structures
- Generally low lying with discontinuous berm
- Modify existing berm with Alternatives 1, 2, 3, 4

LEGEND

EXISTING BERM ALIGNMENT

- NO DISCERNABLE BERM
- EARTH BERM

EXISTING DRAINAGE

- STORM SEWER
- CATCH BASIN

EXISTING GROUND ELEVATIONS

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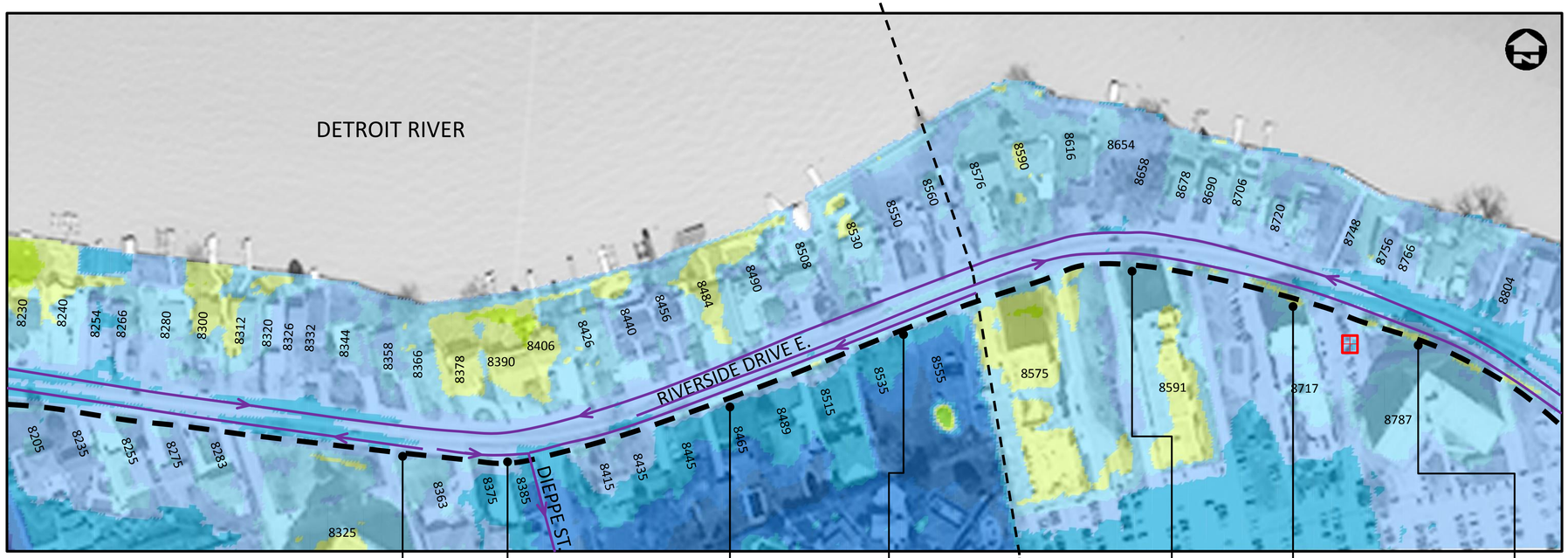
- 174.4m
- 174.1m




LOOKING WEST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LOOKING WEST

AREA 5

RIVERDALE AREA

EAST RIVERSIDE FLOOD RISK ASSESSMENT

- Apartment complexes and parking structures on both sides of Riverside Drive; Residential area north of Riverside Drive
- Generally low lying with existing discontinuous berm
- Modify existing berm with Alternatives 1, 2, 3, 4

- Marina and commercial area north of Riverside Drive; Apartment complexes and parking structures south of Riverside Drive
- Discontinuous existing berm on south side of Riverside Drive
- Modify existing berm with Alternative 1

- Intersection of Riverside Drive and Riverdale Ave.
- Existing berm is discontinuous at Riverdale
- Site-specific design solution required

LEGEND

EXISTING BERM ALIGNMENT

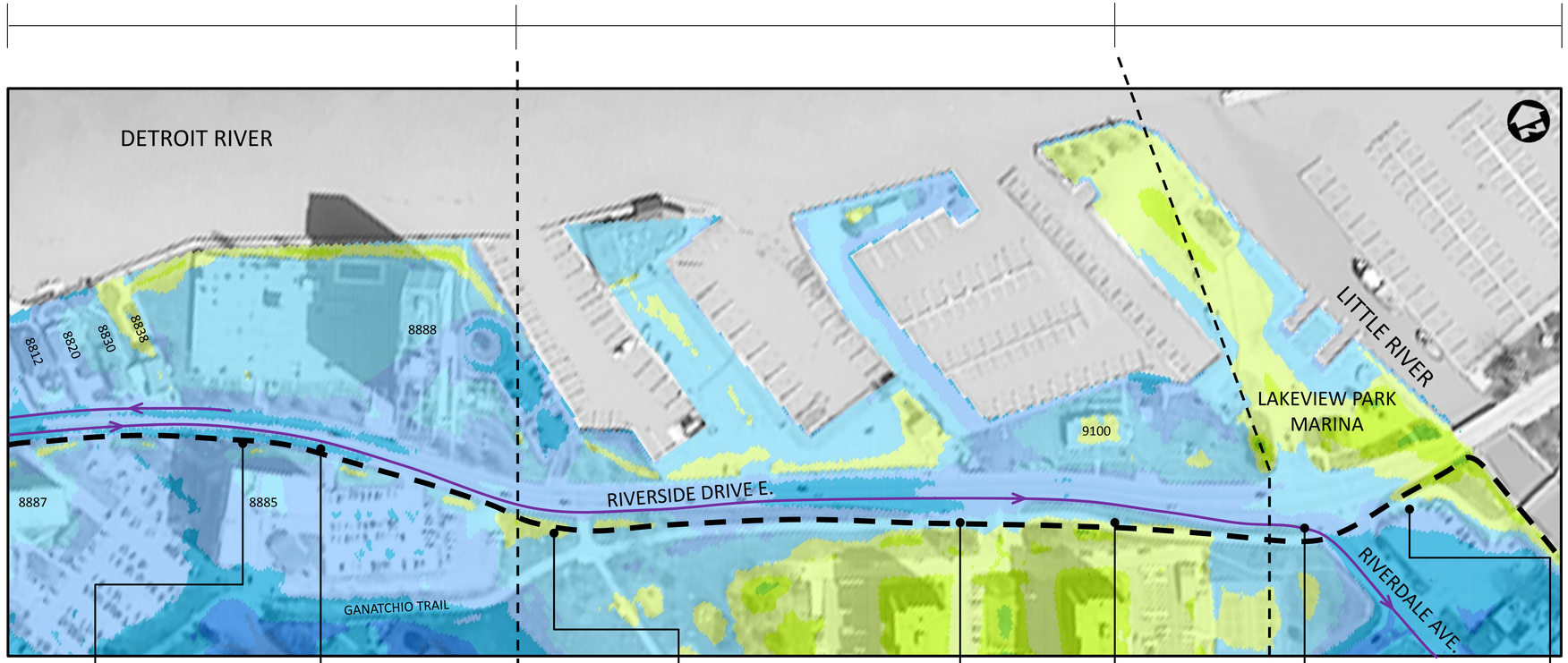
- NO DISCERNABLE BERM
- EARTH BERM

EXISTING DRAINAGE

- STORM SEWER
- CATCH BASIN

EXISTING GROUND ELEVATIONS

177.1m	2050 WATER LEVEL WITH FREEBOARD
176.8m	2050 PROJECTED HIGH WATER LEVEL
176.5m	CURRENT HIGH WATER LEVEL
176.2m	
175.9m	
175.6m	
175.3m	
175.0m	
174.7m	
174.4m	
174.1m	

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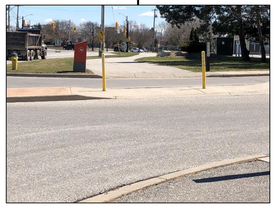
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AREA 6

LAKEVIEW MARINA AREA

EAST RIVERSIDE FLOOD RISK ASSESSMENT

- Commercial area and marina north of Riverside Drive; Residential and parking areas on both sides of Riverside Drive
- Riverside Drive and parking areas are generally low lying. Berm is located on the south side of Riverside Drive along the Ganatchio Trail
- Connected storm sewers at Mountbatten, Vanderbilt and Sand Point – modify with backflow prevention alternative
- Modify existing berm with Alternative 1

- Public park and parking areas on both sides of Riverside Drive
- Generally low lying area with discontinuous berm
- Modify existing berm with Alternative 1

LEGEND

EXISTING BERM ALIGNMENT

- NO DISCERNABLE BERM
- EARTH BERM

EXISTING DRAINAGE

- STORM SEWER
- CATCH BASIN

EXISTING GROUND ELEVATIONS

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- 174.4m
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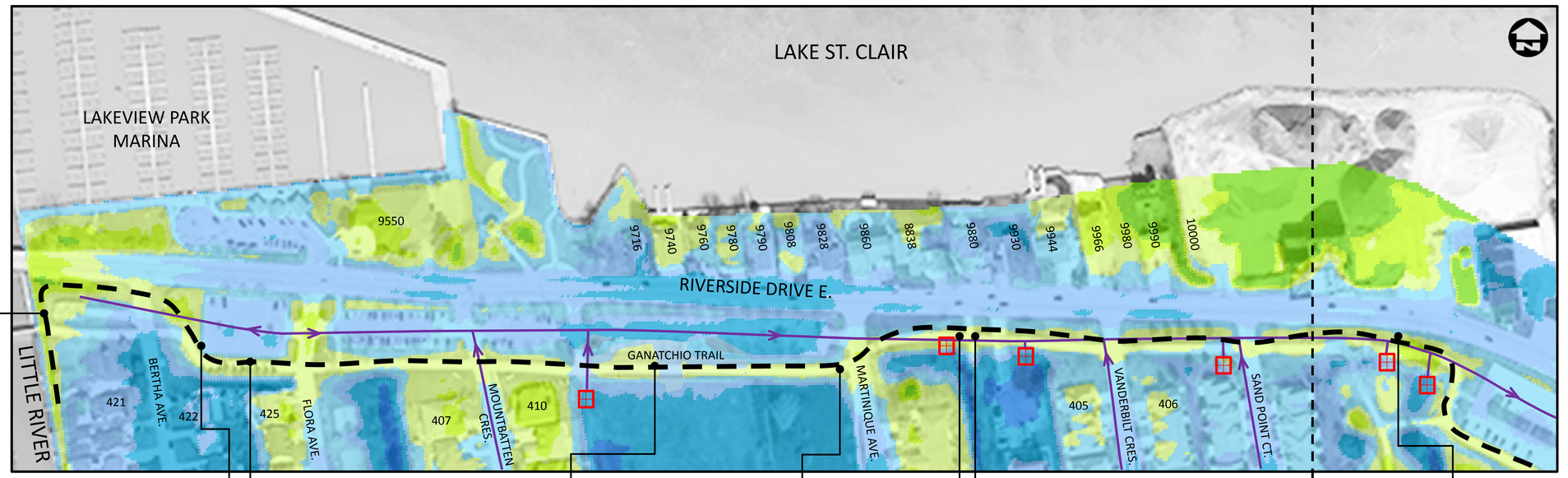


LOOKING SOUTH


LOOKING WEST


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LOOKING WEST


LOOKING NORTH

THE CITY OF WINDSOR ONTARIO, CANADA

Landmark Engineers Inc.

AREA 7

SAND POINT BEACH AREA

EAST RIVERSIDE FLOOD RISK ASSESSMENT

- Public beach and park north of Riverside Drive; Parking area south of Riverside Drive
- Generally low lying with intermittent discontinuities in existing berm
- Connected storm sewers under berm - modify with backflow prevention alternative
- Modify existing berm with Alternative 1

- Public beach and park north of Riverside Drive; Residential on both sides of Riverside Drive
- Generally low lying with intermittent discontinuities in berm
- Connected storm sewers and catch basins under berm - modify with backflow prevention alternative
- Modify existing berm with Alternative 1

LEGEND

EXISTING BERM ALIGNMENT

- NO DISCERNABLE BERM
- EARTH BERM

EXISTING DRAINAGE

- STORM SEWER
- CATCH BASIN

EXISTING GROUND ELEVATIONS

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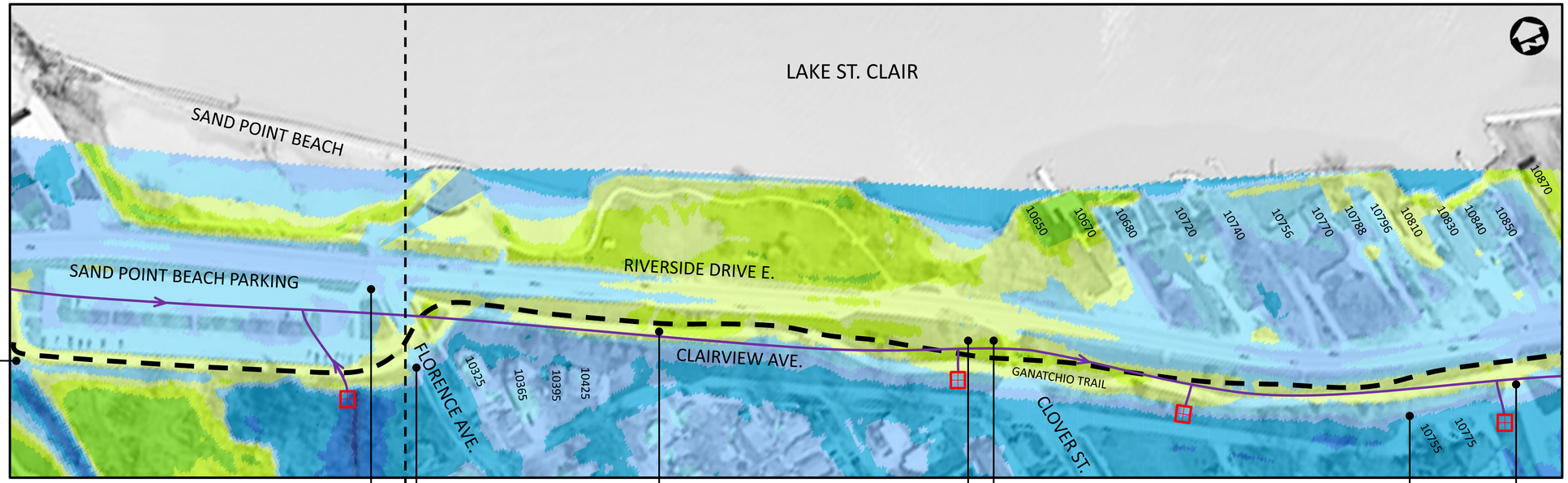


LOOKING EAST


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LOOKING WEST

THE CITY OF WINDSOR ONTARIO, CANADA

Landmark Engineers Inc.

AREA 8

GREENPARK AREA

EAST RIVERSIDE FLOOD RISK ASSESSMENT

- Residential area north of Riverside Drive; Mixed use developments south of Riverside Drive with residential neighbourhoods further inland
- Continuous earth berm with minor deficiencies
- Connected catch basins under berm, modify with backflow prevention alternative
- Modify existing berm with Alternative 1

- Residential areas on both sides of Riverside Drive
- Continuous berm with minor deficiencies
- Modify existing berm with Alternative 1

- Residential areas both sides of Riverside Drive
- Continuous berm with minor deficiencies
- Modify existing berm with Alternative 1

LEGEND

EXISTING BERM ALIGNMENT

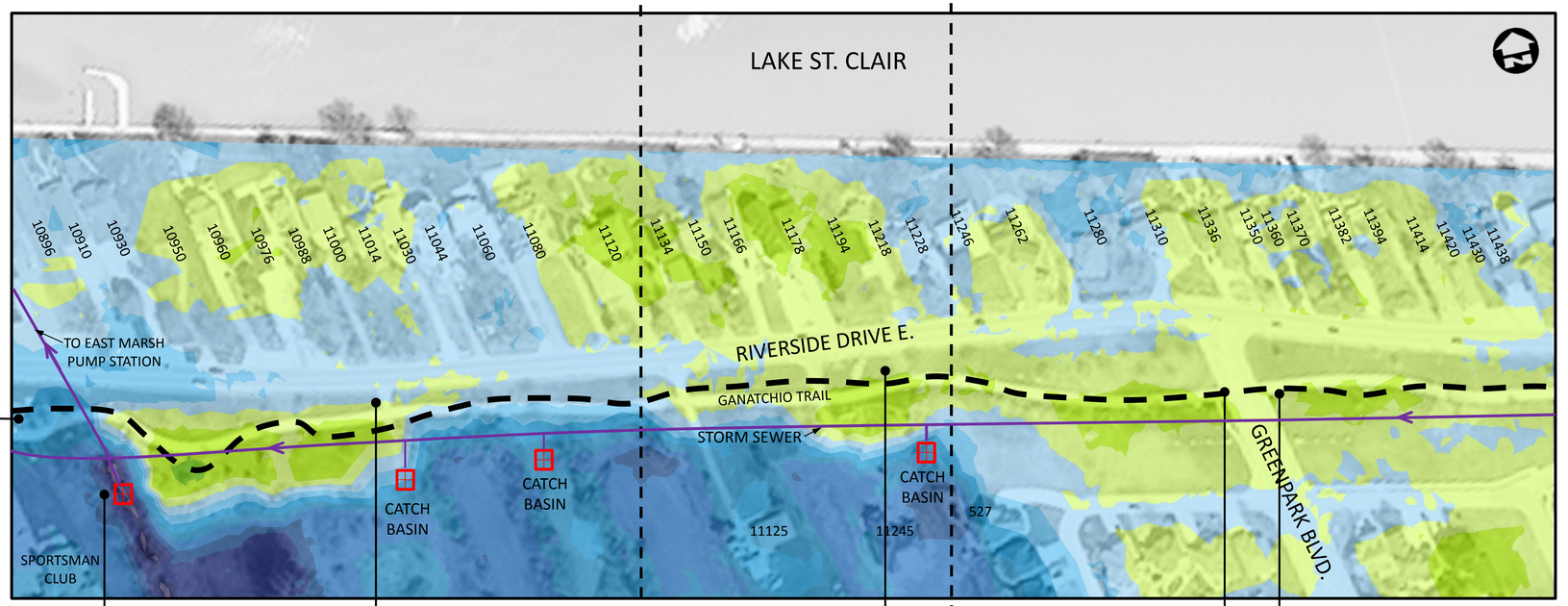
- NO DISCERNABLE BERM
- EARTH BERM

EXISTING DRAINAGE

- STORM SEWER
- CATCH BASIN

EXISTING GROUND ELEVATIONS

- 177.1m — 2050 WATER LEVEL WITH FREEBOARD
- 176.8m — 2050 PROJECTED HIGH WATER LEVEL
- 176.5m — CURRENT HIGH WATER LEVEL
- 176.2m
- 175.9m
- 175.6m
- 175.3m
- 175.0m
- 174.7m
- 174.4m
- 174.1m




LOOKING EAST


LOOKING EAST


LOOKING EAST


LOOKING WEST


LOOKING WEST


LOOKING EAST

AREA 9

RENDEZVOUS AREA

EAST RIVERSIDE FLOOD RISK ASSESSMENT

- Residential areas on both sides of Riverside Drive
- Generally low lying on the south side of the berm
- Existing continuous berm with minor deficiencies
- Connected catch basins and storm sewers under berm – modify with backflow prevention alternative
- Modify existing berm with Alternative 1

- Residential areas on both sides of Riverside Drive
- Continuous berm with minor insufficiencies
- Connected catch basins under berm – modify with backflow prevention alternative
- Modify existing berm with Alternative 1

LEGEND

EXISTING BERM ALIGNMENT

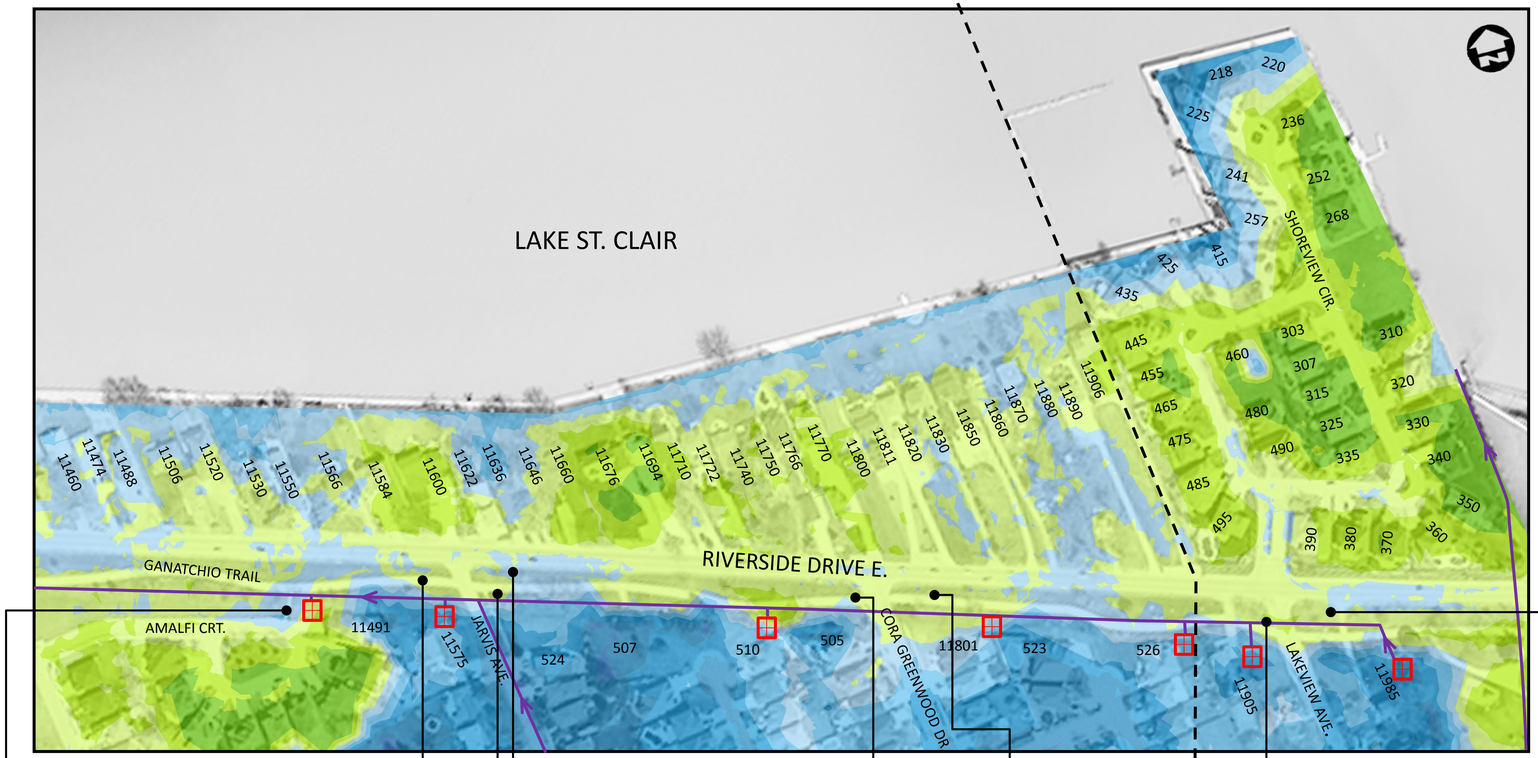
- NO DISCERNABLE BERM
- EARTH BERM

EXISTING DRAINAGE

- STORM SEWER
- CATCH BASIN

EXISTING GROUND ELEVATIONS

- 177.1m – 2050 WATER LEVEL WITH FREEBOARD
- 176.8m – 2050 PROJECTED HIGH WATER LEVEL
- 176.5m – CURRENT HIGH WATER LEVEL
- 176.2m
- 175.9m
- 175.6m
- 175.3m
- 175.0m
- 174.7m
- 174.4m
- 174.1m




LOOKING EAST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LOOKING WEST


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LOOKING WEST


LOOKING EAST


LOOKING EAST


LOOKING WEST

THE CITY OF WINDSOR ONTARIO, CANADA

Landmark Engineers Inc.

AREA 10

CITY LIMIT (INLAND)

- Residential area on west side of berm, bounded on the east by the City of Windsor limits
- A continuous berm exists along the rear yards of properties abutting the City of Windsor limits
- Minor deficiencies with existing berm

LEGEND

EXISTING BERM ALIGNMENT

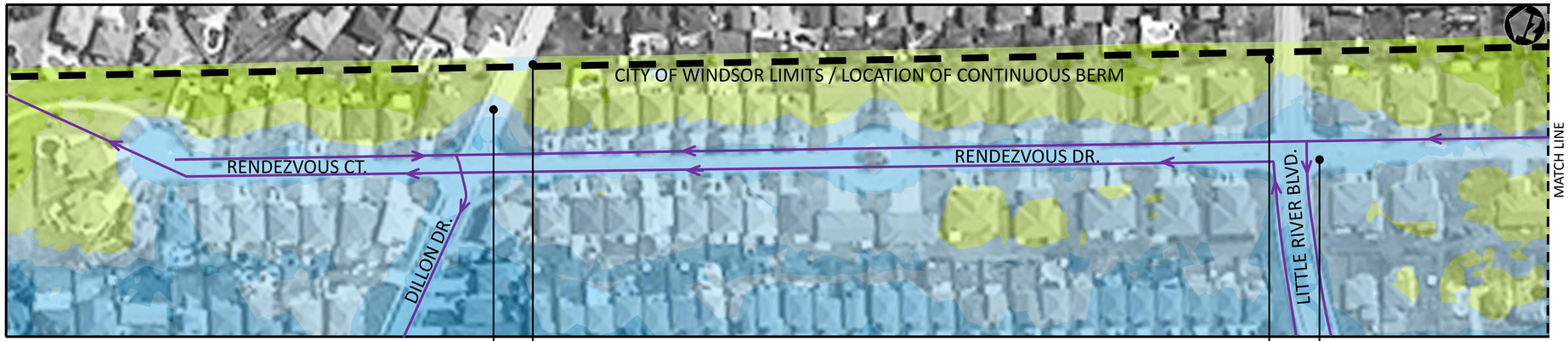
- NO DISCERNABLE BERM
- EARTH BERM

EXISTING DRAINAGE

- STORM SEWER
- CATCH BASIN

EXISTING GROUND ELEVATIONS

177.1m	2050 WATER LEVEL WITH FREEBOARD
176.8m	2050 PROJECTED HIGH WATER LEVEL
176.5m	CURRENT HIGH WATER LEVEL
176.2m	
175.9m	
175.6m	
175.3m	
175.0m	
174.7m	
174.4m	
174.1m	

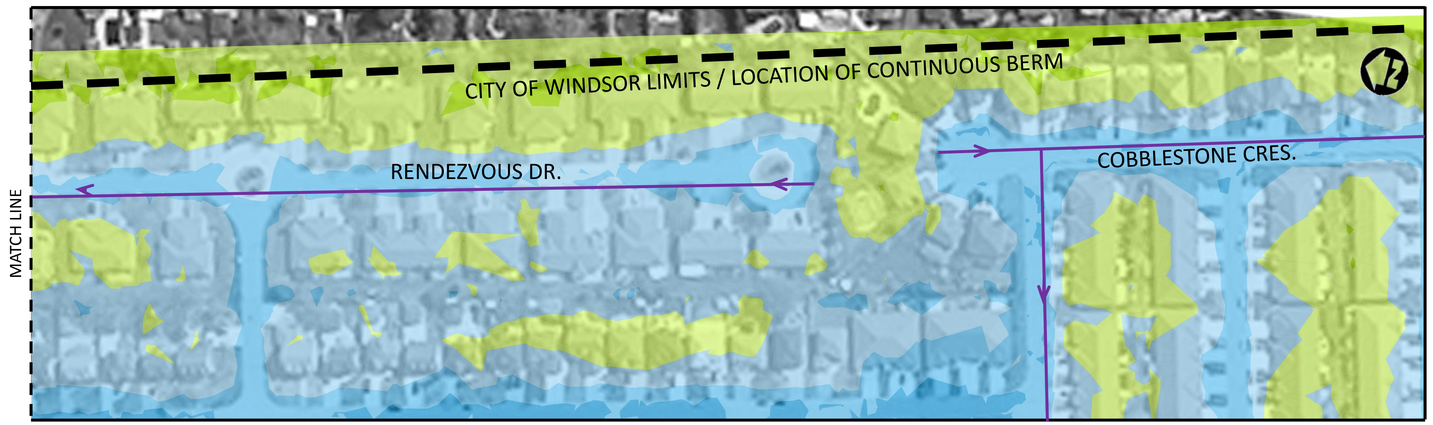


LOOKING EAST

LOOKING NORTH

LOOKING SOUTH

LOOKING EAST



THE CITY OF WINDSOR ONTARIO, CANADA

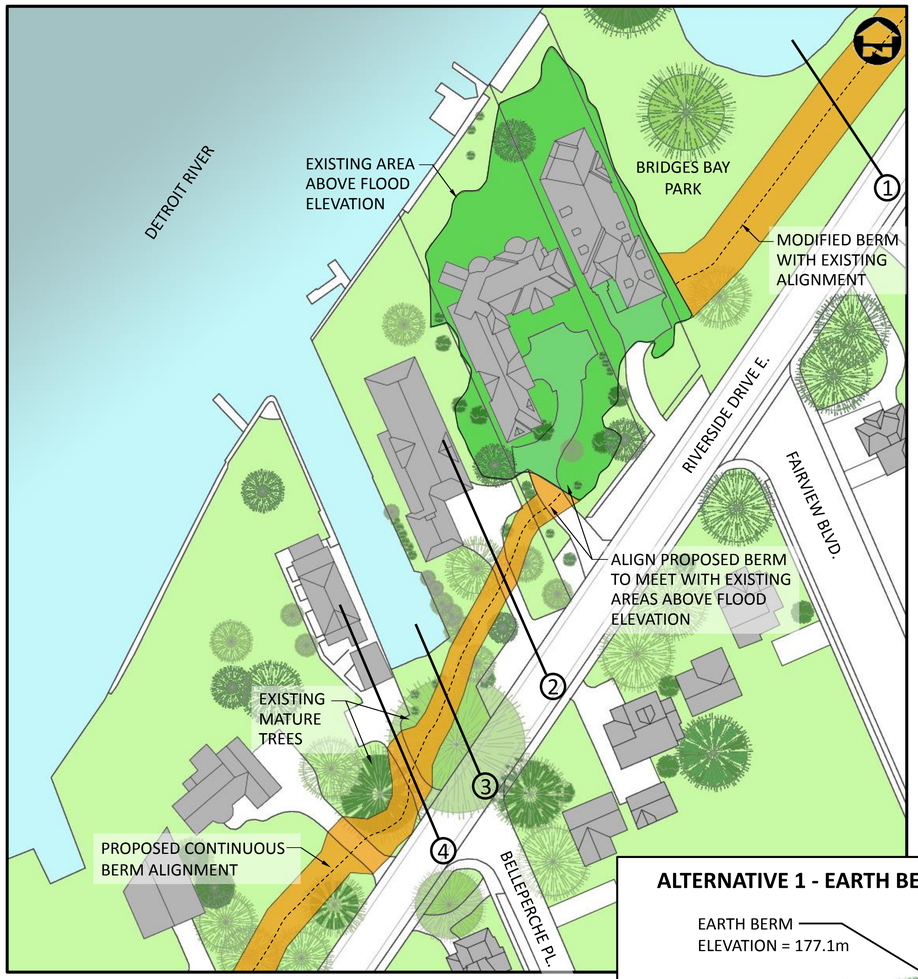
Landmark Engineers Inc.

POTENTIAL DESIGN SOLUTION – BELLEPERCHE PL. TO FAIRVIEW BLVD.

In order to illustrate how the alternative solutions may be applied, a potential design solution has been prepared for three distinct areas along Riverside Drive East. It is important to note that the solutions shown are NOT final designs, but represent one potential solution for the given area.

This slide is intended to depict a potential solution for the area between Belleperche Place and Fairview Boulevard along Riverside Drive East.

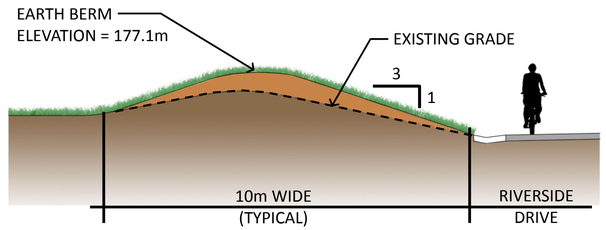
PLAN: APPLIED DESIGN SOLUTION – BELLEPERCHE PL. TO FAIRVIEW BLVD.



LEGEND

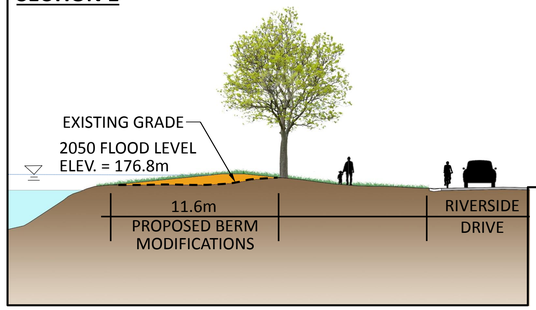
- EXTENT OF PROPOSED BERM MODIFICATION
- AREA ABOVE FLOOD ELEVATION = 176.8m
- AREA BELOW FLOOD ELEVATION = 176.8m
- PROPOSED BERM ALIGNMENT

ALTERNATIVE 1 - EARTH BERM TYPICAL SECTION



SECTIONS: APPLIED DESIGN SOLUTION – BELLEPERCHE PL. TO FAIRVIEW BLVD.

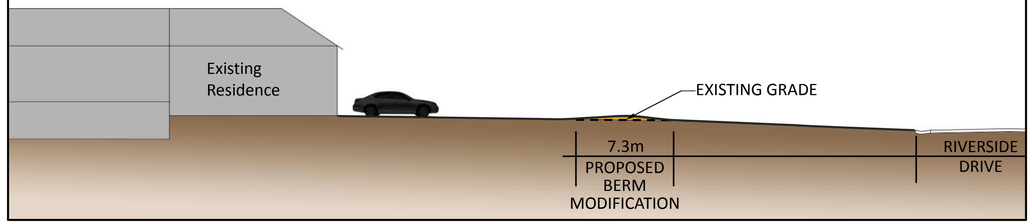
SECTION 1



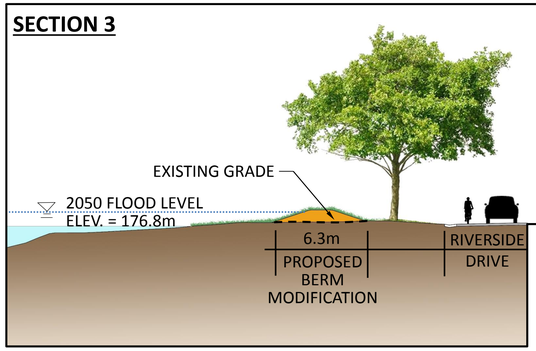
EXISTING CONDITIONS: Public park with existing earth berm. Elevation of berm lower than 2050 flood elevation.
PROPOSED SOLUTION: Modify existing berm to meet 2050 flood elevation. Realign berm to accommodate existing trees and landscaping where possible.

EXISTING CONDITIONS: Residential home with elevations at or above 2050 flood elevation. Neighbouring properties are at higher elevation.
PROPOSED SOLUTION: Construct earth berm as required to 2050 flood elevation. Slope berm at driveway at max 10% slope. Align berm to preserve trees and landscaping where possible.

SECTION 2



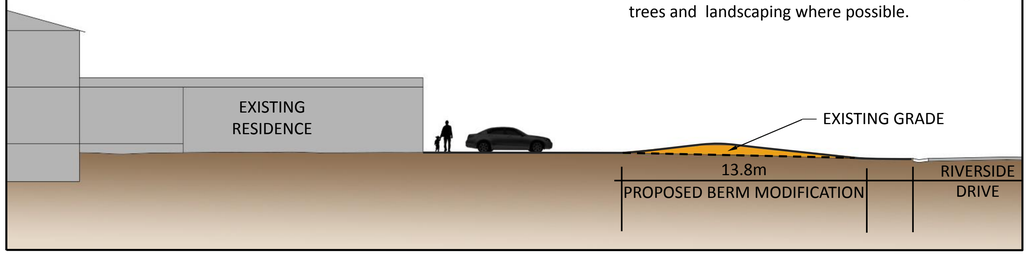
SECTION 3



EXISTING CONDITIONS: Park-like area with elevations below 2050 flood elevation and no discernable berm.
PROPOSED SOLUTION: Construct earth berm to meet 2050 flood elevation. Align berm to preserve existing mature trees and landscaping where possible.

EXISTING CONDITIONS: Residential home with elevations below 2050 flood elevation and no discernable berm.
PROPOSED SOLUTION: Construct earth berm to meet 2050 flood elevation. Slope berm at driveway at max 10% slope. Align berm to preserve existing trees and landscaping where possible.

SECTION 4

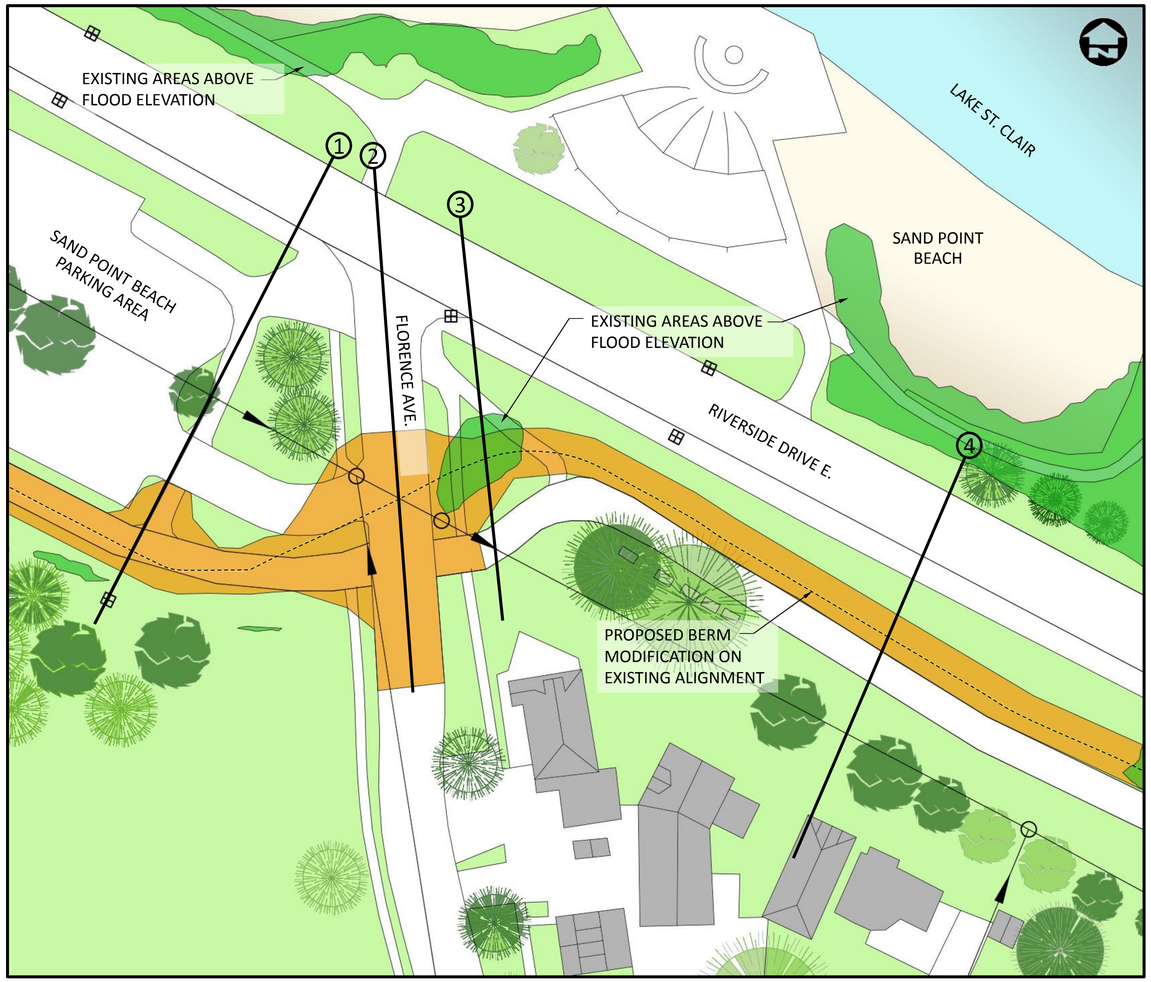


THE CITY OF WINDSOR ONTARIO, CANADA

Landmark Engineers Inc.

POTENTIAL DESIGN SOLUTION – AREA NEAR FLORENCE AVE.

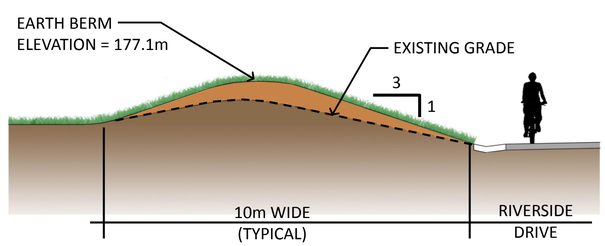
This slide is intended to depict a potential solution for the area of Sand Point Beach along Riverside Drive East.



LEGEND

- EXTENT OF PROPOSED BERM MODIFICATION
- AREA ABOVE FLOOD ELEVATION = 176.8m
- AREA BELOW FLOOD ELEVATION = 176.8m
- PROPOSED BERM ALIGNMENT
- EXISTING STORM SEWER
- EXISTING CATCH BASIN

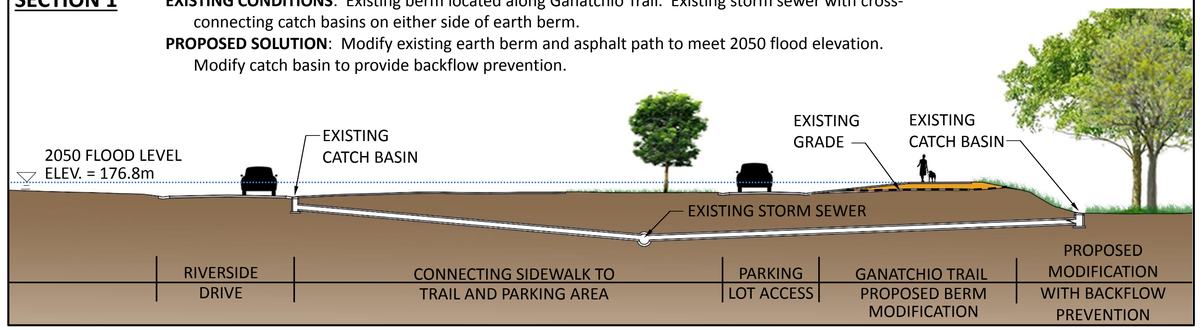
ALTERNATIVE 1 - EARTH BERM TYPICAL SECTION



SECTIONS: APPLIED DESIGN SOLUTION – AREA NEAR FLORENCE AVE.

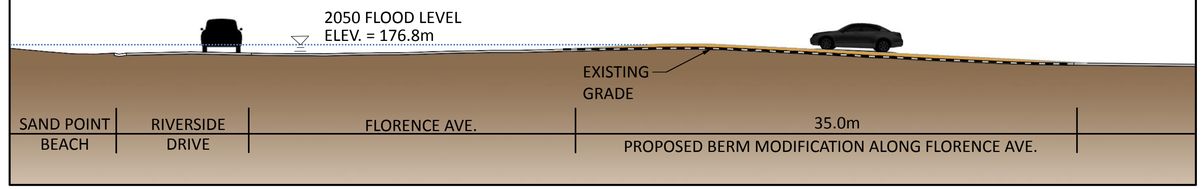
SECTION 1

EXISTING CONDITIONS: Existing berm located along Ganatchio Trail. Existing storm sewer with cross-connecting catch basins on either side of earth berm.
PROPOSED SOLUTION: Modify existing earth berm and asphalt path to meet 2050 flood elevation. Modify catch basin to provide backflow prevention.

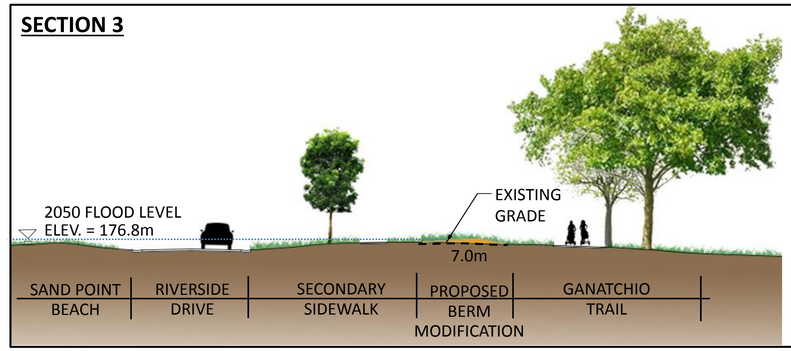


SECTION 2

EXISTING CONDITIONS: Existing asphalt road with berm crossing. Elevation of existing berm lower than 2050 flood elevation.
PROPOSED SOLUTION: Modify road elevation at existing berm alignment to meet 2050 flood elevation. Maintain acceptable road slope and sight lines.

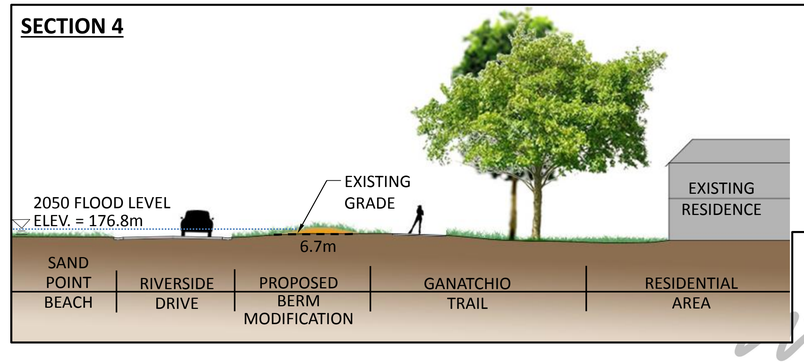


SECTION 3



EXISTING CONDITIONS: Public area with intersecting asphalt paths at signalised intersection crossing existing berm.
PROPOSED SOLUTION: Modify existing earth berm and asphalt path along current alignment to meet 2050 flood elevation.

SECTION 4



EXISTING CONDITIONS: Residential home with elevations below 2050 flood elevation. Existing continuous earth berm adjacent to asphalt path with minor deficiencies.
PROPOSED SOLUTION: Modify existing earth berm along current alignment to meet 2050 flood elevation.

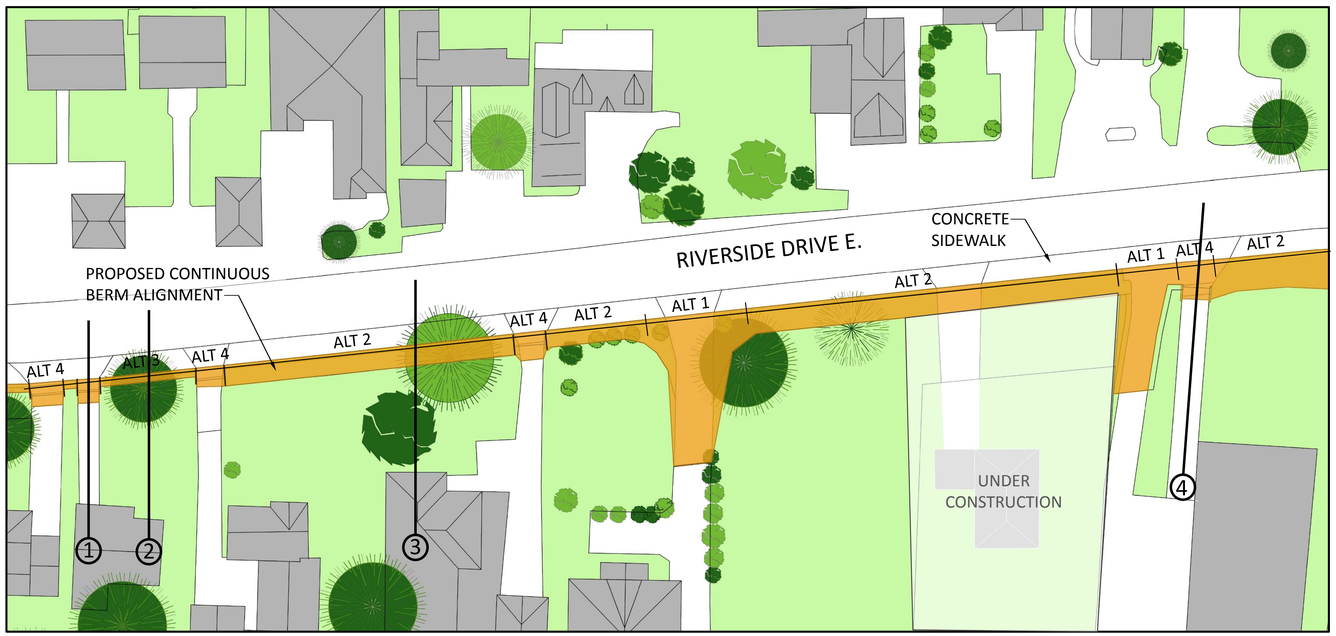
THE CITY OF WINDSOR ONTARIO, CANADA

Landmark Engineers Inc.

POTENTIAL DESIGN SOLUTION – AREA EAST OF DIEPPE AVE.

EAST RIVERSIDE FLOOD RISK ASSESSMENT

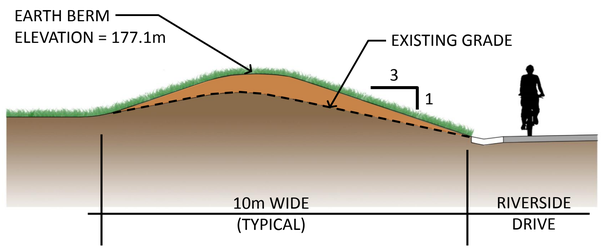
This slide is intended to depict a potential solution for the residential area east of Dieppe Street along Riverside Drive East.



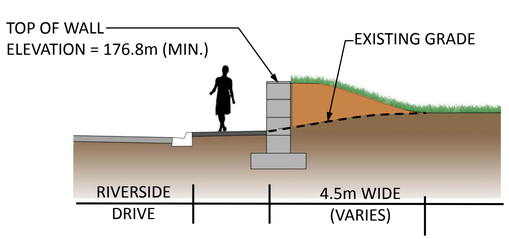
LEGEND

- EXTENT OF PROPOSED BERM MODIFICATION
- AREA ABOVE FLOOD ELEVATION = 176.8m
- AREA BELOW FLOOD ELEVATION = 176.8m
- ----- PROPOSED BERM ALIGNMENT

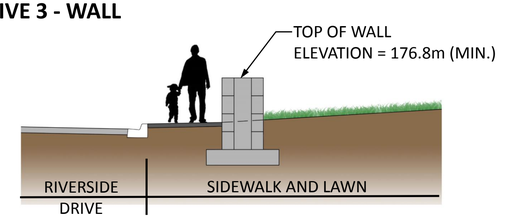
ALTERNATIVE 1 - EARTH BERM TYPICAL SECTION



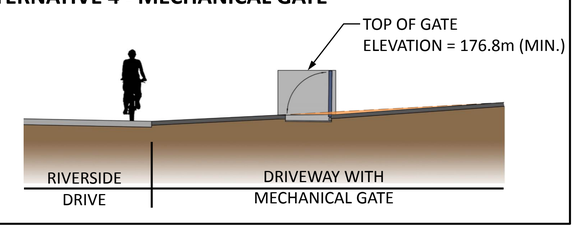
ALTERNATIVE 2 - WALL WITH EARTH BERM



ALTERNATIVE 3 - WALL

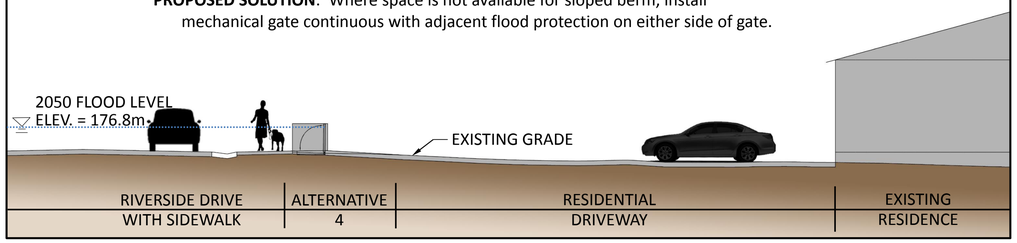


ALTERNATIVE 4 - MECHANICAL GATE



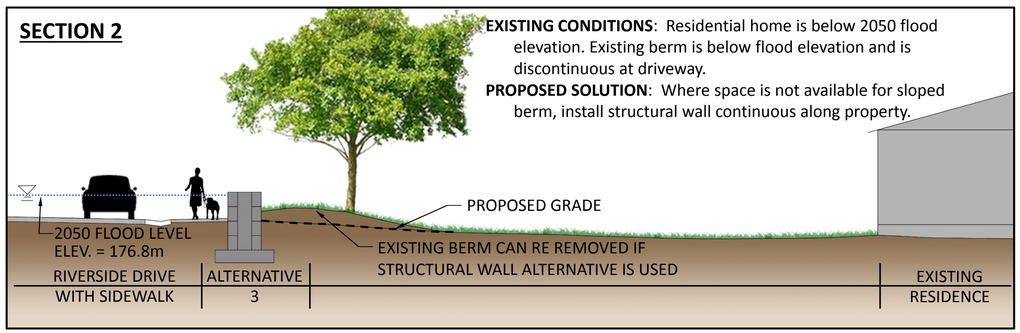
SECTION 1

EXISTING CONDITIONS: Residential driveway at elevations below 2050 flood elevation. Berm is below flood elevation and is discontinuous.
PROPOSED SOLUTION: Where space is not available for sloped berm, install mechanical gate continuous with adjacent flood protection on either side of gate.



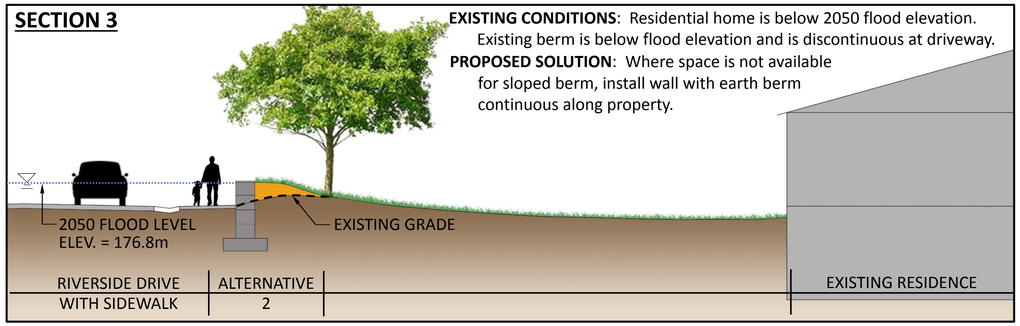
SECTION 2

EXISTING CONDITIONS: Residential home is below 2050 flood elevation. Existing berm is below flood elevation and is discontinuous at driveway.
PROPOSED SOLUTION: Where space is not available for sloped berm, install structural wall continuous along property.



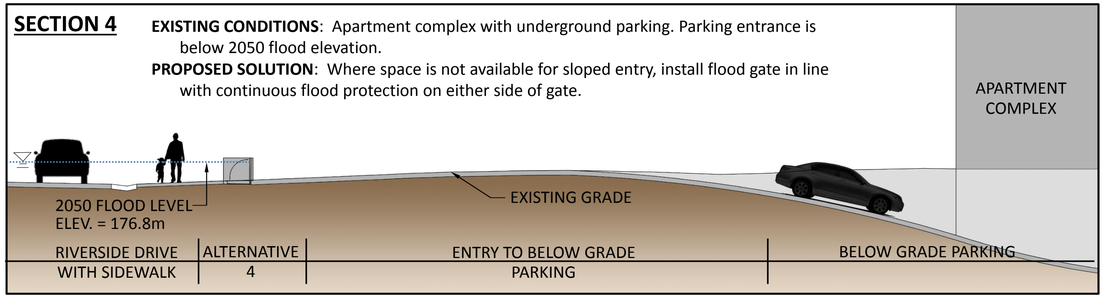
SECTION 3

EXISTING CONDITIONS: Residential home is below 2050 flood elevation. Existing berm is below flood elevation and is discontinuous at driveway.
PROPOSED SOLUTION: Where space is not available for sloped berm, install wall with earth berm continuous along property.



SECTION 4

EXISTING CONDITIONS: Apartment complex with underground parking. Parking entrance is below 2050 flood elevation.
PROPOSED SOLUTION: Where space is not available for sloped entry, install flood gate in line with continuous flood protection on either side of gate.



THE CITY OF WINDSOR ONTARIO, CANADA

Landmark Engineers Inc.

STORM SEWERS

CROSS-CONNECTIVITY OF SEWERS ON EITHER SIDE OF BERM

PROBLEM DEFINITION:

- In the event of high water levels on Lake St. Clair, flooding of Riverside Drive may occur.
- In the event that Riverside Drive is flooded, the storm sewers along the roadway have the potential to convey flood waters inland.
- Flood waters have the potential to enter the catch basins and flow through the sewers under the protective berm and cause inland flooding.
- There are 3 different existing storm sewer configurations where this may occur:

1. Storm sewers that receive flows from the local storm sewers along Riverside Drive and convey this inland to pumping stations.
2. Storm sewers collecting surface runoff from inland locations that convey this flow to the storm sewer along Riverside Drive.
3. Catch basins on the south side of the berm that are directly connected to storm sewers along Riverside Drive.

The following slides are intended to depict the 3 different configurations and potential solutions for each.

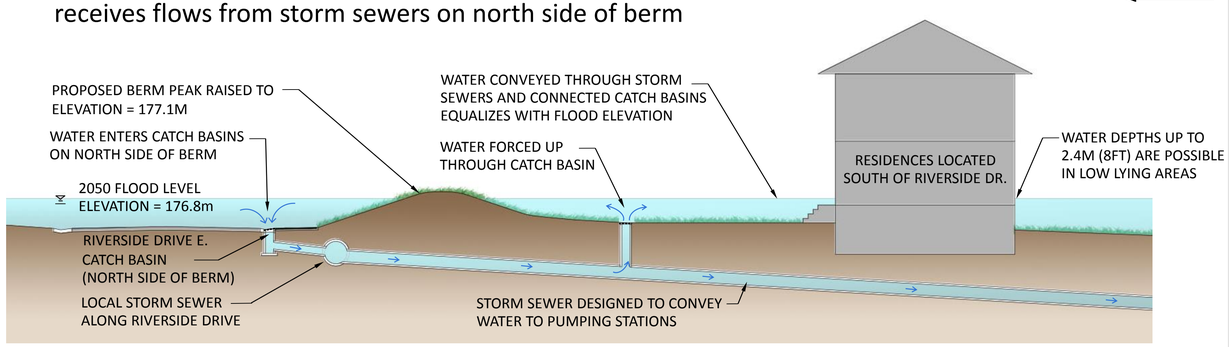
CATCH BASIN AT SPORTSMAN CLUB,
SOUTH SIDE OF EARTH BERM

CATCH BASIN WEST OF JARVIS AVE.,
SOUTH SIDE OF EARTH BERM

CONFIGURATION 1:

EXISTING CONDITION: Storm sewer on south side of berm that receives flows from storm sewers on north side of berm

NORTH

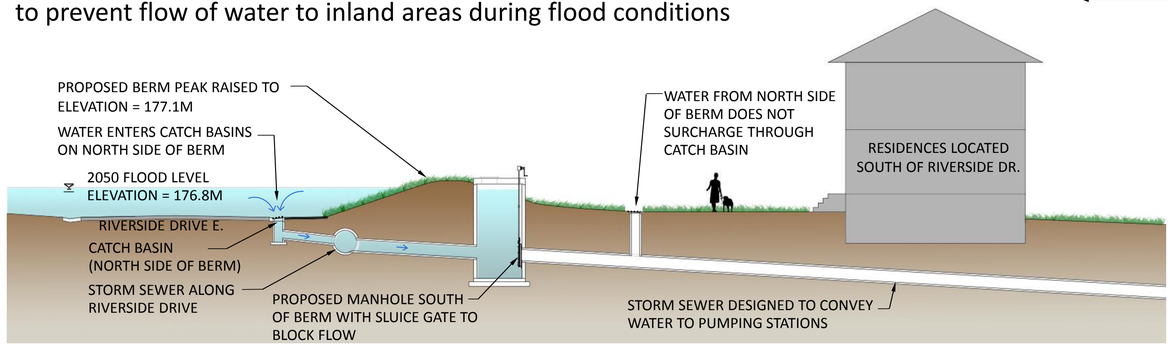


WHAT IS THE PROBLEM?

- During a high water event, catch basins along Riverside Drive may fill with water and surcharge the storm sewers.
- The water on the south side of the berm has the potential to equalize with the lake water level.
- Inland water levels may reach a depth of 2.4m (8ft) in some areas.
- Potential to cause basement and even first floor flooding in low lying areas.

POTENTIAL SOLUTION: Install sluice gate inline with storm sewer to prevent flow of water to inland areas during flood conditions

NORTH



HOW DOES THIS SOLVE THE PROBLEM?

- During a high water event, the sluice gate is lowered to block flow of water into storm sewer on south side of berm.
- Water may rise in manhole to equalize with the Lake levels, but does not flow into neighbourhoods.
- Once the flow to the sewers is blocked south of the berm, water will remain on the north side of the berm.
- Catch basins and storm sewers on south side of berm continue to function and collect surface water and direct this to pumping stations.

STORM SEWERS

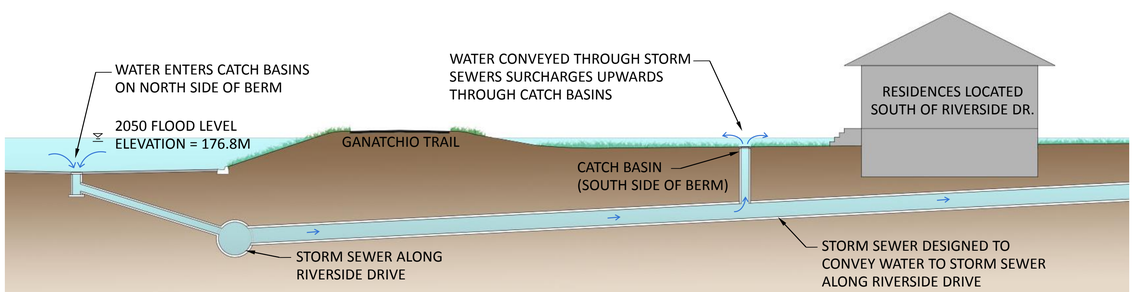
CROSS-CONNECTIVITY OF SEWERS ON EITHER SIDE OF BERM

EAST RIVERSIDE FLOOD RISK ASSESSMENT

CONFIGURATION 2:

EXISTING CONDITION: Storm sewer on south side of berm that directs flow into storm sewer on north side of berm

NORTH

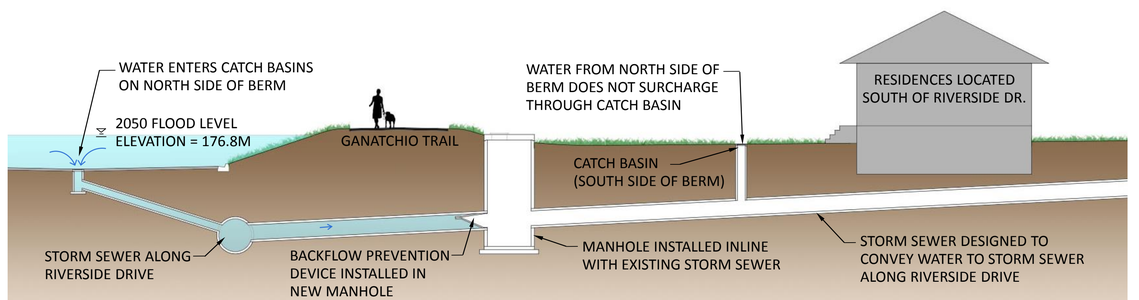


WHAT IS THE PROBLEM?

- During high water events, water enters storm sewers through catch basins along Riverside Drive and in adjacent parking lots.
- Water is forced upwards through connected sewers and exits through catch basins on south side of berm.
- Water on south side of berm has the potential to equalize with lake water level.

POTENTIAL SOLUTION: Install backflow prevention device (duckbill) inline with storm sewer on south side of berm

NORTH



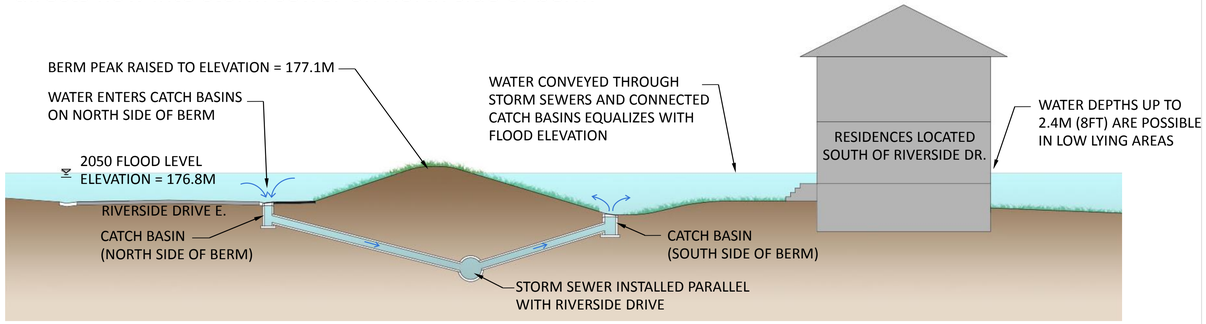
HOW DOES THIS SOLVE THE PROBLEM?

- Backflow prevention device installed inline with sewer inhibits surcharging of water on south side of berm.
- During high water events, water will enter the storm sewer, but the backflow prevention device will restrict the flow beyond the berm.

CONFIGURATION 3:

EXISTING CONDITION: Catch basin on south side of berm that directs flow into storm sewer on north side of berm

NORTH

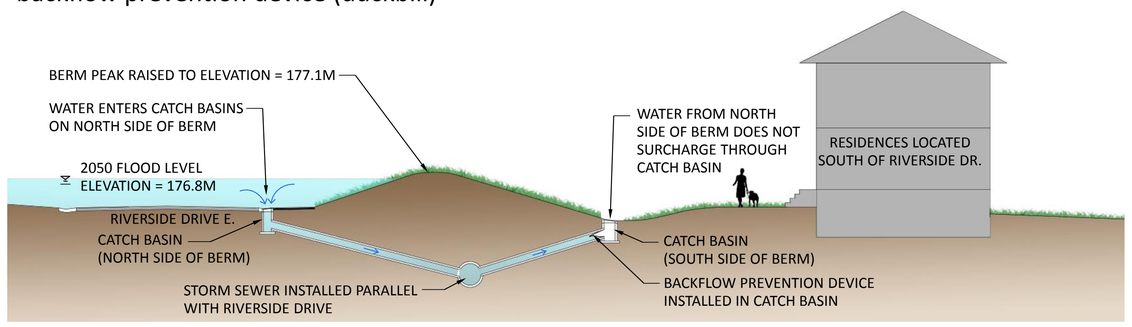


WHAT IS THE PROBLEM?

- During high water events, water enters sewers through catch basins adjacent to Riverside Drive.
- Water flows through cross-connected catch basins on south side of berm and floods neighbourhoods.
- Water on south side of berm has the potential to equalize with lake water level.

POTENTIAL SOLUTION: Modify inlet of catch basin with backflow prevention device (duckbill)

NORTH



HOW DOES THIS SOLVE THE PROBLEM?

- During high water events, water enters sewers through catch basins adjacent to Riverside Drive.
- Backflow prevention device installed in catch basins on south side of berm inhibits surcharging of water on south side of berm.

THE CITY OF WINDSOR ONTARIO, CANADA

Landmark Engineers Inc.