

5 ALTERNATIVES AND EVALUATION

A principle of the Environmental Assessment process is to identify and compare a reasonable range of alternatives to address the stated study problems or opportunities. Alternatives to the Undertaking are defined as *functionally* different ways of addressing the stated problems and opportunities. Alternative Methods are concept level design alternatives to address the operational and infrastructure needs and opportunities (number of lanes, alignment, interchanges, etc.).

5.1 ALTERNATIVES TO THE UNDERTAKING

An analysis of the Alternatives to the Undertaking was completed to determine the preferred solution to be carried forward to the Alternative Methods phase. These planning alternatives were assessed based on their ability to address the purpose of the undertaking, including the previously identified problems and opportunities (as outlined in Section 3), and potential positive and negative effects on the natural, social and economic environments.

The planning alternatives associated with the identified transportation needs are:

- ▶ Do Nothing;
- ▶ Transportation Demand Management (TDM);
- ▶ Improved/New Regional or Municipal Roads;
- ▶ Improved/New Rail Provincial Transportation Facility (Rail and/or Transit) and
- ▶ Improved/New Provincial Transportation Facility (Road).).

The description and summary of recommendation for each planning alternative are summarized in **Table 5-1**.

Table 5-1: Alternatives to the Undertaking

Alternative	Description
Do Nothing	Highway 403, QEW, the Freeman Interchange and other interchanges would remain “as is”. This alternative does not address the identified transportation problems and thus was not carried forward .
Transportation Demand	TDM strategies reduce overall demands on the highway network by shifting demands to time periods outside of the critical congestion

Alternative	Description
Management (TDM)	periods, and shift demands to alternative modes of transportation (e.g., public transit, cycling and walking). Measures have been included in the transportation modelling used in this project, based on policy directions within the Provincial Growth Plan. On their own, TDM strategies do not address the identified transportation problems and thus were not carried forward .
Improved Adjacent Road Systems	Widening of adjacent regional and municipal roads would increase overall transportation network capacity. However, these roadways do not support inter-regional trips. This alternative does not address the identified transportation problems and thus was not carried forward .
Improved Provincial Transportation Facility (Rail and/or Transit)	Measures have been included in the transportation modelling used in this project, based on policy directions within the Provincial Growth Plan and The Big Move. However, transit and/or improved freight rail capacity on their own will not meet the demand within this corridor. In addition to the work presently underway on the 407 Transitway from Brant Street to Winston Churchill Boulevard, MTO will undertake a planning study for a westerly extension from Brant Street as part of a separate study. This alternative does not address the identified transportation problems and thus was not carried forward .
Improved Provincial Transportation Facility (Road)	Expansion, operational and safety improvements to optimize the people and goods moving capacity of the QEW and Highway 403. This alternate also includes a range of Transportation Systems Management (TSM) policies and strategies which may include Managed Lanes, Carpool Parking, ITS strategies, etc. This alternative, including consideration of managed lanes (i.e. HOV lanes), was carried forward for further consideration.

5.2 LONG-LIST OF ALTERNATIVES

Section 3 details the identification of existing conditions, problems and opportunities within the study area. From the identification of these issues, it was possible to generate Alternative Methods that would meet the existing operational and infrastructural requirements while also accommodating future needs. A Long-List of Alternatives was first developed and assessed, and then screened to a Short-List of Alternatives. The Long-List of Alternatives and screening were presented at Public Information Centre #1 held October 10, 2017. The Short-List of Alternatives was further evaluated to identify a Technically Preferred Alternative and subsequently a Recommended Plan, which was presented at Public Information Centre #2 held September 10, 2019.

As the study area is large, there was a potential for improvement alternatives to be so large and numerous that the screening of alternatives would become unwieldy and unmanageable. Thus, when generating the alternatives, the study area was split into three segments: the QEW mainline, Highway 403 and Freeman Interchange Westbound, and Highway 403 and Freeman Interchange Eastbound.

5.2.1 QEW ALTERNATIVES

Three QEW mainline alternatives were generated:

▶ Alternative 1:

- Widen QEW by one HOV lane in both directions from Guelph Line (the existing terminus of the HOV lanes), through the Freeman Interchange, to the North Shore Boulevard Interchange.
- QEW will be widened into the existing median to provide the HOV lane, and the median shoulder widths vary, with some locations being the minimum allowed per MTO standards.

▶ Alternative 2:

- Widen QEW by one HOV lane in both directions from Guelph Line, through the Freeman Interchange, to North Shore Boulevard Interchange.
- QEW will be widened into the existing median to provide the HOV lane, and the median shoulders are designed with desirable widths, per MTO standards.
- Requires easterly widening of the QEW northbound lanes at the Fairview Street / Plains Rd East Interchange, ramp realignments and the relocation of the easterly ramp terminal of Fairview Street.

▶ Alternative 3:

- Widen QEW by one HOV lane in both directions from Guelph Line, through Freeman Interchange, to the North Shore Boulevard Interchange.
- Widen Highway 403 by one HOV lane in both directions including a dedicated connection to the QEW HOV lanes through the Freeman Interchange.
- The HOV lane connection through the Freeman Interchange requires numerous bridge replacements.

The key difference between QEW Alternatives 1 and 2 is the use of minimum and desirable median widths, respectively. The use of desirable widths results in larger infrastructure impacts for Alternative 2 compared to Alternative 1. QEW Alternative 3 is largely different from the other alternatives as it includes an HOV connection through the Freeman Interchange, connecting HOV lanes on the QEW to future potential HOV lanes on Highway 403. The HOV connection would require a large number of new structures and larger infrastructure improvements than the other alternatives.

The QEW mainline long-list alternatives screening is detailed in **Appendix H** and exhibits of the alternatives are included in **Exhibits 5-1 to 5-3**.

5.2.2 HIGHWAY 403 AND FREEMAN INTERCHANGE, WESTBOUND

For the westbound lanes of Highway 403 and the Freeman Interchange, six alternatives were created and are summarized below. As mentioned in **Section 3**, a prominent existing operational issue in the study area is the lack of lane balance heading westbound on QEW, forcing drivers to maneuver or weave ahead of the QEW Hamilton or QEW Niagara split. All alternatives described below mitigate this issue by accommodating three lanes in the Highway 403 westbound direction, thus enabling lane balance at the split. The screening of the alternatives is detailed in **Appendix H** and the alternatives are illustrated in **Exhibit 5-4** through **Exhibit 5-9**.

▶ Alternative 1A

- Realign the QEW northbound to Highway 403 westbound inner loop-ramp to merge with Highway 403 at a more westerly point.
- Widen Highway 403 by an additional general-purpose lane or HOV lane.

▶ Alternative 1B

- Provide a two-lane inner-loop ramp for the QEW northbound to Highway 403 westbound ramp.
- Realign the QEW northbound to Highway 403 westbound inner loop ramp to merge with Highway 403 at a more westerly point.
- Provide a separate two-lane ramp for the QEW northbound to 407 ETR northbound ramp.
- Widen Highway 403 by an additional general-purpose lane or HOV lane.

▶ Alternative 2A

- Provide a new semi directional ramp for the QEW northbound to Highway 403 westbound ramp.
- Widen Highway 403 by an additional general-purpose lane or HOV lane.

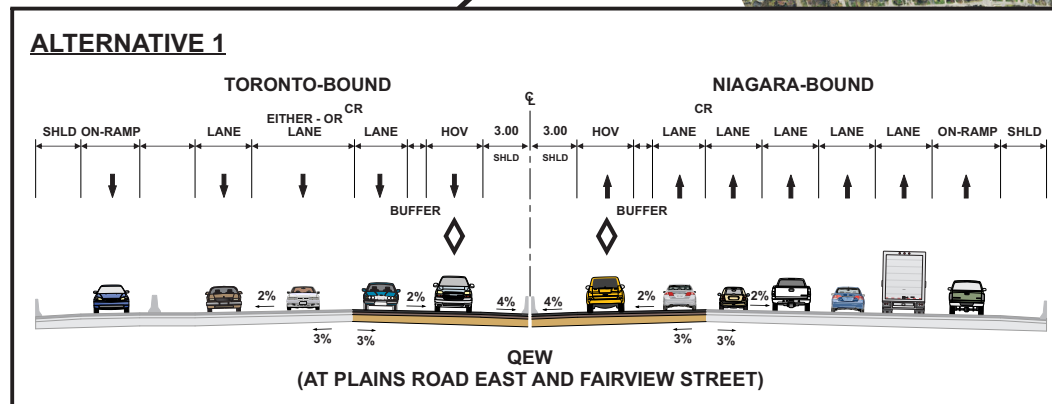
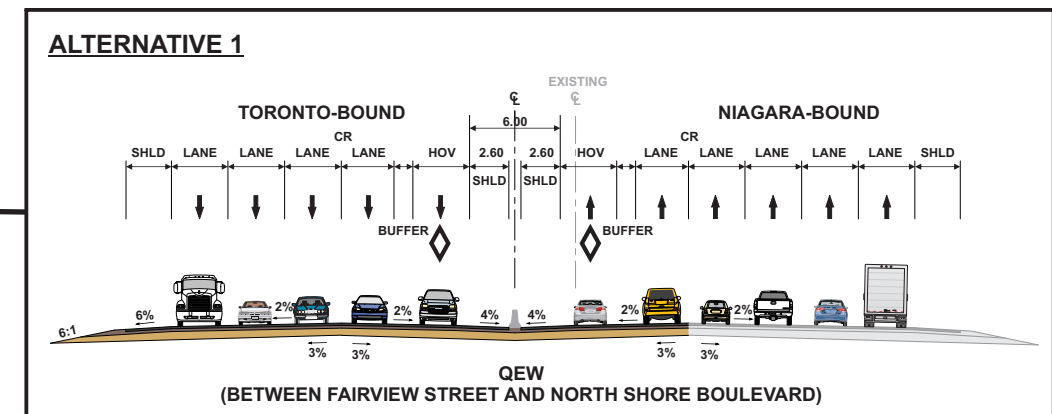
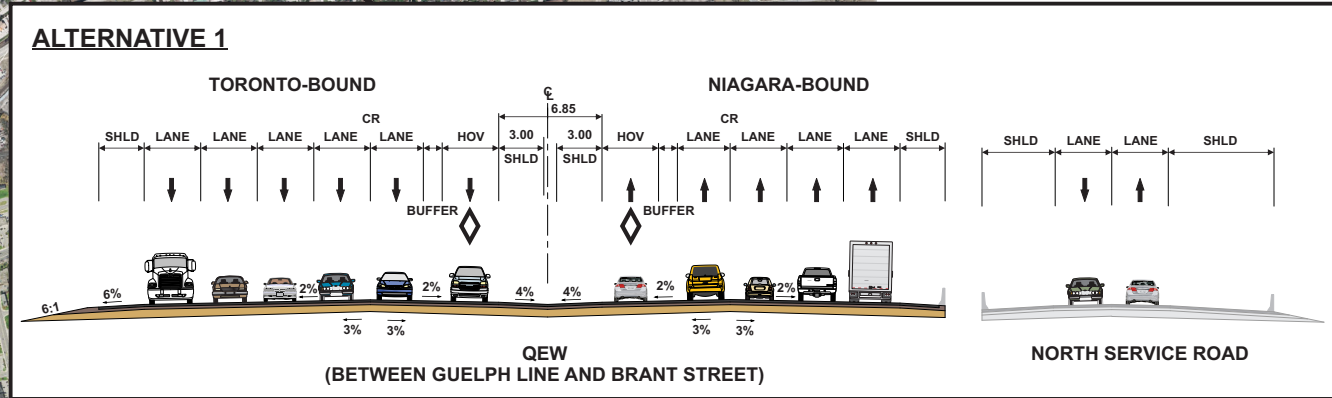
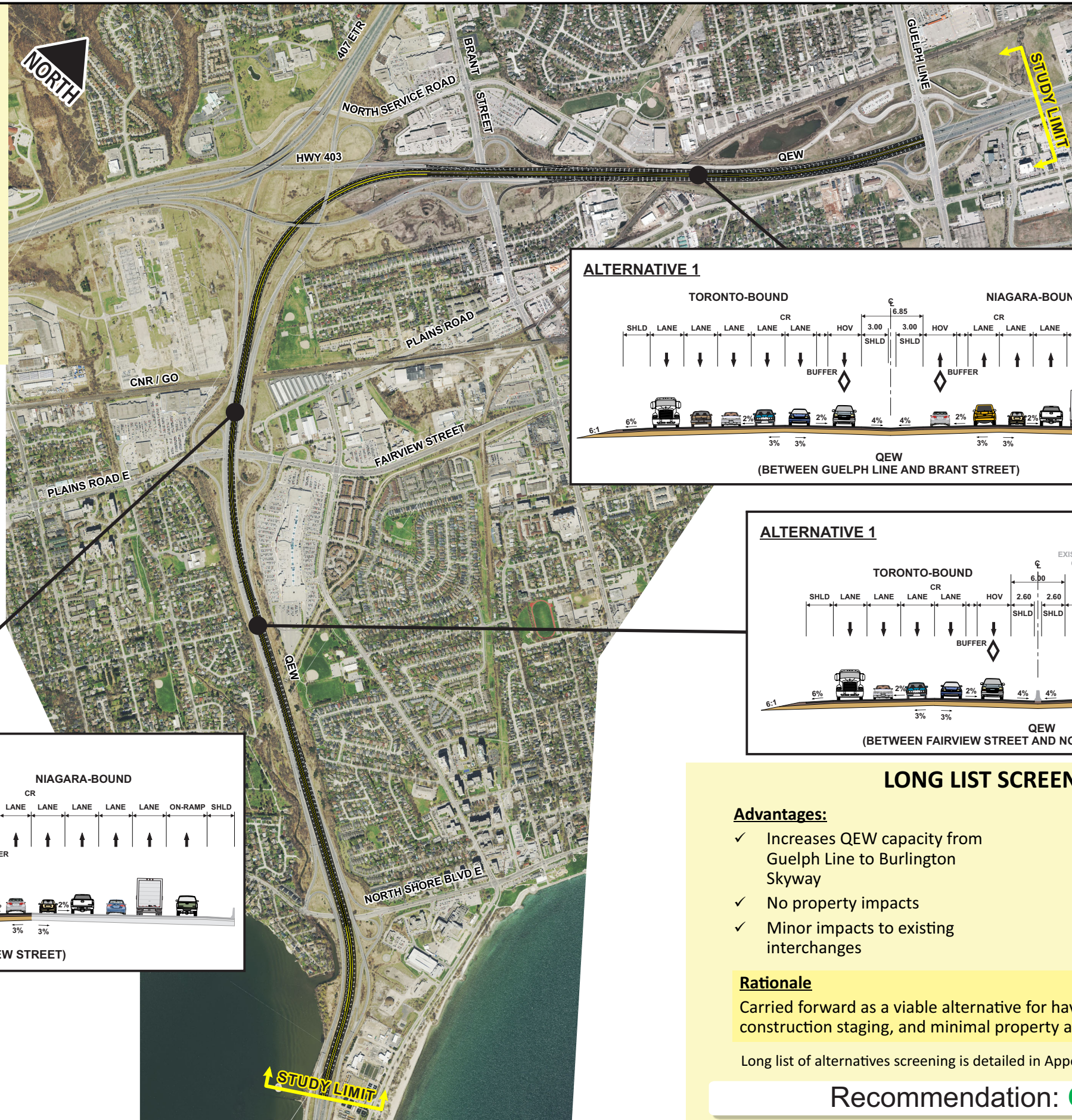
▶ Alternative 2B

- Provide a new semi directional ramp for the QEW northbound to Highway 403 westbound ramp.
- Provide a separate two-lane ramp for QEW northbound to 407 ETR northbound.
- Widen Highway 403 by an additional general-purpose lane or HOV lane.

ALTERNATIVE 1 DESCRIPTION

Widen QEW by one HOV lane in both directions from Guelph Line (the existing terminus of the HOV lanes), through the Freeman Interchange, to the North Shore Boulevard Interchange.

QEW will be widened into the existing median to provide the HOV lane, and the median shoulder widths vary, with some locations being the minimum allowed per MTO standards.



LONG LIST SCREENING SUMMARY

Advantages:

- ✓ Increases QEW capacity from Guelph Line to Burlington Skyway
- ✓ No property impacts
- ✓ Minor impacts to existing interchanges

Disadvantages:

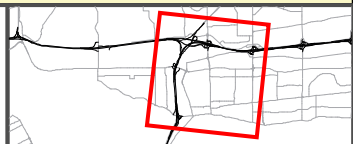
- ✗ Narrow shoulders at bridges within Freeman Interchange

Rationale

Carried forward as a viable alternative for having low construction cost, simple construction staging, and minimal property and natural impacts.

Long list of alternatives screening is detailed in Appendix H.

Recommendation: **Carry Forward**

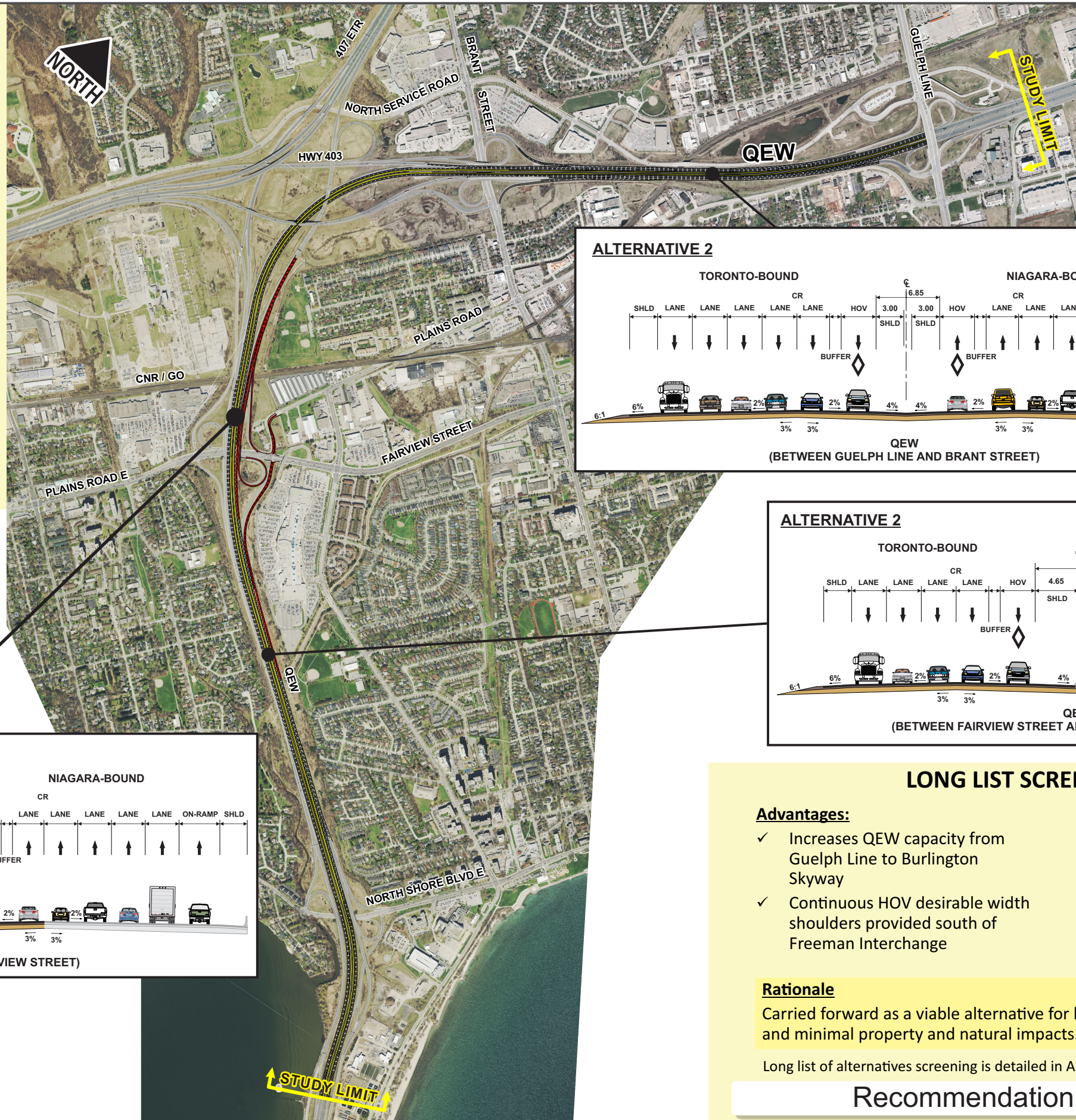


ALTERNATIVE 2 DESCRIPTION

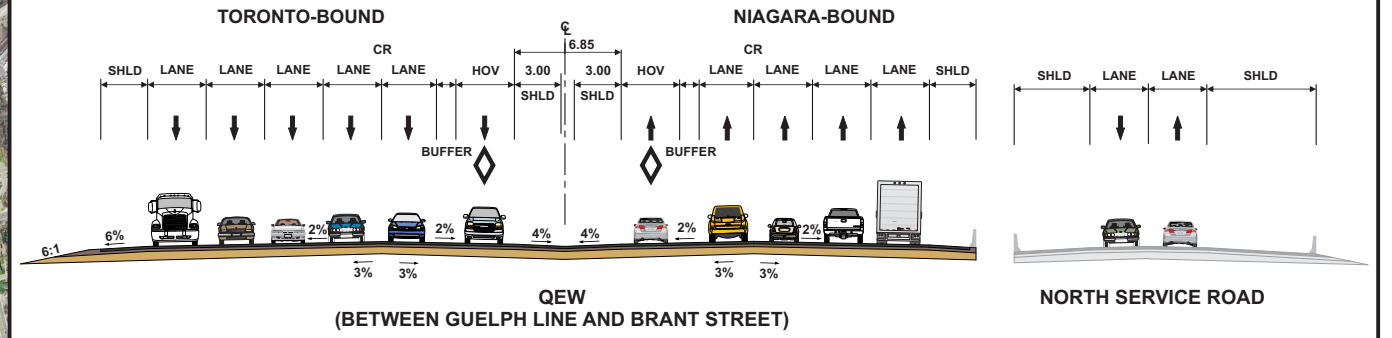
Widen QEW by one HOV lane in both directions from Guelph Line, through the Freeman Interchange, to North Shore Boulevard Interchange.

QEW will be widened into the existing median too provide the HOV lane, and the median shoulders are designed with desirable widths, per MTO standards.

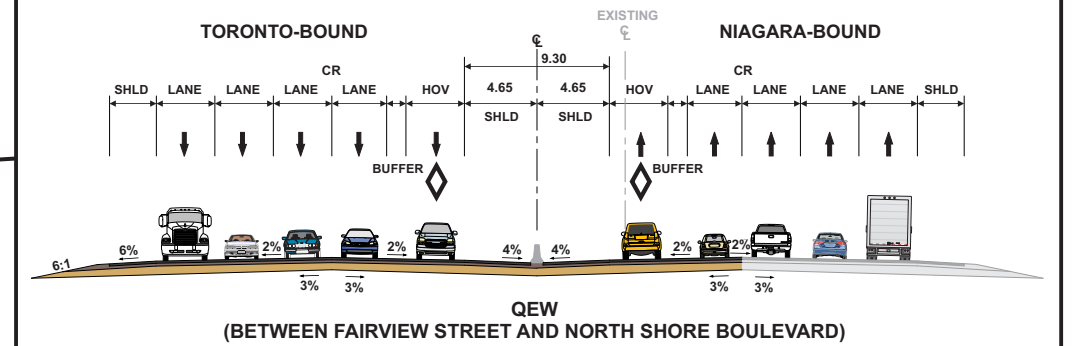
Requires easterly widening of the QEW northbound lanes at the Fairview Street / Plains Rd East Interchange, ramp realignments and the relocation of the easterly ramp terminal.



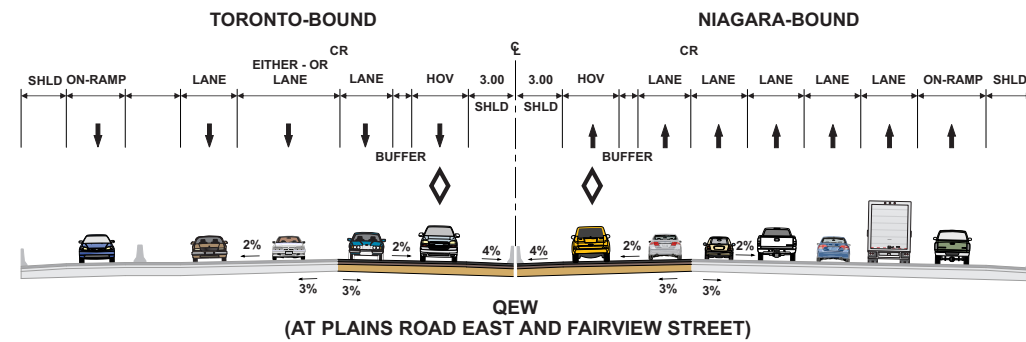
ALTERNATIVE 2



ALTERNATIVE 2



ALTERNATIVE 2



LONG LIST SCREENING SUMMARY

Advantages:

- ✓ Increases QEW capacity from Guelph Line to Burlington Skyway
- ✓ Continuous HOV desirable width shoulders provided south of Freeman Interchange

Disadvantages:

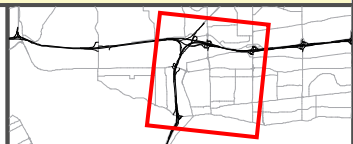
- ✗ Fairview St. / Plains Rd. Interchange easterly ramps must be reconstructed
- ✗ Narrow shoulders at bridges within Freeman Interchange
- ✗ Minor property impacts

Rationale

Carried forward as a viable alternative for having relatively low construction cost, and minimal property and natural impacts.

Long list of alternatives screening is detailed in Appendix H.

Recommendation: **Carry Forward**

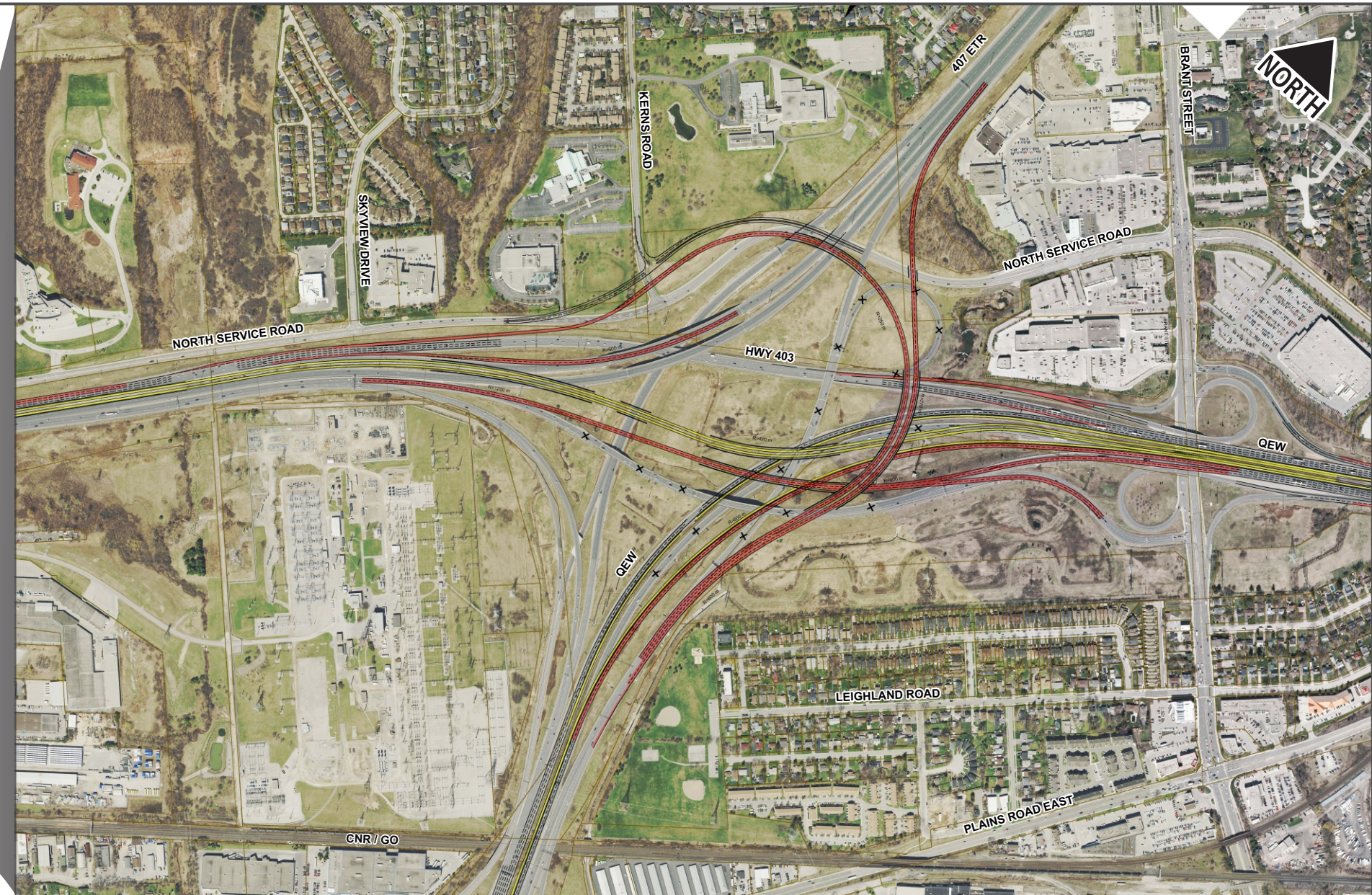


ALTERNATIVE 3 DESCRIPTION

Widen QEW by one HOV lane in both directions from Guelph Line, through Freeman Interchange, to the North Shore Boulevard Interchange.

Widen Highway 403 by one HOV lane in both directions including a dedicated connection to the QEW HOV lanes through the Freeman Interchange.

The HOV lane connection through the Freeman Interchange requires numerous bridge replacements.



LONG LIST SCREENING SUMMARY

Advantages:

- ✓ Direct HOV connection between QEW and Highway 403
- ✓ Provides most opportunity for capacity expansion on QEW and Highway 403
- ✓ Can provide desirable shoulder widths throughout

Disadvantages:

- ✗ Property impacts in north-west and north-east quadrants
- ✗ Very high cost
- ✗ Challenging construction staging
- ✗ Requires replacement of several bridges

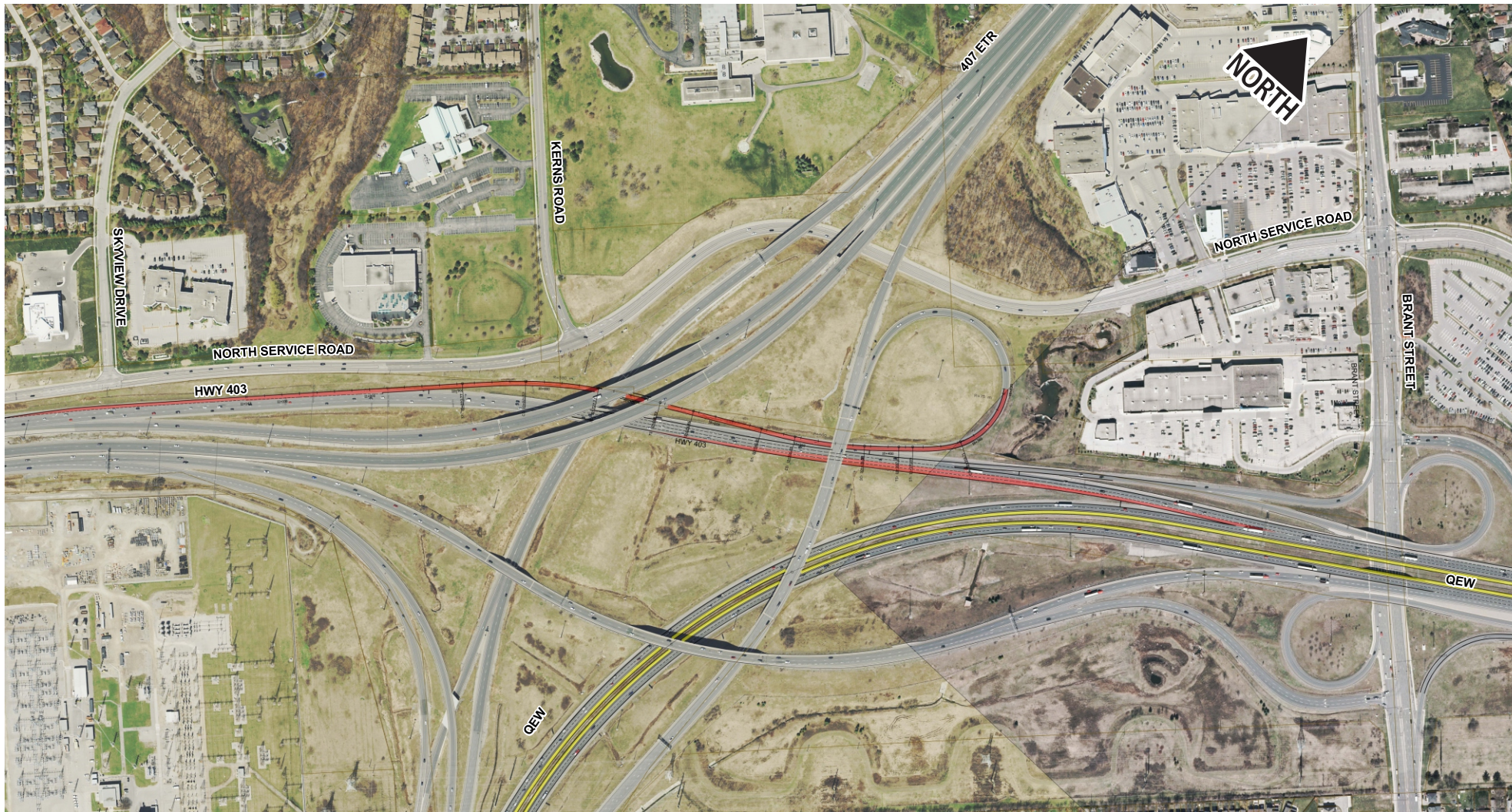
Rationale

Not carried forward as a viable alternative for having very high construction cost, very challenging construction staging, and the need to replace multiple bridges.

Long list of alternatives screening is detailed in Appendix H.

Recommendation: Do Not Carry Forward





ALTERNATIVE 1A DESCRIPTION

Realign the QEW northbound to Highway 403 westbound inner loop-ramp to merge with Highway 403 at a more westerly point.

Highway 403 is widened by one General Purpose Lane (GPL) in each direction by widening into the median.

LONG LIST SCREENING SUMMARY

Advantages:

- ✓ Additional capacity for east-to-west traffic
- ✓ Relatively low cost

Disadvantages:

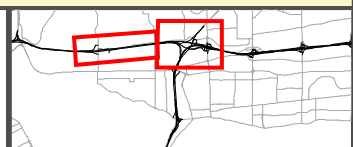
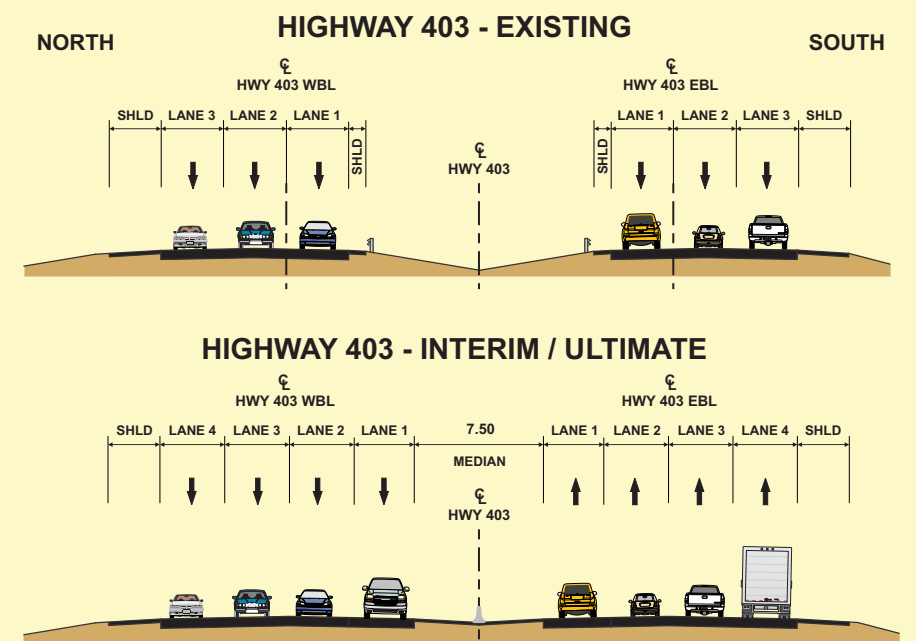
- ✗ Challenging constructability at 407 ETR ramps
- ✗ Does not provide additional capacity for south-to-west ramp
- ✗ Minimal property required

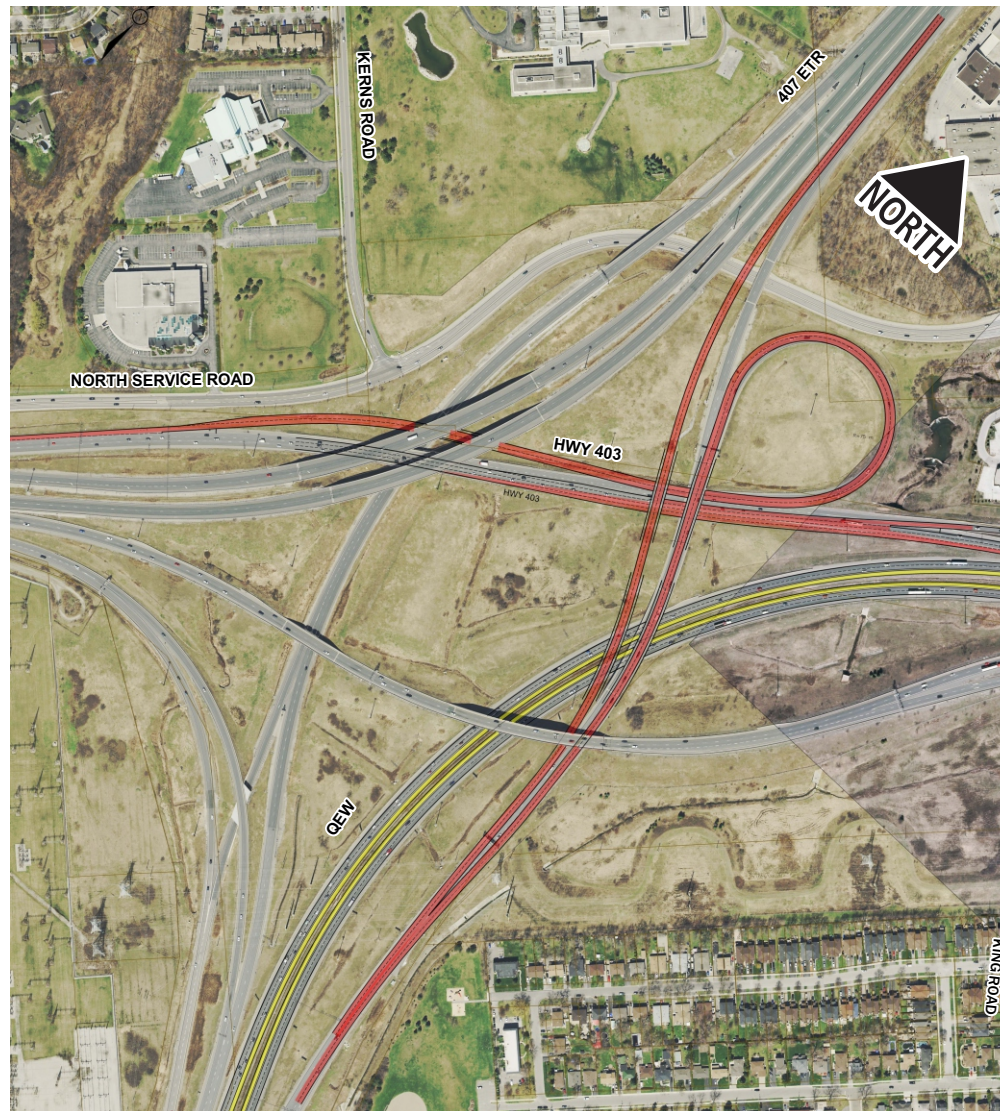
Rationale

Carried forward as an interim solution only as additional capacity for the south-to-west movement is also required to accommodate long-term needs.

Long list of alternatives screening is detailed in Appendix H.

Recommendation: **Carry Forward as Interim Solution**





ALTERNATIVE 1B DESCRIPTION

Provide a two-lane inner-loop ramp for the QEW northbound to Highway 403 westbound ramp.

Realign the QEW northbound to Highway 403 westbound inner loop ramp to merge with Highway 403 at a more westerly point.

Provide a separate two-lane ramp for the QEW northbound to 407 ETR northbound ramp.

Highway 403 is widened by one General Purpose Lane (GPL) in each direction by widening into the median

LONG LIST SCREENING SUMMARY

Advantages:

- ✓ Additional capacity for east-to-west and south-to-west traffic
- ✓ Relatively low cost
- ✓ Minimal property required

Disadvantages:

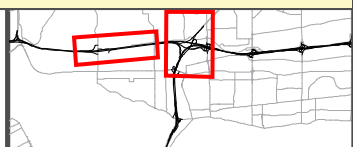
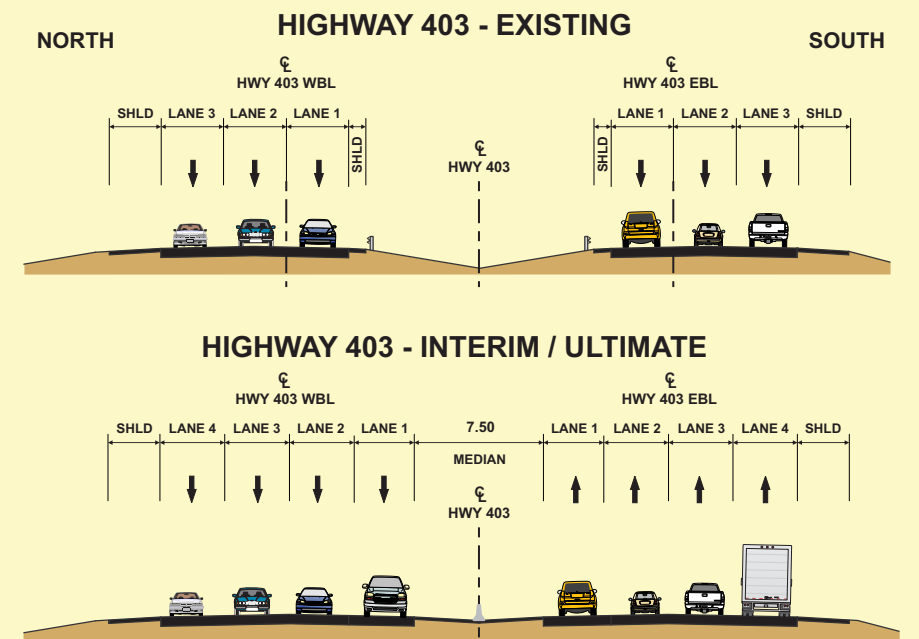
- ✗ Challenging constructability at 407 ETR ramps
- ✗ Requires new QEW NB to 407 ETR ramp

Rationale

Carried forward as a viable alternative for having relatively low construction cost, no natural environment impacts, and the additional capacity for east-to-west and south-to-west traffic.

Long list of alternatives screening is detailed in Appendix H.

Recommendation: **Carry Forward**





ALTERNATIVE 2A DESCRIPTION

Provide a new semi directional ramp for the QEW northbound to Highway 403 westbound ramp.

Highway 403 is widened by one General Purpose Lane (GPL) in each direction by widening into the median.

LONG LIST SCREENING SUMMARY

Advantages:

- ✓ Additional capacity for east-to-west and south-to-west traffic
- ✓ Improved geometry for south-to-west ramp

Disadvantages:

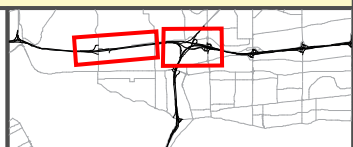
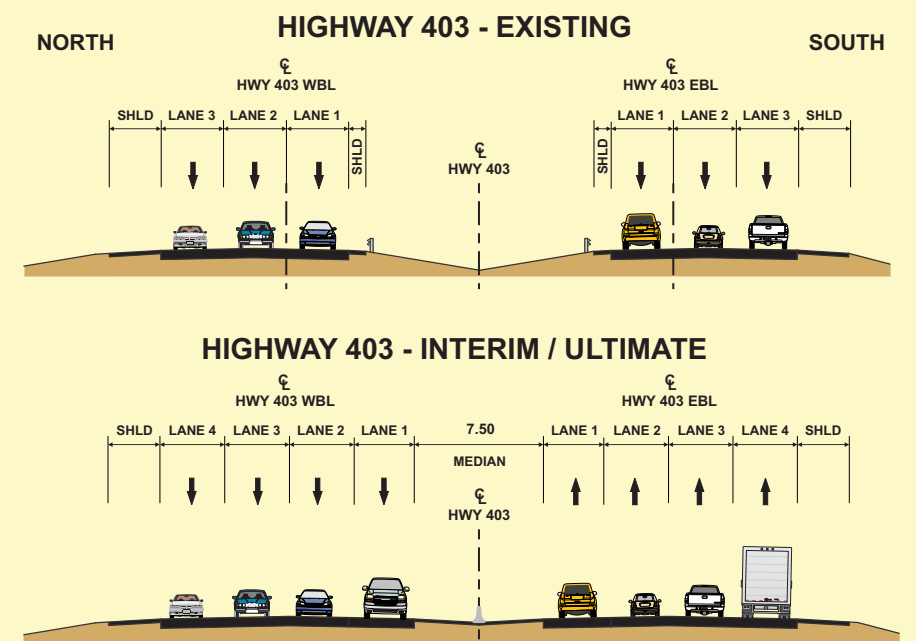
- ✗ Relatively high cost due to long bridge
- ✗ Challenging constructability under EB 403 ramp
- ✗ Potential traffic weaving impacts between Fairview St. / Plains Rd. Interchange and new WB ramp
- ✗ May require modification to Fairview St. / Plains Rd. Interchange ramps to mitigate weaving issues
- ✗ Property impacts in northwest quadrant

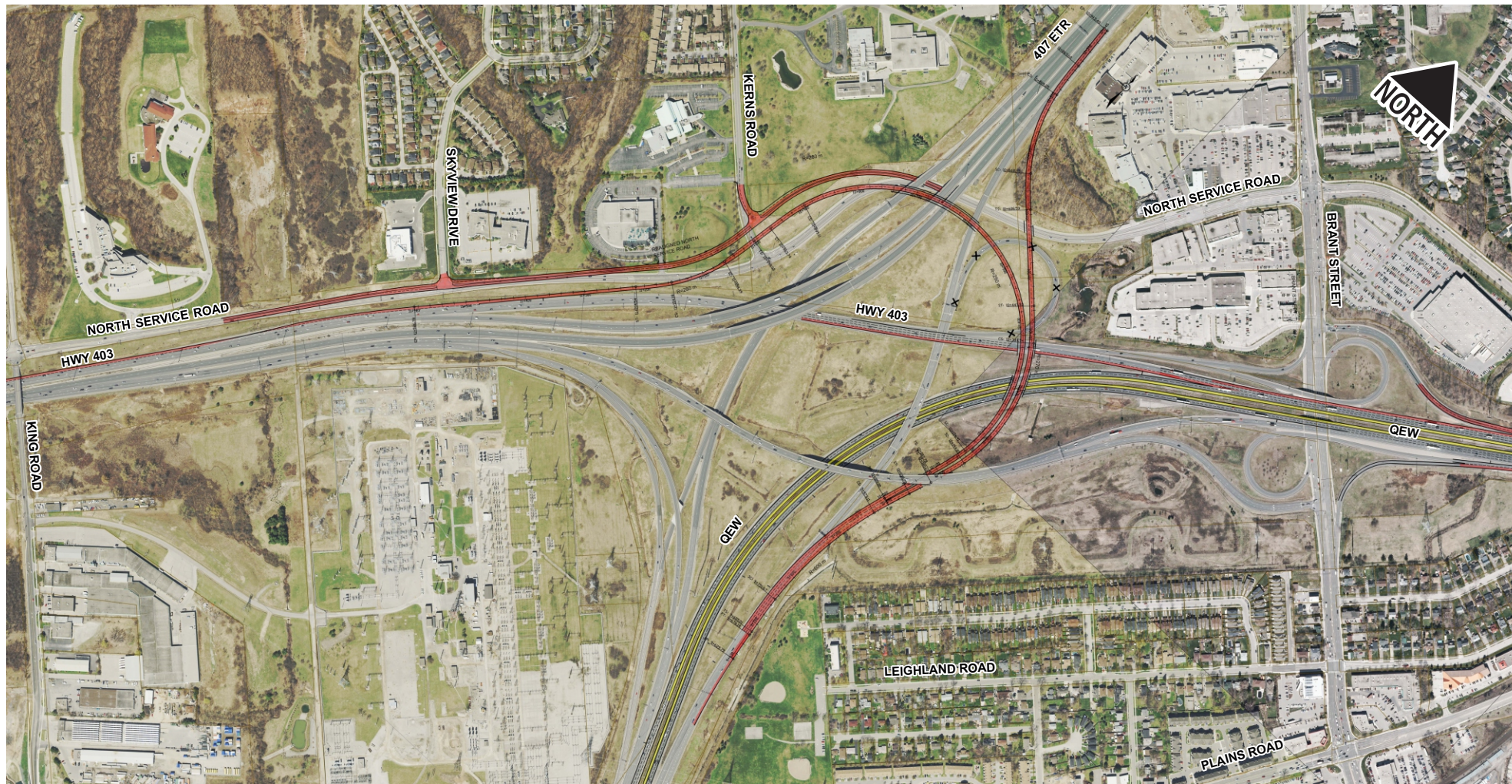
Rationale

Carried forward as a viable alternative for having relatively low construction cost, improved geometry for south-to-west ramp, and the additional capacity for east-to-west and south-to-west traffic.

Long list of alternatives screening is detailed in Appendix H.

Recommendation: **Carry Forward**





ALTERNATIVE 2B DESCRIPTION

Provide a new semi directional ramp for the QEW northbound to Highway 403 westbound ramp.

Provide a separate two-lane ramp for QEW northbound to 407 ETR northbound.

Highway 403 is widened by one General Purpose Lane (GPL) in each direction by widening into the median.

LONG LIST SCREENING SUMMARY

Advantages:

- ✓ Additional capacity for east-to-west and south-to-west traffic
- ✓ Improved geometry for south-to-west ramp

Disadvantages:

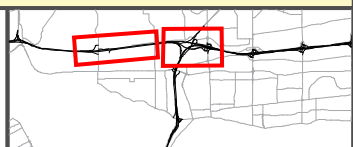
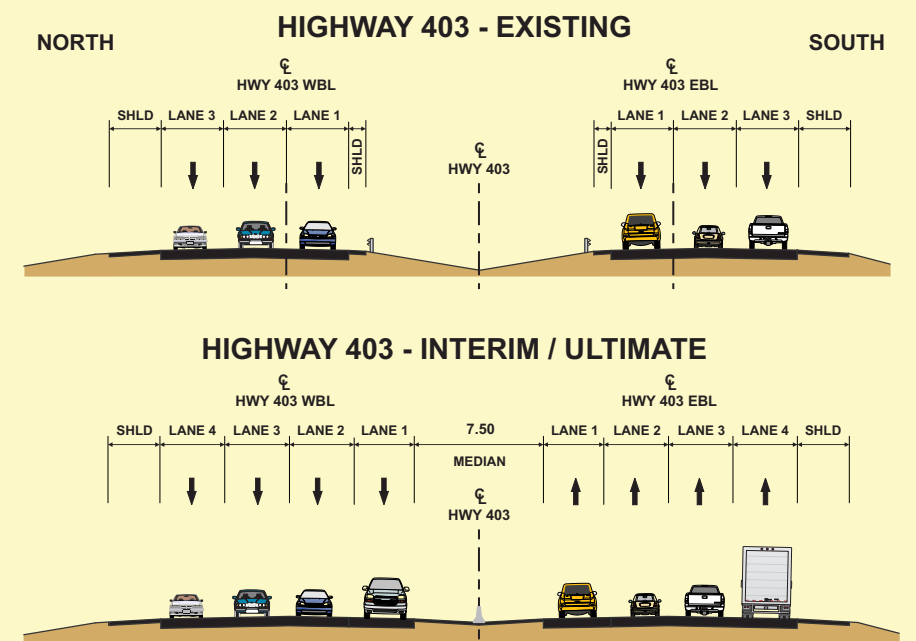
- ✗ Relatively high cost due to long bridge
- ✗ Challenging constructability under EB 403 ramp
- ✗ Potential impacts in northwest quadrant
- ✗ Requires new ramp from QEW to 407 ETR to mitigate weaving issues
- ✗ Reduced design speed between NB QEW and 407 ETR

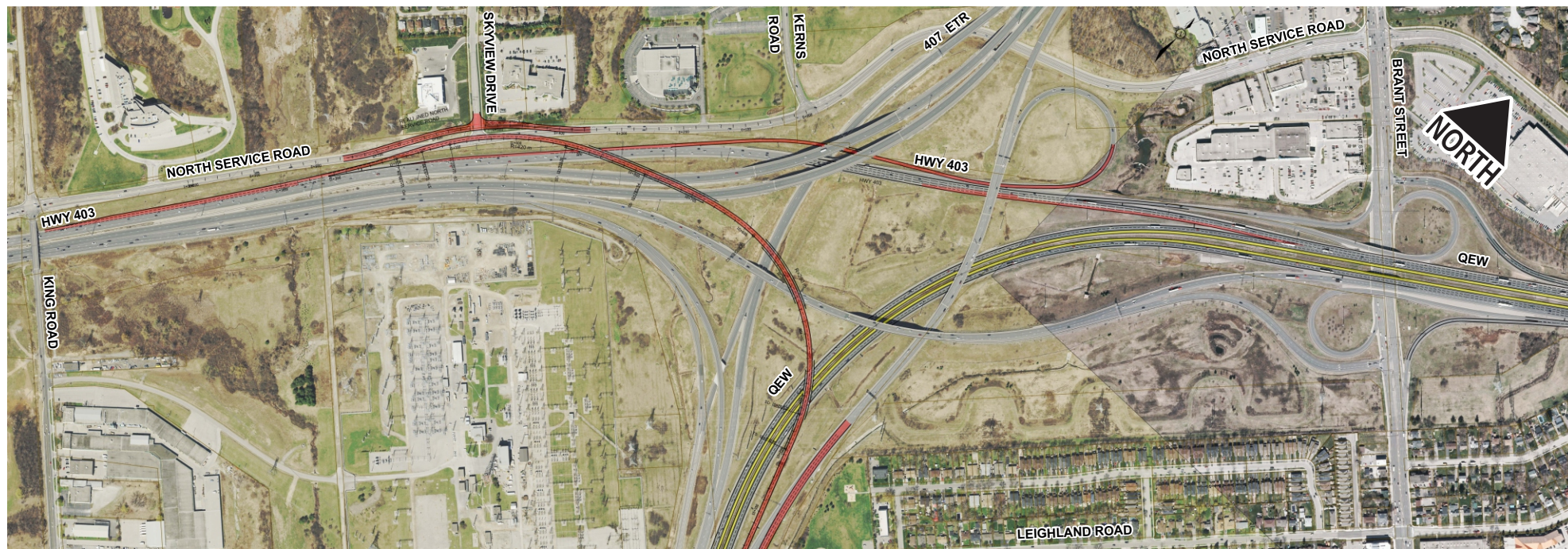
Rationale

Not carried forward for having relatively high construction cost, challenging constructability, and property impacts in north-west quadrant.

Long list of alternatives screening is detailed in Appendix H.

Recommendation: Do Not Carry Forward





ALTERNATIVE 3A DESCRIPTION

Provide a new directional ramp for the QEW northbound to Highway 403 westbound ramp. Highway 403 is widened by one General Purpose Lane (GPL) in each direction by widening into the median. Directional ramp has a 'broken back' design (less desirable) to mitigate property impacts.

LONG LIST SCREENING SUMMARY

Advantages:

- ✓ Additional capacity for east-to-west and south-to-west traffic
- ✓ Improved geometry for south-to-west ramp
- ✓ Avoids weaving issues

Disadvantages:

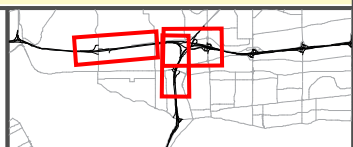
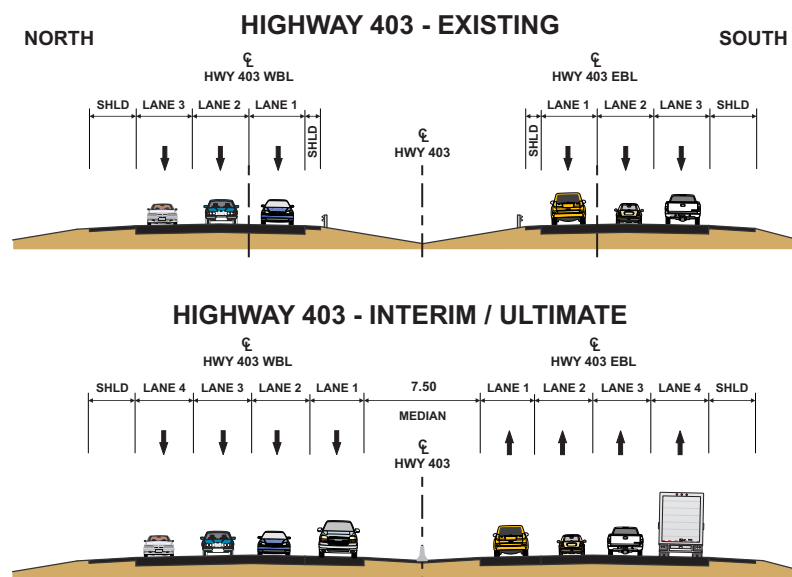
- ✗ Relatively high cost
- ✗ Significant impacts to existing hydro transmission corridor and towers
- ✗ 'Broken-back' curve on new south-to-west ramp less desirable than simple curve
- ✗ Inner-loop ramp (Alternative 1A) must be used to avoid weaving issue.
- ✗ Relatively minor property impacts

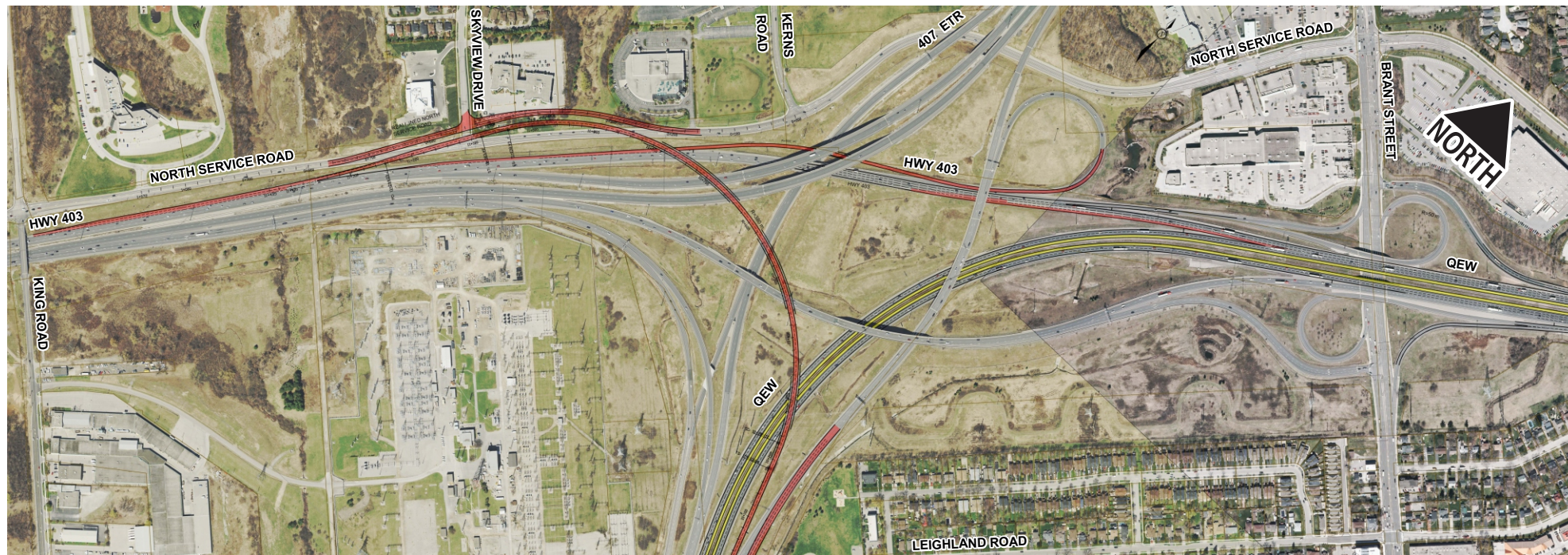
Rationale

Not carried forward for having relatively high construction cost, potential significant impacts to the existing hydro transmission corridor, and property impacts in north-west quadrant.

Long list of alternatives screening is detailed in Appendix H.

Recommendation:
Do Not Carry Forward





ALTERNATIVE 3B DESCRIPTION

Provide a new directional ramp for the QEW northbound to Highway 403 westbound ramp.
 Highway 403 is widened by one General Purpose Lane (GPL) in each direction by widening into the median.
 Use of single curve for directional ramp results in property impacts.

LONG LIST SCREENING SUMMARY

Advantages:

- ✓ Additional capacity for east-to-west and south-to-west traffic
- ✓ Improved geometry for south-to-west ramp
- ✓ Avoids weaving issues

Disadvantages:

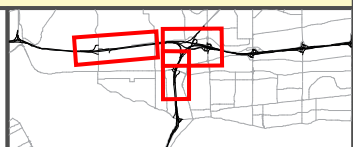
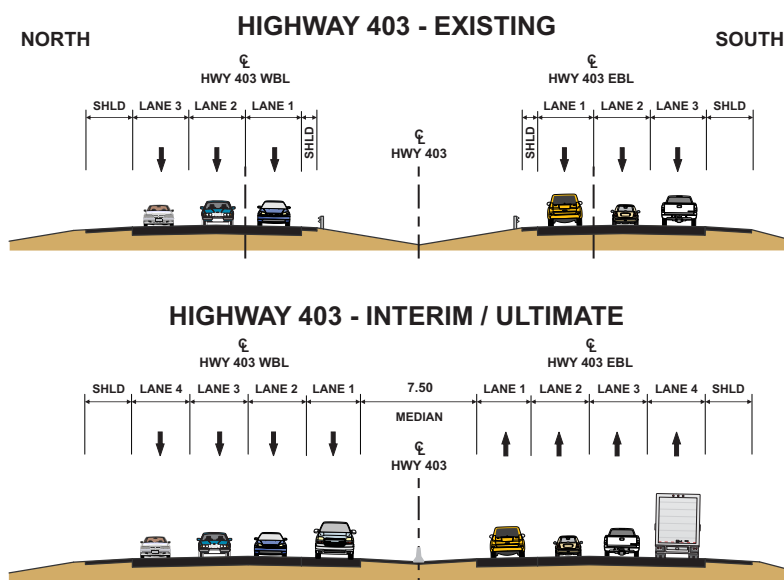
- ✗ Relatively high cost
- ✗ Significant impacts to North Service Road
- ✗ Significant impacts to existing hydro transmission corridor and towers
- ✗ Inner-loop ramp (Alternative 1A) must be used to avoid weaving issue

Rationale

Not carried forward for having relatively high construction cost, property impacts in north-west quadrant, and challenging constructability under EB 403 ramp.

Long list of alternatives screening is detailed in Appendix H.

Recommendation:
Do Not Carry Forward



- ▶ Alternative 3A
 - Provide a new directional ramp for the QEW northbound to Highway 403 westbound ramp.
 - Widen Highway 403 by an additional general-purpose lane or HOV lane.
 - Directional ramp has a 'broken back' design (less desirable) to mitigate property impacts.
- ▶ Alternative 3B
 - Provide a new directional ramp for the QEW northbound to Highway 403 westbound ramp.
 - Widen Highway 403 by an additional general-purpose lane or HOV lane.
 - Use of single curve for directional ramp results in property impacts

5.2.3 HIGHWAY 403 AND FREEMAN INTERCHANGE, EASTBOUND

For the eastbound lanes of Highway 403 and the Freeman Interchange, two alternatives were created and are summarized below.

- ▶ Alternative 1
 - Provide a new ramp for the Highway 403 to QEW eastbound movement.
 - Widen Highway 403 by an additional general-purpose lane.
- ▶ Alternative 2
 - Provide a new ramp for the Highway 403 to QEW eastbound movement
 - Widen Highway 403 by an additional general-purpose lane.
 - Provide an additional lane on the Highway 403 to QEW southbound ramp.

The key difference between the alternatives is the provision of two lanes from Highway 403 eastbound to QEW southbound, which is only included in Alternative 1B. Both alternatives included a new ramp for the Highway 403 eastbound to QEW eastbound movement, as the traffic analysis identified that three lanes would be required to accommodate traffic by the project horizon year of 2041. The existing ramp is limited to two lanes and uses two structures of a type that is technically unfeasible to widen, thus a new ramp is proposed. The traffic analysis conducted as part of this study is detailed in **Sections 4.4.7 and Section 7.7**

Exhibits of the Highway 403 and Freeman Interchange, Eastbound Alternatives 1 & 2 are included in **Exhibits 5-10 and Exhibits 5-11**, respectively, and their screening is detailed in **Appendix H**.

5.3 SCREENING OF LONG-LIST OF ALTERNATIVES

The screening of the long-list of alternatives is included in **Appendix H**. The screening of the long-list of alternatives is used to identify a short-list of alternatives. The short-list of alternatives is carried forward and subjected to a detailed evaluation to identify the Technically Preferred Alternative.

5.4 IDENTIFICATION OF SHORT-LIST ALTERNATIVES

A summary of the long-list screening and identification of the short-list of alternatives is detailed in **Table 5-2**. From the long-list screening, two QEW alternatives (Alts 1 and 2), two Highway 403 and Freeman Interchange Westbound alternatives (Alts 1B and 2A) and two Highway 403 and Freeman Interchange Eastbound alternatives (Alts 1 and 2) were carried forward to the shortlist of alternatives.

Table 5-2: Summary of Screening of Long-list Alternatives

Alternative	Carried Forward?
QEW - Alternative 1	✓
QEW - Alternative 2	✓
QEW - Alternative 3	✗
Hwy 403 / Freeman Westbound - Alternative 1A	✓*
Hwy 403 / Freeman Westbound - Alternative 1B	✓
Hwy 403 / Freeman Westbound - Alternative 2A	✓
Hwy 403 / Freeman Westbound - Alternative 2B	✗
Hwy 403 / Freeman Westbound - Alternative 3A	✗
Hwy 403 / Freeman Westbound - Alternative 3B	✗
Hwy 403 / Freeman Eastbound - Alternative 1	✓**
Hwy 403 / Freeman Eastbound - Alternative 2	✓

*Interim condition only

Hwy 403/ Freeman Eastbound Alternative 1 was carried forward but later screened out as further traffic analysis identified that it did not provide the required long-term capacity needs (further detailed in **Section 5.5.1.)

Highway 403 and Freeman Interchange Westbound Alternative 1A was carried forward but for interim purposes only. Traffic analysis had identified that two lanes would be required for the QEW northbound to Highway 403 westbound movement by the project horizon. Thus, while the alternative had several operational and technical benefits, it would not serve as a long-term solution.

5.5 DEVELOPMENT OF SHORT-LIST ALTERNATIVES

Once the shortlisted alternatives for both QEW and Highway 403 were identified, the next step taken was to combine the Highway 403 and Freeman Westbound alternatives with the Highway 403 and Freeman Eastbound alternatives. Thus, the alternatives were developed into QEW Alternatives and Highway 403 / Freeman Interchange Alternatives. The QEW Alternatives are shown in **Exhibit 5-12** while the Highway 403/Freeman Interchange Alternatives are shown in **Exhibit 5-13**.



ALTERNATIVE 1 DESCRIPTION

Provide a new ramp for the Highway 403 to QEW eastbound movement. Highway 403 is widened by one General Purpose Lane (GPL) in each direction by widening into the median.

LONG LIST SCREENING SUMMARY

Advantages:

- ✓ Additional capacity for east Hwy 403 EB to QEW EB ramp
- ✓ No property requirements
- ✓ Minimal staging impacts

Disadvantages:

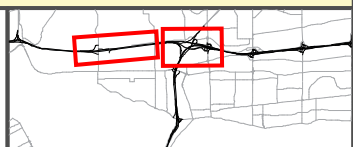
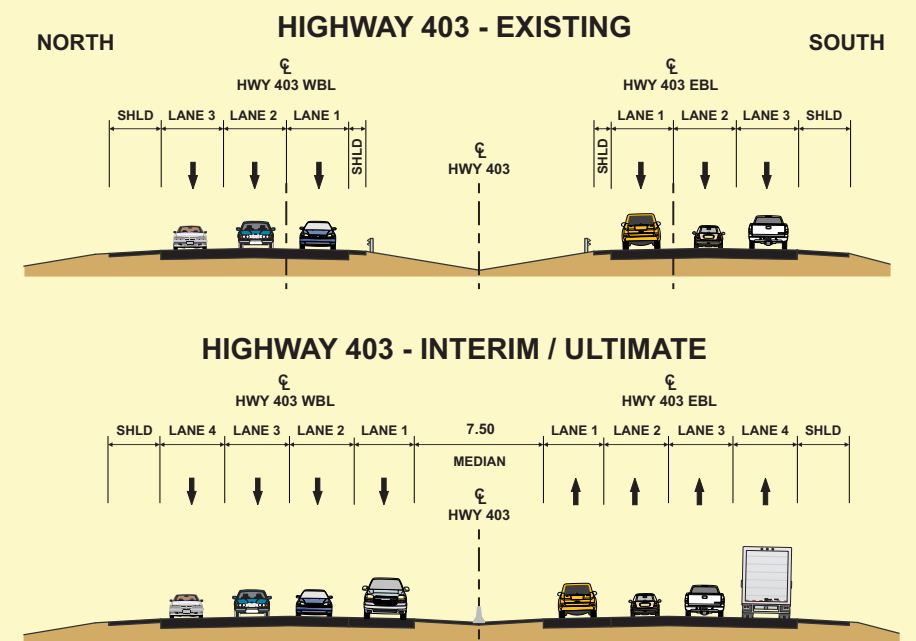
- ✗ Requires replacement of existing Toronto-bound bridges

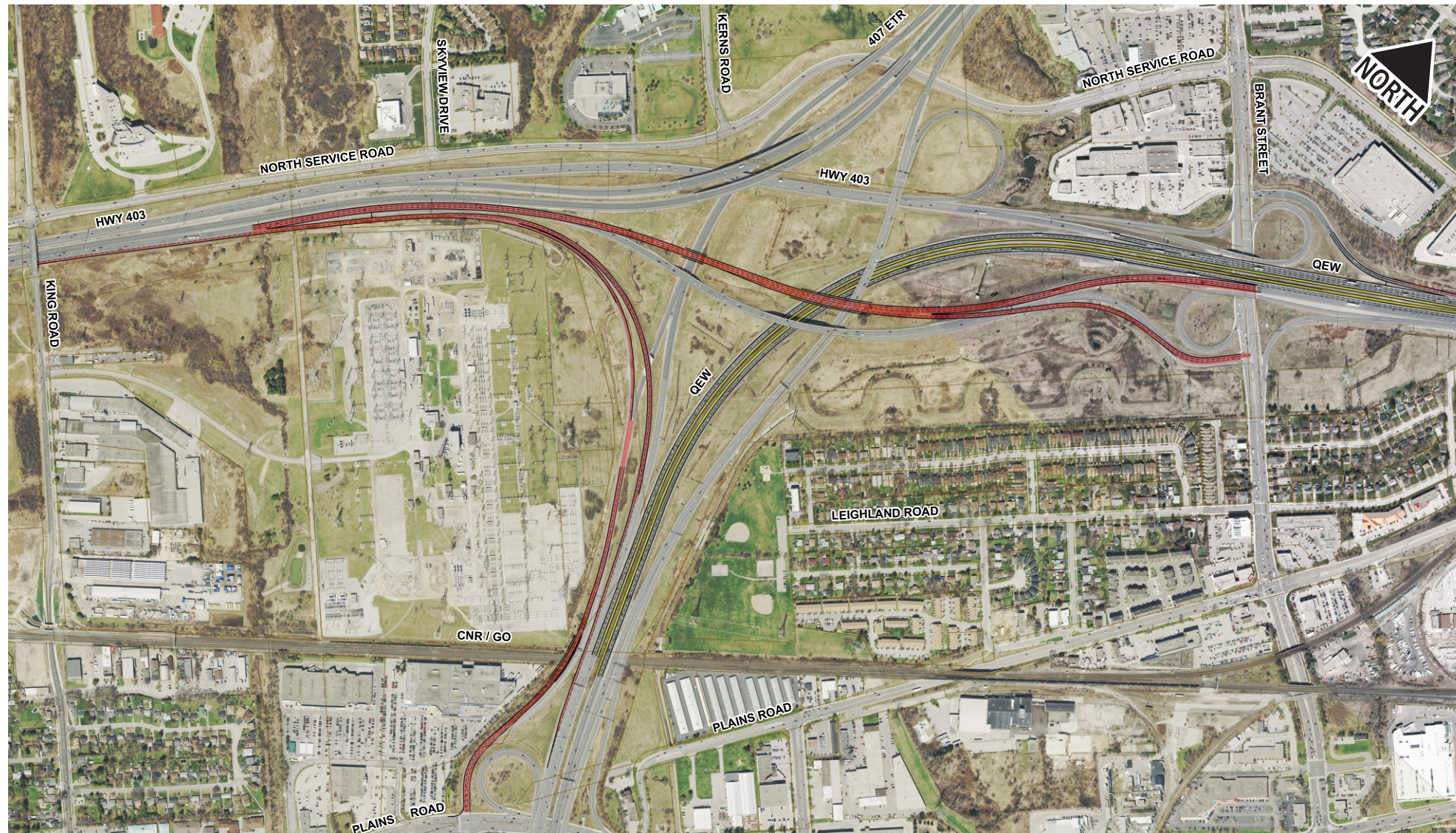
Rationale

Carried forward as a viable alternative for having relatively low construction cost, minimal construction staging impacts, no property impacts, and additional capacity for Toronto-bound traffic.

Long list of alternatives screening is detailed in Appendix H.

Recommendation: Carry Forward





ALTERNATIVE 2 DESCRIPTION

Provide a new ramp for the Highway 403 to QEW eastbound movement
 Highway 403 is widened by one General Purpose Lane (GPL) in each direction by widening into the median.
 Provide an additional lane on the Highway 403 to QEW southbound ramp.

LONG LIST SCREENING SUMMARY

Advantages:

- ✓ Additional capacity for west-to-east and west-to-south traffic

Disadvantages:

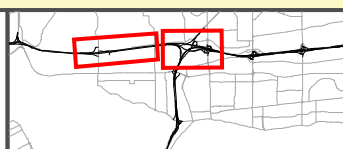
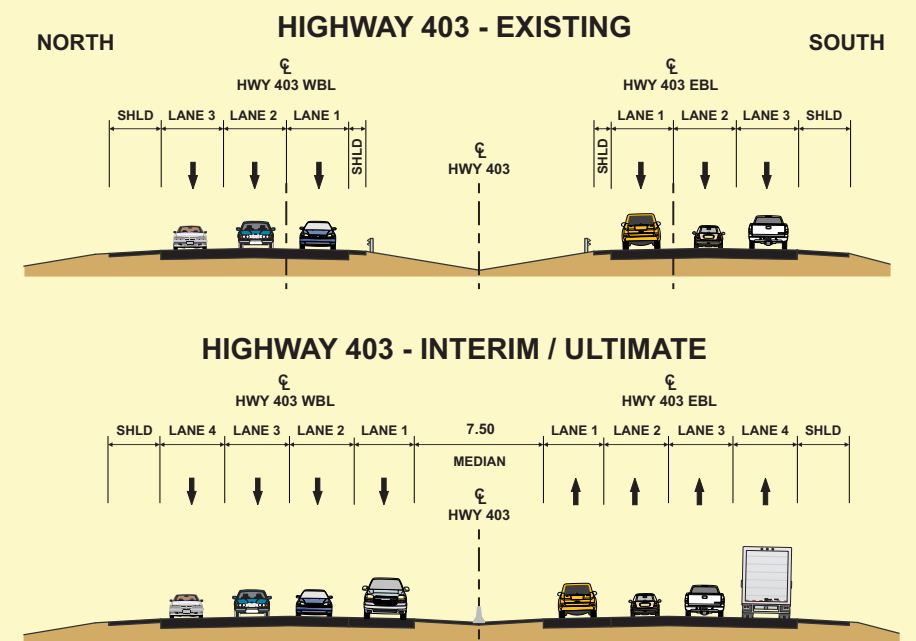
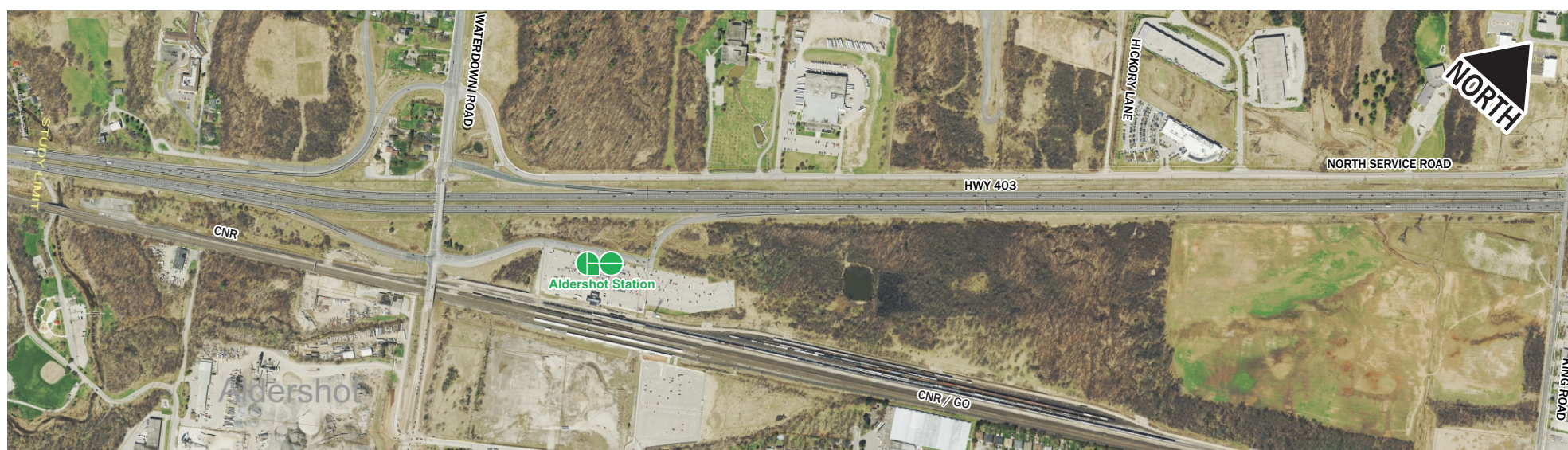
- ✗ Requires replacement of Fairview St. off-ramp bridge over CN Rail
- ✗ Requires widening / replacement of bridge over 407 ETR ramp
- ✗ Minimal property requirements

Rationale

Carried forward as a viable alternative for having relatively low construction cost, minimal construction staging and property impacts, and additional capacity for Toronto-bound traffic.

Long list of alternatives screening is detailed in Appendix H.

Recommendation: **Carry Forward**



5.5.1 HIGHWAY 403 / FREEMAN EASTBOUND ALTERNATIVE 1

After the screening of the long-list of alternatives, the identification of the shortlist alternatives and their presentation at PIC #1 (held October 10, 2017), further detailed traffic analysis was conducted on the alternatives. The detailed traffic analysis concluded that the Highway 403 / Freeman Eastbound Alternative 1 was only suitable as an interim improvement measure. By the project horizon, both the Highway 403 eastbound to QEW eastbound and the Highway 403 eastbound to QEW southbound ramps needed an additional lane each to accommodate forecast traffic volumes (as proposed in Highway 403 / Freeman Eastbound Alternative 2).

The combination of the single remaining eastbound alternative and the two shortlisted westbound alternatives created two complete Highway 403 / Freeman Interchange Alternatives as detailed in **Exhibit 5-13A** and **Exhibit 5-13B**:

Table 5-3: Combination of alternatives to complete Highway 403 / Freeman Alternatives

Highway 403/Freeman Interchange Westbound Alternative 1B	+	Highway 403/Freeman Interchange Eastbound Alternative 2	=	Highway 403/Freeman Interchange WB 1B + EB 2
Highway 403/Freeman Interchange Westbound Alternative 2A				Highway 403/Freeman Interchange WB 2A + EB 2

5.5.2 NEW QEW ALTERNATIVES 4 AND 5

The detailed traffic analysis also identified further traffic benefits on the QEW by providing for an additional general-purpose lane in each direction. The additional general-purpose lane is in addition to the proposed HOV lane in QEW Alternatives 1 and 2. Thus, new QEW Alternatives 4 and 5 were developed. The two alternatives provided for the additional HOV and additional general-purpose lane in each direction and only differed in how the northbound traffic from the Plains Road East / Fairview Street interchange merged with the QEW; Alternative 4 proposed a basket-weave (where one ramp crosses over the other on a structure to avoid merging together and the resultant weaving issues) and Alternative 5 proposed dedicated ramps to similarly avoid a point of merge and associated weaving. Alternative 4 and Alternative 5 are shown in **Exhibit 5-12C** and **Exhibit 5-12D** respectively.

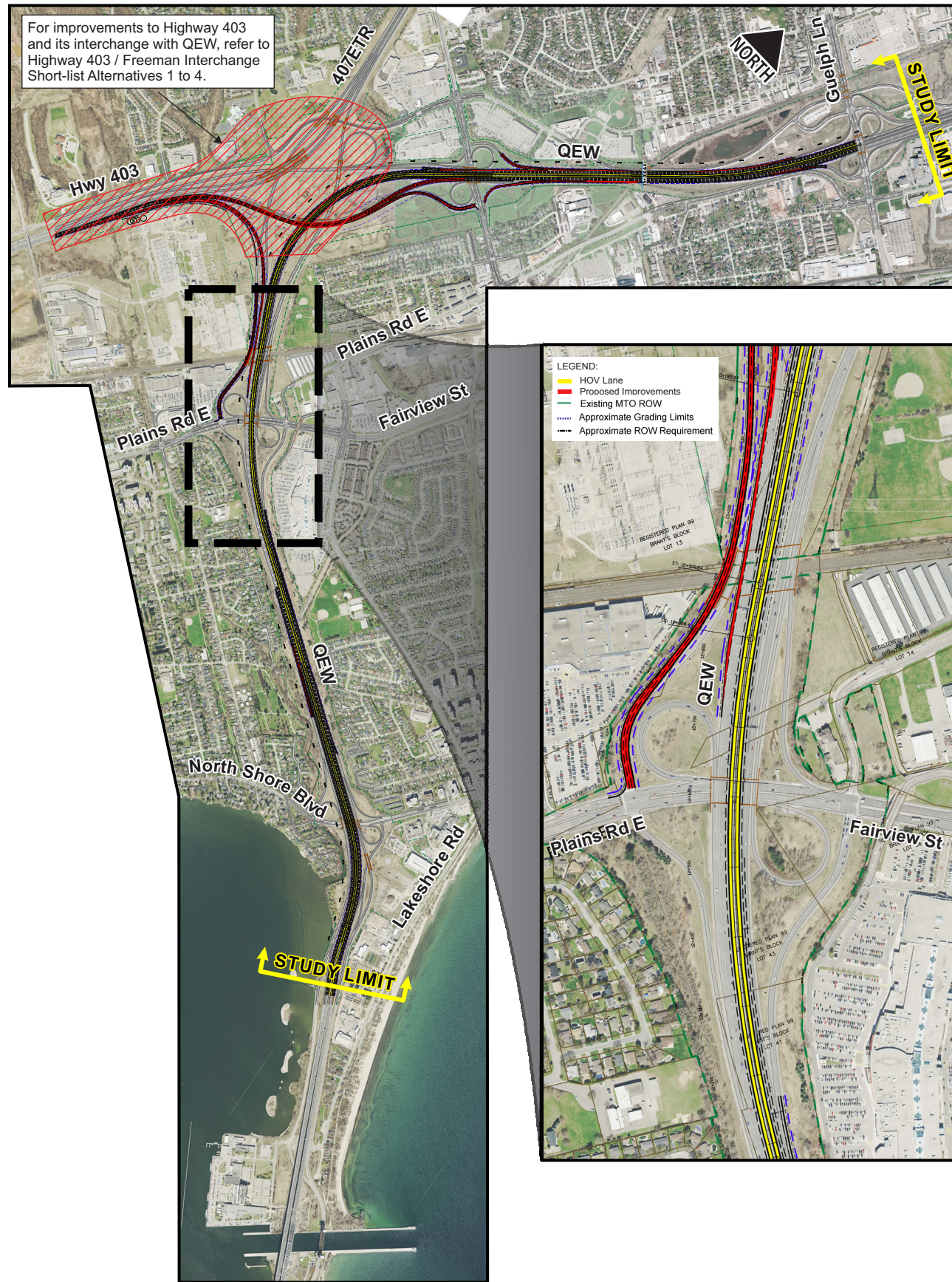
In QEW Alternative 5, the dedicated ramps worked by providing a 'split' movement: vehicles heading eastbound on Fairview Street, on approach to the interchange, would have a choice to turn right to use a dedicated ramp to access Highway 403, or turn left to use the inner-loop ramp to access 407 ETR. Detailed evaluation of the all alternatives is included in **Appendix H**.

5.5.3 SHORT-LIST ALTERNATIVES FOR EVALUATION

Ahead of the evaluation, the Short-List of Alternatives were refined as described below. As the new QEW Alternatives 4 and 5 required a wider cross-section through the Freeman Interchange, it was necessary to develop two versions of the two shortlisted Highway 403 / Freeman Interchange alternatives. Also at this stage, the naming convention of the Highway 403 / Freeman Interchange Alternatives was simplified.

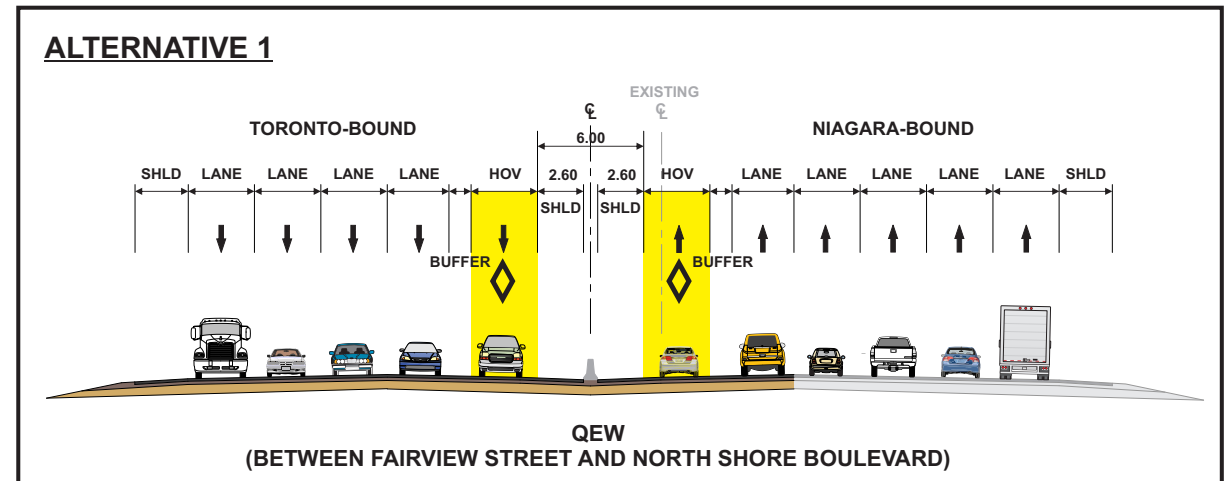
- ▶ QEW Alternatives (+ 1 HOV per direction)
 - Alternatives 1 and 2 (**Exhibit 5-12A** and **Exhibit 5-12B**)
- ▶ QEW Alternatives (+ 1 HOV and + 1 general purpose lane per direction)
 - Alternatives 3 and 4 (**Exhibit 5-12C** and **Exhibit 5-12D**)
- ▶ Highway 403 / Freeman Interchange (Compatible with QEW Alternatives 1 and 2)
 - Highway 403 / Freeman Interchange WB Alternative 1B and EB Alternative 2
 - Named Alternative 1 (**Exhibit 5-13A**)
 - Highway 403 / Freeman Interchange WB Alternative 2A and EB Alternative 2
 - Named Alternative 2 (**Exhibit 5-13B**)
- ▶ Highway 403 / Freeman Interchange (Compatible with QEW Alternatives 3 and 4)
 - Highway 403 / Freeman Interchange WB Alternative 1B and EB Alternative 2
 - Required additional Freeman Interchange structure replacement due to the wider QEW cross-section
 - Named Alternative 3 (**Exhibit 5-13C**)
 - Highway 403 / Freeman Interchange WB Alternative 2A and EB Alternative 2
 - Required additional Freeman Interchange structure replacement due to the wider QEW cross-section
 - Named Alternative 4 (**Exhibit 5-13D**)

QEW - ALTERNATIVE 1

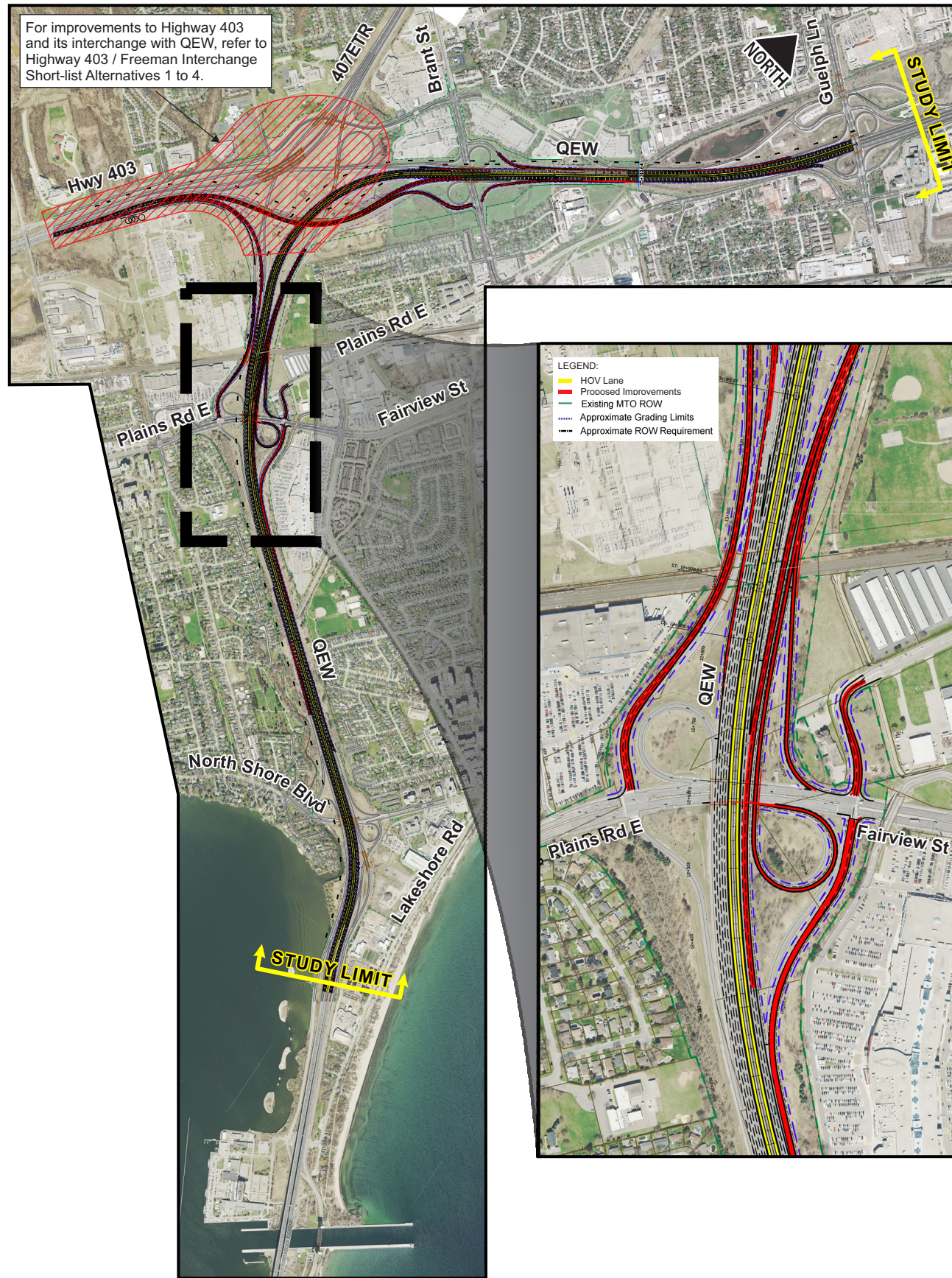


- In Alternative 1, the QEW is widened into the median and accommodates an HOV lane in each direction between Guelph Line and the Burlington Skyway.
- In Alternative 1, narrow shoulders are used to widen the HOV lane into the median.
- No extra property is required and there is minimal impact to the adjacent ramps.

Short list of alternatives evaluation is detailed in Table 5-4 and Appendix H.

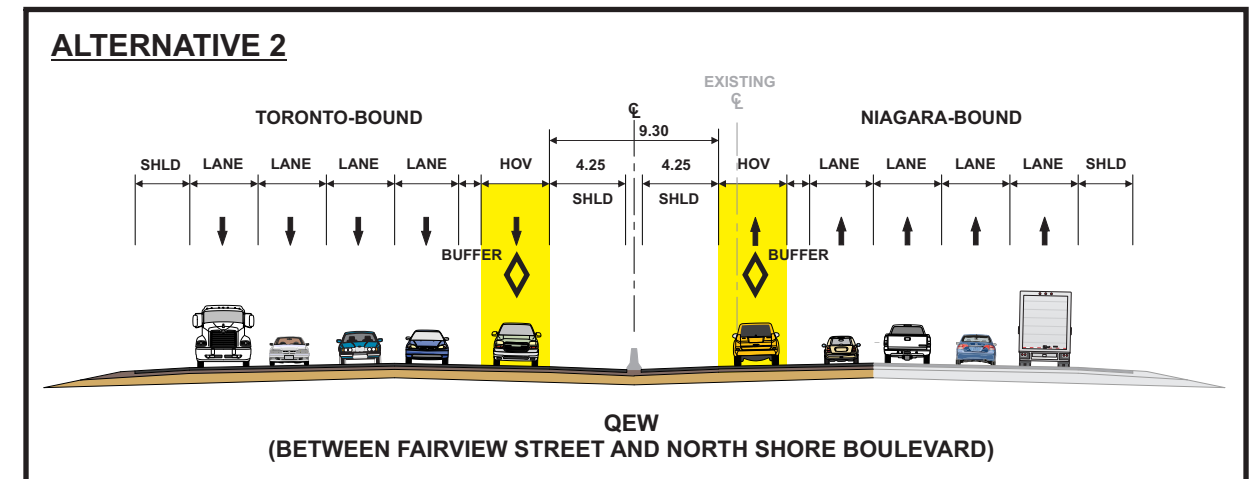


QEW - ALTERNATIVE 2

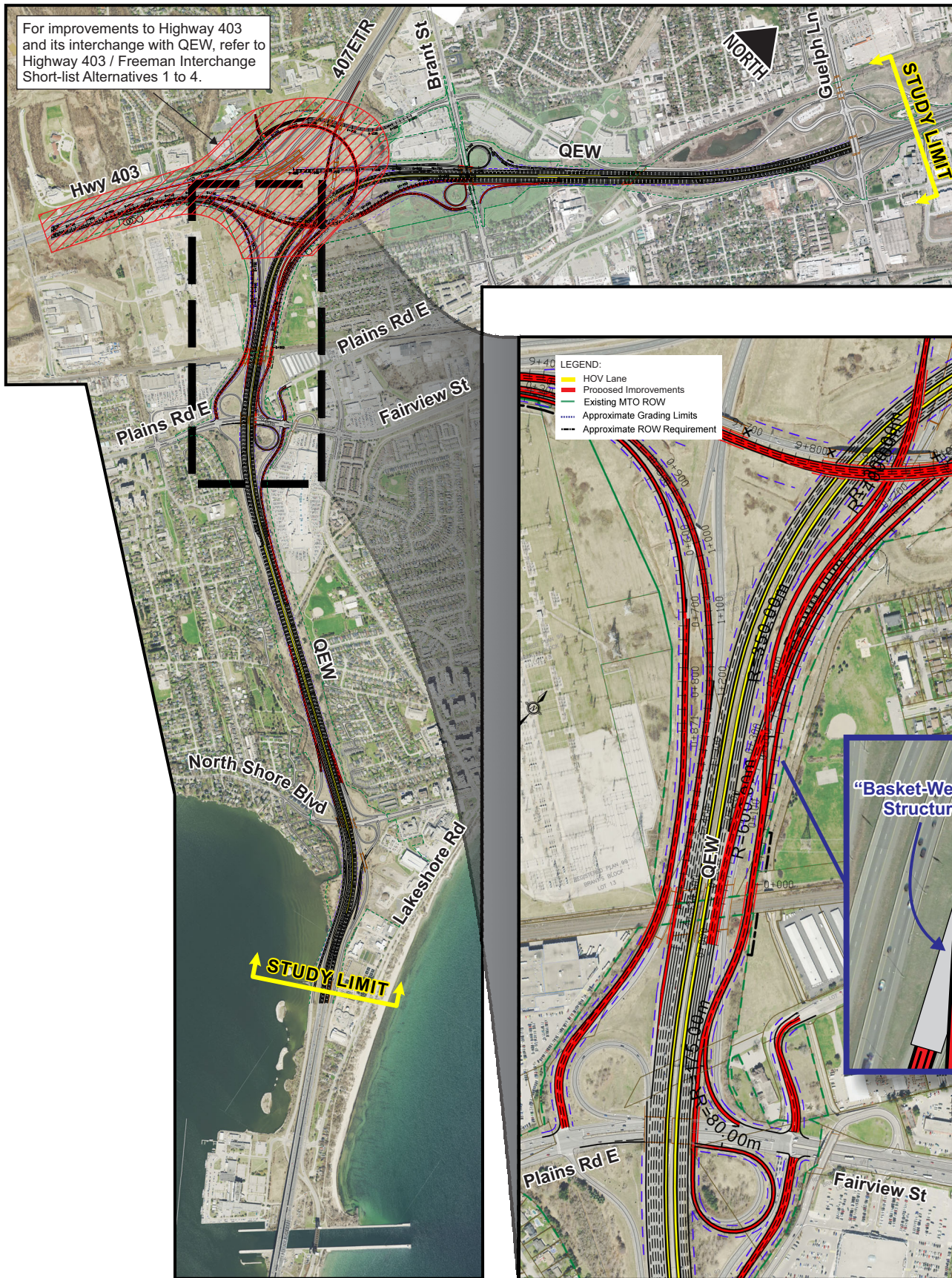


- In Alternative 2, the QEW is widened into the median and accommodates an HOV lane in each direction between Guelph Line and the Burlington Skyway.
- In Alternative 2, wider shoulders are used to widen the HOV lane into the median. This provides better driving conditions than Alternative 1.
- No extra property is required however northbound ramps on Plains Rd E / Fairview St have to be relocated to the east resulting in construction impacts such as ramp closures.

Short list of alternatives evaluation is detailed in Table 5-4 and Appendix H.

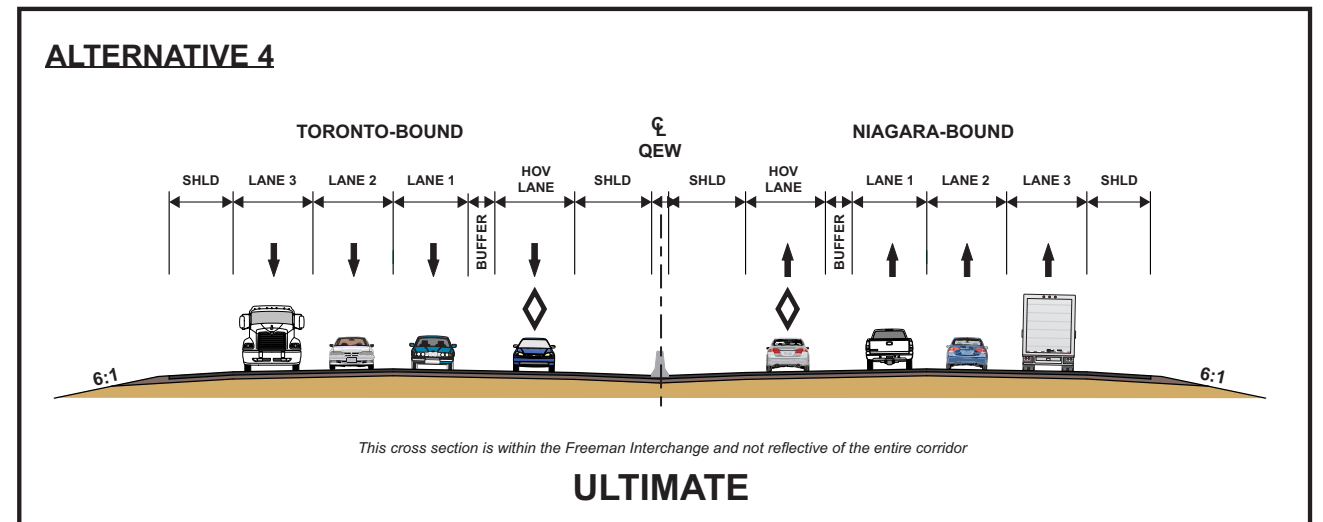


QEW - ALTERNATIVE 4

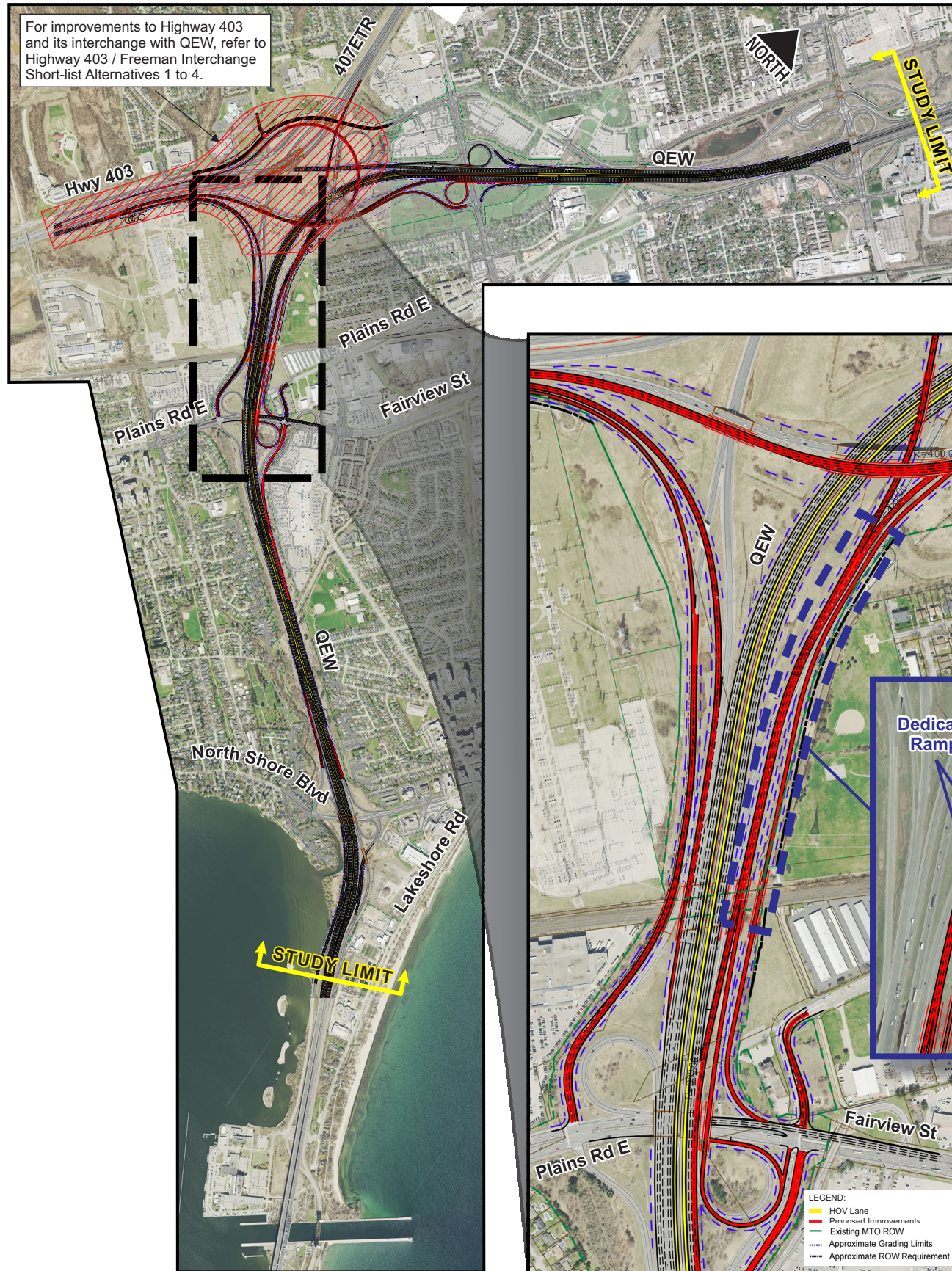


- In Alternative 4, the QEW is widened into the median as well as the outside resulting in a larger footprint. This accommodates an HOV lane as well as a General Purpose Lane in each direction between Guelph Line and the Burlington Skyway.
- In Alternative 4, an additional structure called a 'basket-weave' is built to carry Northbound traffic from Plains Rd E / Fairview St to 407 ETR or Highway 403. No additional property is required for this structure however there are greater costs due to construction complexity.
- Property is required on the north side of the existing CN Rail structure to accommodate the new on-ramp alignment.
- The on-ramps at Plains Rd E / Fairview St would be relocated easterly resulting in construction impacts such as ramp closures.

Short list of alternatives evaluation is detailed in Table 5-4 and Appendix H.

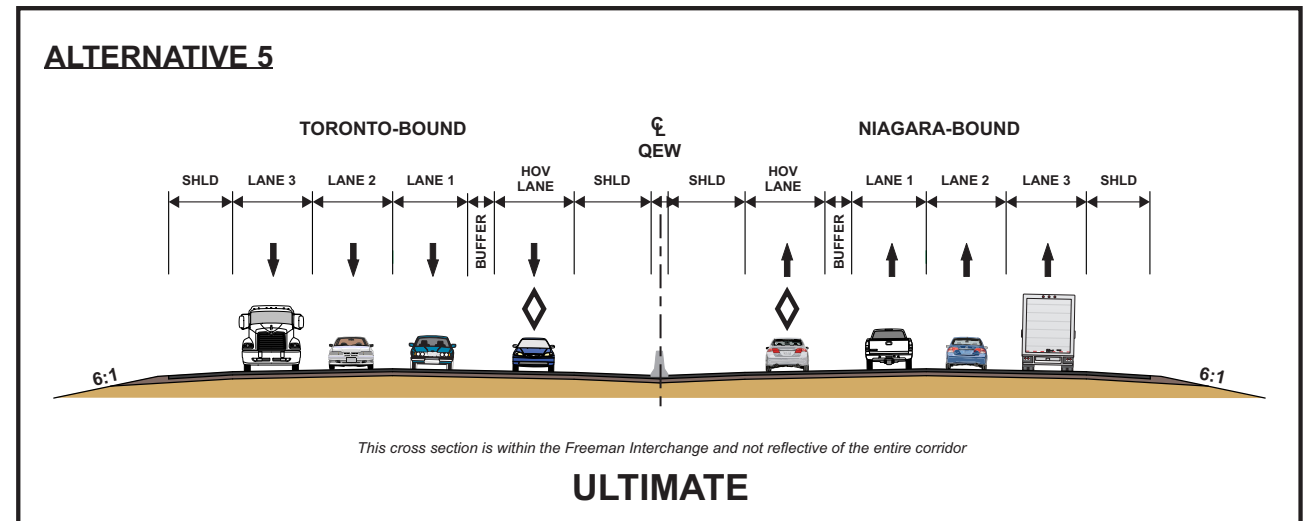


QEW - ALTERNATIVE 5



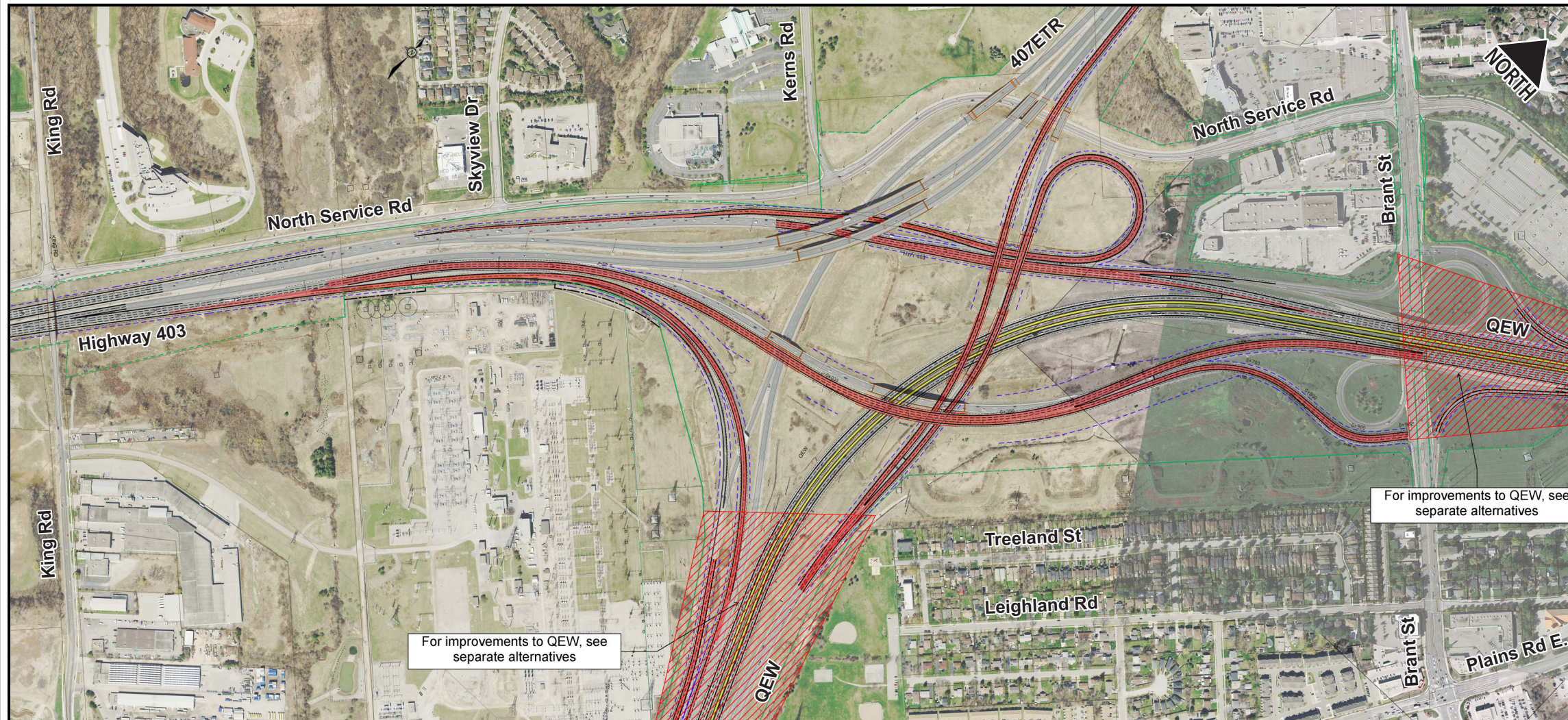
- In Alternative 5, the QEW is widened into the median as well as the outside resulting in a larger footprint. This accommodates an HOV lane as well as a General Purpose Lane in each direction between Guelph Line and the Burlington Skyway.
- In Alternative 5, dedicated ramps are provided to carry Northbound traffic to 407 ETR or Highway 403.
- The on-ramps at Plains Rd E / Fairview St would be relocated easterly resulting in construction impacts such as ramp closures.

Short list of alternatives evaluation is detailed in Table 5-4 and Appendix H.



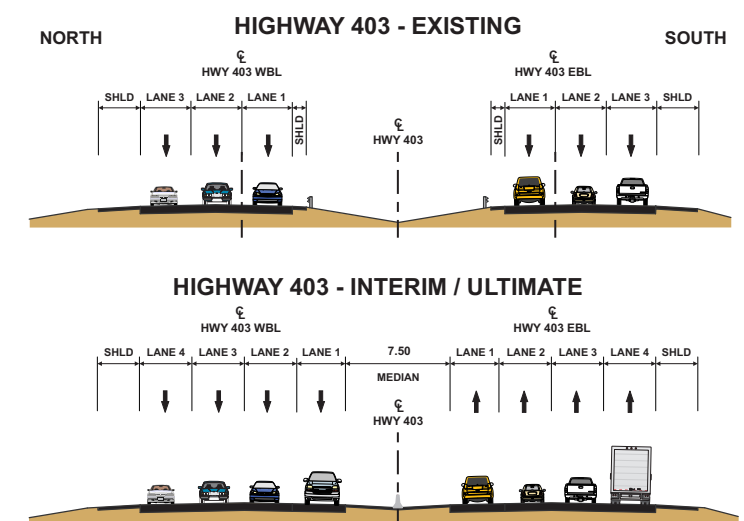
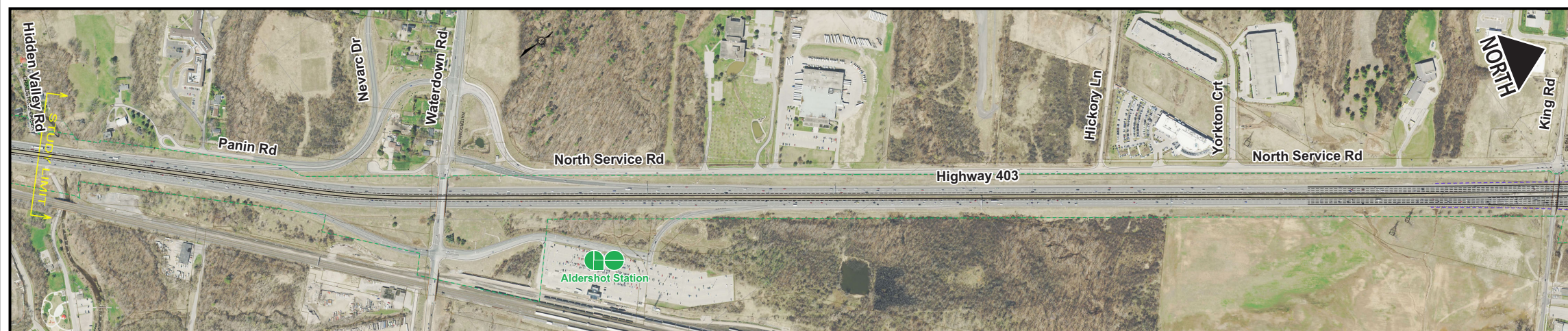
ALTERNATIVE 1

Highway 403 / Freeman Interchange - WB Alternative 1B + EB Alternative 2
(Compatible with QEW Short-list Alternatives 1 and 2)

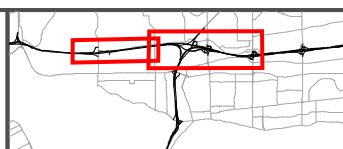


- Alternative 1 utilizes an inner loop ramp to move QEW Toronto-bound traffic to Highway 403 Westbound. One lane is added to Highway 403 and new ramps are built to carry traffic from Highway 403 Eastbound to QEW Toronto-bound, and Highway 403 Eastbound to QEW Niagara-bound.
- This alternative has minor impacts on property and surrounding environmental features.
- This alternative is compatible with QEW Alternative 1 and 2 which include widening of the highway and accommodation of 1 HOV lane.

Short list of alternatives evaluation is detailed in Table 5-4 and Appendix H.

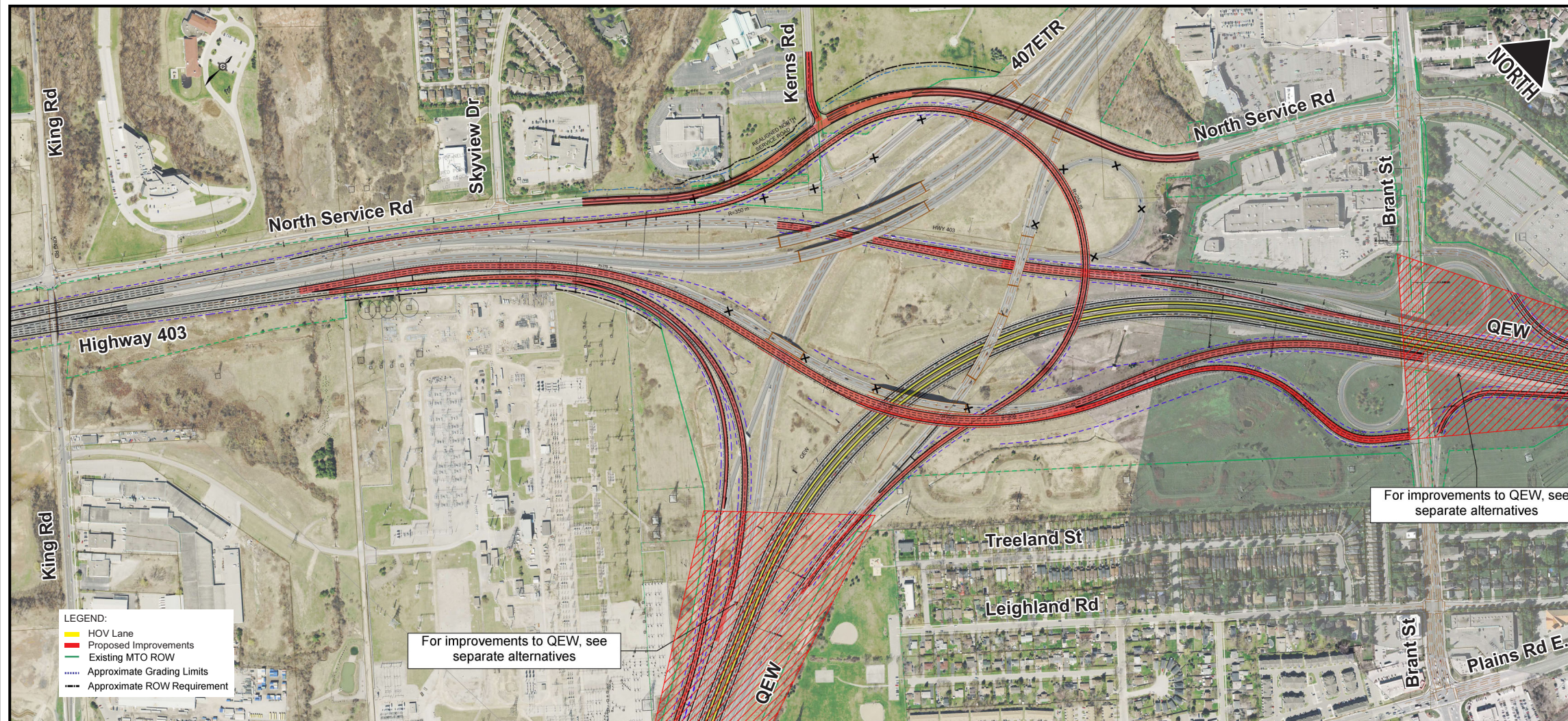


In all alternatives, Highway 403 is widened by one General Purpose Lane (GPL) in each direction by widening into the median.



ALTERNATIVE 2

Highway 403 / Freeman Interchange - WB Alternative 2A + EB Alternative 2
(Compatible with QEW Short-list Alternatives 1 and 2)

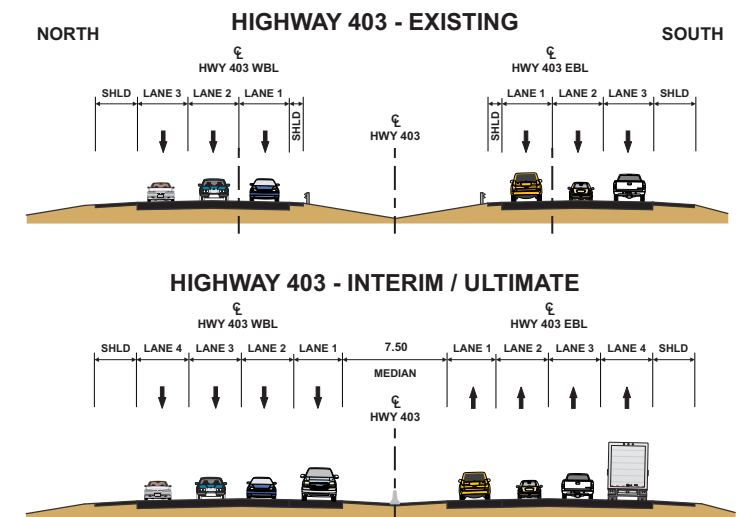


- Alternative 2 utilizes a semi-direct ramp to move QEW Toronto-bound traffic to Highway 403 Westbound. One lane is added to Highway 403 and new ramps are built to carry traffic from Highway 403 Eastbound to QEW Toronto-bound, as well as Highway 403 Eastbound to QEW Niagara-bound.
- This alternative requires significant property in the Northwest quadrant of the interchange.
- This alternative is compatible with QEW Alternative 1 and 2 which include widening of the highway and accommodation of 1 HOV lane.

Short list of alternatives evaluation is detailed in Table 5-4 and Appendix H.

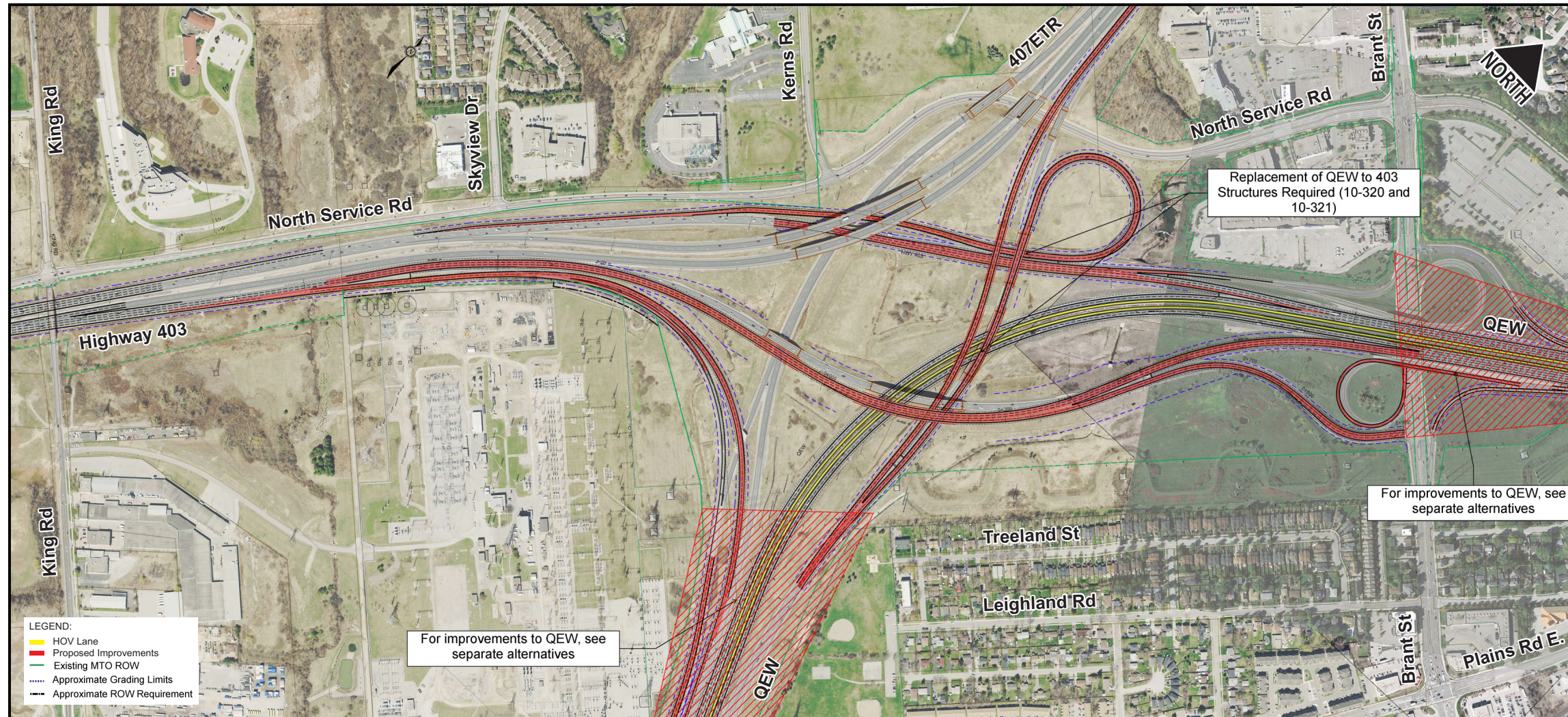


In all alternatives, Highway 403 is widened by one General Purpose Lane (GPL) in each direction by widening into the median.

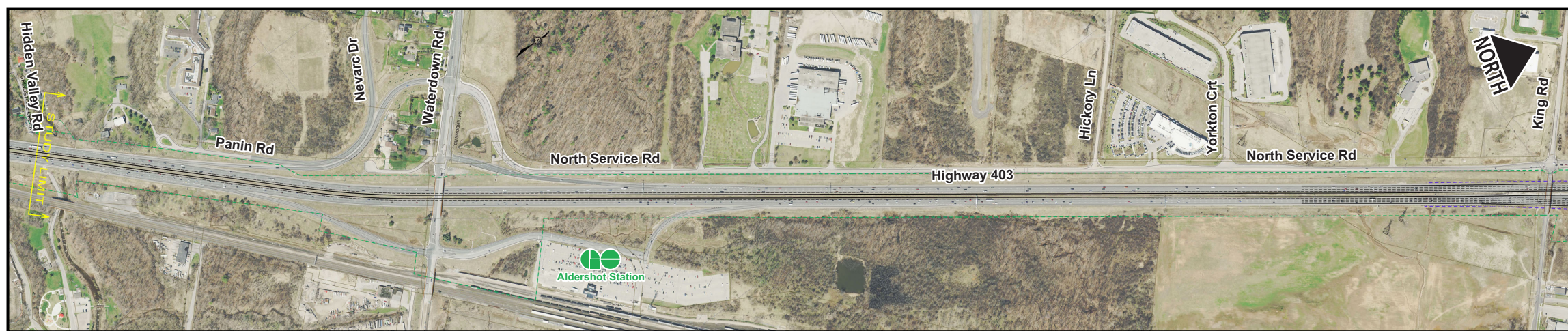


ALTERNATIVE 3

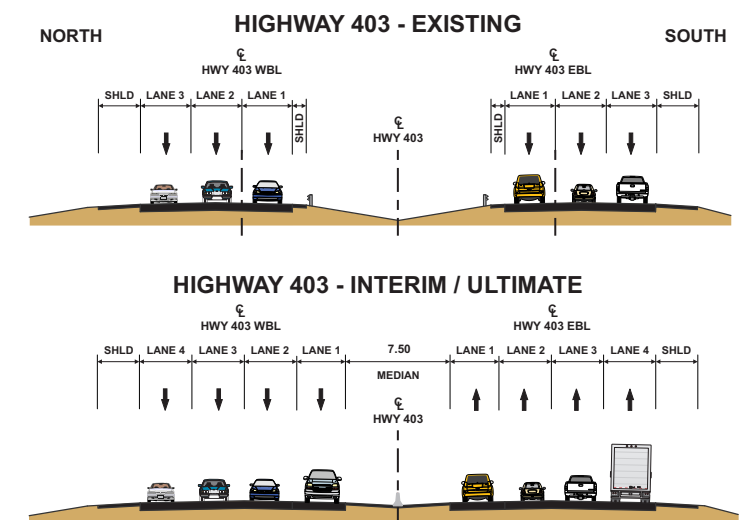
Highway 403 / Freeman Interchange - WB Alternative 1B + EB Alternative 2
(Compatible with QEW Short-list Alternatives 4 and 5)



- Alternative 3 utilizes an inner loop ramp to move QEW Toronto-bound traffic to Highway 403 Westbound. One lane is added to Highway 403 and new ramps are built to carry traffic from Highway 403 Eastbound to QEW Toronto-bound, and Highway 403 Eastbound to QEW Niagara-bound.
 - This alternative has minor impacts on property and surrounding environmental features.
 - This alternative is compatible with QEW Alternative 4 and 5 which include widening of the highway and accommodation of 1 HOV lane as well as 1 General Purpose Lane. Replacement of structures is required for this configuration.
- Short list of alternatives evaluation is detailed in Table 5-4 and Appendix H.

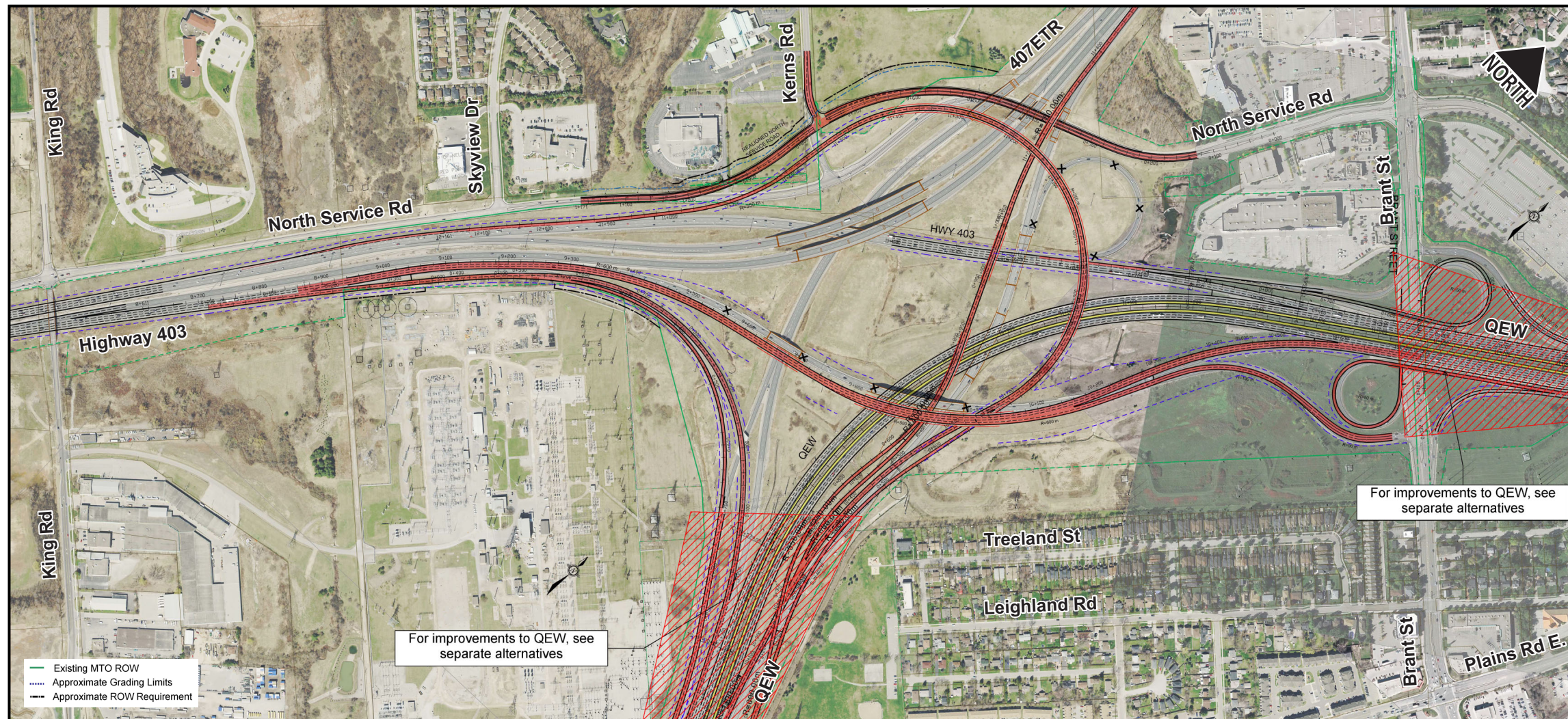


In all alternatives, Highway 403 is widened by one General Purpose Lane (GPL) in each direction by widening into the median.



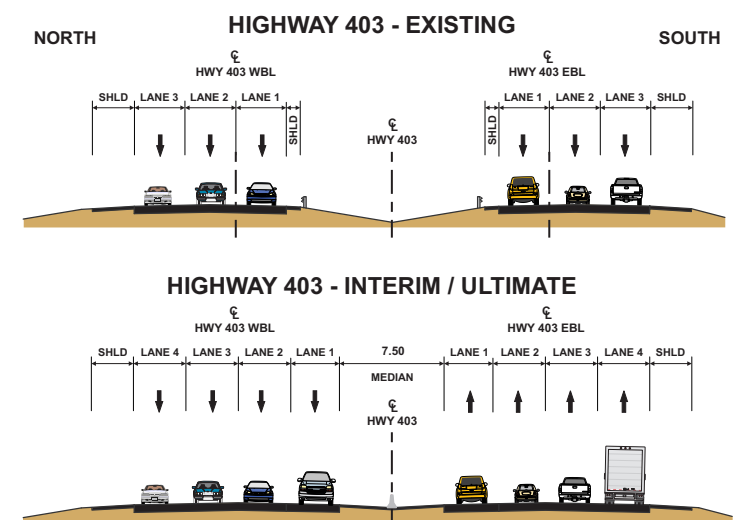
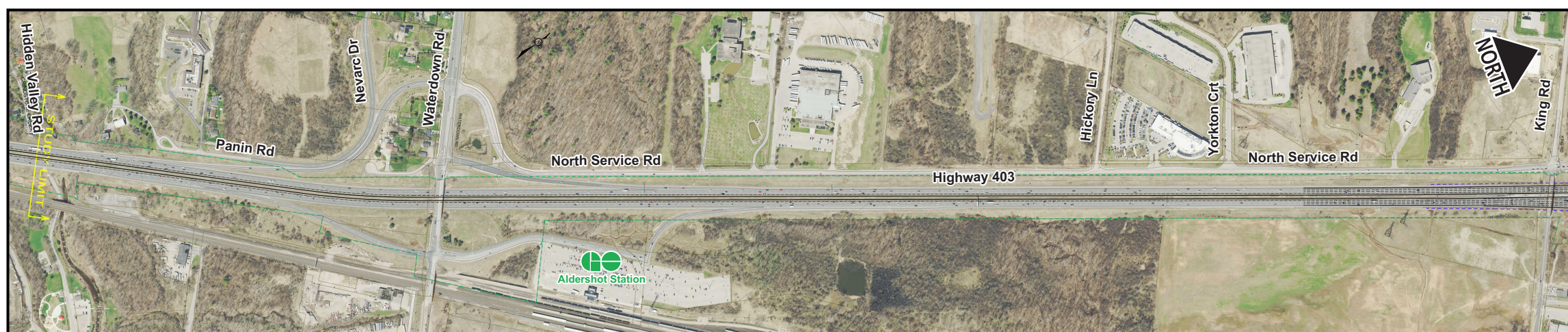
ALTERNATIVE 4

Highway 403 / Freeman Interchange - WB Alternative 2A + EB Alternative 2
(Compatible with QEW Short-list Alternatives 4 and 5)



- Alternative 4 utilizes a semi-direct ramp to move QEW Toronto-bound traffic to Highway 403 Westbound. One lane is added to Highway 403 and new ramps are built to carry traffic from Highway 403 Eastbound to QEW Toronto-bound, as well as Highway 403 Eastbound to QEW Niagara-bound.
- This alternative requires significant property in the Northwest quadrant of the interchange.
- This alternative is compatible with QEW Alternative 4 and 5 which include widening of the highway and accommodation of 1 HOV lane as well as 1 General Purpose Lane. Replacement of structures is required for this configuration.

Short list of alternatives evaluation is detailed in Table 5-4 and Appendix H.



In all alternatives, Highway 403 is widened by one General Purpose Lane (GPL) in each direction by widening into the median.



5.6 ASSESSMENT AND EVALUATION OF SHORT-LIST ALTERNATIVES

The assessment and evaluation of the short-list of alternatives is detailed in **Tables 5-4** and **Table 5-5** which provide a summary of the evaluation.

5.7 IDENTIFICATION OF THE TECHNICALLY PREFERRED ALTERNATIVE

As detailed in **Table 5-4**, **Table 5-5** and **Appendix H**, the assessment and evaluation of the short-list of alternatives identified QEW Alternative 5 and Highway 403 / Freeman Interchange Alternative 3 as the Technically Preferred Alternative. The key attributes of the Technically Preferred Alternative are summarized below:

- ▶ QEW is widened and would accommodate an additional HOV lane and an additional general-purpose lane in each direction.
 - ▶ QEW widening would require several ramp realignments, including relatively significant improvements at the Brant Street Interchange and Plains Road East / Fairview Street Interchange.
 - ▶ Highway 403 is widened and would accommodate an additional general-purpose lane in each direction.
 - ▶ Freeman Interchange improvements to accommodate traffic growth to the project horizon year (2041), including:
 - Widen the QEW northbound to Highway 403 westbound ramp to two lanes and use a two-lane inner-loop ramp for this movement.
 - Provide a new two-lane QEW northbound to 407 ETR northbound ramp.
 - Provide a new three-lane Highway 403 eastbound to QEW Toronto-bound ramp.
 - Widen the Highway 403 eastbound to QEW Niagara-bound ramp to two-lanes.
-

5.8 VALUE ENGINEERING STUDY

An independent Value Engineering Study was completed by MTO in September 2018. The VE study team identified 12 design modifications to the Technically Preferred Alternative that could potentially add value to the project, either through improved performance, cost savings or a combination of both. Through further assessment and deliberation with MTO Senior Management, six of the 12 modifications

were chosen for further study as part of this project. Upon further investigation, three of the six design modifications were found unviable, one recommended optimization of ramps to better structure constructability and the remaining two recommended changes to the proposed Plains Road East / Fairview Street Interchange east ramp terminal to improve operations. The investigation of the changes to the proposed Plains Road East / Fairview Street Interchange east ramp terminal led to a design refinement to the Technically Preferred Alternative which is described in **Section 5.9**.

5.9 DESIGN REFINEMENTS TO THE TECHNICALLY PREFERRED ALTERNATIVE

After the identification of the Technically Preferred Alternative and the Value Engineering Study, the Project Team undertook further investigation into the design of the Plains Road East / Fairview Street east ramp terminal. QEW Alternative 5 proposed a 'split' movement to help avoid weaving issues on the QEW north of the interchange: vehicles heading westbound on Fairview Street, on approach to the interchange, would have a choice to turn right to use a dedicated ramp to access Highway 403, or turn left to use the inner-loop ramp to access 407 ETR.

Upon further review of the operations at the interchange, amendment to the design of the QEW north of the Plains Road East / Fairview Street Interchange, and detailed traffic analysis, it was concluded that the dedicated ramp to Highway 403 was not required. Thus, the design refinement reduced the footprint impacts to the southeast of the Freeman Interchange, and reduced the socio-economic and cost impacts as detailed in the shortlist evaluation.

The refined Technically Preferred Alternative was carried forward for development of the Recommended Plan, as discussed in **Section 7**.

Table 5-4: Evaluation of QEW Short-List Alternatives Summary

Factor/Criteria/Indicator	QEW Alternatives 1 & 2 (+1 HOV): Widen QEW by 1 HOV lane in both directions from Guelph Line to the Burlington Skyway		QEW Alternatives 4 & 5 (+1 HOV and +1 GPL): Widen QEW by 1 HOV lane and 1 General Purpose Lane (GPL) in both directions from Guelph Line to the Burlington Skyway		
	Alternative 1: Widen into the existing median, with narrow median shoulders at Fairview Street Interchange.		Alternative 2: Widen into the existing median, and maintain standard median throughout		
		Alternative 4: Widen into existing median and maintain standard median throughout, widen to outside throughout, use a basket-weave configuration in southeast quadrant to avoid northbound weaving issues ahead of Freeman Interchange.		Alternative 5: Widen into existing median and maintain standard median throughout, widen to outside throughout, use dedicated ramps in southeast quadrant to avoid northbound weaving issues ahead of Freeman Interchange.	
SOCIO-ECONOMIC ENVIRONMENT ▶ Property and Access ▶ Community Effects					
Alternatives 1 and 2 have no property impacts, while Alternatives 4 and 5 are anticipated to impact mixed-use commercial-industrial property northeast of Fairview Street Interchange, with potential impacts to Leighland park, and are slightly closer to sensitive receptors; Alternative 4 results in slightly lower impacts than Alternative 5. Alternative 1 is anticipated to have the least noise impact and Alternative 5 could have the most impact to noise. Alternatives 1 and 2 are slightly preferred from an air quality perspective as well since roadways further away from sensitive receptors are preferred.					
CULTURAL ENVIRONMENT ▶ Archaeological ▶ Heritage Features ▶ First Nation Lands					
There is no significant difference between the alternatives.					
NATURAL ENVIRONMENT ▶ Fisheries and Aquatic Habitat ▶ Terrestrial Ecosystems ▶ Designated Natural Features ▶ Excess Materials Management ▶ Surface Water ▶ Groundwater					
Alternative 1 has the least impact as it results in minimal vegetation and wildlife impacts, only one watercourse culvert extension and has the lowest ratio of impervious area increase to catchment area. Alternative 4 is slightly preferred over Alternative 5 as it avoids impact to the Swamp Thicket and drainage channel northeast of the Fairview Street interchange.					
TRANSPORTATION INFRASTRUCTURE ▶ Operational Performance ▶ Geometry ▶ Structures ▶ Future Considerations ▶ Constructability and Utilities					
Alternative 5 provides the best ability to accommodate future traffic demand, with better traffic performance than Alternatives 1 and 2, with a lower cost / simpler constructability than Alternative 4 and less potential for impacts to Hydro one infrastructure than Alternative 4.					
▶ Cost (high-level estimate)	\$95M	\$107M	\$175M	\$169M	
OVERALL SUMMARY					
Overall, Alternative 5 is the preferred alternative as it: <ul style="list-style-type: none"> • Provides the best ability to accommodate future traffic demand (in terms of operations and constructability), compared with all other alternatives; • Provides better traffic performance than Alternatives 1 and 2, and similar performance as Alternative 4, however at a lower cost; • Has a lesser impact to Hydro One infrastructure in the study area than Alternative 4; and • Has transportation benefits over all other alternatives, that outweigh its relatively lower socio-economic and natural environmental impacts. 					

Table 5-5: Evaluation of Highway 403 and Freeman Interchange Short-List Alternatives Summary

Factor/Criteria/Indicator	Compatible with QEW Alternatives 1 and 2		Compatible with QEW Alternatives 4 and 5	
	Alternative 1:WB 1B (Two lane inner loop ramp) + EB2	Alternative 2:WB 2A (Semi-direct ramp) + EB2	Alternative 3:WB 1B (Two lane inner loop ramp) + EB2	Alternative 4:WB 2A (Semi-direct ramp) + EB2
SOCIO-ECONOMIC ENVIRONMENT ▶ Property and Access ▶ Community Effects				
Alternatives 1 and 3 have reduced property impacts compared to Alternatives 2 and 4, as the semi-direct ramp and resulting realignment of the North Service Road both require acquisition of property northwest of the interchange and along the north side of Highway 403. This configuration is also in closer proximity to noise sensitive receivers.				
CULTURAL ENVIRONMENT ▶ Archaeological ▶ Heritage Features ▶ First Nation Lands				
There is no significant difference between the alternatives.				
NATURAL ENVIRONMENT ▶ Fisheries and Aquatic Habitat ▶ Terrestrial Ecosystems ▶ Designated Natural Features ▶ Excess Materials Management ▶ Surface Water ▶ Groundwater				
The semi-direct ramp and realignment of the North Service Road and Alternatives 2 and 4 require a new crossing of Hagar Creek, and it anticipated to require channel modifications and culvert extensions along North Service Road. These alternatives also encroach on a wetland area northeast of the interchange. Alternatives 1 and 3 do not require alignment of the North Service Road and therefore avoids these impacts.				
TRANSPORTATION INFRASTRUCTURE ▶ Operational Performance ▶ Geometry ▶ Structures ▶ Future Considerations ▶ Constructability and Utilities				
This semi-direct ramp design of Alternatives 2 and 4 allow for better geometry and slightly better operations through the interchange compared to Alternatives 1 and 3; however, at a slightly greater cost to Alternatives 1 and 3. While Alternatives 1 and 3 result in a larger number of structures, Alternatives 2 and 4 require long, large structures, meaning that all alternatives are similar in structural requirement. In terms of constructability, all alternatives have complex construction staging with Alternatives 1 and 3 requiring a structure be constructed underneath existing structures and the construction difficulty potentially increasing for Alternatives 2 and 4 if the new Hwy 403 to QEW eastbound ramp is not constructed first. All alternatives have similar impacts to utilities.				
▶ Cost (High-level Estimate)	\$103M	\$118M	\$114M	\$136M
OVERALL SUMMARY				
Overall Alternative 3 (WB Alternative 1B and EB Alternative 2) is preferred because it represents a good balance of transportation needs versus costs, and will minimize property requirements and environmental impacts. In comparing with other alternatives, the following is to be noted: <ul style="list-style-type: none"> • Although the semi-directional ramp (Alternatives 2 and 4) allows for higher-speed traffic operations and better geometry, it requires realignment of North Service Road and impacts to private property as well as wetlands and watercourses; • Alternatives 2 and 4 would require long, curved bridges required to carry a ramp over the QEW, 407 ETR and other existing interchange ramps, resulting in a large footprint. Whereas Alternatives 1 and 3 can be constructed within the existing interchange right-of-way (ROW); • Alternative 3 is preferred over Alternative 1 as it is compatible with QEW Alternative 5 (the identified preferred QEW alternative, as detailed in Table 5-4). 				



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