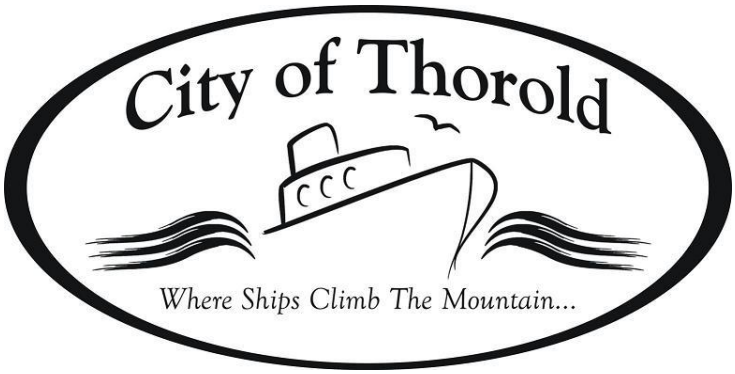

CITY OF THOROLD

GUIDELINES FOR TRANSPORTATION IMPACT STUDIES

MARCH 2018

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1 Introduction

The City of Thorold recognizes the importance of all modes of transportation to its citizens and businesses and to their ability to move around and through the City. The municipal road network serves as a system of routes for the safe and efficient movement of people and goods. It was constructed and is maintained at great public expense and forms a significant public asset. The City of Thorold has a responsibility to effectively manage and maintain each roadway and intersection within its municipal boundary in order to preserve its safety, functional integrity and public purpose.

The goal of a transportation impact study is to assess potential impacts of traffic changes caused by proposed development on municipal roads and to identify any infrastructure improvements or mitigation measures needed to ensure the road network will operate acceptably and safely upon completion of the proposed development.

A transportation impact study may vary in scope and complexity depending on the type and size of the proposed development. A transportation impact study should consider all modes of travel including cars, trucks, transit, cyclists and pedestrians. It should be consistent with the City's goals as expressed in the Strategic Plan, Transportation Master Plan and other planning documents.

1.1 Purpose of a Transportation Impact Study

The fundamental purpose of a Transportation Impact Study is:

- To identify the benefits and impacts of a proposed development or redevelopment;
- To identify how the proposed development can benefit the existing transportation network and vice versa; and
- To identify how any transportation impacts associated with the proposed development can be mitigated and addressed in a manner that is consistent with the objective of the City of Thorold.

The Transportation Impact Study also serves as the basis for the identification of existing or proposed safety concerns and evaluation of transportation related improvements or measures to be included as a condition of access approval for the development or redevelopment. The Transportation Impact Study addresses connectivity between the development and the existing transportation networks, for all modes (cars, trucks, transit, cyclists and pedestrians) expected to access or leave the development.

2 General Study Requirements

2.1 Need for a Transportation Impact Study

There are a number of criteria under which a transportation impact study may be required. Generally, a transportation impact study will be required whenever a proposed development will generate more than 100 additional (new) peak hour, peak direction trips to or from the site during the adjacent roadway's peak hour or the development's peak hour.

A Transportation Impact Study may also be required even if there are less than 100 peak hour, peak direction trips when one or more of the following conditions are anticipated or present:

- The development/redevelopment is located in an area of high roadway congestion and/or high expected rate of population or employment growth.
- The development, its access or type of operation is not envisaged by local land use or transportation plans
- The development or redevelopment proposal requires amendment of the applicable Official Plan(s)
- As part of the proposed development, a new traffic control signal is proposed to be installed on a City roadway
- If, in the opinion of the City, the development/redevelopment has the potential to create unacceptable adverse operational and safety impacts on the City road network. Examples include the following:
    - Inadequate horizontal or vertical sight distances at access points
    - The proximity of the proposed access points to other existing driveways or intersections
    - Absence of a left or right turn lane(s) on the adjacent roadway at the proposed access point(s)
    - The vehicular traffic generated by the development/redevelopment would result in volume/capacity ratios at the signalized intersection becoming critical (i.e. greater than 0.85 overall or for a shared through/turning movement, or greater than 0.95 for an exclusive turning movement)

The City reserves the right to require the submission of a Transportation Impact Study notwithstanding the criteria listed above.

2.2 Data Collection

The applicant must provide both electronic and hard copies of all raw data collected for the Transportation Impact Study. This includes but is not limited to the following:

- Turning movement counts.
- Traffic signal timing
- ATR and AADT counts
- Collision records
- Gap study observations
- Proxy site surveys
- Cordon counts

2.3 Staff Consultation

It is recommended that prior to commencing a transportation impact study the consultant meet with City of Thorold Engineering staff to review the level of detail required, to confirm the scope, and to determine data requirements and their availability. Alternatively, in the event of critical time constraints, the consultant can submit a detailed work plan to City staff for review and comment.

2.4 Qualifications to Conduct a Transportation Impact Study

Where a transportation impact study is required or requested by the City, it will be the responsibility of the proponent to retain a qualified transportation consultant experienced in transportation planning and traffic engineering.

The consultant must be registered as a Professional Engineer in the Province of Ontario and a member of both the Transportation Association of Canada and the Institute of Transportation Engineers. The study must be signed, dated and stamped accordingly. The signing Engineer is verifying that appropriate assumptions and methodologies have been utilized in the completion of the transportation impact study and that (s)he is the individual who is taking corporate and professional responsibility for the study.

Alternatively, at the discretion of the Manager of Engineering, City of Thorold, or his/her designate, the City may retain a transportation consultant at the proponent's expense.

3 Transportation Impact Study Requirements

3.1 Description of the Proposed Development

A detailed description of the proposed development will enable City staff to identify the site location, its anticipated operation and its area of potential influence. It is recommended that the description include the following elements, as appropriate:

- Municipal address
- Existing land uses or permitted use provisions
- Proposed land use
- Number and type of residential units
- Proposed total building size and building location(s)
- Floor Space including a summary of each type of use
- Anticipated date of occupancy
- Approximate days and hours of operation
- Planned phasing of development

If the development is to be constructed in phases, then a description of each phase and its proposed timing of implementation should be included. A site plan or plan of subdivision, if available, would be useful for consideration in the review of the Transportation Impact Study.

3.2 Study Area

The study area should extend far enough from the development to contain all municipal and provincial roadways that will be noticeably affected by the traffic generated by the proposed development. Typically, this will include the area that may be impacted as follows:

- An increase by 5% or more of traffic volumes on adjacent facilities
- Volume/capacity (v/c) ratios for overall intersections operations, through movements or shared though/turning movements increased to 0.85 or greater.
- Volume/Capacity (v/c) ratios for exclusive turning movements to increase to 0.90 or greater.

The City of Thorold reserves the right to establish the study area as may be deemed necessary. Consultation with appropriate City of Thorold Engineering staff, prior to initiating the study, is recommended.

A description of the existing transportation system within the study area, using a combination of maps and other documents should identify relevant information such as;

- Existing roads, number of lanes, on-street bike lanes and posted speed limits.
- Existing signalized intersections, roundabouts, lane configuration, lane widths.

- If appropriate, on-street parking spaces, stopping restrictions, parking meters in the vicinity of the development site and those which affect the operation of key intersections being analyzed.
- Other traffic controls and transportation facilities.
- Existing transit routes, stops and terminals.
- Other features of interest such as designated trails, walkways etc.

3.3 Horizon Years and Time Periods for Analysis

Generally, the horizon year will be taken as 5 years from the anticipated build-out of the site. Horizon years must also be identified for any interim development where phasing, temporary access measures and planned transportation system improvements are anticipated.

The highest 2 weekly peak hours will be the defining factors for determining the study peaks. Typically, the AM peak or PM peak hours will constitute the heaviest combination of site related and background traffic, however in the case of commercial, entertainment, religious, institutional or sport facility uses one or more weekend peaks may be the contributing factor.

3.4 Existing Traffic Conditions

The Transportation Impact Study must include exhibits showing the existing traffic volumes and turning movements for roadways and intersections within the study area, including pedestrian, cyclist and heavy vehicle volumes.

Traffic volume information may be acquired from the City of Thorold or previous Transportation Impact Studies undertaken in the study area. Traffic counts more than 2 years old or counts that appear not to be reflecting existing conditions should be updated to ensure they reflect current traffic volumes. Where the consultant chooses to conduct studies on behalf of the proponent, the raw data must be included in the appendices of the report and must include date, day, road surface and weather conditions.

Regardless of age of the traffic volume data, a minimum one-hour field observations during the peak hour must be undertaken at each affected intersection to verify that traffic volumes through each intersection reflect actual demand and to confirm the necessary adjustment factors for level of service calculations.

Concerns regarding discrepancies in volume data provided by the City should be brought to the attention of Engineering staff rather than adjusting volume data.

3.5 Background Traffic

3.5.1 Future Background Traffic

The background growth projects future traffic without the proposed development. It includes at a minimum, annual growth rates and future traffic from other proposed (approved) developments to be located within the vicinity of the site. The growth in traffic should be established in consultation with City staff through one of the following methods:

- Estimation of roadway growth factors from a calibrated traffic forecast model.
- Regression analysis of historical traffic growth.
- A growth rate based on approved area transportation studies including Environment Assessments, master plans and neighbourhood studies.

In the absence of these methods, a growth rate of 2% per annum should be used.

3.5.2 Planned Roadway Improvements

Any planned roadway improvements to be completed within the study area should be identified and discussed within the report. These improvements shall be reflected in the Future Background and the Future Total Traffic conditions. Notwithstanding this, the existing road conditions must also be analyzed under future background and future total traffic conditions.

3.5.3 Other Developments within the Study Area

All significant developments under construction, approved and in the approval process within the study area that are likely to occur by the specific horizon year(s) are to be identified and included in the background traffic growth for the study. The land-use types and magnitude of the probable future developments in the horizon years should be identified through consultation with City staff.

3.6 Site Generated Traffic

All trip generation, trip distribution, trip assignment and modal split assumptions should be in accordance with standard/accepted techniques and be based on local parameters. Sources should be well documented and any assumptions which may be considered less than conservative must be justified.

3.6.1 Trip Generation

The method of determining trip generation rates should be clearly identified.

Trip generation methods may include one or more of the following and will be a function of the proposed development and its intended operations:

- Trip generation surveys from similar developments in the City of Thorold or comparable municipality which has similar operating characteristics as the proposed development.
- ITE Trip Generation Manual
- First Principals calculations of anticipated trips to and from the site.

Where appropriate it may be justified to reduce the base trip generation rates of the proposed development to account for:

- **Pass-by Trips** – Trips that represent intermediate stops on a trip already on the road network, i.e. a motorist stopping into a service station on their route to and from work. These trips are also called "Synergy" trips. It is important to note that the trip generation rates at the accesses themselves will not be affected by pass-by trips. Only the estimated number of new trips on the surrounding road network will be affected.
- **Transit Usage** – Reductions in automobile travel to the site to account for travel to/from the site by public transit. Transportation planning projections/goals shall be considered; however, shall not replace good engineering judgment and actual modal split data current and historic.
- **Internal Synergy or Captive Market Effects** – Trips which are shared between two or more uses on the same site; i.e. a motorist visiting a retail store and a grocery store on the same site.
- **Redundant Land Use** – Trips which are generated by existing land use activity and reflected in current traffic volumes and will be replaced by the proposed development. Unless otherwise accounted for, these trips will normally be subtracted from the trip generation estimates.
- **Travel Demand Management (TDM)** – strategies to be employed at the proposed development to reduce single occupancy vehicle (SOV) trip making; i.e. staggered work hours, ridesharing, company/hotel shuttle etc.

All trip generation assumptions and adjustments assumed in the calculation of "new" vehicle trips should be supported and well documented. Sensitivity analysis should be undertaken where trip generation parameters have the potential to vary considerably and most probable values cannot be readily identified.

A table should be provided in the study report identifying the categories and quantities of land uses, with the corresponding trip generation rates or equations and the resulting number of trips. For large developments that will be phased in over time, the table should identify each significant phase separately.

3.6.2 Trip Distribution

Trip distribution assumptions should be supported by one or more of the following:

- Transportation Tomorrow Survey (TTS) data
- Origin-destination surveys
- Comprehensive travel surveys
- Existing/anticipated travel patterns

Engineering judgment should be utilized to determine the most applicable of the above methodologies for each particular application.

3.6.3 Trip Assignments

Traffic assignment assumptions shall reflect the most "probable" travel patterns considering the planned site accesses. Traffic assignments may be estimated using a transportation planning model or "hand assignment" based on knowledge of the proposed road network in the study area.

The assumptions shall take into account projected "pass-by" trips and "internal" trips.

3.7 Total Future Traffic

A summary of the existing and future traffic demands shall be provided in a series of exhibits/illustrations that summarize the following:

- Existing traffic;
- Future background traffic – existing plus background traffic growth
- Site generated traffic including a separate graphic for pass-by trip assumptions and:
- Future total traffic – future background plus site generated traffic

Summary exhibits must be provided for each peak period and analysis horizon. It is recommended that the exhibits be provided within the body of the document where they are referenced as opposed to an appendix.

3.8 Evaluation of Site Generated Traffic

An evaluation of signalized and unsignalized intersections that will be affected by site generated traffic volumes for the peak time periods is required with summaries provided in a tabular format.

The objective should be to ensure that no new problem movements are created by the development and that existing problem movements are not worsened to an unacceptable level with the addition of site generated traffic.

An appendix to the traffic study must provide complete documentation of all assumptions used in the analyses concerning lane configuration/use, pedestrian activity, saturation flows, traffic signal cycle length, phasing and timing, utilization of inter-green phase and other relevant parameters. Existing signal timings should be used for existing intersections and signal timing modifications, when not part of a signal system, may be considered as a measure to address capacity or level of service deficiencies.

3.8.1 Capacity Analysis at Intersection without Roundabouts

For each intersection in the study area, the analyses must include capacity calculations with average vehicle delays and volume to capacity ratios for overall intersection operations and individual critical movements for each combination of time and horizon year. Level of service will be stated based both on delay and volume to capacity ratios. Analysis will be done for the existing plus background growth scenarios; and for the scenario with full development. If the development is proposed to be phased, phasing scenarios must also be analyzed as noted above.

The analyses must incorporate adequate crossing times for pedestrians and appropriate assumptions for modelling heavy vehicle operations. A summary of the conclusions should be included in the report with full documentation provided in an appendix.
The City of Thorold accepts both the Highway Capacity Manual (HCM) and Canadian Capacity Guide (CCG) methodologies for intersection analysis.

The analysis must highlight all conditions at signalized intersections or movements where:

- Volume to capacity (v/c) ratios for through movements or shared through / turning movements will operate at 0.85 or greater (0.85 is considered the maximum acceptable level of service for these movements);
- Volume to capacity (v/c) ratios for exclusive turning movements increase to 0.90 or greater (0.90 is considered the maximum acceptable level of service for these movements):
- Queues for an individual movement are projected to exceed available turning lane storage at 95th percentile volumes.

The analysis must highlight unsignalized intersections or movements where:

- Level of service, based on average delay per vehicle or individual movements is LOS “D” or greater;
- The estimated 95th percentile queue length for an individual movement exceeds the available queue storage.

Synchro Modelling:

The model must be calibrated to accurately reflect existing conditions. This will be achieved by adjusting saturation flow rates, lost time or other variable inputs. Proof and verification that outputs such as volume to capacity, queue lengths, delay etc. reflect actual conditions is required. For existing volumes, the volume to capacity should be 1.0 or less since counted volumes are used.

The following system settings are to be used:

- Metric units (km/h, m etc.).
- Lane widths – use actual width or default to 3.3m if modeling future roads.
- Base saturation flow rates for existing and future conditions will be 1900 pcu/hr green. These will then be adjusted for traffic composition, geometrics, lane configurations, pedestrian flows, transit stops, bicycles, and all other applicable factors, as per the Canadian Capacity Guide, Highway Capacity Manual or other recognized methodology for defining and applying the adjustments. The adjustments may be internal to Synchro or applied externally to the saturation flow rate for a particular movement, depending on the specific adjustment. Adjustments may be based on actual conditions, if appropriately documented field observations can be provided, on typical Thorold values or on future assumptions, but the assumptions must be stated in all cases.
- Peak hour factor (PHF) is to be 0.92 unless a calculation based on actual traffic counts demonstrates another value is more appropriate.

The following applies to input data:

- Proper lane designation and storage; do not include taper as storage length
- Volume data must be City approved. Conflicting pedestrian volumes for right and left turns are to be entered accordingly from existing traffic counts or based on approved volumes for future scenarios.
- For actuated operation, include at least one pedestrian call/cycle based on calculated cycle lengths and pedestrian volumes.
- Account for on-street parking by varying the number of lanes for mid-block locations and intersections. (Assume that parking zones are fully occupied).
- Mode of operation should be based on existing conditions; future signals should be modeled as fully actuated with recall to the main street.
- Minimum phase timings will be 10s for through phases, 5s for protected/permissive turn phases with a 3s amber and 5s for fully protected left turn phases with a 3s amber and 1.5s all red.
- The model must include at least 2 existing signalized intersections both upstream and downstream of the proposed signal.
- Future proposed signals must have amber and all-red clearances based on OTM Book 12.

- Pedestrian timings for proposed signals must include a clearance sufficient to cross the entire road at 1.2 m/s; the pedestrian clearance input will be the required clearance minus the amber/all-red for that phase; minimum walk time is 7s.
- Heavy vehicle percentage must be based on actual volumes or City approved volumes for future scenarios; do not use defaults.

The following applies to proposed new signals:

- Network seeding for simulation should be at least a 15-minute interval; recording for four 15 minute intervals with one interval using the PHF and one using the anti-PHF.
- Time-space diagrams should show 100% usage of green time (i.e. as though the signal was operating in a fixed time mode).
- Queue length vs. storage: 95th percentile queue length must not create obstructions.
- All movements at new signals must not have volume to capacity ratios of 0.85 or greater and delay greater than one cycle length.
- Progression and time space diagrams: identify any narrowing of green bands.
- Output should summarize levels of service for each movement at each intersection under all scenarios as well as SimTraffic delay, stops, fuel consumption and GHG emission and any progression issues.
- When Synchro results are questionable a comparison of Synchro and SimTraffic results is required to determine the cause of discrepancy.

Justification of New Signals:

The applicant will be responsible for justifying the need for a new signal by addressing the following:

- Details of the full 8-hour signal warrant data and output using Thorold's signal warrant worksheet with up to date data.
- A safety audit to determine if the proposed traffic management plan could result in a safer overall operation. The audit will be based on the most recent collision data available for the 5 previous calendar years.
- Functional requirements of the proposed signal must be identified including a detailed review of proposed geometry/alignment, pavement markings, signal head locations, new or modified traffic islands etc.
- Identify any easements required from all property owners affected and approval of said property owners.

3.9 Access Location Analysis

3.9.1 Access Geometrics

Existing and proposed access locations should be reviewed to ensure the minimum number is provided to serve the development without negatively impacting flow of traffic along abutting streets. Consideration with respect to possible mutual access with adjacent properties or consolidation of properties should be explored. Access points should be located appropriately in terms of land use and road classification (i.e. no commercial access to local roads). Justification for more than one access must be based on capacity of site traffic and not design preference.

The locations should be adequately spaced from adjacent street and driveway intersections. The number of exit lanes, radii and vehicle storage should be appropriate to accommodate traffic demands. The driveway throat length at the road should be sufficiently long to minimize conflicts between street traffic and vehicles within the site.

Access points should be evaluated in terms of capacity, safety and adequacy of queue storage. Accesses should be free of all encumbrances and provide appropriate visibility triangles. For local roads a minimum 3m x 3m visibility triangle will be required and for collector and arterial roads a minimum 5m x 5m visibility triangle will be required. Proposed loading facilities and access to such facilities should be evaluated to ensure they are adequately sized, designed and accessible so they will not adversely affect traffic operations or pedestrian movements on municipal roads. Manoeuvring on municipal right of way to access loading facilities is not considered acceptable. Access standards should be in conformity with the Transportation Association of Canada (TAC) Manual.

3.9.2 Turn Lane Requirements

The traffic study must examine the requirements for right and left turn lanes. Adequate spacing must be provided between access points to avoid potential turn lane overlaps. All design standards must be in accordance the TAC Manual. Left turn lane determinations at unsignalized intersections must be based on the Geometric Design Standards for Ontario Highways Manual, published by the Ministry of Transportation of Ontario and must also consider the safety benefits of providing a turning lane for the site.

Where turning lanes are warranted the length of storage and taper must be documented in the study.

3.9.3 Sight Distance Evaluation

Analysis for access design and roadway improvements should ensure:

- Safe stopping distance
- Decision sight distance
- Departure sight distance

At each access and at each intersection where a new road is proposed, the sight distance requirements should be examined based on appropriate standards (TAC) and the availability of sight distance determined from actual field measurements.

3.10 Collision and Safety Analysis

The initial review of existing conditions within the study area should include recent (5 year) collision history. A safety evaluation shall be undertaken for each intersection and/or major accesses within the study area to identify locations where traffic safety should be given extra consideration. High collision locations (based on number, rate and severity) within the study area must be analyzed and measures to alleviate collision hazards must be explored.

For locations in the top 25% of the City's network screening list, evidence must be provided that the development will not exacerbate conditions or an alternative to improve conditions must be proposed.

The objective of the safety analysis is to assess the proposed development and determine if there are design alternatives that would enhance the level of safety of the site and adjacent road network for all users.

3.11 Improvement Alternatives Required to Mitigate Traffic Impacts as per City Policies

This section of the Transportation Impact Study will identify operational transportation system improvements and other measures required to ensure that acceptable operation of the transportation system is maintained. The improvements must incorporate recommendations outlined in previous city transportation studies or improvement projects.

The physical and operational road network deficiencies that have been identified in the Transportation Impact Study must be addressed and solutions provided that are feasible and economic to implement.

Improvements could include but are not limited to:

- Widening of the adjacent road network
- Pedestrian sidewalks, multi-use paths or walkways
- Addition of on-street bike lanes
- New transit stops or relocation of existing stops

- Addition of left or right turn lanes at intersections and/or accesses
- Restriction or relocation of existing accesses
- Change in traffic control at an intersection
- Upgrading of traffic control signal through additional phasing and/or improved timing
- Co-ordination of traffic control signals
- Relocation or closure of existing public streets or intersections
- Installation or removal of a median barrier or other median treatments
- Turning restrictions at accesses or intersections

3.12 Recommendations

It is important to structure recommendations for improvements within the appropriate time perspectives. Recommendations should be sensitive to the following issues:

- Timing of short-range and long-range network improvements that are already planned and scheduled.
- Anticipated time schedule of adjacent developments.
- Size and timing of individual phase of the proposed developments.
- Part of the City's transportation planning initiatives.
- Logical sequencing of various improvements if not completed in Phase 1.
- Right-of-way requirements and the availability of additional right-of-way within the appropriate time frames.
- Local priorities for transportation improvements and funding.
- Cost-effectiveness of implementing improvements at a given stage of development.
- Necessary lead-time for additional design and construction

Since improvements can often be implemented in more than one order, the recommendation should address an implementation sequence that provides maximum compatibility with the overall roadway system.

4 Documentation and Reporting

The structure and format of the Transportation Impact Study should follow the guidelines outlined
in this document, as applicable. The following is a suggested study structure:

- Executive Summary
- Development description with a suitable plan
- Study area map identifying the study area and site
- Existing traffic conditions in the study area
- Anticipated nearby development (tabular summaries)
- Identification of all assumptions

    - Analysis period
    - Trip generation rates for each land use
    - Synergy trips
    - Trip assignment
    - Modal split
- Existing traffic volumes (exhibit required)
- Site generated traffic assignment (exhibit required)
- Traffic demand (future background without development – exhibit required)
- Total traffic demand (future total background with development – exhibit required)
- Improvement alternatives required to mitigate traffic impacts
- Transportation impacts for future background and total traffic with and without mitigation measures (tabular summaries)
- Access requirements including visibility requirements
- Safety considerations including collision summaries (collision diagrams, tabular summary)
- Summary of findings
- Conclusions and Recommendations

This format will facilitate review, discussion and communication. Relevant maps, graphs and tables should be placed adjacent to the relevant text.

The Transportation Impact Study should consist of a main document, supplemented by technical appendices containing detailed analyses as required.

Two (2) copies of the final Transportation Impact Study complete with supporting documentation must be submitted to City staff (1- Planning and Development, 1 Development Engineering). All electronic Synchro and SimTraffic files must be provided on one compact disk upon submission of the reports. The files shall be appropriately names to easily identify their targeted analysis period.

All information submitted to the City of Thorold in connection with any traffic impact study will be considered to be in the public domain.

5 Bibliography

Guidelines for the Preparation of Transportation Impact Studies and Site Plan Review – City of Niagara Falls, Revised 2011

Guidelines for Transportation Impact Studies – Niagara Region, May 2012

Transportation Impact Study Guidelines – City of Hamilton, July 2009