

10. ASSESSMENT OF THE PREFERRED DESIGN

10.1 ASSESSMENT METHODOLOGY

An impact analysis was undertaken to identify the potential effects, both positive and negative of the pre-construction, construction and operational activities required for project implementation. In the case of negative effects, mitigation opportunities and methods were also identified. The evaluation criteria and indicators established during the alternatives evaluation process were used as the basis for assessing the effects of the preferred design on the social, physical and natural environments. The effects analysis involved applying the following steps:

- Step 1:** Identify and analyze activities where the project, as described in Chapter 9 may interact with existing environmental conditions, as described in Chapter 6.
- Step 2:** Acknowledge predetermined project activities that act as built-in positive attribute and/or propose mitigation measures that can be implemented during construction or operation of the undertaking, as outlined in Section 9.4
- Step 3:** Identify the residual environmental effects, if any.
- Step 4:** Identify opportunities for further mitigation of residual effects, if possible/practical, including monitoring.
- Step 5:** Determine the significance of the residual environmental effects, after further mitigation. The potential effects of project implementation were described based on their level of significance.
- Step 6:** Recommend monitoring activities during the construction or operation of the undertaking.

Professional experience, analysis, simulation and judgement formed the basis for identifying environmental effects and mitigation measures. The analysis was based primarily on comparing the existing environment condition with the anticipated future environment, prior to, during, and after construction. The prediction of effects considered:

- The interaction between a project activity and the valued environmental components;
- The effects of the project activities on the environmental values; and
- The combined effects of multiple activities and/or multiple effects.

Within this context, consideration was given to:

- The magnitude, spatial extent, and duration of effects;
- The proportion of a population or community affected;
- Direct or indirect effects;
- The degree to which the effect responds to mitigation.

In this assessment, “residual” environmental effects are defined as changes to the environment caused by the project, and vice versa, when compared to existing conditions and taking into account all built-in mitigation measures. Potential residual environmental effects were assessed as to their significance, including spatial and temporal considerations, and were categorized according to the following definitions:

“Positive effect” means an effect that will contribute to the wellbeing or health of a valued environmental component.

“Negligible” means an effect that may exhibit one or more of the following characteristics:

- nearly-zero or hardly discernible effect; or
- affecting a population or a specific group of individuals at a localized area and/or over a short period in such a way that the effect is similar to random small changes but would have no measurable effect on the population as a whole.

“Insignificant” means an effect that may exhibit one or more of the following characteristics:

- not widespread;
- temporary or short-term duration (i.e., only during construction phase);
- recurring effect lasting for short periods of time during or after project implementation;
- affecting a specific group of individual in a population or community at a localized area or over a short period, but not affecting the integrity of the population or community; or
- not permanent, so that after the stimulus (i.e., project activity) is removed, the integrity of the environmental component would be resumed.

“Moderately Significant” means an effect that may exhibit one or more of the following characteristics:

- not widespread with mostly local effects;
- requires further investigation

- permanent reduction in species diversity or population of a species, but not in sufficient magnitude to cause a decline in abundance and/or change in distribution beyond which natural reproduction or immigration would not return that population, or any species dependent on it, to its former level within several generations; and
- could be alleviated with additional detailed design.

“Significant” means an effect that may exhibit one or more of the following characteristics:

- widespread;
- permanent transgression or contravention of legislation, standards, or environmental guidelines or objectives;
- permanent reduction in species diversity or population of a species in sufficient magnitude to cause a decline in abundance and/or change in distribution beyond which natural reproduction or immigration would not return that population, or any species dependent on it, to its former level within several generations;
- permanent loss of critical/productive habitat; and
- permanent alternation to community characteristics or services, established land use patterns, which is severe and undesirable to the community as a whole.

The definitions of significance were adopted for use in this assessment because many of the impacts cannot be quantified in absolute terms, although changes and trends can be predicted. The definitions provide guidance and were intended to minimize personal bias. This is important because the analyses are sometimes based on professional judgement and limited information.

Once the potential effects were predicted, additional mitigation measures were identified. Often these mitigation measures were sufficient to reduce potential negative effects to an insignificant or negligible status.

Monitoring is important to verify the accuracy of predicting effects. Monitoring measures were recommended to determine what effects would actually occur with project implementation, and may result in the modification of mitigation measures to improve their effectiveness. Identified monitoring measures included inspection, surveillance and compliance monitoring.

10.2 ASSESSMENT RESULTS

An environmental effect requires consideration of all project activities and their interaction with the environment. Pre-construction, construction and operational activities were assessed. Table 10-1 describes these project

activities and their interaction with the environment and location, the potential effects, mitigation measures, residual effects and their significance, and monitoring recommendations. Project stages are coded as follows:

- P – Pre-construction
- C – Construction
- O – Operation

10.3 PROJECT-RELATED EFFECTS AND MITIGATION

The evaluation of project-related effects was performed using the same general objectives used to evaluate alternatives to the undertaking and alternative methods. These objectives are:

- To protect and enhance the social environment in the corridor
- To protect and enhance the natural environment in the corridor
- To promote smart growth and economic development in the corridor
- To provide an effective transportation service

The issue of cost-effectiveness was considered in selecting the preferred undertaking and is not considered further here.

Goals defined by professionals in the study team are subsets of these objectives and refer to an environmental value or criterion. The effect of the proposed undertaking in terms of each environmental value was rated using a qualitative scale ranging from a positive or beneficial effect through negligible to a potentially significant negative effect as described in the above methodology.

10.4 ANALYSIS OF ENVIRONMENTAL EFFECTS AND MITIGATION

10.4.1 OBJECTIVE A: To protect and enhance the social environment in the corridor

Overall, the various goals set to protect and enhance the social environment are largely achieved. The assessment in terms of the related environmental values indicates that most adverse effects are generally mitigated by the built-in attributes of the design and benefits for the communities within the corridor can be maximized. The assessment of Objective A is tabulated in Table 9-1.

In particular, the undertaking will very likely improve community cohesion as well as access to municipal and community facilities within the corridor. Because most properties fronting Warden Avenue are access from local

streets to the side and rear, the adoption of a median transitway location on Warden Avenue will not require road users to modify their travel patterns. Similarly, by maintaining mixed traffic operations along Denison Street, existing properties along that portion of the transit routing will enjoy the same access as they do today.

Preserving and improving public safety and security in the corridor was an important consideration in development of the design concept. Again, several features of the median transitway design were able to, not only allow frequent access across the median for Emergency Response Vehicles, but also provide pedestrians with a safer environment.

In addition, noise and vibration studies at representative sensitive receptors have demonstrated that the combined effect of median transitway operation and general traffic on the widened Warden Avenue roadway will not result in a noticeable increase in noise or vibration levels for residents located south of Denison Street or in Markham Centre.

A number of Built Heritage Features (BHF) and Cultural Landscape Units (CLU) were identified within the corridor, including two cemeteries. No changes to the roadway (i.e. Highway 407 ramps) are planned near the Bethel Cemetery. Road widening is may occur next to the St. John's 5th line cemetery on the east side of Warden Avenue south of Denison Street in the longer term if an option to extent the transitway south to Steeles Avenue is pursued. To minimize impacts on the cemetery, the width of Warden Avenue has been kept as compact as possible and the alignment has been shifted to the west. In addition, the length of the exclusive right turn lane has been minimized.

A Stage 1 Archaeological Assessment, conducted during the study, indicated the absence of archaeological sites within the project impact area. As is usually the case, a Stage 2 archaeological study will be conducted during the construction phase for the transitway.

Finally, the introduction of a transitway, even in a highly developed urban context, has the potential to worsen the visual aesthetics of the road. To minimize the effects, and potentially improve the street environment over existing conditions, a landscaped median between the transitway lanes has been included in the preferred design between 14th Avenue and Denison Street.

10.4.2 OBJECTIVE B: To protect and enhance the natural environment in the corridor

The protection and enhancement of the natural environment within the corridor has been entirely achieved. By definition, the undertaking along

the Warden Avenue right-of-way is set in a highly developed urban environment, where natural features have mostly been disturbed by previous development. Nevertheless, the Rouge River watershed crosses Warden Avenue north of Enterprise Drive. Similarly, nearby urban green spaces still exist and must be protected. In terms of all valued environmental components to be considered, effects on aquatic and terrestrial ecosystems are either negligible or insignificant when built-in mitigation measures are implemented or sensitive construction and operation methods are respected. The potential need to widen existing roadways and bridges along the transitway will incorporate mitigation measures where required to preserve or enhance the terrestrial ecosystems.

Future air quality, except for PM, is expected to be better than current air quality mainly due to improvements in automobile engine technology and fuels but also with some contribution from the diversion of trips to rapid transit. While PM levels can be expected to increase as traffic increases, rapid transit will slow the rate of increase.

The assessment in terms of Objective B is tabulated in Table 9-2.

Table 10-1
Assessment of Environmental Effects for Objective A – Social Environment

GOAL	Environmental Value/ Criterion	Project Activity/ Issue	Project Phase ¹			Location	Assessment of Effect on the Environment	Built-In Positive Attributes and/or Mitigations	Potential Residual Effects	Further Mitigation	Level of Significance after Mitigation	Monitoring and Recommendation
			P	C	O							
OBJECTIVE A: To protect and enhance the social environment in the corridor												
A1	Minimize adverse effects on and maximize benefits for communities in corridor	Potential displacement of community features		✓	✓	Entire Corridor	Potential displacement or loss of unique features.	Avoided known locations of distinct features to minimize impact: Incorporated streetscaping and road furniture to enhance corridor and community environment.	None required	None required	Negligible	Future community consultation
		Effect on Community Cohesion			✓	Entire corridor	Widening of Warden Avenue an insertion of median transitway may increase barrier effect	South of 14 th Avenue, retained existing number of lanes for regular vehicles on Warden Avenue	None expected	None necessary	Overall positive effect	Monitor traffic levels on Warden Avenue
		Community facility utilization			✓	Entire corridor	Improved transit access increases demand on facilities and services within the corridor.	Municipality can expand services and facilities through the increased development charge revenue.	None expected	Include mitigation measures in community facility expansion.	Positive effect	None required
A2	Maintain a high level of public safety and security in corridor	Access for emergency vehicles	✓	✓	✓	Warden Avenue	Incorporation of median and construction will have adverse effects on Emergency Response Services (ERS) access and time (one development only)	Provided U-Turns at intersections. Meet with emergency representatives. Breaks to be provided in the median to allow access to Emergency Response Vehicles only.	None expected	Address during detail design in conjunction with ERS	Insignificant	Obtain feedback from ERS
A3	Minimize adverse noise and vibration effects	Noise effect for BRT and LRT due to Widening of Warden Avenue			✓	Entire corridor in proximity of residential uses	Combine effect of median Transitway operation and general traffic on the widened Warden Avenue roadway may result in increased noise levels.	Modeling of future traffic activities indicated that expected noise increases will not exceed the 5dB threshold at which mitigation measures are required. BRT and LRT sound levels expected to be marginal to none.	None expected	None necessary	Negligible	Conduct audit measurements to confirm compliance once the Transitway is fully operational.
		Vibration effect for BRT and LRT due to widening of Warden Avenue			✓	Entire corridor in proximity of residential uses	Combine effect of median Transitway operation and general traffic on the widened Warden Avenue roadway may result in increased vibration levels.	Modeling of future traffic activities indicated that expected vibration increases will not exceed the protocol limit of 0.1 mm/sec for LRT. BRT vibration levels are expected to be negligible.	None expected	None necessary	Negligible	Conduct audit measurements to confirm compliance once the Transitway is fully operational.
A4	Minimize adverse effects on cultural resources	Displacement of Built Heritage Features (BHF) Displacement of Cultural Landscape Units (CLU)		✓		Bethel Cemetery	Construction will occur near the cemetery	No changes to the Warden Avenue/Highway 407 ramps are expected in this location.	None expected	None necessary	Negligible	None required
				✓		St. John's 5 th Line Cemetery	Road widening will reduce boulevard width and distance from cemetery to edge of pavement	Minimized roadway width and minimized length of NB right turn lane.	None expected	Review potential impacts during preliminary and detailed design stage.	Moderately significant	Conduct detailed survey during preliminary design
		Possible impacts to areas with potential for identification of archaeological sites.	✓			Entire Corridor	There is potential for identification of archaeological sites within the project impact area.	Stage 2 Archaeological Assessment: field survey to identify any sites that may be present within the proposed impact area. If areas of further archaeological concern are identified during Stage 2 assessment, such areas must be avoided until any additional work required by the Ministry of Culture has been completed. Mitigation options, including avoidance, protection, or salvage excavation must be determined on a site-by-site basis. If no potentially significant archaeological sites are identified during Stage 2, it will be recommended to the Ministry of Culture that the areas assessed be considered free of further archaeological concern.	Archaeological sites may be identified during the course of Stage 2 Archaeological Assessment.	Needs for further mitigation, possibly including Stage 3 Archaeological Assessment (test excavation) and Stage 4 Archaeological Assessment (further mitigative work, including mitigative excavation), must be determined following Stage 2 Archaeological Assessment, if archaeological resources are identified during survey.	Negligible for stage 1 Archaeological Assessment	No requirement for monitoring has been identified as a result of Stage 1 Archaeological Assessment. Monitoring may be required, depending on the results of Stage 2 Archaeological Assessment.

Table 10-1 (Cont'd)
Assessment of Environmental Effects for Objective A – Social Environment

GOAL	Environmental Value/ Criterion	Project Activity/ Issue	Project Phase ¹			Location	Assessment of Effect on the Environment	Built-In Positive Attributes and/or Mitigations	Potential Residual Effects	Further Mitigation	Level of Significance after Mitigation	Monitoring and Recommendation
			P	C	O							
OBJECTIVE A: To protect and enhance the social environment in the corridor												
A5	Minimize disruption of community vistas and adverse effects on street and neighbourhood aesthetics	Visual Effects	✓		✓	Entire Corridor	Introduction of transit may reduce visual aesthetics of road	Introduction of a comprehensive landscaping and streetscaping plan for the corridor.	Narrow sections of ROW where property cannot be acquired may limit incorporation of streetscaping	None necessary	Moderately Significant	Monitor redevelopment and acquire property through redevelopment applications
		Landscaping	✓		✓	Entire Corridor	Landscaping species may not survive in winter months	Choose appropriate species for both winter and other months to maintain greenery throughout corridor. Place landscaping in planters and incorporate buried irrigation systems.	Species may still not survive	Change species, irrigation patterns, etc	Insignificant	Monitor health of landscaping continuously
		Encroachment on sites of existing property	✓	✓		Warden Avenue north of 14 th Avenue	Additional road width required to accommodate station platforms would result in property encroachment on both side of Warden Avenue	Alignment has been centred on R.O.W. to minimize impacts. Dual southbound left turn (previously contemplated by Warden Avenue widening design) has not been included.	Loss of landscaping	Retaining walls should be designed to improve aesthetics.	Moderately Significant	Work with property owners during preliminary design to develop acceptable design.

Table 10-2
Assessment of Environmental Effects for Objective B - Natural Environment

GOAL	Environmental Value/ Criterion	Project Activity/ Issue	Project Phase ¹			Location	Assessment of Effect on the Environment	Built-In Positive Attributes and/or Mitigations	Potential Residual Effects	Further Mitigation	Level of Significance after Mitigation	Monitoring and Recommendation
			P	C	O							
OBJECTIVE B: To protect and enhance the natural environment in the corridor												
B1	Minimize adverse effects on Aquatic Ecosystems	Fuel spills, due to accidents during construction refuelling and accidents during operation, entering the watercourses.		✓	✓	Entire Corridor	Fish kills due to chemical spills resulting in short term population decline.	No refuelling within 10 m of a watercourse. Emergency Response Plan	Short term population decline. Some contaminants within storm water system.	None practical	Insignificant	None required
		Sediment laden storm water entering watercourses during construction.		✓		Entire Corridor	Fish kills and loss of aquatic habitat resulting in short term population decline.	Construction fencing at work areas near watercourses limiting area of disturbance. Erosion and Sediment Control Plan	Short term population decline.	None practical	Insignificant	None required
		Sediment laden storm water entering watercourses during operation.			✓	Entire Corridor	Loss of aquatic habitat resulting in population decline.	Storm water management facilities such as grassed swales, oil and grit separators, storm water ponds	Short term population decline.	Clean-out facilities as required.	Insignificant	Monitor sediment accumulation in storm water management facilities.
		Loss of site-specific habitat		✓		Rouge River (see Hwy 7 Transitway EA)	The Rouge River is north of Enterprise Drive and the point where the Markham Link Transitway will turn east.	Highway 7 transitway design will address potential impacts on Rouge River.	Not applicable	Highway 7 EA will identify mitigation measures, if required.	Not applicable	Highway 7 EA will identify monitoring requirements.
		Fish mortality		✓		Rouge River (see Hwy 7 Transitway EA)	Fish may be injured or killed by dewatering or physical harm. Note comment above.	Highway 7 transitway design will address potential impacts on Rouge River.	Not applicable	Highway 7 EA will identify mitigation measures, if required.	Not applicable	Highway 7 EA will identify monitoring requirements.

Table 10-2 (Cont'd)
Assessment of Environmental Effects for Objective A – Natural Environment

GOAL	Environmental Value/ Criterion	Project Activity/ Issue	Project Phase ¹			Location	Assessment of Effect on the Environment	Built-In Positive Attributes and/or Mitigations	Potential Residual Effects	Further Mitigation	Level of Significance after Mitigation	Monitoring and Recommendation
			P	C	O							
OBJECTIVE B: To protect and enhance the natural environment in the corridor												
B1 (Cont'd)	Minimize adverse effects on Aquatic Ecosystems	Barriers to fish movement		✓	✓	Rouge River (see Hwy 7 Transitway EA)	Culvert/bridge extension, repair or replacement may create a barrier to fish movement. Note comment above.	Use open footing culverts or countersink closed culverts a minimum of 20% of culvert diameter.	The culvert extension at Rouge River will be designed to avoid the creation of a barrier to fish movement.	Negotiations with regulatory agencies during detail design.	Negligible	On-site environmental inspection during in-water work.
		Baseflow alterations		✓	✓	Rouge River (see Hwy 7 Transitway EA)	New impervious surfaces can lead to changes in the frequency, magnitude and duration of flows.	Reduce the area of impervious surfaces to the extent possible. Use storm water management practices that encourage infiltration and recharge of groundwater.	None expected.	None	Negligible	Post-construction inspection of storm water management facilities to evaluate their effectiveness. On-going maintenance as required.
		Increased temperature		✓	✓	Rouge River (see Hwy 7 Transitway EA)	Clearing of riparian vegetation and storm water management practices can impact temperature regimes.	Minimize the area of stream bank alteration to the extent possible. Use storm water management practices that encourage infiltration and recharge of groundwater.	Shading provided by culvert/bridge offsets shading lost through removal of riparian vegetation.	Restore riparian areas disturbed during construction with native vegetation.	Negligible	Post-construction inspection of storm water management facilities to evaluate their effectiveness. On-going maintenance as required. Post-construction inspection of riparian plantings to confirm survival.
		Disturbance to rare, threatened or endangered species		✓	✓	Rouge River (see Hwy 7 Transitway EA)	Rouge River watershed known to support reidside dace, American brook lamprey, and stoneroller.	No species-specific mitigation required.	None expected	None required	Negligible	None required.
B2	Minimize adverse effects on Terrestrial Ecosystems	Barriers to wildlife movement		✓	✓	Entire corridor	Construction of the transitway and associated facilities will result in the removal of vegetation and the wildlife habitat that it supports. Activities such as site grubbing, staging and stockpiling during construction could result in destruction or disturbance of migratory birds.	Minimize the area of vegetation removals to the extent possible. Minimize grade changes to the extent possible. Use close cut clearing and trimming to minimize the number of trees to be removed. Delineate work zones using construction fencing/tree protection barrier. Protect trees within the clear zone using guide rail, curbs, etc. to prevent removal.	Removal of approximately 0.095 ha of Dry-moist open field meadow (CUM1-1) on the east and west sides of Warden Avenue south of Highway 407.	Restore natural areas disturbed during construction with native vegetation, where feasible. Replace ornamental vegetation as part of landscaping. Restoration should follow a net gain approach	Negligible	Post-construction inspection of vegetation plantings to confirm survival.
		Wildlife mortality.		✓		Entire corridor	Removal of wildlife habitat may result in wildlife mortality.	Perform vegetation removals outside of wildlife breeding seasons (typically April 1 to July 31). Perform bridge/culvert extension, repair and replacement outside of wildlife breeding seasons.	None expected	None required	Negligible	None required.
		Barriers to wildlife movement and wildlife/vehicle conflicts		✓	✓	Entire corridor	Culvert/bridge extension, repair or replacement may create a barrier to wildlife movement. Increase in the width of Warden Avenue to accommodate widening and transitway and associated facilities may create an additional impediment to wildlife movement and increase the potential for wildlife/vehicle conflicts.	Enhance wildlife passage under transitway, where feasible through culvert/bridge modifications.	Transitway and widening represents an incremental increase in road width compared to existing barrier created by Warden Avenue.	Use of existing culverts/bridges maintains wildlife passage under transitway and does not offer opportunities to enhance wildlife passage.	Negligible.	None required.
		Disturbance to rare, threatened or endangered wildlife.		✓		Entire corridor	No rare, threatened or endangered wildlife identified within study area.	No species-specific mitigation required	None expected	None required	Negligible	None required.

Table 10-2 (Cont'd)
Assessment of Environmental Effects for Objective B – Natural Environment

GOAL	Environmental Value/ Criterion	Project Activity/ Issue	Project Phase ¹			Location	Assessment of Effect on the Environment	Built-In Positive Attributes and/or Mitigations	Potential Residual Effects	Further Mitigation	Level of Significance after Mitigation	Monitoring and Recommendation
			P	C	O							
OBJECTIVE B: To protect and enhance the natural environment in the corridor												
B2 (Cont'd)	Minimize adverse effects on Terrestrial Ecosystems	Disturbance to vegetation through edge effects, drainage modifications and road salt.		✓	✓	Entire corridor	Ditching, grading and other drainage modifications may alter local soil moisture regimes. Road salt may result in vegetation mortality and dieback.	Minimize the area of vegetation removals to the extent possible. Minimize grade changes and cut/fill requirements to the extent possible. Use close cut clearing and trimming to minimize encroachment on remaining vegetation. Delineate work zones using construction fencing/tree protection barrier. Manage the application of road salt to the extent possible.	Vegetation communities within the study area are primarily cultural in origin and have been impacted by Warden Avenue. Transitway represents an incremental encroachment into these already disturbed communities.	Landscape treatments	Insignificant	None required.
		Rare, threatened or endangered flora.		✓		Entire Corridor	No regionally rare or uncommon tree species are located within the study limits.	Minimize the area of vegetation removals to the extent possible. Minimize grade changes to the extent possible. Use close cut clearing and trimming to minimize the number of trees to be removed. Delineate work zones using construction fencing/tree protection barrier. Protect trees within the clear zone using guide rail, curbs, etc. to prevent removal.	Trees may be removed by the transitway and its associated facilities.	None required	Insignificant	None required.
B3	Improve regional air quality and minimize adverse local effects	Degradation of existing local and regional air quality when compared to MOE standards			✓	York Region	Situation expected to be unchanged or marginally better than 2001	The fleet average emissions will drop significantly due to technological improvements balancing the increase in traffic volumes. The RT will divert commuters from individual highly polluting sources (single passenger automobiles)	Forecast improvement in all pollutants assessed (PM ₁₀ , NO _x , SO ₂ , CO) when compared with 2021 forecasts with and without proposed rapid transit (See Appendix K).	None required	Positive Effect	None at this time
		Increase in emissions of Greenhouse Gases (GhG)			✓	York Region	Fewer GhGs are expected to be emitted	Compared to the status quo (no additional transit) there will be far less GhGs emitted per commuting person	Reduced per capita emissions of GhGs	None required	Negligible	None required
		Degradation of air quality during construction		✓		Warden Avenue	Some dust is expected during the construction period.	The law requires that all possible pollutant emission mitigation steps possible be taken during construction activities	Some PM emissions locally.	None required	Negligible	None recommended
B4	Minimize adverse effects on corridor hydro-geological, geological and hydrological conditions	Increased pavement; decreased infiltration			✓	Entire corridor	Minor increase in quantity of surface runoff. Minor decrease in quantity of groundwater.	Storm water management facilities such as grassed swales and storm water ponds.	Minor increase in peak streamflows. Minor decrease in groundwater.	None practical	Negligible	None required

10.4.3 OBJECTIVE C: To promote smart growth and economic development in the corridor

One of the main purposes of the Rapid Transit System is to support the smart growth policies of the Provincial and Regional Governments and simultaneously encourage economic development. From this perspective, the Markham North South Transitway strongly supports Regional and Municipal planning policies, such as the Centres and Corridors urban form. In many respects, the undertaking will contribute to the intensification of

underutilized sites within the corridor and encourage transit-oriented development at infill locations and vacant land along the corridor. At the same time, several built-in design characteristics are aimed at reducing the potential for adverse effects on business or access to social and community facilities.

The transit system will support the overall objective of the Region's Planning Policies to ensure that form follows function. The transit system must contribute to a sustainable environment by improving access to new

and existing development leading to increased business and economic activity along the corridor. Through this increase in business activity, infill locations and vacant land is more likely to be developed, maximizing the desired concentration of development within municipal zoning controls and leading to a more viable alternative of rapid transit in York Region. The assessment in terms of Objective D is tabulated in Table 10-3.

Table 10-3
Assessment of Environmental Effects for Objective C – Smart Growth and Economic Development

GOAL	Environmental Value/ Criterion	Project Activity/ Issue	Project Phase ¹		Location	Assessment of Effect on the Environment	Built-In Positive Attributes and/or Mitigations	Potential Residual Effects	Further Mitigation	Level of Significance after Mitigation	Monitoring and Recommendation
OBJECTIVE D: To promote smart growth and economic development in the corridor											
C1	Support Regional and Municipal Planning Policies and approved urban structure	Need for pedestrian-friendly streets and walkways for access to stations	✓	✓	Entire corridor	Streetscape will create a more pedestrian-friendly atmosphere.	Signalized pedestrian crosswalks will be provided at all stations and intersections. Pedestrian safety will be considered in designs for station precincts and road signage will be highly visible to both pedestrians and automobiles.	Potential for jaywalking in vicinity of stations	Platform edge treatment will discourage illegal access	Insignificant and positive	Monitor traffic accidents involving pedestrians to establish whether cause is transit related.
		Locating higher density and transit-oriented development where it can be served by transitway		✓	New and redevelopment/infill locations	Current landowners could be resistant to increased infill development due to potential effects on traffic generation	Regional/Municipal land use controls and approval processes to encourage transit-oriented development or re-development in support of OP objectives.	Redevelopment pressure on surrounding areas	Apply Municipal Site Plan approval process	Insignificant	Monitor re-development activity to control overall increase in development density
C2	Provide convenient access to social and community facilities in corridor	Potential barrier effects during construction and operation	✓	✓	Entire corridor	Transitway could be perceived as a barrier in access to future office buildings, industrial and business park areas, commercial buildings etc.	Construction Traffic and Pedestrian Management Plan will avoid wherever possible, barriers to entrances/exits along Warden and on side streets.	Alternative access routes to facilities may affect adjacent properties	Mark detours and alternative access points clearly	Insignificant	Monitor congestion levels during construction and traffic patterns during operations.
C3	Minimize adverse effects on business activities in corridor	The potential for an increase in business activity.	✓	✓	Entire corridor	As Warden Avenue is a relatively developed corridor, increased activity could require a change in urban form.	Intensification of underutilized sites along with the development of infill locations and any vacant land should increase the market for some business activity.	Increase in traffic; increase in workforce/ population.	Encourage intensification meeting urban form objectives.	Insignificant and positive	Monitor building applications/ permits, economic influences (employment rate, etc.)
		The potential for a decrease in business activity.		✓	Entire corridor	Modification of road access could lead to displacement and/or business loss.	Implement procedures to address requests of affected businesses; Incorporate design solutions and construction methods to minimize number of businesses affected.	Decrease in traffic; decrease in workforce/population	Encourage alternative compatible development	Moderately significant	Cooperative response to business loss concerns addressed to municipalities.
C4	Protect provisions for goods movement in corridor	Ease of Truck Movement		✓	Entire Corridor	Median transitway will restrict truck movement in corridor	Provided U-turns at major intersections to allow for truck access to side streets and properties. Traffic analysis at intersections indicated sufficient capacity for trucks using U-turns	Intersections with no station in median does not allow sufficient turning width for WB 17(articulated trucks)	Traffic signs prohibit large truck at stations with no stations in median. Designate truck routes	Insignificant	Monitor and widen Warden Avenue with right turn tapers at side streets to allow for movement
			✓		Entire Corridor	Construction may limit access for trucks	Traffic management plan to ensure truck access at all times	May not be possible in some areas	Designate alternative truck routes	Negligible	None required

10.4.4 OBJECTIVE D: To provide an effective transportation service

Generally, the undertaking has the ability to improve mobility within the region and provide good connectivity with inter-regional transit services, all while maintaining an acceptable level of service for general traffic. From this point of view, the proposed transitway will have an overall positive effect on transit ridership in the region. The planned alignment characteristics and geometry will provide a fast, convenient and reliable service in most respects. Although grades at some stations exceed LRT standards, the BRT technology, proposed for initial implementation, will be accommodated in every case. The recommended mitigation, to provide for future LRT technology if required in the longer term, will be local modifications to the running way and station platform configuration at the stations where standards are not met.

Stations are located in areas with modest to residential density (Markham Centre), high employment numbers or a mixture of the two to capitalize on the effectiveness of implementing the improved public transit system. The strategic locations of stations generally achieve the goal of increasing the attractiveness of the rapid transit service and make a positive contribution towards maximizing ridership. In order for all members of society to have access to the system, all stations, shelters and the transit system itself will be accessible for the mobility impaired by providing ramps, elevators, etc. Attractiveness of the rapid transit service is implicit in the design of the undertaking, however, achieving the desired transit speed may affect the capacity for general traffic movements at certain intersections. In this respect, the effect on traffic may be moderately significant. The analysis relative to Objective D is tabulated in Table 10-4.

Table 10-4
Assessment of Environmental Effects for Objective D – Transportation Service

GOAL	Environmental Value/ Criterion	Project Activity/ Issue	Project Phase ¹			Location	Assessment of Effect on the Environment	Built-In Positive Attributes and/or Mitigations	Potential Residual Effects	Further Mitigation	Level of Significance after Mitigation	Monitoring and Recommendation
			P	C	O							
OBJECTIVE D: To provide an effective transportation service												
D1	Maximize Inter-regional and local transit connectivity	Connections to inter-regional services and future gateways	✓		✓	Esna Park Drive and Steeles Avenue	Opportunity to connect to City of Toronto and improve ridership on these transit services.	Markham North South Link will provide a direct connection to City of Toronto transit services including a connection to the Sheppard Don Mills Subway Station.	Increased potential for infill development around this transfer point.	None	Positive effect	Monitor ridership and the performance of the connection to Toronto.
			✓		✓	Warden Avenue and Enterprise Drive	Improved connection between Highway 7 RT corridor.	Markham North South Link will provide a direct connection to the Highway 7 RT system, which will span from western York Region to the Region of Peel.	Increased potential for infill development around this transfer point.	None	Positive effect	Monitor ridership and the performance of the connection to the Highway 7 RT corridor.
		Compatibility with proposed local network	✓		✓	Entire Corridor	Inconvenient transfer between local transit and Markham North South Transit may discourage transit ridership	Stations generally located on local transit routes ensuring convenient transfers between services. Integrated fare system proposed.	Project may change the configuration of local transit.	Local services configured as grid where practical, to provide both community coverage and feeder roles	Positive effect	Regular review of effectiveness of local service plans.
D2	Maximizes speed and ride comfort and minimizes safety risks and maintenance costs with an optimized alignment geometry	Grades at station in excess of standards	✓		✓	North platform	Running way grade at platform exceeds max grade of 0.5% for LRT (actual is 1.29%)	Platform grade is adequate for BRT operations. Could be modified in future for LRT.	None expected.	None	Insignificant	Review situation if LRT is considered
D3	Increase attractiveness of rapid transit service	Travel time and service reliability	✓		✓	Entire Corridor	Adjustments to signal timing to achieve progression and minimize delay to rapid transit.	Micro-simulation of rapid transit operation and general traffic movements during detailed design will be used to optimize signal timing. Transit speed will be increased to maximum achievable with reasonable intersection operation.	Delay to transit or intersecting traffic may be unacceptable. May affect intersection capacity for general traffic movements.	Modification of intersection signal timing.	Moderately significant	Pursue an on-going intersection performance monitoring program
D4	Locate stations to maximize ridership potential and convenience of access for all users	Residents or employees within walking distance of stations. Accessibility for mobility impaired	✓		✓	Entire Corridor	Stations at locations without transit-oriented land use and convenient access could discourage rapid transit use.	Station locations selected to serve supportive land use. Facilities designed with weather protection, direct barrier free access and attractive streetscapes within surrounding residential neighbourhoods.	Continued dependence on automobile if land use objectives not achieved	Greater emphasis on supportive land use	Positive effect	Regular review of land use and new or infill development potential during detailed design phases for transitway and stations.
D5	Maintain or improve road traffic and pedestrian circulation	Reduction in main street intersection capacities due to rapid transit operations			✓	Enterprise Drive	Implementation of Markham North South and Highway 7 transit routes reduces the intersection capacity after future growth.	A dedicated transit phase of 10s has been introduced.	Capacity conditions resulting from high projected traffic volumes expected at the intersection. Impact of RT system on the intersection will be negligible as transit vehicles will only remove 10 seconds from 120 second cycle length	None required.	Moderately significant	Monitoring of traffic volumes to determine if additional capacity is required at the intersection. Monitoring required for active transit signal priority.
					✓	14 th Avenue/Alden Road	Implementation of RT reduces intersection capacity.	N-S left turn lanes will operate as protected only. Extension of Birchmount Road should reduce traffic volumes at intersection and improve operations.	SB left turn will continue to operate at capacity.	None required.	Moderately Significant	Monitor intersection operations.
					✓	McPherson Street/McNabb Street	Implementation of RT reduces the intersection capacity.	E-W green time has been increased to accommodate the minimum pedestrian crossing time. Protected NB and SB left turns have been introduced.	SB left will continue to operate at capacity. E-W approaches will operate at capacity.	None required	Moderately significant	Review opportunities to provide additional E-W capacity during detailed design phase.
					✓	Denison Street	Transition of transit vehicle between Warden Avenue and Denison Street.	Transit vehicle to operate in conjunction with EB advance phase.	Capacity conditions during AM peak hour.	None required.	Moderately Significant	Monitor delay to transit vehicle for active transit signal priority.

Table 10-4 (Cont'd)
Assessment of Environmental Effects for Objective D – Transportation Service

GOAL	Environmental Value/ Criterion	Project Activity/ Issue	Project Phase ¹			Location	Assessment of Effect on the Environment	Built-In Positive Attributes and/or Mitigations	Potential Residual Effects	Further Mitigation	Level of Significance after Mitigation	Monitoring and Recommendation
			P	C	O							
OBJECTIVE D: To provide an effective transportation service												
D5 Cont'd	Maintain or improve road traffic and pedestrian circulation				✓	Hood Road	Requirement for transit vehicle to transition to mixed traffic complicates the intersection operation.	A dedicated transit phase of 10s has been introduced.	Removal and prohibition of E-W left turns due to space restrictions.	None required.	Moderately significant	Review the need to provide transit vehicle priority.
		NB/SB U-turn movements and the corresponding side street right-turn-on-red (RTOR) movements	✓	✓	✓	Warden Avenue north of Denison Street	Median transitway will eliminate random left turns into one development on east side alternative access route	U-turns provided at adjacent intersections for safe manoeuvres into side streets and to properties. Random permissive left turns eliminated thus increasing safety. Develop traffic management plans for construction.	Conflict with U-turns and Right Turns on Red from side streets at Denison Street/Warden Avenue and McPherson/Warden Avenue may decrease safety	None required.	Insignificant	Monitor the intersection operations and conflict potential. If necessary, prohibit NB u-turns and SB and WB right turn on reds at subject intersections.
		Pedestrian Crossings			✓	Enterprise Drive/Warden Avenue and 14 th Avenue/Warden Avenue	The required pedestrian crossing times at these locations have the potential to reduce the green time allocated to the north-south traffic flows on Warden Avenue. A two-stage crossing would reduce the minimum requirements.	A centre median refuge will allow for a two-stage pedestrian crossing decreasing the required east-west phase time.	Reduction in pedestrian level of service	None necessary	Negligible	The decision to implement these special provisions should be deferred until post-operation conditions are monitored and the need is identified.
		Critical left turn storage length Critical left turn storage length (Cont'd)			✓	Southbound left at 14 th Avenue	High left turn volumes resulting from business park/industrial area and conversion of left turns to protected only will effect traffic operation at intersection	Birchmount Road extension will provide an alternate route. Left turn storage lengths have been maximized.	Due to the constraint of the intersection spacing, the maximized left turn storage lengths still cannot provide the require capacity. Left turn vehicles may spill out onto the adjacent through lane blocking the through traffic. This occurs under the existing situation.	None expected	Moderately Significant	Conduct turning movement counts prior to detailed design to determine impact of not providing double SB left turn.
					✓	SB and NB left at McPherson/McNabb	High left turn volumes resulting from business park/industrial area and conversion of left turns to protected only will effect traffic operation at intersection	Left turn storage lengths have been maximized.	Due to the constraint of the intersection spacing), the maximized left turn storage lengths still cannot provide the require capacity. Left turn vehicles may spill out onto the adjacent through lane blocking the through traffic.	None expected	Moderately Significant	Conduct turning movement counts prior to detailed design.
					✓	EB and SB left at Denison Street	High left turn volumes resulting from business parks east and west of Warden Avenue.	The left turn storage lengths have been maximized.	Due to the constraint of the intersection spacing on Denison Street, the maximized left turn storage lengths still cannot provide the require capacity. Left turn vehicles may spill out onto the adjacent through lane blocking the through traffic.	None expected	Moderately Significant	Conduct turning movement counts prior to detailed design.

Notes:

1. P – Pre construction, C – Construction, O – Operation

10.5 ENVIRONMENTAL EFFECTS ASSESSED FOR CEAA REQUIREMENTS

10.5.1 Cumulative Environmental Effects

Cumulative environmental effects are defined as, "... the effects on the environment caused by an action in combination with other past, present and future human actions" (CEAA, 1999). They occur when two or more project-related environmental effects, or two or more independent projects, combine to produce a different effect. The effects may be positive or negative, and may have regional as well as site-specific implications. They can be assessed on the basis of their spatial and temporal boundaries.

10.5.1.1 Spatial Cumulative Effects

Spatial cumulative effects may be experienced by:

- crowding of more than one project or activity within a single space;
- compounding of effects from a localized activity with other activities or conditions over a broader (i.e., regional) area;
- indirect consequence of an activity's effect on a seemingly unrelated activity of condition;
- fragmenting the value of a larger environmental component by small incremental changes (i.e., nibbling).

The facilities planned for the Markham N-S Link Corridor have been sited in locations and designed in configurations such that there will be no spatial cumulative effects during the construction and operation of the rapid transit service.

During project implementation, staging of the construction of elements of the undertaking will ensure that temporary construction disruption does not present a risk of reaching an unacceptable level of adverse effect on community and business access and mobility. Traffic accommodation, noise and dust control measures will be planned and designed to mitigate the overall level of construction activity at any one time and location. Monitoring programs will be followed to verify that the level of construction activity is not accumulating to a level with potential for adverse effects on the social and natural environment.

10.5.1.2 Temporal Cumulative Effects

Temporal cumulative effects may be experienced by:

- accumulation of repetitive yet insignificant effects, reaching a significant level (i.e., crossing a threshold) over a long period of time.

10.5.2 Timelags whereby the effects of short-term activities are not experienced until the future.

The one potential temporal cumulative effect relates to the introduction of surface rapid transit services north of Steeles Avenue prior to the full development of rapid transit networks south of Steeles Avenue. Specifically, the development of a rapid transit service on Warden Avenue north of Steeles Avenue, combined with the extension of the Sheppard Subway, would result in a compelling case to extend rapid transit services south of Steeles Avenue on Warden Avenue to a new subway station. Although this extension may consist of buses in mixed traffic only, any adverse effects would need to be addressed jointly by both York Region and the City of Toronto through a subsequent EA.

10.5.3 Effects of a Project Malfunction or Accident

Rapid transit service will be operated both using dedicated lanes within the Warden Avenue right-of-way and in mixed traffic on other route segments. All transit vehicle movements will be subject to the *Ontario Highway Traffic Act* and general traffic will only be permitted to cross the dedicated lanes at signalized intersections. These measures will reduce the probability of a system malfunction due to collisions with other vehicles. In the event such as a collision occurs, rapid transit vehicle operators will be able to obtain instant assistance from the transit control centre. If required, the centre will request emergency response services that will be able to reach the site of the incident using the general traffic lanes and, when necessary, the median crossings for emergency vehicles provided at regular intervals along the routes. This will permit management of any environmental hazards at incidents by the appropriate emergency service. The maintenance and storage of rapid transit vehicles will be carried out at the Region's maintenance facility proposed in the Langstaff industrial area of Markham. The effects of a project malfunction or accident at this facility have been described in the Yonge Street Corridor Public Transit Improvements Environmental Assessment.

10.5.4 Effects of the Environment on the Undertaking

All infrastructure required for the Undertaking will be designed to function satisfactorily and safely in the range of environmental conditions stipulated in the applicable Ontario design codes and standards. Since the infrastructure and systems anticipated comprise typical road and rail transit facilities, proven in service in the transportation industry in Canadian urban environments, no adverse effects of normal environmental conditions are expected. The service will be operated mostly in existing road rights-of-way where drainage systems and snow or ice clearing measures will mitigate the effects of severe weather conditions on operations in both summer and

winter. Where exclusive rights-of-way are used for rapid transit, the Region will provide all necessary transitway maintenance services to enable safe operation in all normal weather conditions. In the event that extreme conditions (e.g. blizzards or hurricanes), make rapid transit operation unsafe, services will be halted and reinstated under direction from the Region's Transit System Control Centre.

10.5.5 Full Life-Cycle Effects

The assessment described in this chapter considers the potential environmental effects during both construction and operation of the undertaking. In accordance with the requirements of the CEAA, the effects during the remaining phase of the project life-cycle, the Decommissioning phase are discussed below. York Region's rapid transit service is planned as a permanent public service with facilities designed for a service life of 30 – 50 years. Consequently, most of the infrastructure will be maintained or replaced to support the service for the foreseeable future. The only instance where a component may be decommissioned would be if the Region decided to replace all or part of the Maintenance Centre with another facility at another site. If this were to occur, the Region would decommission the facility in accordance with all requirements of the relevant.