

APPENDIX M: EROSION AND SEDIMENT OVERVIEW RISK ASSESSMENT



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 Ministry of Transportation
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From: Amber Garrett, P. Eng
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File: 165001160 Date: May 19, 2022

Reference: Highway 401 Planning, Preliminary Design, and Class Environmental Assessment (Class EA) Study, City of Brockville - Erosion and Sediment Overview Risk Assessment - GWP 4003-19-00

BACKGROUND AND APPROACH

The Ontario Ministry of Transportation (MTO) retained Stantec Consulting Ltd. to undertake a Preliminary Design and Class Environmental Assessment for the rehabilitation and/or replacement of five (5) structures along Highway 401 in the City of Brockville. The project limits are from 2 km west of the Highway 401 & Stewart Boulevard Interchange (IC 696) to 750 m east of the Highway 401 & North Augusta Road Interchange (IC 698). The total project length is approximately 4.5 km and is within the City of Brockville.

Highway 401 is classified as a freeway within the project limits. A typical cross-section of Highway 401 in the project area consists of two paved lanes and a paved shoulder in each direction separated by a paved median and concrete barrier.

This memo presents the Erosion and Sediment Overview Risk Assessment (ESORA) for the proposed design work associated with the project limits. The objective of this assessment is to evaluate the probability of erosion and sediment migration off-site during construction and identify associated risks.

Previous studies and technical guidance documents related to this project have been reviewed and referenced during the preparation of this report, including:

- *Environmental Guide for Erosion and Sediment Control During Construction of Highway Projects*. Ministry of Transportation, 2015.
- *MTO Environmental Reference for Highway Design*. Ministry of Transportation, 2013.
- *Groundwater Assessment – Highway 401 Rehabilitation / Replacement of Various Structures and Pavement Reconstruction, City of Brockville (GWP 4003-19/WP 4006-1901)* Stantec, 2020.
- *Terrestrial Ecosystems Existing Conditions Report – Highway 401 Brockville (GWP 4003-19-00)*. Stantec, 2021.

The approach to completing the ESORA for this development is summarized in the following tasks:

- An overview of the risk of the study area;
- An overview of the expected construction activities; and
- An assessment of erosion and sediment risk based on construction activities and environmental features.

Reference: Highway 401 Planning, Preliminary Design, and Class Environmental Assessment (Class EA) Study, City of Brockville - Erosion and Sediment Overview Risk Assessment - GWP 4003-19-00

SITE DESCRIPTION

The project limits for the Highway 401, City of Brockville project, include the eastbound and westbound lanes from 2 km west of the Highway 401 & Stewart Boulevard Interchange to 750 m east of the Highway 401 & North Augusta Road Interchange. The project limits are within the municipality of the City of Brockville, and in the Catarqui Region Conservation Authority. A key plan of the project limits is shown below as Figure 1. The Study Area considered in the ESORA is outlined in Figure 3 and Figure 4 attached.

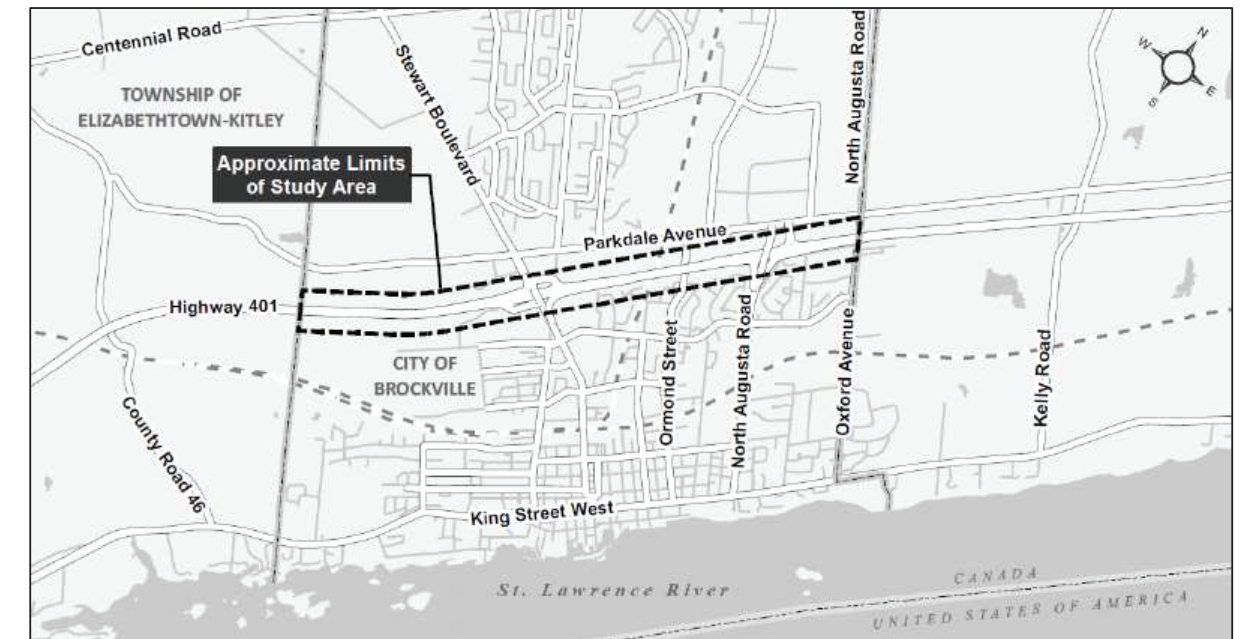


Figure 1: Key Plan - Project Limits

PROPOSED PROJECT ACTIVITIES

The proposed project activities include establishing the future footprint of Highway 401 within the project limits for an ultimate eight-lane cross-section and interchange improvements/modifications to accommodate an ultimate eight-lane highway. At this stage of the Preliminary Design and Environmental Assessment it is expected that the project will involve structural replacement in the project limits of the following:

- Highway 401 & Stewart Boulevard Interchange
- Highway 401 Buells Creek Culvert
- Highway 401 & CNR Overhead
- Highway 401 & Ormond Street Overpass
- Highway 401 & North Augusta Road Interchange

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In addition, a total of 8 Highway 401 centerline crossing culverts are within the study area. Replacement and/or rehabilitation recommendations will be made for specific culverts based on condition and hydraulic capacity.

The specific construction activities associated with these modifications will include stripping, site grading, placement of granular material, paving works, pile-driving, groundwater dewatering, stormwater sewer/pond construction, possible bridge demolition and retaining wall construction and potential realignment of existing channels. This construction work will involve staging and will require temporary storage areas and construction yards.

EXISTING ENVIRONMENTAL CONDITIONS

TOPOGRAPHY AND SURFACE WATER FEATURES

Within the project limits, the area north of Highway 401 is dominated by commercial buildings and parking, while the area south of Highway 401 is generally residential with single lot homes. The topography within the project limits consists of rolling hills with grades that are consistently less than 5%. Several drainage catchments outlet to the Highway 401 centerline culverts which discharge to Buells Creek, and ultimately flow downstream to the St. Lawrence River.

SOILS AND HYDROGEOLOGY

Soil data was confirmed using data from the Ontario Geological Survey (2010) and OMAFRA mapping. It was confirmed that the soil is predominantly fine-textured glaciomarine deposits, stone-poor and carbonate-derived silty to sandy till and paleozoic bedrock-drift complex. The soil type associated with these descriptions is primarily sand to silty sand.

ENVIRONMENTALLY SENSITIVE FEATURES

The *Groundwater Assessment – Highway 401 Rehabilitation / Replacement of Various Structures and Pavement Reconstruction, City of Brockville* (Stantec, 2020) was reviewed to identify sensitive groundwater and surface water features within the proximity of study area. Using MECP records, it was confirmed that 193 Water Well Records were within 500 m of the project limits. These well include public supply wells, commercial supply well, abandoned wells, and potential private supply wells, as shown on Figure 2, attached.

Additional mapping from the Ontario Ministry of Agricultural, Food and Rural Affairs was reviewed to identify other environmentally sensitive features such as Well-head Protection Areas, Water Intake Protection Zones and Significant Groundwater Recharge areas. Review of available information confirmed the following:

- There are no Well-head Protection Areas within the study area
- There are no Significant Groundwater Recharge Areas within the study area
- There are no Intake Protection Zones within the study area
- There is no interception of Provincially Significant Wetlands within the study area
- The study area is within a Highly Vulnerable Aquifer area

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The *Terrestrial Ecosystems Existing Conditions Report – Highway 401 Brockville* (Stantec, 2021) was reviewed to confirm the presence of significant wildlife habitat and species at risk / species of conservation concern within the study area. Review of this document confirmed the following:

- There are 19 terrestrial Species at Risk identified through a background review that could potentially be located within the study area. Field investigations confirmed that 1 of these species are present and 14 species may be potentially present due to suitable habitat.
- There are 4 categories of Significant Wildlife Habitat within the study area, inclusive of seasonal concentration areas, rare / specialized habitats, habitat for species of conservation concern and animal movement corridors.
- The best available wildlife habitat includes nearby vegetative areas and does not include the Highway 401 right-of-way area.
- During future design phases, it is recommended that consultation with the MECP be completed to determine permit / authorization needs resulting from the identified Species at Risk and Significant Wildlife Habitat within the study area.

As part of the background review, an aquatic biologist was consulted to understand the presence of fish habitat and thermal regimes within the study area. Background review and on-site temperature measurements determined that it is unlikely that any watercourses within the study area are cold water systems. No aquatic Species at Risk were identified through field investigation or background review.

EROSION AND SEDIMENT OVERVIEW RISK ASSESSMENT

An ESORA was performed for the study area to determine which Erosion and Sediment Control (ESC) approach is best suited for the anticipated construction works. To complete the assessment, the study area was divided into the evaluation polygons using surficial geology data. These areas were each assigned a Soil Erodibility Rating based on soil type, and an Erosion Potential Rating which combined soil type as well as the proposed slope gradient and proposed slope length. Figure 3, attached, illustrates the evaluated areas and the associated Soil Erodibility Ratings.

The site soils are sand to silty-sand loams and have a medium to high erosion potential. Generally, sandy soils were assigned a medium soil erodibility rating and silty-sand was assigned a high soil erodibility rating, following Table 5.1 – Hierarchy of Soil Erodibility in the *Environmental Guide for Erosion and Sediment Control During Construction of Highway Projects* (Ministry of Transportation, 2015).

The Erosion Potential Rating for each polygon was assigned based on Table 5.2 – Erosion Potential Associated with Slope Length, Slope Gradient and Soil Erodibility Rating of the *Environmental Guide for Erosion and Sediment Control During Construction of Highway Projects* (Ministry of Transportation, 2015). The gradient discretization considered was less than 10%, between 10% and 20% and greater than 20%. The slope length discretization considered was less than or greater than 70 m. The slope gradient across the study area was consistently less than 5 % and the slope length was consistently less than 70 m, except for a longer slope length in the Highway 401 & Stewart Boulevard Interchange vicinity.

The Environmental Consequence rating was assigned based on the sensitivity of the nearby environmental features to construction activity. The study area was deemed to have a moderate environmental sensitivity rating, as the sensitive features are limited to identified nearby water wells and the Highly Sensitive Aquifer

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designation. As discussed above, none of the following sensitive features were found within the project limits: Well Head Protection Areas, Significant Groundwater Recharge Areas, Intake Protection Zones, Provincially Significant Wetlands or coldwater thermal regime watercourses. It was also deemed unlikely that Species at Risk or Significant Wildlife Habitat would be located within the Highway 401 right-of-way.

The three ratings (Soil Erodibility, Erosion Potential and Environmental Consequence) were all considered to assign the cumulative Erosion and Sediment Risk rating to each evaluated area. Results of the completed evaluation, including rationale for the assigned Erosion Potential Rating, Environmental Risk Rating and cumulative Erosion and Sediment Risk rating are shown in Table 1 below. The attached Figure 4 shows the Erosion Risk rating for each evaluated polygon.

Table 1: Erosion and Sediment Overview Risk Assessment Summary

Polygon No.	Soil Type	Soil Erodibility Rating	Slope Gradient (%)	Slope Length (m)	Erosion Potential Rating	Rationale for Erosion Potential Rating	Environmental Consequence Rating	Rationale for Consequence Rating	Erosion and Sediment Risk
1	Sandy	M	<10	<70	M	Medium soil erodibility, slope length less than 70 m and slope gradient less than 10%	L	No nearby water wells or environmentally sensitive features.	L
2	Silty / Sand	H	<10	<70	L	High soil erodibility, slope length less than 70 m and slope gradient less than 10%	M	Domestic and commercial wells identified within 500 m of study area; no other nearby environmentally sensitive features	M
3	Sandy	M	<10	<70	M	Medium soil erodibility, slope length less than 70 m and slope gradient less than 10%	M	Domestic and commercial wells identified within 500 m of study area; no other nearby environmentally sensitive features	M

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4	Silty / Sand	H	<10	>70	H	High soil erodibility, slope length greater than 70 m and slope gradient less than 10%	M	Domestic and commercial wells identified within 500 m of study area; no other nearby environmentally sensitive features	H
5	Sandy	M	<10	<70	M	Medium soil erodibility, slope length less than 70 m and slope gradient less than 10%	M	Domestic and commercial wells identified within 500 m of study area; no other nearby environmentally sensitive features	M
6	Silty / Sand	H	<10	<70	L	High soil erodibility, slope length less than 70 m and slope gradient less than 10%	M	Domestic and commercial wells identified within 500 m of study area; no other nearby environmentally sensitive features	M

As described in the previous section, the site soils are generally sand to silty-sand and have medium to high soil erodibility. The general slope gradient is typically low (< 10%) and the slope length is typically short (< 70 m), producing a typical medium erosion potential across the study area.

The study area's sensitive environmental features are limited to the nearby water wells, and the Highly Vulnerable Aquifer. It is not expected that the construction activities will significantly impact these features, and no other sensitive environmental features have been identified. Therefore, the environmental consequence risk is moderate.

It is further expected that erosion potential exists as part of the project due to the anticipated grading work associated with the interchange modifications and overall highway widening. As a conservative best management practice, it is recommended that the erosion and sediment control measures consider the study area to have a moderate-high erosion and sediment risk.

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GRADING RECOMMENDATION

The standard grading treatment includes 2:1 maximum fore-slopes and back-slopes for cuts and high fills. However, given the anticipated erodibility of the soils in the study area, maximum slopes of 3:1 are recommended for preliminary design purposes. The flatter slopes and interceptor ditches will better control sheet drainage velocity and quantity when compared to standard 2:1 slopes, which will help mitigate erosion of the cut and fill slopes. The grading cross-sections and erosion and sediment control measures will be confirmed during future design phases when additional geotechnical and soils information is available for the study area.

EROSION AND SEDIMENT CONTROL RECOMMENDATION

Based on the preceding assessment, it is recommended that Approach 3: Two Part ESCP – Main and Supplemental be implemented for the study area during future design phases, in accordance with MTO Guidelines. This approach will provide the contractor with the ability to adapt the Erosion and Sediment Control Plan without having to go through the change control process for the supplemental plan, should the site conditions found during construction differ than conditions assumed during design, as part of a Best Management Practice.

The following ESC procedures will be considered for the ESCP:

- Procedural Best Management Practices (BMPs).
- Various ESC measures and structural BMPs.
- Divert runoff around site.
- Staged construction and progressive rehabilitation.
- More intensive sediment control BMPs.
- Construction monitoring and maintenance requirements of the ESC measures.
- Ensure construction activities in the proximity of a watercourse follow the allowable in-water work period.
- A Technical Memo to record information and provide guidance for recommended ESC measures, including installation requirements.

CONCLUSION

The majority of evaluated areas had an overall medium-high erosion and sediment risk rating based on medium erodibility soils and moderately sensitive environmental features. An erosion and sediment control plan will be developed for all construction zones in future design phases to mitigate the erosion and sediment risk and minimize impacts downstream.


We trust this memo meets your requirements at this time. Should you have questions regarding this ESORA please contact the undersigned.

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STANTEC CONSULTING LTD.

 Digitally signed by
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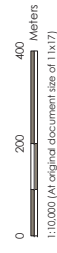
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Date: 2022.05.19
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Heather Amirault P.Eng.
Water Resources Engineer
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Attachments: Figure 2 – Map of Wells Identified within the Project Limits
Figure 3 – Soil Erodibility Rating
Figure 4 – Erosion and Sediment Risk



- Legend
- Project Structure
 - Hwy 401 Study Area
 - ▭ MECP Water Well Record (within 500 m)
 - Unknown
 - Municipal
 - Commercial
 - Domestic
 - Monitoring
 - ★ Not Used/ Abandoned
 - Public



Notes
 1. Coordinate System: NAD 83 UTM Zone 18N
 2. Base feature produced under license with the Ontario Ministry of Natural Resources and Forestry © Ontario Trillium Foundation for Ontario, 2015
 3. Water Well Records obtained from Ontario Ministry of the Environment, Conservation and Parks © Ontario Trillium Foundation for Ontario, 2015.

Project Location: 16500 160th Ave, City of Rockville
 Prepared by: JWC on 2020-09-18
 Technical Review by: ABC on 2020-09-18
 Independent Review by: AEC on 2020-09-18

Client/Project:
 ONTARIO MINISTRY OF TRANSPORTATION
 HIGHWAY 401 REHABILITATION/ RECONSTRUCTION
 GWP: 4003-19-00/ WP: 4006-1901

Figure No.: 2a

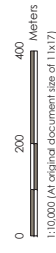
Title: MECP Water Well Records (within 500 m)



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- Legend
- Project Structure
 - Hwy 401 Study Area
 - ▭ MECP Water Well Record (within 500 m)
 - Unknown
 - Commercial
 - Domestic
 - Industrial
 - Monitoring
 - ★ Not Used/ Abandoned
 - Public



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Figure No.: 2b

Title: MECP Water Well Records (within 500 m)



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- Legend
- MTO ROW
 - Study Area
 - Highway
 - Watercourse (Permanent)
 - Erosibility - Medium

0 50 100 Meters
1:2,500 (At original document size of 11x17)

Notes
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Project Location
 City of Brockville
 Prepared by: JW on 2021-12-07

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Figure No.
3-a

Erosion and Sediment Overview Risk Assessment

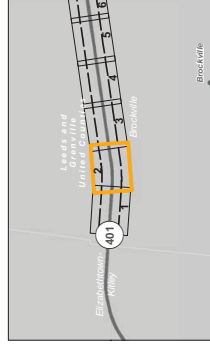
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- Legend
- MTO ROW
 - Study Area
 - Highway
 - Major Road
 - Minor Road
 - Erosibility - High
 - Erosibility - Medium

0 50 100 Meters
1:2,500 (At original document size of 11x17)

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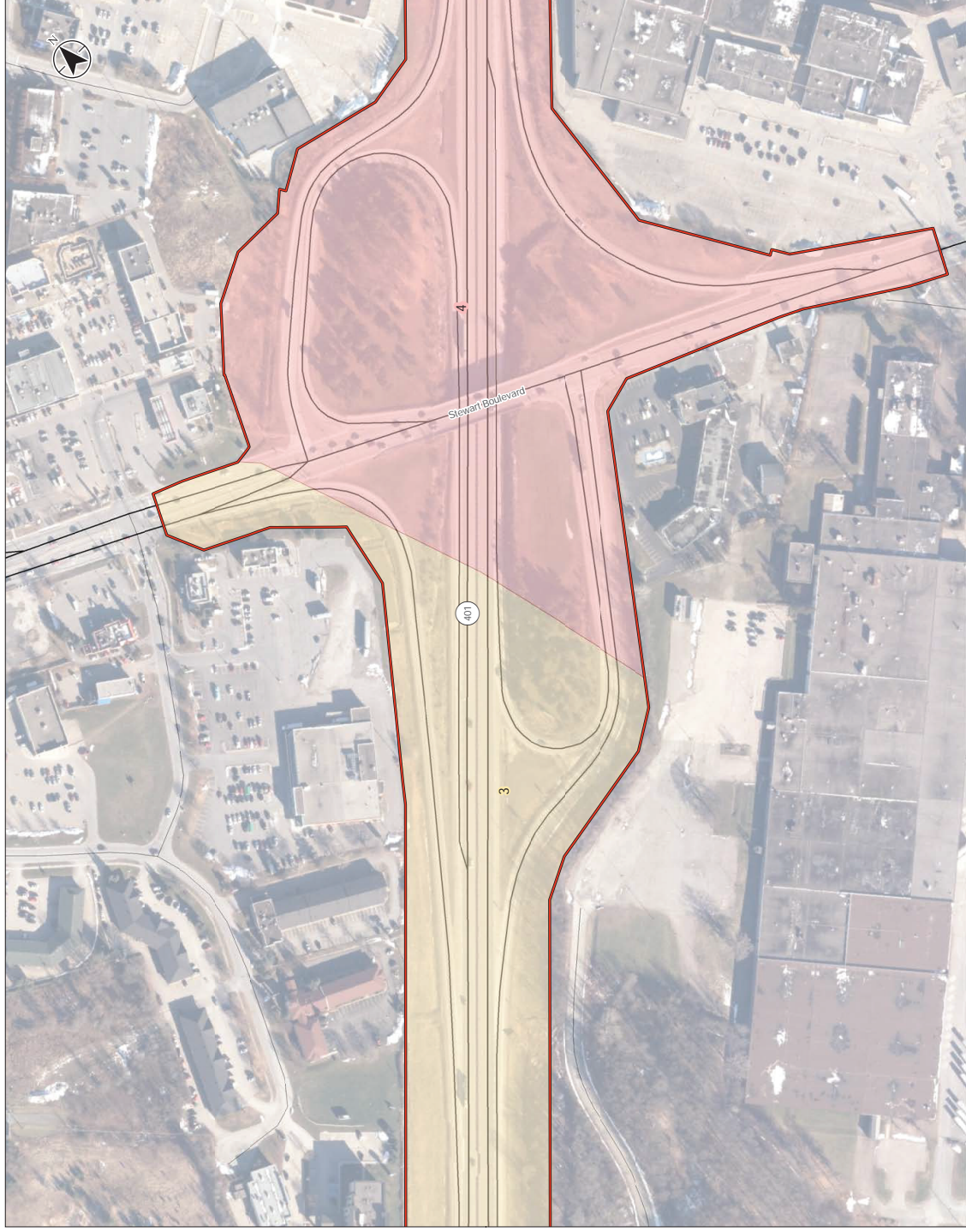
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Figure No.
3-b

Erosion and Sediment Overview Risk Assessment

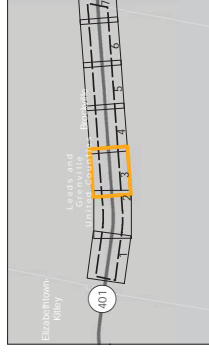
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- Legend**
- MTO ROW
 - Study Area
 - Highway
 - Major Road
 - Minor Road
 - Erodibility - High
 - Erodibility - Medium

0 50 100 Meters
1:2,500 (At original document size of 11x17)

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Figure No.
3-c

Title
Erosion and Sediment Overview Risk Assessment

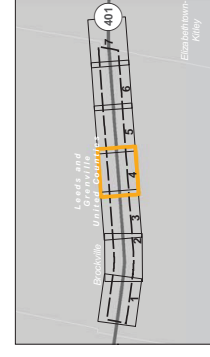
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- Legend**
- MTO ROW
 - Study Area
 - Railway
 - Highway
 - Major Road
 - Minor Road
 - Watercourse (Permanent)
 - Erodibility - High
 - Erodibility - Medium

0 50 100 Meters
1:2,500 (At original document size of 11x17)

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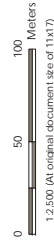
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3-d

Title
Erosion and Sediment Overview Risk Assessment

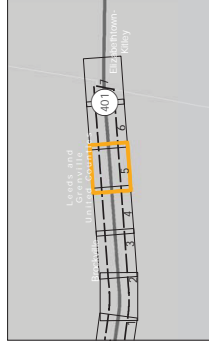
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- Legend
- MTO ROW
 - Study Area
 - Railway
 - Highway
 - Major Road
 - Minor Road
 - Watercourse (Permanent)
 - Erosibility - Medium



NOTES
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Figure No.
3-e

Title
 Erosion and Sediment Overview Risk Assessment

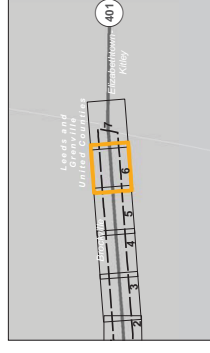
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- Legend
- MTO ROW
 - Study Area
 - Highway
 - Major Road
 - Minor Road
 - Erosibility - High
 - Erosibility - Medium



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Figure No.
3-f

Title
 Erosion and Sediment Overview Risk Assessment

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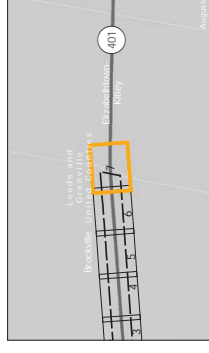
- Legend
- MTO ROW
 - Study Area
 - Highway
 - Major Road
 - Minor Road
 - Watercourse (Permanent)
 - Erodibility - High

6

0 50 100 Meters

1:2,500 (At original document size of 11x17)

- Notes
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Project Location
City of Brockville

1:6500 (1:600 REV A)
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Figure No.
3-9

Title
Erosion and Sediment Overview Risk Assessment

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- Legend
- MTO ROW
 - Study Area
 - Highway
 - Watercourse (Permanent)
 - Erosion and Sediment Risk
 - Low

0 50 100 Meters

1:2,500 (At original document size of 11x17)

- Notes
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HIGHWAY 401 REHABILITATION/ RECONSTRUCTION
GWP 4003-19-00/ WP 4006-1901

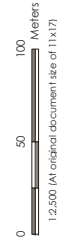
Figure No.
4-a

Title
Overall Erosion and Sediment Risk

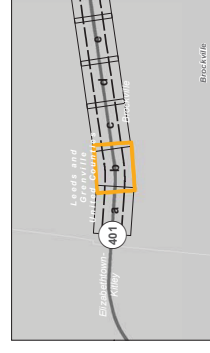
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- Legend**
- MTO ROW
 - Study Area
 - Highway
 - Major Road
 - Minor Road
 - Erosion and Sediment Risk
 - Medium
 - Low



Notes
 1. Coordinate System: NAD 1983 (83) Zone 18N
 2. Base feature production under license with the Ontario Ministry of Natural Resources and Forestry © Ontario, 2020.
 3. All data obtained from Ontario Ministry of Natural Resources and Forestry © Ontario, 2020.



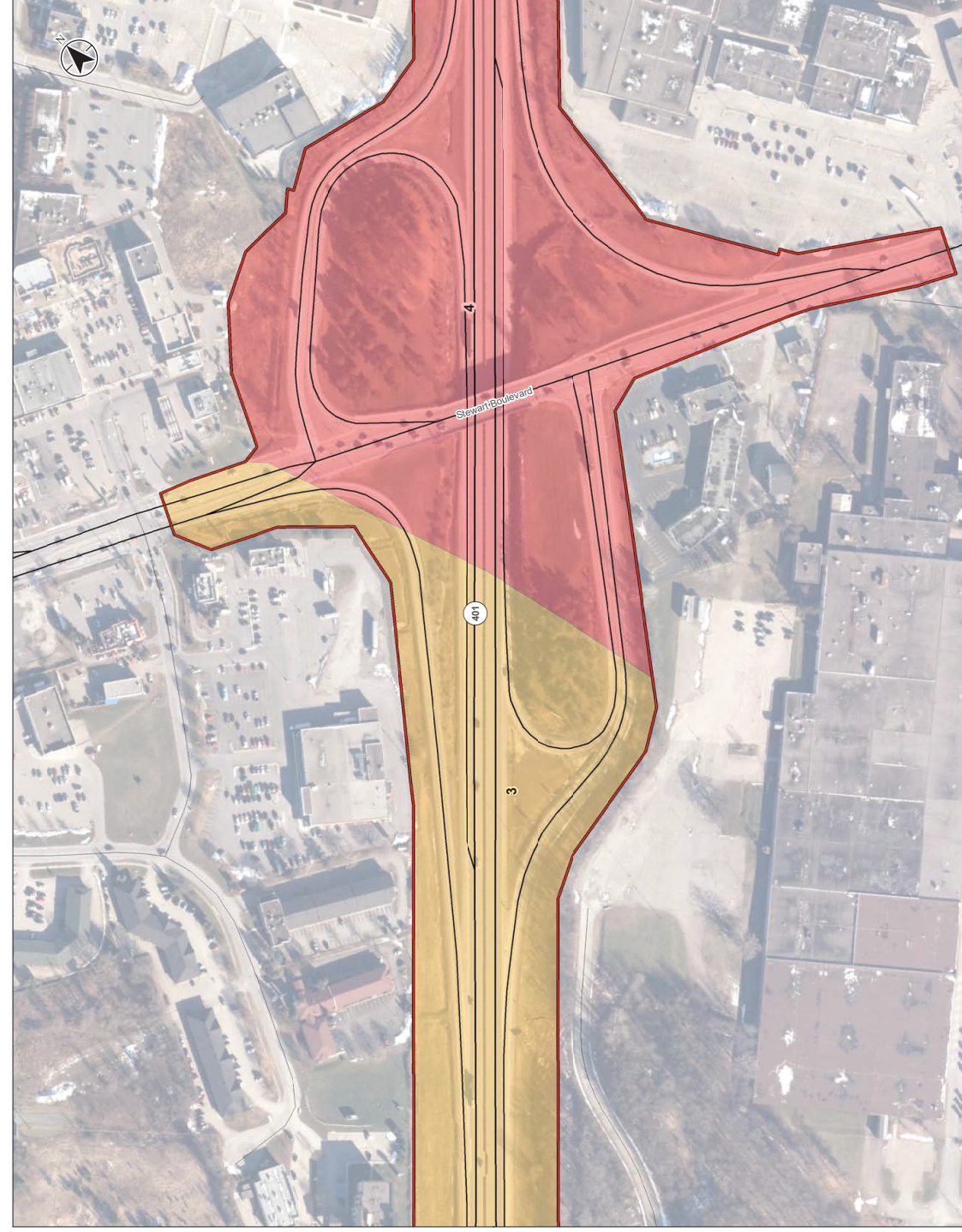
Project Location: City of Brockville
 1:6500 (1:6500 REV A)
 Prepared by: JW on 2021-12-16

Client/Project:
 ONTARIO MINISTRY OF TRANSPORTATION
 HIGHWAY 401 REHABILITATION/ RECONSTRUCTION
 GWP: 4003-19-00/ WP: 4006-1901

Figure No. **4-b**

Title: **Overall Erosion and Sediment Risk**

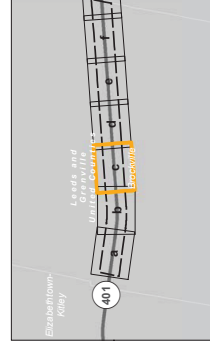
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- Legend**
- MTO ROW
 - Study Area
 - Highway
 - Major Road
 - Minor Road
 - Erosion and Sediment Risk
 - High
 - Medium



Notes
 1. Coordinate System: NAD 1983 (83) Zone 18N
 2. Base feature production under license with the Ontario Ministry of Natural Resources and Forestry © Ontario, 2020.
 3. All data obtained from Ontario Ministry of Natural Resources and Forestry © Ontario, 2020.



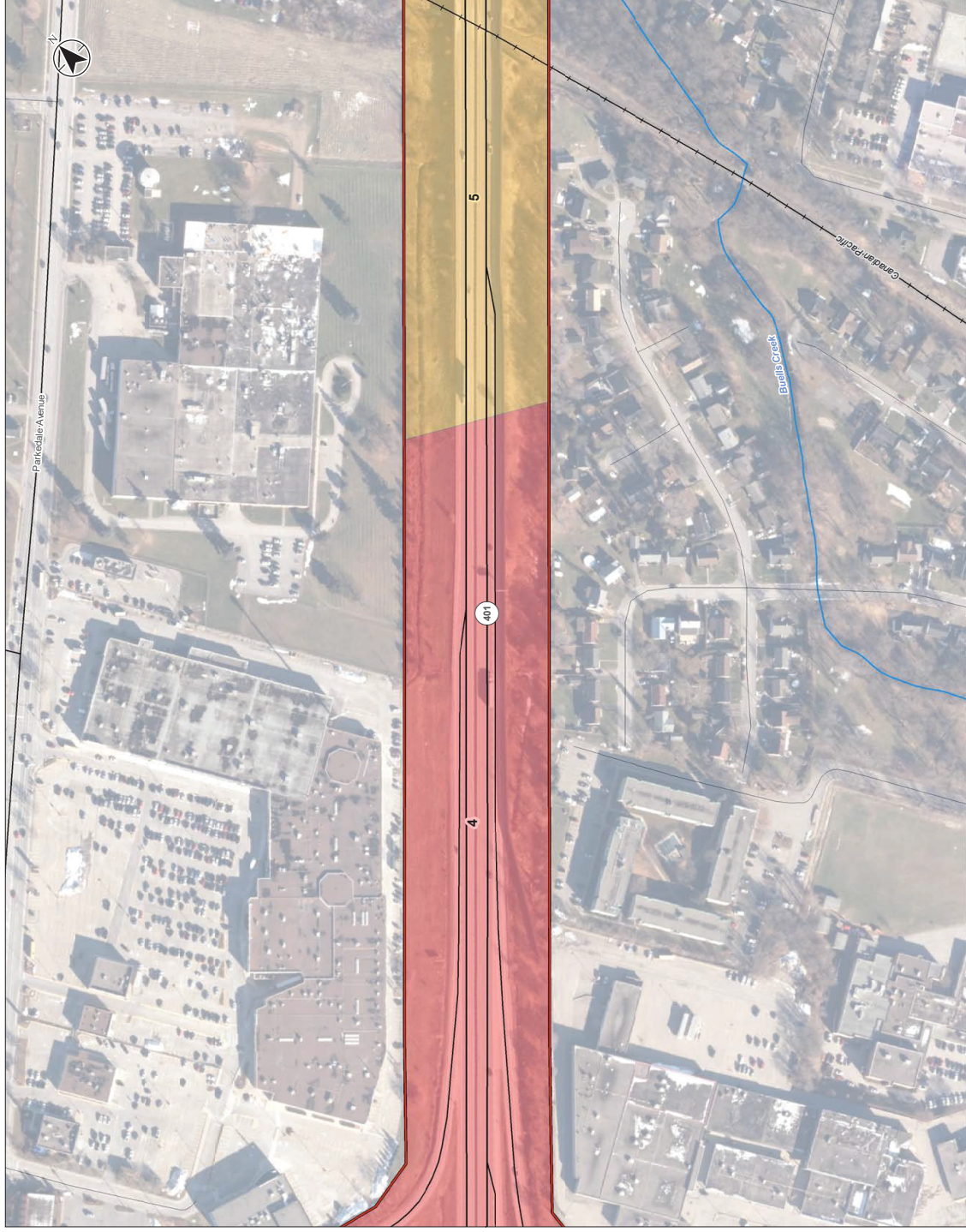
Project Location: City of Brockville
 1:6500 (1:6500 REV A)
 Prepared by: JW on 2021-12-16

Client/Project:
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 HIGHWAY 401 REHABILITATION/ RECONSTRUCTION
 GWP: 4003-19-00/ WP: 4006-1901

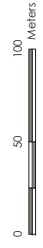
Figure No. **4-c**

Title: **Overall Erosion and Sediment Risk**

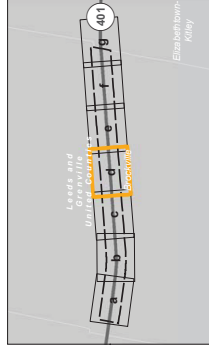
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- Legend
- MTO ROW
 - Study Area
 - Railway
 - Highway
 - Major Road
 - Minor Road
 - Watercourse (Permanent)
 - Erosion and Sediment Risk
 - High
 - Medium



Notes
 1. Coordinate System: NAD 1983 (EPSG: Zone 18N)
 2. Base feature production under license with the Ontario Ministry of Natural Resources and Forestry © Ontario, 2020.
 3. All data obtained from Ontario Ministry of Natural Resources and Forestry © Ontario, 2020.



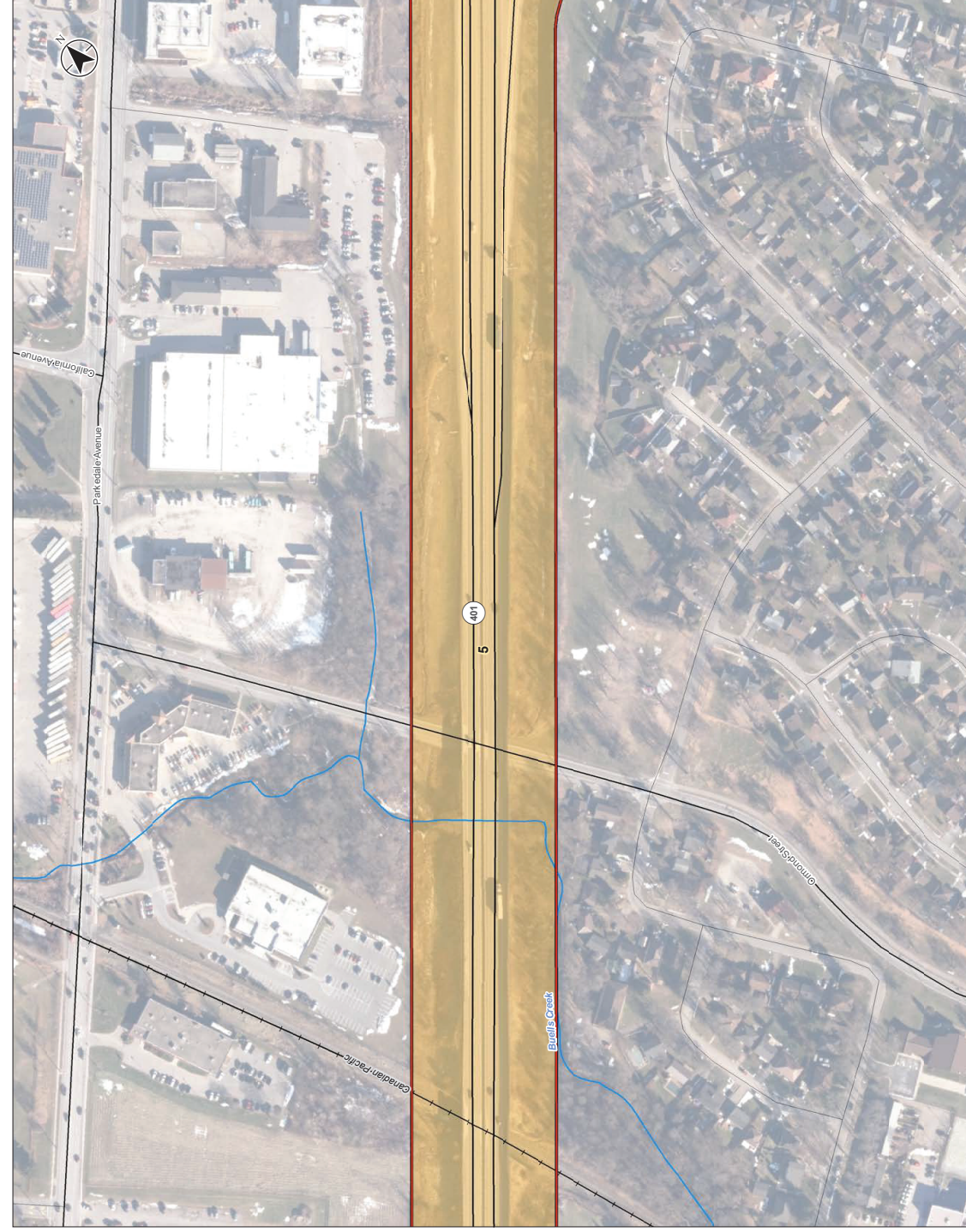
Project Location
 City of Rockville
 Prepared by JW on 2021-12-16

Client/Project
 ONTARIO MINISTRY OF TRANSPORTATION
 HIGHWAY 401 REHABILITATION/ RECONSTRUCTION
 GWP 4003-19-00/ WP 4006-1901

Figure No.
4-d

Title
Overall Erosion and Sediment Risk

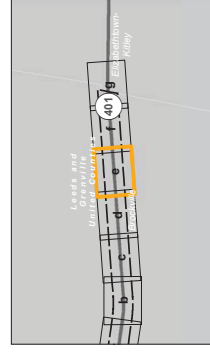
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- Legend
- MTO ROW
 - Study Area
 - Railway
 - Highway
 - Major Road
 - Minor Road
 - Watercourse (Permanent)
 - Erosion and Sediment Risk
 - High
 - Medium



Notes
 1. Coordinate System: NAD 1983 (EPSG: Zone 18N)
 2. Base feature production under license with the Ontario Ministry of Natural Resources and Forestry © Ontario, 2020.
 3. All data obtained from Ontario Ministry of Natural Resources and Forestry © Ontario, 2020.



Project Location
 City of Rockville
 Prepared by JW on 2021-12-16

Client/Project
 ONTARIO MINISTRY OF TRANSPORTATION
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 GWP 4003-19-00/ WP 4006-1901

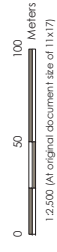
Figure No.
4-e

Title
Overall Erosion and Sediment Risk

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- Legend**
- MTO ROW
 - Study Area
 - Highway
 - Major Road
 - Minor Road
 - Erosion and Sediment Risk
 - Medium



Notes

1. Coordinate System: NAD 1983 (EPSG: Zone 18N)
2. Base feature products were prepared with the Ontario Ministry of Natural Resources and Forestry (OMNR) data for Ontario, 2020.
3. All data obtained from Ontario Ministry of Natural Resources and Forestry (OMNR) for Ontario, 2020.



Project Location: 45001 1100 BEVA
City of Brockville
Prepared by: JW on 2021-12-16

Client/Project:
ONTARIO MINISTRY OF TRANSPORTATION
HIGHWAY 401 REHABILITATION/ RECONSTRUCTION
GWP 4003-19-00/ WP 4006-1901

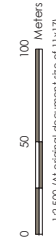
Figure No. **4-f**

Title: **Overall Erosion and Sediment Risk**

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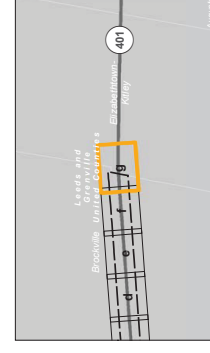


- Legend**
- MTO ROW
 - Study Area
 - Highway
 - Major Road
 - Minor Road
 - Watercourse (Permanent)
 - Erosion and Sediment Risk
 - Medium



Notes

1. Coordinate System: NAD 1983 (EPSG: Zone 18N)
2. Base feature products were prepared with the Ontario Ministry of Natural Resources and Forestry (OMNR) data for Ontario, 2020.
3. All data obtained from Ontario Ministry of Natural Resources and Forestry (OMNR) for Ontario, 2020.



Project Location: 45001 1100 BEVA
City of Brockville
Prepared by: JW on 2021-12-16

Client/Project:
ONTARIO MINISTRY OF TRANSPORTATION
HIGHWAY 401 REHABILITATION/ RECONSTRUCTION
GWP 4003-19-00/ WP 4006-1901

Figure No. **4-g**

Title: **Overall Erosion and Sediment Risk**

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