APPENDIX D

Natural Environmental Technical Report, December 2003, Mayfield Road Class EA

Mayfield Road
Class Environmental Assessment
Heart Lake Road to Airport Road

Natural Environment Technical Report

Prepared for:
Stantec Consulting Limited
49 Frederick Street
Kitchener, Ontario
N2H 6M7

Prepared by:
Natural Resource Solutions Inc.
279 Weber Street North, Unit 15
Waterloo, ON
N2J 3H8

Project No. 413

December 2003

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

TABLE OF CONTENTS

Figure

Tables

Appendix

1.0 Introduction

The Town of Caledon and the City of Brampton have been experiencing accelerated growth and an increase in traffic volumes, specifically on Mayfield Road. Based on this, the Region of Peel has undertaken a Schedule "C" Class Environmental Assessment (EA) for the section of Mayfield Road between Heart Lake Road and Airport Road.

In August 2002, the Region of Peel awarded the Class Environmental Assessment (EA) and Preliminary Design Study for Mayfield Road to Stantec Consulting Ltd. The proposed undertaking includes the widening of Mayfield Road from Heart Lake Road to Airport Road.

Stantec Consulting Ltd. retained the services of Natural Resource Solutions Inc. (NRSI) on behalf of the Region of Peel to integrate biological assessment and environmental analyses into the EA process. This work began in the fall of 2002 and continued into the summer of 2003 as part of the Mayfield Road Class EA study. The focus was on the identification, review and assessment of natural environment features within the Mayfield Road corridor.

This report has been written as an appendix to the Environmental Study Report (ESR) prepared by Stantec Consulting Ltd. The objectives of this technical report are to address the natural environment component requirements to the Municipal Class EA process as follows:

- Document existing natural environmental features within the study area for the undertaking;

- Evaluate from an environmental perspective, the various alternatives proposed for carrying out the undertaking;

- Recommend from an environmental perspective, the preferred alternative for carrying out the undertaking;

- Determine the potential impacts to the natural environmental features from the construction and operation of the preferred alternative;

- Where appropriate, formulate mitigation measures and recommendations to reduce or eliminate the identified impacts; and

- Where appropriate, recommend appropriate monitoring to evaluate the accuracy of impact predictions and to ensure protection of the natural environmental features.

1.1 Study Area

The Ministry of Transportation completed a Class Environmental Assessment (Class EA) Study for the proposed Highway 410 Extension (from Bovaird Drive to Highway 10 (Main Street) in 1989, which transects the current study area between Heart Lake Road and Dixie Road. The Environmental Assessment Report (EAR) was updated in 1995 and approved by the Minister of the Environment in 1997. Therefore, the limits of the Highway 410/Mayfield interchange do not form part of the current Class EA, as the Highway 410 extension project has been previously approved.

This report describes the existing natural environment (Section 3.0) for the entire study area from Heart Lake Road to Airport Road, including the area of the Hwy 410/Mayfield Road interchange, however, does not include it in the analysis of the alternatives or the impact analysis in Sections 4.0 and 5.0 respectively.

Please refer to the Environmental Study Report prepared by Cole, Sherman and Associates (1999) for details regarding the environmental impacts associated with the section of Mayfield Road that will be affected by the Highway 410 interchange.

2.0 Study Approach

Preliminary tasks for undertaking the natural environment component of the Mayfield Road Class EA study were identified and initiated in fall 2002. The general approach of our study included: contact with resource management agencies; the collection and review of background information; site inspections and inventories; data summation and analyses; impact identification and assessment; formulation of mitigation measures and recommendations; and consolidation of all data into a technical report.

2.1 Collection and Review of Background Information

Existing secondary source file material pertaining to the natural environmental features of the study area was obtained from the Ontario Ministry of Natural Resources (OMNR) Aurora District office, the Toronto Regional Conservation Authority (TRCA), the Royal Ontario Museum (ROM), the Region of Peel Planning Department, and the Town of Caledon.

2.1.1 Agency Contacts

The OMNR, TRCA, ROM and the Town of Caledon were contacted for first-hand information on the study area, particularly for background file material and documents regarding planning and policy issues surrounding the environmental designations within the study area. The following agency contacts were made:

- TRCA: June Murphy, Gary Wilkens, Noah Gaetz and Aileen Barcley for data on natural environmental features (i.e. ANSIs and ESAs, wetland evaluations, fisheries, floristic and wildlife inventories, stream designations (i.e. municipal agricultural drains), information on rural clean water program and vulnerable, threatened or endangered (VTE) species.

- OMNR: Mark Heaton, Biologist, Aurora District for fisheries and VTE species.

- ROM: Erling Holm, Assistant Curator for updated site occurrences from the Ontario redside dace database (threatened status in Ontario).

- Town of Caledon: Geoff Hebbert and Craig Campbell for information regarding whether the creeks in the study area are classified as municipal agricultural drains.

Background information in the form of historical fisheries collection records were obtained from the MNR, Aurora District and the TRCA. These records revealed that redside dace, a provincially threatened cyprinid species has historically occupied headwater reaches of the West Humber River watershed. This was confirmed by cross-checking the study area with the database that Erling Holm (ROM) has developed for redside dace in Ontario. Please refer to Appendix I for historical fish sampling data.

A *Recovery Strategy For Redside Dace in Canada, 2002 – 2007 (Draft)* was prepared by the Redside Dace Recovery Team (RDRT) in 2003. The redside dace is a small colourful cyprinid that requires cool, clear flowing water with riffle-pool sequences and overhanging bank vegetation for its survival (RDRT 2003). In Canada, the redside dace is found only in southern Ontario and is most frequently found in small streams flowing into western Lake Ontario (RDRT 2001).

In 1987, COSEWIC (Committee on the Status of Endangered Wildlife in Canada) updated the national status of the redside dace from vulnerable to special concern (Parker et al. 1988). Status reports on the redside dace will be reviewed in 2004 by COSEWIC that may result in a new designation for redside dace (MNR, personal communication with Alan Dextrase 2003). In Ontario, the redside dace was designated as a threatened species in 2000 due to loss of habitat and deteriorating water quality. The RDRT (2003) identifies at least nine potential threats to redside dace populations left remaining in Ontario. The two

most predominant threats are urban development and agricultural activities. Siltation and removal of bank cover in urban and rural headwater areas are important limiting factors directly related to the decline of redside dace populations (RDRT 2003).

The TRCA and the Town of Caledon were contacted to determine whether the creeks located within the study area have been designated as municipal agricultural drains. Although the majority of the streams or section of streams within the study area function as agricultural drains, they have not been officially designated as municipal agricultural drains (Town of Caledon, personal communication with Craig Campbell 2003). Therefore, these streams were not classified under the Municipal Drain Class Authorization System initiated in 1999 by Fisheries and Oceans Canada and the South-Western Conservation Authorities.

At one tributary of the West Humber River (located east of Torbram Road), a Livestock Access Restriction Project was completed in 1996 (TRCA, personal communication with Aileen Barcley 2003). This project was partially funded by the Metro Rural Clean Water Program in conjunction with the TRCA and was supported by the landowner. This project entailed the erection of fencing (800m on the north side and 500m on the south side of Mayfield Road) to restrict cattle access to the creek and provide an alternative source of water for the cattle.

2.2 Site Inspection and Inventories

Detailed site inspections and inventories were conducted within the study area on various dates from February through August, 2003. The study area included the existing Mayfield Road right-of-way from Heart Lake Road, eastward to the intersection with Airport Road, as well as adjacent lands within approximately 200m of the right-of-way.

2.2.1 *Vegetation and Floristics*

The existing natural vegetation and features were documented, delineated and mapped using qualitative sampling methods. Natural features included vegetation communities and wetland areas.

2.2.2 *Wildlife and Wildlife Habitats*

Background information on wildlife species known from the area was recorded and supplemented with limited observations of wildlife, which were recorded during the field visits. Based on the vegetation communities in the study area, the likelihood of wildlife species known from the background information being found in the study area was determined. It is probable that wildlife species within the study area are the same as those recorded for a previous study completed by Natural Resource Solutions Inc. for Stantec Consulting Ltd. This study evaluated a Mayfield Road widening west of Heart Lake Road in 2002.

2.2.3 *Aquatic Environment and Fisheries*

Aquatic biologists visited the study area on July 29 and August 8, 2003. During the site visits, the aquatic environment, including surface watercourses and fisheries were investigated and documented.

Each surface water feature was assessed for a distance of at least 100m (where accessible) on either side of the Mayfield Road right-of-way to document the aquatic habitat conditions within the watercourses along the proposed alignment. Because of the historical occurrences of the provincially threatened redside dace, exploratory fish sampling was undertaken. Where sufficient water was present on July 29, 2003, a backpack electro-shocker was used to sample the fish community. Assessment of the habitat conditions of the watercourses was also completed. A subsequent site visit was made on August 8, 2003 to observe flow conditions and complete habitat assessments for the remaining watercourses.

3.0 Existing Natural Environment Conditions

This report deals with the study area of the Mayfield Road right-of-way from Heart Lake Road to Airport Road. The natural environment features within this area are described below and are illustrated on Figure J11-J15.

3.1 Designated Environmental Areas

The Heart Lake wetland complex is located within the study area for the Mayfield Road widening as shown on Figure J11-J15. This wetland complex has been evaluated in 1985 and 2000 by the Ministry of Natural Resources and found to be provincially significant. Significant features of the wetland are its large size (87ha) and diverse wetland habitats including thicket swamps, deciduous swamps, marshes, two bogs, and two kettle lakes. This wetland supports one regionally rare species (few flowered sedge, *Carex tenuiflora*) and 42 locally significant species (MNR 2000).

Portions of the wetland have also been designated as an Environmentally Sensitive Area (ESA), a regional life science Area of Natural and Scientific Interest (ANSI) known as the Heart Lake Forest and Bog and a regional earth science ANSI, the Brampton Buried Esker.

This wetland has also been identified in the Region of Peel Official Plan as a Core Area of the Greenlands System (Region of Peel 2001).

The Heart Lake Conservation Area, owned by the Toronto Region Conservation Authority, contains part of the wetlands and adjacent forested lands to the south of Mayfield Road.

A small area to the north of Mayfield Road between Heart Lake Road and Dixie Road is designated as 'Environmental Constraint Policy Area' by the Town of Caledon. The Town of Caledon also shows this area as 'Environmental Policy

Area' in the *Mayfield West Land Use Plan*, but not only includes the small vegetated area to the north of Mayfield Road, but also the channel that extends to the north and flows through this area.

The TRCA has designated several fill regulated areas which are directly associated with several of the watercourses that traverse Mayfield Road throughout the study area. Please refer to Table 1 for these areas.

3.2 Vegetation and Floristics

The area surrounding Mayfield Road, between Heart Lake and Airport Roads, is primarily agricultural land; however old field habitats, hedgerows and landscaped areas are also common. The slopes along the side of the road vary from flat to steep, mostly dominated by herbaceous plant species typical of old field habitats such as wild carrot, goldenrod, grasses, raspberry, red osier dogwood, and thistle species.

The most significant natural feature in this portion of the study area is the Heart Lake provincially significant wetland and associated upland forest communities. This provincially significant wetland is part of the Heart Lake Wetland complex that stretches north and south of Mayfield Road and beyond Heart Lake Road into the Heart Lake Conservation Area. The wetland is dominated by a complex of marsh and upland communities, and portions of it are also designated as both life and earth science Areas of Natural and Scientific Interest (ANSI) (OMNR 2000). The location of the wetland and other vegetation communities is shown on Figure J11-J15.

Vascular Plants

A total of 117 vegetation species were recorded on site visits completed February 20, July 31, and August 8, 2003. Out of the species recorded, 41 (35%) are non-native to Ontario. A list of all the vegetation species is included in Appendix I.

Vegetation Communities

The study area is mostly flat, with some rolling topography, typical of southern Ontario's agricultural areas. The vast majority of the area is active agricultural land, but some remnant natural vegetation areas exist. The hedgerows are predominantly Norway spruce and pine species. The landscaped areas are associated with buildings, and contain a variety of trees, such as willow species, apple, honey locust and pines. In some locations individual trees line the road. The natural habitat communities are described below and shown in Figure J11-J15.

Dry-Moist Old Field Meadow (ELC Code: CUM1-1)

Most areas along Mayfield Road, as well as some other, larger areas, are old field meadow. These areas are mainly made up of a variety of grasses and herbaceous species, with some shrubs dispersed throughout. Certain areas contain common buckthorn.

Mineral Cultural Woodland (ELC Code: CUW1)

A few small cultural woodlands are found dispersed through the study area. Buckthorn, apple trees and a variety of other species are found in these areas.

Fresh – Moist Poplar Deciduous Forest (ELC Code: FOD8-1)

Trembling aspen are interspersed with low willow species and red osier dogwood, in an area within the Heart Lake Wetland Complex, south of Mayfield Road.

Dry-Fresh White Cedar Mixed Forest (ELC Code: FOM4)

An area within the Heart Lake wetland complex is composed mostly of white cedar and white ash. Sugar maple and red maple are also found within this area.

Fresh – Moist Sugar Maple – Hemlock Mixed Forest (ELC Code: FOM6-1)
An upland ridge, located within the Heart Lake wetland complex, north of Mayfield Road, is dominated by sugar maple and hemlock. White ash and white elm, together with a variety of other species, complete the species composition.

Fresh – Moist White Cedar – Hardwood Mixed Forest (ELC Code: FOM7)
The majority of the forested area around the cattail marsh in the northern lobe of the Heart Lake wetland complex is white cedar with white ash, and a mixture of other species, such as black cherry, basswood, American beech, yellow birch, and sugar maple.

Broad-leaved Sedge Mineral Meadow Marsh (ELC Code: MAM2-6)
A small wetland pocket within the Heart Lake Wetland Complex is dominated by tussock sedge.

Cattail Mineral Shallow Marsh (ELC Code: MAS2-1)
Low pockets along Mayfield Road are mostly dominated by cattail species, both common and narrow-leaved. Grasses and sedges are also present.

Landscape Trees
A number of landscape trees are found along the roadside, which may be impacted by the road widening. Many are found within hedgerows.

3.3 Wildlife

Incidental wildlife observations were made during field visits to the study area. Background information and habitat preferences were documented to determine the potential wildlife community in the study area. Lists of wildlife species including birds, mammals, reptiles and amphibians are included in Appendix I. No significant species of wildlife were observed during the field visits or were documented in the background information.

3.4 Aquatic Environment and Fish Habitat

There are eleven surface watercourses within the study area, which includes tributaries of the Etobicoke Creek and the West Humber River watersheds. These tributaries flow from north to south traversing Mayfield Road from Heart Lake Road to Airport Road. For the purposes of this report, the creeks will be referred to as Creek One through Eleven numbered from west to east along Mayfield Road (refer to Figure J11-J15). Table 1 gives an overview of the habitat characteristics and conditions found along the creek corridors immediately upstream and downstream of the road right-of-way.

3.4.1 Etobicoke Creek Watershed

Creeks One through Five are headwater tributaries of Etobicoke Creek. Etobicoke Creek has been included as a Core Area within the Greenlands System for the Region of Peel (Region of Peel Official Plan 2001). All five creeks are intermittent unnamed drainage channels that appear to flow in the wetter months collecting the runoff from the lands on the north side of Mayfield Road.

Creek One appears to drain and be associated with a wetland feature (portion of the Heart Lake Wetland Complex) located upstream (north) of Mayfield Road and then re-enters a wetland on the south side of Mayfield Road. During both field visits in July and August, there was no defined channel or appreciable flow, although standing water was present at the culvert on both sides of Mayfield Road. There may be ground water linkages present north of Mayfield Road (Cole, Sherman & Associates 1999). The channel was choked with aquatic and terrestrial vegetation and sampling of the vernal pools was not possible due to the highly dense vegetation reducing visibility. No other aquatic habitat features were present. The portion of channel (in association with a small vegetation area) upstream of Mayfield Road has

Table 1: Overview of the watercourse crossings found within the study area (Heart Lake Road to Airport Road).

Watercourse No. and Drainage	Channel Type	Flow Characteristics [1]	Riparian Features	Adjacent Land-use	Instream Habitat	TRCA Fill Regulated Area
Creek One Etobicoke Creek	Intermittent	No flow, standing water at culvert	> 5m, marsh and some meadow upstream	70% wetland and 30% meadow	Limited, pools at culvert, channel choked with vegetation	fill regulated extension area
Creek Two Etobicoke Creek	Intermittent, no defined channel	Dry	Absent	100% crop	Absent, plowed through	No
Creek Three Etobicoke Creek	Intermittent	No flow, standing water	Absent	100% crop	Absent, plowed through	No
Creek Four Etobicoke Creek	Intermittent	No flow, standing water in large pool downstream	< 5m, terrestrial vegetation	50% farm and pasture 50% crop	Absent, suspended waste from cattle	No
Creek Five Etobicoke Creek	Intermittent, no defined channel	Dry	Absent	100% crop	Absent, plowed through	No
Creek Six West Humber River	Intermittent	Minor flow	< 5m, terrestrial vegetation	100% crop	Limited, small riffle area and pools	fill regulated extension area
Creek Seven West Humber River	Permanent	Good flow	> 5m downstream (and absent upstream (lawn)	50% residential 40% crop 10% meadow	Riffle/pools, woody debris, undercut banks, aquatic vegetation and boulder/cobbles	fill regulated area
Creek Eight West Humber River	Intermittent	No flow, standing water	< 5m, terrestrial vegetation	50%crop 25% meadow 25% developed	Limited, Minor boulder and cobble	fill regulated extension area (downstream)
Creek Nine West Humber River	Intermittent	No flow, standing water	Absent	100% crop	Limited, Minor boulder and cobble, ploughed through	fill regulated extension area (downstream)
Creek Ten West Humber River	Permanent	Beaver dam approx. 75m on downstream side	> 5m, trees and shrubs	75% crop 25% meadow	Riffle/pools, woody debris, undercut banks, aquatic vegetation and boulder/cobbles	fill regulated area
Creek Eleven West Humber River	Permanent	No flow, standing water	> 5m, meadow	70% meadow 30% crop	Limited, small pools and channel choked with vegetation	fill regulated extension area

[1] Observations were made during the July and August 2003 field visit.

been included in an area designated as 'Environmental Policy Area' in the Mayfield West Land Use Plan. This tributary has been previously referred to as "Tributary 11" in the *Environmental Study Report* prepared by Cole, Sherman and Associates Ltd. (1999) for the Ministry of Transportation Highway 410 Extension where the MNR classified this creek as an ephemeral tributary with no fish or fish habitat (MTO 2000).

Creeks Two, Three and Five are agricultural drainage systems that were dry during field investigations. The adjacent land-use is agricultural crops and all three creeks lack a riparian buffer and therefore are susceptible to being plowed through. No aquatic habitat features are present.

Creek Four located immediately to the east of the Mayfield Road intersection with Dixie Road, flows through farm land. There was no flow observed in the channel during the field visits but standing water was present in vernal pools located at the culvert. The water quality is highly degraded as a direct result of run-off from a cattle manure pile directly associated with the channel on the north side of Mayfield Road. Downstream of Mayfield Road a large pool is present, however, there was a large amount of suspended waste, the water colour was brown and there was a fowl odour, which is likely the result of the farming practices directly upstream. Aquatic habitat conditions are highly degraded and no in-situ fish habitat was present.

3.4.2 West Humber River Watershed

Creeks Six to Eleven are headwater tributaries of the West Humber River. Three of the six creeks (Creeks Six, Eight, and Nine) flow on an intermittent and seasonal basis as evidenced by the absence of flow during field observatios for this study. However the MNR considers Creek 8 to be a permanently flowing coldwater stream supporting Type I and II habitat, including the redside dace near the downstream confluence with Creek 7. Creeks Seven and Ten are permanent watercourses that provide good quality fish habitat and were sampled using a backpack electro-shocking unit. Creek Eleven is a permanent watercourse but does not provide quality fish habitat.

Creeks Six and Eight are agricultural drainage systems that were dry during the initial site visit in July, but vernal pools were noted during a subsequent site visit in August. The water was likely the result of a recent precipitation event. Creek Six adjacent land-use is crops and Creek Eight is bordered by a school and soccer fields to the north, and greenhouse and crops to the south. Both creeks have < 5m buffer along the channel consisting of terrestrial grasses and shrubs. No in-situ fish habitat was present.

Creek Seven flows through residential private property on the north side of Mayfield Road where the lawn is mowed to the waters edge thus providing no buffer to the creek. As a result of signage and a fence that restricted access, no sampling was conducted upstream of Mayfield Road. On the south side of Mayfield Road the creek meanders within the boundaries of an adequate vegetative buffer comprised of shrubs and trees. Adjacent land-use activities are agricultural crops. Aquatic habitat consisted of pool-riffle-run sequences, boulder, instream vegetation, woody debris and undercut banks. The channel width ranged from 0.40 to 3.0m and the water depth ranged from 0.20 to 1.0m. The substrate included sand, gravels, small cobble, and boulder, which are utilized by non-specialist fish species (i.e. creek chub) for spawning purposes. A mixture of fine sediments was also present within the depositional pool areas (i.e. muck, silt and clay). The water clarity was good and the current was slow to moderate. The water temperature was 23°C and the air temperature was 28°C on July 29th. The following table provides the sampling results for Creek Seven. A total of 534 fish were sampled within a 100 linear metre reach of stream located downstream of Mayfield Road and throughout the culvert.

Table 2: Fish community sampled at Creek Seven located immediately to the west of Bramalea Road (July 29, 2003).

Scientific Name	Common Name
Catostomus commersoni	white sucker
Etheostoma nigrum	johnny darter
Micropterus salmoides	largemouth bass
Rhinichthys atratulus	blacknose dace
Semotilus atromaculatus	creek chub

Although not found during our sampling efforts, historical records indicate that brook trout have been sampled from this tributary (in the Campbells Cross area), and local residents have also observed trout in the upstream reaches of this tributary (TRCA 1998).

Creek Nine is an agricultural drainage system that likely flows during wetter months. The channel had standing water within the creek channel during the field observations. This system is completely confined within crop land, where it is plowed through as a result of no riparian buffer. No in-situ fish habitat was present.

Creek Ten flows through a well established riparian zone on the north and south side of Mayfield Road. The creek corridor meanders through a low lying area several metres below the roadway. Adjacent land-use activities are primarily agricultural crops. Aquatic habitat consisted of pool-riffle-run sequences, boulder, instream vegetation, woody debris, undercut banks and backwater areas. The channel width ranged from 0.80 to 5.0m and the water depth ranged from 0.25 to 1.5m. The substrate consisted of a mixture of sand, gravel, small cobble, and boulder, and fine sediments were also present within the depositional pool areas (i.e. muck, silt and clay). The water clarity was generally fair with more turbid conditions downstream of the culvert and the current was slow. A significant beaver dam is located approximately 80m downstream of the road culvert. The water temperature was 18°C and the air temperature was 27°C on July 29th. This water temperature is

considered cool water, which may indicate ground water input upstream of the study area. Table 3 provides the sampling results for Creek Ten. A total of 294 fish were sampled within a 75m reach.

Table 3: Fish community sampled at Creek Ten located to the east of Torbram Road (July 29, 2003).

Scientific Name	Common Name
Ambloplites rupestris	rock bass
Catostomus commersoni	white sucker
Etheostoma caeruleum	rainbow darter
Etheostoma flabellare	fantail darter
Etheostoma nigrum	johnny darter
Lepomis gibbosus	pumpkinseed
Micropterus salmoides	largemouth bass
Notropis cornutus	common shiner
Pimephales notatus	bluntnose minnow
Pimephales promelas	fathead minnow
Rhinichthys atratulus	blacknose dace
Semotilus atromaculatus	creek chub

A Livestock Access Restriction Project partially funded by the Metro Rural Clean Water Program in conjunction with the TRCA and supported by the landowner was completed at Creek Ten in 1996 (Barcley, personal communication 2003). This project entailed the erection of fencing to restrict cattle access to the creek and provide an alternative source of water for the cattle. A total of 800m of fencing was raised on the north side and 500m on the south side of Mayfield Road. Since 1996, a small area has been made available to the cattle for drinking due to calf dehydration concerns. No vegetation was planted.

No redside dace were captured at either Creeks Seven or Ten during field sampling efforts, although the fish community found at Creek Ten in particular, represents a diverse fish assemblage. The common shiner and creek chub are among the twelve species that were found. The redside dace is known to utilize the nests of the

aforementioned species for spawning activity to increase egg survivorship. Observations noted at Creek Seven and Ten indicate that current habitat conditions are adequate for the redside dace life stage requirements (i.e. the majority of its food source are terrestrial insects that occupy overhanging riparian vegetation like grasses, shrubs and small trees). Thus, the current habitat provides a potential for the provincially threatened redside dace species to re-establish a population or to migrate upstream into the reaches of Creek Seven and Ten. Although the redside dace was not captured during the sampling exercise, these sections of creek should be treated as having the habitat present to potentially sustain a redside dace population.

Creek Eleven is a permanent watercourse that appears to convey minor flow year round from upstream ponds located north of Mayfield Road. Meadow and crop land borders the creek channel on both sides of the road providing more than 5m of riparian buffer. The creek channel was choked with aquatic vegetation (i.e. cattails and duckweed) and terrestrial grasses on August 8, 2003. Due to poor instream visibility, the vernal pools at the culvert were not sampled. This portion of creek is very limited in terms of opportunities for fish habitat.

To summarize, the aquatic habitats in the study area corridor vary in their sensitivity to disturbance from the proposed undertaking. Resilience to disturbance is based partially on the permanence of flow, flow dependencies on groundwater contributions, and the existing level of disturbance.

The five headwater reaches of Etobicoke Creek are intermittent agricultural drainage systems, with the exception of Creek One which is closely associated with a wetland. Habitat viability is poor due to the lack of flow and high degree of disturbance from rural land uses. As a result, these surface water features have a low potential for supporting aquatic life.

Of the six headwater tributaries of the West Humber River, two creeks, Creeks Seven and Ten are intact, ecologically functioning headwater systems. They are characterized by a diverse fish species assemblage providing good instream habitat for critical life stages (i.e. spawning) for a variety of fish species including redside dace. Due to the potential for and presence of cool water habitat at Creeks Seven and Ten respectively, aquatic habitat conditions and historical presence of the redside dace and brook trout, these reaches will be treated as critical and sensitive fish habitat.

The remaining four tributaries of the West Humber River are considered to be of a lower quality than previously mentioned tributaries due to their either intermittent flows, adjacent agricultural activities, the general lack of a riparian corridor and or limited aquatic habitat present. It is likely that these watercourses do not support a fishery or may be seasonally utilized by species that are more tolerant of disturbances and poor habitat conditions.

3.5 Summary of Constraints

Terrestrial Vegetation

- The provincially significant Heart Lake wetland complex is within the limits of the Highway 410/Mayfield Road interchange. The impacts associated with construction of the 410 interchange has been studied and reported on in two reports prepared by MTO, *Highway 410 Extension from Bovaird Drive to Highway 10 (Main Street)* (Cole, Sherman & Associates 1999) and *Highway 410 Extension from Bovaird Drive to Highway 10 (Main Street)* (Ontario Ministry of Transportation 2000). The current EA study does not address the area impacted by the highway 410 interchange.

Wildlife

- There are no significant wildlife species found within the area of the proposed road widening.

Aquatic

- Nine tributaries of the Etobicoke Creek and West Humber River watersheds are intermittent systems (with the exception of Creek Eleven which is permanent), with no direct fish habitat value and are not considered to be significant, nor highly sensitive aquatic environments. Standard mitigation measures should be practiced at these locations to limit any immediate or downstream impacts.

- Two tributaries of the West Humber River are ecologically functioning headwater reaches. One is coolwater habitat (Creek Ten) based on temperature monitoring and fish community sampling and the other (Creek Seven) has coolwater potential with historical occurrences of brook trout. In addition , MNR requires that Creek 8 be managed as a permanently flowing coldwater stream. These creeks have the potential for redside dace (VTE species) due to existing habitat conditions and historical occurrences. It is considered significant and sensitive in terms of the level of protection for the existing habitat features.

- Specific considerations include the protection of:
    - Riparian vegetation and overhanging vegetation (canopy) to maintain cool water temperatures, buffering capacity for the stream, fish habitat, and feeding opportunities for fish.
    - Instream fish habitat such as substrate, woody debris and undercut banks. This poses a constraint to any instream work or channel modifications.
    - Water clarity. Best management practices should be utilized for sediment and erosion control to reduce the impacts of runoff and siltation on the creek systems.
    - Stormwater management should include Level 1 quality control for protection of sensitive fish species in the streams.

4.0 Analysis of Alternatives

One alternative was developed for the widening of Mayfield Road from Heart Lake Road to Airport Road. In order to provide similar impacts in both the Town of Caledon to the north and the City of Brampton to the south, the proposed alternative provides for a symmetrical widening throughout the entire portion of Mayfield Road, thus neither favouring a north or south road widening. Therefore, the proposed widening was compared to a "do nothing" approach to assess the various natural environment impacts associated with the project.

For the purposes of environmental analysis, the study area includes the Mayfield Road right-of-way and the adjacent lands approximately 200m north and south of Mayfield Road from Heart Lake Road intersection, eastward to the Airport Road intersection. However, it excludes the limits of the Highway 410/Mayfield interchange, located just east of Heart Lake Road. Please refer to the Environmental Study Report prepared by Cole, Sherman and Associates (1999) for details regarding the environmental impacts associated with the Highway 410/Mayfield Road interchange.

4.1 Approach

Natural Resource Solutions provided a summary of the natural environment features and the constraints to the project study team. This information identified any significant constraints to the road-widening project early in the process so that emphasis could be placed on the development of the preferred alternative and the details of the design to avoid or mitigate impacts.

The proposed plan was compared to the natural features in the study area to determine potential impacts that could arise from the construction and operation of the road widening.

For the purposes of evaluating the natural environment impacts associated with the two alternatives, Mayfield Road is divided into two road sections, which is based on the proposed lane widening and the type of road edge treatment.

4.2 Evaluation of Alternatives

4.2.1 Heart Lake Road to Dixie Road

Agricultural fields abut the road in most areas, but cultural meadows and some landscaped areas are located in this stretch of Mayfield Road as well. No rare species are known within the current study area.

There are two watercourse crossings in this section of Mayfield Road.

Terrestrial and Wetland Impacts

Do Nothing Approach

The natural features on either side of Mayfield Road would not be impacted by any construction, and would remain as they are. The natural features along side the road are predominantly cultural meadows (old fields) and landscaped areas with individual trees and hedgerows.

Proposed Alternative

The proposed symmetrical widening of Mayfield Road would impact the terrestrial features. The road widening would cause the removal of cultural meadow habitats and individual trees associated with landscaped areas and hedgerows along the road. However, no significant species are known from these areas. The curb and gutter approach proposed for this section of road will allow the storm water to be collected with some treatment provided before being released into the natural areas.

There are few terrestrial features in this portion of the study area. No significant species of plants or vegetation communities are found within the area of road

widening. No significant species of wildlife or significant wildlife habitats are known to this area. As the road is widened, the ability of wildlife to cross this road becomes more difficult.

Aquatic Impacts

Do Nothing Approach

There are two headwater tributaries of Etobicoke Creek located between Heart Lake Road and Dixie Road. These aquatic features and their associated stream banks would not be impacted by the "do nothing" approach and would remain as they are.

Proposed Alternative

Throughout this portion of Mayfield Road, there are two surface watercourses that will be affected by the road improvements. They are un-named tributaries of Etobicoke Creek, which are referred to as Creeks Two and Three.

Creeks Two and Three are intermittent agricultural drainage swales. Both creeks lack a riparian buffer and are exposed to routine agricultural practices. No aquatic habitat features were documented.

The road widening would occur approximately on equal sides of the existing road centreline (symmetrical widening). In order to widen the road to six lanes along this stretch, culvert extensions will be required on both sides of the road. There is minimal aquatic habitat value associated with these drainage channels due to the intermittency of flow, the lack of defined channels and the adjacent agricultural practices. These tributaries are not considered highly significant or sensitive to the proposed road widening.

4.2.2 Dixie Road to Airport Road

Mayfield Road crosses eight creeks in this section of the study area. Cultural meadows and/or marsh communities are associated with many of these streams.

Cultural meadows and landscaped areas of individual trees or hedgerows are found from Dixie Road to Airport Road. Portions of Mayfield Road in this area are located beside steep embankments. One such area is located approximately half-way between Torbram Road and Airport Road. A cattle access restriction project was undertaken here along the banks of Creek Ten.

Terrestrial and Wetland Impacts

Do Nothing Approach

The "do nothing" approach would clearly not impact the natural features found adjacent to Mayfield Road. The cultural meadows, landscaped areas and marsh habitats associated with some of the creeks would remain as they are.

Proposed Alternative

The road widening would cause the encroachment into some marsh communities associated with the creeks that flow under Mayfield Road. The marsh communities vary between cattail dominated communities and those dominated by a variety of grasses and sedges. Cultural meadows found adjacent to the road would either be removed completely, or significantly reduced in size. Many landscaping trees would need to be felled. In this area, a four-lane road is proposed with a gravel shoulder and associated ditch. Storm water from the road will be conveyed via grassed swales (roadside ditches), which provide water quality control, prior to entering the natural areas directly. No significant flora or fauna are known from this area, nor are any significant wildlife habitats.

Aquatic Impacts

Throughout this portion of Mayfield Road, there are eight surface watercourses: two tributaries of Etobicoke Creek and six tributaries of the West Humber River. The two tributaries of Etobicoke Creek and three tributaries of the West Humber River are considered to be ephemeral drainage systems with no in-situ fish habitat. Of the remaining three tributaries, two creeks of the West Humber River

are permanent watercourses supporting a diverse fishery and the other tributary of the West Humber River is permanent, however, fish habitat is not evident.

Do Nothing Approach

All creeks and aquatic habitat features would not be impacted by the "do nothing" approach and would remain as they are.

Proposed Alternative

Creeks Four to Nine (with exception of Creek Seven) are intermittent warmwater drainage channels that contribute seasonal flow to the Etobicoke Creek and West Humber River watersheds. The creek channels were dry during field investigations; however, a number of tributaries had standing water at the road-side culverts. Also, Creek Eleven flows on a permanent basis that appears to originate from the ponds upstream of Mayfield Road, however, no in-situ fish habitat is present. TRCA has also designated Creeks Six and Eleven and the downstream portions (south side of Mayfield Road) of Creeks Eight and Nine as 'fill regulated extension' areas. These tributaries are not considered highly significant or sensitive to the proposed road improvements based on either their lack of perennial flow, poorly defined channels or instream characteristics. Although fish habitat potential is limited for these creeks, it is important to maintain flow conveyance and opportunities via culvert extensions for these tributaries.

Creeks Seven and Ten are ecologically functioning headwater tributaries of the West Humber River, which support a diverse fish community. Both creeks have been designated as fill regulated areas by the TRCA. Creek Seven has coolwater potential and has had historical occurrences (unconfirmed) of brook trout upstream of the study area and redside dace downstream of the study area. Creek Ten is coolwater habitat and has historical occurrences of redside dace (provincially threatened species) populations. Refer to Appendix I, historical fish

sampling data. These two creeks are considered significant aquatic habitats and sensitive to the proposed road widening.

The proposed road widening would occur approximately on equal sides of the existing road centreline (symmetrical widening). In order to widen the road to four lanes along this stretch, and allow for a wide gravel shoulder, extensions to the existing concrete box culverts will be necessary. In-water work to re-construct culvert footings beneath the stream bed may be necessary. In addition, the disturbances to the creek valleys associated with culvert extensions, specifically, the loss of riparian vegetation associated with channel banks may constitute a harmful alteration, destruction and disruption (HADD) of fish habitat under Section 35 (2) of the Federal Fisheries Act. This policy requires that there be "no net loss" of fish habitat and thus an appropriate compensation plan would be required to attain a fisheries act authorization in order to proceed with proposed road widening. Discussions with the TRCA are required to address acceptable mitigation and/or compensation measures.

Standard road mitigation measures will be required such as sediment and erosion control methods (Best Management Practices) during construction. Site restoration would occur through grading and vegetation plantings post construction, to stabilize the banks and provide shoreline cover outside the culvert walls.

4.3 Summary of the Natural Environment Evaluation

The proposed alternative was compared to "do nothing" alternative to evaluate and determine potential impacts to the natural environment features in the study area. The "do nothing" alternative had no impacts to the natural environment. Based on a review by the study team and the public, the proposed alternative that widens the road to six lanes from Heart Lake Road to Dixie Road (with curb and gutter) and to four lanes from Dixie Road to Airport Road (with gravel shoulder and ditches) was chosen as the preferred alternative.

The preferred alternative would encroach into some marsh communities associated with the creeks that flow under Mayfield Road. Cultural meadows found adjacent to the road would either be removed completely, or significantly reduced in size. Landscape trees would also be lost.

Ten tributaries occur within the study area, of which, only two are considered significant and sensitive to the proposed road widening. Although no instream work is anticipated, in-water work associated with the construction of culvert footing extensions at three creek crossings may represent a HADD under the federal Fisheries Act. A meeting with the TRCA review team is recommended prior to final design to discuss the aquatic features within the study area and an appropriate approach to mitigation and/or compensation for the impacts associated with road widening activities.

The impact analysis in terms of economics, construction, hydraulics, on-going maintenance and aesthetic requirements for the road widening is outlined in the main ESR document prepared by Stantec Ltd. The natural environment issues related to the direct and indirect impacts of the preferred alternative are addressed below in Section 5.0.

5.0 Impact Analysis and Mitigation of the Preferred Alternative

5.1 Description of the Preferred Alternative

The proposed alternative was chosen to be the preferred alternative. The details of this alternative are described and shown in the main report prepared by Stantec Ltd.

Heart Lake Road to Dixie Road

This alternative includes a general symmetrical six lane road widening with curb and gutter edge treatment on both sides of the road and turning lanes at the Heart Lake Road and Dixie Road intersections.

Dixie Road to Airport Road

The section of Mayfield Road from Dixie Road to Airport Road will be widened to four lanes with gravel shoulder and ditches on both the north and south sides of Mayfield Road. The gravel shoulder width will allow for the passage of farm vehicles. The ultimate widening of this section to six lanes is undetermined at this time.

5.2 Approach to Impact Assessment

The preferred alternative was compared to the existing natural features in order to determine the potential impacts of the proposed project. This included direct and indirect impacts. Mitigation measures to reduce or eliminate impacts are given in Section 6.0.

5.2.1 Direct Impacts

Direct impacts include "footprint" impacts that result in the removal or direct disturbance of a natural feature, habitat or species. Possible direct impacts that were evaluated included:

- impacts to core areas/significant corridors;

- vegetation loss;
- significant species of fauna or flora and their habitats;
- fisheries; and
- surface watercourses.

The following table was used to summarize the potential impacts of the preferred alternative.

Table 4: Assessment of the natural environment impacts for the Preferred Alternative.

Type of Impact	Heart Lake Road to Dixie Road	Dixie Road to Airport Road
Impacts to Core Areas, Significant Corridors	None	Encroachment into two West Humber River tributary valleys. This area consists of natural vegetation and manicured lawn found directly along the creek corridor.
Vegetation Loss	Some cultural meadow areas and landscape trees would need to be removed.	Cultural meadows, landscape trees and small marsh communities would be impacted by the road widening.
Significant Species	None	Redside dace cyprinid species (provincially threatened) has historically and recently occurred in West Humber River tributaries.
Aquatic	Two intermittent un-named tributaries of Etobicoke Creek. - No in-situ fish habitat present, therefore no direct impacts.	Two intermittent un-named tributaries of Etobicoke Creek and Four un-named tributaries of the West Humber River. - No in-situ fish habitat present, therefore no direct impacts. Two perennial tributaries of the West Humber River with diverse fishery. - No instream work is anticipated. Impacts to redside dace habitat may be associated with the removal of riparian vegetation and the input of sediment to the creek.

Surface Watercourses	Two intermittent un-named tributaries of Etobicoke Creek. - Maintain flow conveyance through culvert extensions therefore no direct impacts.	Two intermittent un-named tributaries of Etobicoke Creek and Four un-named tributaries of the West Humber River. - Maintain flow conveyance through culvert extensions therefore no direct impacts. Two perennial tributaries of the West Humber River with diverse fishery. -Several metres of the creek channel will be covered with an additional loss of riparian vegetation associated with the channel banks from the culvert extensions.

Heart Lake Road to Dixie Road

The direct impacts associated with this section of Mayfield Road widening include a loss or reduction of agricultural land and cultural meadows, and a loss of landscape trees. Each of these is discussed below.

Widening of Mayfield Road to six lanes in this section will remove some agricultural land and cultural meadow vegetation. The removal of this vegetation is not significant.

The clearing of treed areas will be limited as much as possible and mitigation measures for preserving trees are included in Section 6.0.

There are no significant watercourses in this portion of the study area. There are two ephemeral tributaries to Etobicoke Creek that are ill-defined drainage swales to the north and south of Mayfield Road and flow during localized runoff events. These drainage swales are not considered direct fish habitat and therefore no direct impacts are anticipated. Flow conveyance will be maintained through extensions of the existing culverts.

The loss of the landscape trees from this section is not significant. Trees will be replanted with native species following the construction of Mayfield Road.

Dixie Road to Airport Road

The direct impacts associated with widening Mayfield Road from Dixie to Airport Road include encroachment and loss of vegetation associated with two tributaries of the West Humber River, potential impacts to redside dace habitat, loss or reduction of agricultural land and cultural meadows, a loss of landscape trees, and of small marsh communities associated with some of the creeks. Each of these is discussed below.

The loss of vegetation associated with the creek corridors is a significant impact. The fill required to widen Mayfield road will be extensive, particularly at Creek Ten due to its steep creek valley slopes. Refer to Table 1 for the fill regulated areas designated by the TRCA.

Several methods of reducing the footprint impact of the road widening were considered including different methods of side slopes and treatment of the road edge. The following table outlines the different road edge treatments that were considered during the preliminary design in order to reduce the impacts on vegetation, and stream and valley corridors.

Table 5: Comparison of road edge treatments on the natural environment.

Road Edge Treatment	Impact on Natural Features
Gravel Shoulder and Ditch	This treatment generally impacts less natural area than the curb and gutter based on a 2:1 or 3:1 slope. The ditch provides protection to the vegetation and natural features from contaminants such as oil and sediment entering from road runoff.
Curb and Gutter	The curb and gutter generally requires less area than the gravel shoulder and ditch. It provides protection against road runoff directly entering natural areas.

The desire to maintain a rural appearance to this section of Mayfield Road and to allow for passage of farm vehicles has resulted in the gravel shoulder with ditch to being the preferred road edge treatment.

The loss of the landscape trees in this section is not significant. Many of the trees are non-native species, which are not desirable species due to their introduced status and invasive character. Trees will be replanted with native species along Mayfield Road once construction has been completed.

Potential impacts to significant species in this section include the threatened redside dace, which is known to inhabit reaches connected with Creeks Seven and Ten of the West Humber River watershed. The construction of the extensions for the concrete structures, specifically excavation required to pour the concrete footings may involve in-water work and therefore may constitute a harmful alteration, destruction or disruption (HADD) of fish habitat. Further discussion with the TRCA is recommended to address appropriate mitigation measures and to determine whether compensation will be required.
There are eight tributaries to Etobicoke Creek and the West Humber River in this section of Mayfield Road, of which five are intermittent and three (tributaries to

the West Humber River) are permanent. The five intermittent tributaries (Creeks Four, Five, Six, Eight and Nine) are poorly defined drainage channels that generally flow during localized runoff events. In addition, Creek Eleven appears to maintain a minor base flow from ponds located north of Mayfield Road. These drainage channels are not considered significant nor deemed fish habitat and therefore there are no fisheries related direct impacts. Flow conveyance will be maintained through extensions of the existing culverts thus providing future fishery opportunities.

The two tributaries of the West Humber River (Creeks Seven and Ten) are ecologically functioning headwater reaches. One is coolwater habitat (Creek Ten) based on temperature monitoring and fish community sampling and the other (Creek Seven) has coolwater potential with historical occurrences of brook trout. Both creeks have the potential for redside dace (VTE species) due to existing habitat conditions and historical occurrences. It is considered significant and sensitive in terms of the level of protection for the existing habitat features.

Specific considerations include the protection of:

- Riparian vegetation and overhanging vegetation (canopy) to maintain cool water temperatures, buffering capacity for the stream, fish habitat, and feeding opportunities for fish.
- Instream fish habitat such as substrate, woody debris and undercut banks. This poses a constraint to any instream work or channel modifications.
- Water clarity. Best management practices should be utilized for sediment and erosion control to reduce the impacts of runoff and siltation on the creek system.

Mitigation measures regarding sediment and erosion control to be used in the construction of the culvert extensions are provided in Section 6.0.

5.2.2 *Indirect Impacts*

Indirect impacts are associated with changes in site conditions such as drainage. For the purposes of the analysis of potential indirect impacts, the discussion is divided to the following:

- Sediment and erosion
- Stormwater management

Sediment and Erosion

During the widening of Mayfield Road, areas of bare soil will be exposed. It is possible that during rainfall events, sediment-laden runoff from the construction area could enter watercourses. In order to ensure that runoff from the construction site does not impact the tributaries of Etobicoke Creek and the West Humber River, sediment and erosion control measures will be required during construction.

Sediment and erosion control measures will be required during the construction of all culvert extensions that convey flow to tributaries of Etobicoke Creek and the West Humber River. This will ensure that runoff from the construction area does not directly enter the watercourses and impact the watersheds downstream. Sediment barriers should be installed along the edge of the construction area to protect the natural areas, which will be retained. Options for this mitigation measure should be included in the tender documents for the contractor to select from and/or elaborate on. Refer to Section 6.0 for details regarding mitigation.

Sediment and erosion control measures should be installed prior to any site clearing or grading. Sediment barriers, rock check dams and straw bales are all examples of sediment control methods, which could be employed. At a minimum, erosion/sediment control should meet the standards outlined in Ontario Provincial Standard Specification (OPSS) 577, *Construction Specification for Temporary Erosion and Sediment Control Measures*, a copy of which is appended to this report (see Appendix II).

Stormwater Management

There are no stormwater management (SWM) ponds proposed as part of this study. Two SWM facilities (ponds) are proposed along Mayfield Road within the Highway 410 Extension interchange right-of-way. Please refer to the MTO Pre-Design Report (May 2000) for details regarding the specific locations and treatment.

Between Dixie Road and Heart Lake Road, it is proposed to install curb and gutter and storm sewers. The high point on Mayfield Road in this area is at the Highway 410 interchange. Within the interchange, drainage will be accommodated by the MTO design. The short stretch between the interchange and Heart Lake Road is proposed to be outletted into the existing ditches such that the existing drainage patterns will be maintained.

Between the Highway 410 interchange and Dixie Road, it is proposed to outlet the storm sewer near Dixie Road into the Dixie Road ditch. Existing drainage from Mayfield Road flows into the existing drainage courses which flow southerly toward Dixie Road.

From Dixie Road to Airport Road, ditches are proposed to be maintained by outletting to the existing drainage courses. Due to the relatively small increase in drainage due to the additional pavement, the ditch drainage should be acceptable for stormwater management. The TRCA has indicated that the MOE standard ditch width of 3/4m flat bottom should be used.

6.0 Mitigation Recommendations

The following recommendations are provided to mitigate negative impacts to the terrestrial and aquatic features in the study area. Specific monitoring recommendations are provided below in Section 7.0.

During construction, sediment and erosion control will be a concern. Best management practices will be developed and employed to ensure that excessive amounts of sediment are not released into the aquatic habitat. A detailed comprehensive sediment and erosion control plan is required to be prepared by the engineer prior to any construction. Sediment and erosion control measures must be installed prior to, and maintained during construction. This plan will also detail measures to be employed on a day to day basis, and emergency response measures in case of a sediment release will detail how monitoring will be completed. Areas of bare soil should be re-vegetated with native species as soon as feasible to prevent erosion of soils.

Appropriate timing of culvert extension activities is an important mitigation measure. Etobicoke Creek is managed as warmwater and the West Humber is managed as coolwater riverine habitat. As such, it will be necessary to adopt a construction window that reflects the importance of the creeks to support and provide for the respective fishery. An instream construction window of June 30 to March 30 will be respected for the tributaries of Etobicoke Creek and June 30 to September 15 for Creeks 7, 10 and 11 of the West Humber River. The remaining three tributaries of the West Humber River are intermittent and provide limited fish habitat and thus it is recommended that construction for these tributaries be completed in the dryer months, also respecting the June 30 to September 15 window. These dates are consistent with timing routinely recommended by the MNR, Aurora District and the TRCA. Dates that are more specific will need to be negotiated based on agency knowledge of species-specific timing of spawning activities. Additional details regarding standard

mitigation measures for road improvement projects, including culvert extensions is provided in Appendix II. Restoration work at the creeks in the Humber River watershed should follow the Humber River Watershed Fisheries Management Plan DRAFT (January 1998) management options.

In areas where construction sites or roadways are located in proximity to wetland features or watercourses, the use of minor grading to direct surface runoff away from the aquatic habitats is recommended. This generally consists of the slope leading to a very shallow swale created by a low ridge of topsoil. The vegetated swale is configured to direct surface runoff along the swale back away from the edge.

Maintenance and refuelling of machinery during construction should occur at a designated location away from the creeks or other natural features.

In treed areas where clearing will be undertaken, it is recommended that the clearing be minimized as much as possible and care be taken to preserve trees where feasible. Existing areas of natural vegetation are to be retained wherever possible. In order to maximize the retention of trees and other areas of vegetation, the following recommendations are provided:

- trees and other areas of vegetation to be retained should be identified and delineated with temporary fencing located beyond the dripline of trees to ensure that vehicle movement or material storage does not disrupt vegetation (especially tree root zones); and
- any limbs or roots of trees to be retained that get damaged during construction should be pruned using appropriate arboricultural techniques.

Any areas of bare soil that arise should be graded and re-vegetated with native species as soon as possible to avoid gullying and erosion probems.

7.0 Monitoring Recommendations

The following monitoring recommendations are provided for pre, post and during construction activities.

7.1 Prior to Construction

- Preparation of landscape plans for wetland edges, setbacks and vegetated berms.

- On-site inspections of the following to ensure proper installation:
  - sediment and erosion control measures; and
  - tree saving measures, such as fences installed beyond the dripline of trees to be retained.

7.2 During Construction

- Regular monitoring of the above measures to ensure maintenance and effectiveness, and repaired/replaced as necessary.

- Pruning of any limbs or roots (of trees to be retained) disrupted during construction.

- Fuelling and maintenance of machinery to be done at designated location away from any wetland areas and watercourses.

- Storage of machinery and material, fill, etc. to be done in designated areas.

- Equipment movement through natural areas and setbacks to be controlled.

7.3 Post Construction

- Plantings along roadside and watercourses to consist of a mixture of native woody tree and shrub species with native groundcover.

- Effective stormwater management.

7.4 Construction Monitoring

Given the nature of this undertaking it is not considered necessary to have a full-time biologist on site to supervise construction. Many of the routine, day-to-day construction activities do not require supervision by a biologist. However, there are certain key aspects of construction where it is considered imperative to have a supervising biologist on site. These include:

- During initial placement of environmental protection features such as settling ponds, silt fences, vegetation fences or any other features required to ensure day-to-day protection of natural environment features;

- In the event of a spill or any other event which has the potential to cause significant damage to the natural environment;

- Upon completion of the construction project when all cleanup and restoration activities have been completed; and

- During the planting of any vegetation required as mitigation or compensation for fish habitat impacts or tree loss to ensure that planting is carried out correctly.

Following each site inspection, the inspecting biologist should provide the site engineer with a written report that identifies any observed deficiencies and give

recommendations for correction of these deficiencies. During the next inspection visit, the biologist should confirm that the required corrections have been made.

7.5 Operational Monitoring

Once the project is constructed, operational monitoring should occur to ensure that the mitigation and/or compensation measures incorporated in the project construction are functioning effectively. At a minimum, a biologist should visit the site during the first growing season following construction to ensure that:

- Planted vegetation has become established and die off is not occurring. Watering/tending of new vegetation should be undertaken as required. If vegetation does not survive, it should be replaced and with subsequent tending and monitoring;

- Erosion and sedimentation is being controlled such that suspended sediment runoff to the local watercourses is limited;

- Any mitigation or compensation measures implemented with respect to aquatic habitat are functioning effectively and as planned; and

- Impact predictions in the EA with respect to aquatic and terrestrial impacts are confirmed and no additional unanticipated impacts are occurring.

The results of this monitoring event should be documented in a brief report, which should be submitted to the following agencies for their review and acceptance:

- TRCA - Toronto Regional Conservation Authority;
- DFO - Fish Habitat Management; and
- MNR - Aurora District Office.

8.0 Conclusions

The widening and re-alignment options for Mayfield Road between Heart Lake Road and Airport Road were reviewed and compared to existing terrestrial, wetland and aquatic features in the vicinity. Key biological features in the study area include ten watercourses, two of which may support the threatened redside dace species.

The proposed alignment alternative was assessed relative to its potential for impacts compared to the "do nothing" approach. The proposed road widening alternative was the preferred option.

Detailed analysis of impacts associated with the preferred alternative was undertaken. Tree and vegetation loss along the widened right-of-way and the construction of culvert extensions associated with two watercourse crossings were identified as potential impacts. Recommendations regarding sediment and erosion control measures for mitigating impacts on watercourses were provided. In terms of potential fish habitat impacts, in-water work may be necessary at two significant and sensitive locations for the extensions of the culvert footings. This may constitute a HADD under the federal Fisheries Act, and thus the possibility of appropriate compensation was identified. Monitoring recommendations were also provided.

9.0 References

Cadman, M.D., P.F.J. Eagles, and F.M. Helleiner. 1987. Atlas of the Breeding Birds of Ontario. Federation of Ontario Naturalists and Long Point Bird Observatory. University of Waterloo Press, Waterloo.

Cole, Sherman & Associates. October 1999. Highway 410 Extension from Bovaird Drive to Highway 10 (Main Street). Environmental Study Report prepared for the Ministry of Transportation.

Dobbyn, J.S. 1994. Atlas of the Mammals of Ontario. Federation of Ontario Naturalists.

Natural Heritage Information Centre. 1999. Ontario Herpetofaunal Inventory. Ministry of Natural Resources.

Ontario Ministry of Natural Resources. 2003. Personal communication between Jennifer Wright (NRSI) and Alan Dextrase (SAR Projects Coordinator/Aquatic SAR Biologist, Peterborough District Office).

Ontario Ministry of Natural Resources. 2000. Provincially Significant Heart Lake Wetland Complex. Aurora District.

Ontario Ministry of Natural Resources. 1993/4. Ontario Wetland Evaluation System Southern Manual. Third Edition.

Ontario Ministry of Transportation, Central Region, Highway Engineering. May 2000. Highway 410 Extension from Bovaird Drive to Highway 10 (Main Street). Pre-Design Report W.P. 22-79-00.

Parker, B. J., P. McKee, and R. R. Campbell. 1988. Status of Redside Dace, *Clinostomus elongatus*, in Canada. Canadian Field-Naturalist 102: 163-169.

Region of Peel. 2001. Region of Peel Official Plan. Office Consolidation May, 2001.

Toronto and Region Conservation Authority. 1998. Mayfield West Natural Features Study. Town of Caledon.

Toronto and Region Conservation Authority. 2003. Personal communication between Jennifer Wright (NRSI) and Aileen Barcley (TRCA).

Twon of Caledon. 2003. Personal communication between Jennifer Wright (NRSI) and Craig Campbells (Town of Caledon).

APPENDIX I

VASCULAR PLANTS OBSERVED IN THE STUDY AREA AND WILDLIFE SPECIES REPORTED FROM THE VICINITY OF THE SUBJECT PROPERTY:

BIRDS
MAMMALS
AMPHIBIANS AND REPTILES
FISH

MAMMALS REPORTED IN THE STUDY AREA

Common Name	Scientific Name	Background Data	SRANK	COSEWIC	MNR
Eastern Chipmunk	*Tamias striatus*	X	S5		
Woodchuck	*Marmota monax*	X	S5		
Muskrat	*Ondatra zibethicus*	X	S5		
Raccoon	*Procyon lotor*	X	S5		
Striped Skunk	*Mephitis mephitis*	X	S5		
White-tailed Deer	*Odocoileus virginianus*	X	S5		

REPTILES AND AMPHIBIANS REPORTED IN THE VICINITY OF THE STUDY AREA

Common Name	Scientific Name	Background Data	SRANK	COSEWIC	MNR
Wood Frog	*Rana sylvatica*	X	S5		
Northern Leopard Frog	*Rana pipiens*	X	S5	NAR	NIAC
Green Frog	*Rana clamitans melanota*	X	S5		
Common Snapping Turtle	*Chelydra serpentina serpentina*	X	S5		
Midland Painted Turtle	*Chrysemys picta marginata*	X	S5		

LIST OF BIRDS KNOWN FROM THE STUDY AREA

SRANK	COSEWIC	MNR	Background Data	Common Name	Scientific Name	Foraging Guild	Nest Site	Habitat Preference
				HERONS				
S5B,SZN			AN	Great Blue Heron	*Ardea herodias*	F, AM, I, R	C, TR	SL
				GEESE				
S5B,SZN			X	Canada Goose	*Branta canadensis*	V	SH	GL
				DUCKS				
S5B,SZN			PO	Mallard	*Anas platyrhynchos*	V, I, AM, G	GR	SL, WT
				HAWKS AND EAGLES				
S5B,SZN	NAR	NIAC	CO	Red-tailed Hawk	*Buteo jamaicensis*	R, SM	TR	M, ED
				PLOVERS				
S5B,SZN			PO	Spotted Sandpiper	*Actitis macularia*	I	GR	SH
S5B,SZN			X	American Woodcock	*Scolopax minor*	IV	GR	SG
				DOVES				
S5B,SZN			PO	Mourning Dove	*Zenaida macroura*	S	TR	OP, ED
				CUCKOOS				
S4B,SZN			X	Black-billed Cuckoo	*Coccyzus erythropthalmus*	I	TR	SB
				KINGFISHERS				
S5B,SZN			PO	Belted Kingfisher	*Ceryle alcyon*	F	BU	L, R
				WOODPECKERS				
S5			PO	Downy Woodpecker	*Picoides pubescens*	IE	CA	OW
S5B,SZN			PO	Northern Flicker	*Colaptes auratus*	IE	CA	OW
				FLYCATCHERS				
S5B,SZN			PO	Eastern Wood-peewee	*Contopus virens*	IA	TR	OW
S5B,SZN			X	Willow Flycatcher	*Empidonax traillii*	IA	TR	SB, SG
S5B,SZN			PO	Least Flycatcher	*Empidonax minimus*	IA	TR	OW, SG
S5B,SZN			PR	Great Crested Flycatcher	*Myriarchus crinitus*	IA	CA	M
S5B,SZN			PO	Eastern Kingbird*	*Tyrannus tyrannus*	IA	TR	OP
				SWALLOWS				
S5B,SZN			CO	Bank Swallow	*Riparia riparia*	IA	BU	OP
S5B,SZN			PO	Barn Swallow	*Hirundo rustica*	IA	B, CL	OP, WT, L
				JAYS				
S5			PO	Blue Jay	*Cyanocitta cristata*	I, S, FR, B	TR	M, ED
				CROWS				
S5B,SZN			PO	American Crow	*Corvus brachyrhynchos*	V, GR, SC, B	TR	OP, M, ED, L, WM, SI
				CHICKADEES				
S5			PO	Black-capped Chickadee	*Poecile atricapillus*	I, S, FR	CA	M, ED, SG, SB
				NUTHATCHES				
S5B,SZN			PO	Red-breasted Nuthatch	*Sitta canadensis*	FR, I	CA	M
S5			PO	White-breasted Nuthatch	*Sitta carolinensis*	FR, I	CA	M
				WRENS				
S5B,SZN			PR	House Wren	*Troglodytes aedon*	I	CA	SB, OW, B
				THRUSHES				
S5B,SZN			MGR	Hermit Thrush	*Catharus guttatus*	I	GR	M, B, SG
S5B,SZN			PO	Wood Thrush	*Hylocichla mustelina*	I	TR	M
S5B,SZN			PO	American Robin	*Turdus migratorius*	I, IV, FR	TR, BU	OW, OP, GL, SG
				MIMIDS				
S5B,SZN			PO	Gray Catbird	*Dumetella carolinensis*	I	TR	SB, ED

		WAXWINGS				
S5B,SZN	PO	Cedar Waxwing	*Bombycilla cedrorum*	FR, I	TR	OW, SB
		STARLINGS				
SE	PO	European Starling	*Sturnus vulgaris*	I, FR	CA, NB, B	D, OP
		VIREOS				
S5B,SZN	PO	Warbling Vireo	*Vireo gilvis*	I	TR	OW, ED
S5B,SZN	PO	Red-eyed Vireo	*Vireo olivaceus*	I	TR	M, SG
		WOOD WARBLERS				
S4B,SZN	MGR	Blue-winged Warbler	*Vermivora pinus*	I	GR	SB, ED
S5B,SZN	PR	Yellow Warbler	*Dendroica petechia*	I	TR	SB
S5B,SZN	MGR	Magnolia Warbler	*Dendroica magnolia*	I	TR	M, OW, ED, OP
S5B,SZN	MGR	American Redstart*	*Setophaga ruticilla*	IA	TR	OW, SG
S5B,SZN	MGR	Ovenbird	*Seiurus aurocapillus*	I	GR	M
S5B,SZN	PO	Common Yellowthroat	*Geothlypis trichas*	I	GR	WT, OP
		CARDINALS				
S5	PO	Northern Cardinal	*Cardinalis cardinalis*	S, FR	TR	SB, ED
		SUMMER FINCHES				
S5B,SZN	MGR	Rose-breasted Grosbeak	*Pheucticus ludovicianus*	S, FR	TR	M, SG, ED
		SPARROWS				
S5B,SZN	PO	Field Sparrow	*Spizella pusilla*	I, S, FR	TR, GR	SB, ED, SG, OP
S5B,SZN	PO	Song Sparrow	*Melospiza melodia*	I, S, FR	GR, TR	SB, ED
		BLACKBIRDS				
S4B,SZN	X	Bobolink	*Dolichonyx oryzivorus*	S, GR	GR	GL, OP
S5B,SZN	PR	Red-winged Blackbird	*Agelaius phoeniceus*	S, GR	V	WT, OP
S5B,SZN	PO	Eastern Meadowlark	*Sturnella magna*	I, GR	GR	GL, OP
S5B,SZN	PO	Common Grackle	*Quiscalus quiscula*	GR, I, IV	C, TR	OP, WT, OW
S5B,SZN	PO	Brown-headed Cowbird	*Molothrus ater*	I, GR	P	OP
		ORIOLES				
S5B,SZN	PO	Northern Oriole	*Icterus galbula*	I	TR	OP, OW
		WINTER FINCHES				
S5B,SZN	PO	American Goldfinch	*Carduelis tristis*	S, I	TR	ED, OP, SB, SG

LEGEND

FORAGING GUILD

AI aquatic insects
AM amphibians
B birds, nestlings or eggs
F fish
FR fruits
GR grains
I terrestrial insects
IA flying insects
IE insects excavated from tree
IV invertebrates
N flower nectar
R rodents
S seeds
SA sap
SC scavenger
SM small mammals
V vegetation

NEST SITE

B building
BU burrow
C colonial
CA cavity
CL cliff ledge
FL floating
GR ground
NB nest boxes
P parasitic
PL platform
SH shoreline, close to water
TR tree
V in vegetation
A abandoned nests

HABITAT PREFERENCE

B burntlands
D developed areas
ED edge, hedgerows, scattered trees
GL grassland
L lakes, ponds, calm water
M mature dense woodland
OP open field
OW open woodland
R rivers, streams, flowing water
SB shrubland, thickets
SG second growth, immature woods
SH shoreline
SL shallow water
WM wet meadows
WT wetlands - swamps, marshes, bogs, fens

VASCULAR PLANTS OBSERVED IN THE STUDY AREA

	EQUISETACEAE	HORSETAIL FAMILY
	Equisetum arvense	Field Horsetail
	ASPLENIACEAE	SPLEENWORT FAMILY
	Onoclea sensibilis	Sensitive Fern
	THELYPTERIDACEAE	BEECH FERN FAMILY
	Thelypteris palustris	Marsh Fern
	PINACEAE	PINE FAMILY
	Larix laricina	Tamarack
+	*Picea abies*	Norway Spruce
	Picea glauca	White Spruce
	Pinus resinosa	Red Pine
	Pinus strobus	White Pine
+	*Pinus sylvestris*	Scots Pine
	Tsuga canadensis	Eastern Hemlock
	CUPRESSACEAE	CYPRESS FAMILY
	Thuja occidentalis	White Cedar
	TYPHACEAE	CATTAIL FAMILY
	Typha angustifolia	Narrow-leaved Cattail
	Typha latifolia	Common Cattail
	POACEAE	GRASS FAMILY
+	*Bromus inermis ssp. inermis*	Smooth Brome Grass
+	*Hordeum jubatum*	Foxtail Barley
	Phalaris arundinacea	Reed Canary Grass
	Phragmites communis	Common Reed
	Poa spp.	Grass
	CYPERACEAE	SEDGE FAMILY
	Carex stricta	Stiff Sedge
	ARACEAE	ARUM FAMILY
	Arisaema triphyllum	Jack-in-the-pulpit
	LILIACEAE	LILY FAMILY
	Trillium erectum	Purple Trillium, Stinking Benjamin
	Trillium grandiflorum	Common Trillium
	SALICACEAE	WILLOW FAMILY
	Populus balsamifera	Balsam Poplar
	Populus deltoides	Cottonwood
	Populus tremuloides	Trembling Aspen

+	*Salix babylonica*	Weeping Willow
+	*Salix fragilis*	Crack Willow
	Salix spp.	Willow
	BETULACEAE	BIRCH FAMILY
	Betula alleghaniensis	Yellow Birch
	Betula papyrifera	White Birch
	FAGACEAE	BEECH FAMILY
	Quercus macrocarpa	Bur Oak
	ULMACEAE	ELM FAMILY
	Ulmus americana	White Elm
+	*Ulmus pumila*	Siberian Elm
	URTICACEAE	NETTLE FAMILY
	Urtica dioica ssp. gracilis	American Stinging Nettle
	ARISTOLOCHIACEAE	BIRTHWORT FAMILY
	Asarum canadense	Wild Ginger
	POLYGONACEAE	BUCKWHEAT FAMILY
+	*Rumex crispus*	Curly Dock
	CHENOPODIACEAE	GOOSEFOOT FAMILY
+	*Chenopodium album*	Lamb's-quarters, Pigweed
	BRASSICACEAE	MUSTARD FAMILY
+	*Alliaria officinalis*	Garlic Mustard
	Lepidium densiflorum	Common Pepper-grass
	GROSSULARIACEAE	GOOSEBERRY FAMILY
	Ribes cynosbati	Prickly Gooseberry
	Ribes sp.	Currant
	ROSACEAE	ROSE FAMILY
	Aruncus dioicus	Dioecious Goat's-beard
	Crataegus spp.	Hawthorn
+	*Crataegus monogyna*	English Hawthorn
	Fragaria virginiana	Common Strawberry
+	*Malus domestica*	Apple
	Potentilla sp	Cinquefoil species
	Prunus serotina	Wild Black Cherry
	Prunus virginiana	Chokecherry
	Rubus idaeus	Red Raspberry
	Rubus occidentalis	Black Raspberry
	Sorbus americana	Mountain-ash
	FABACEAE	PEA FAMILY
	Gleditsia triacanthos	Honey Locust
	Lathyrus odoratus	Sweet Pea

+	*Lotus corniculatus*	Bird-foot Trefoil
+	*Medicago lupulina*	Black Medic
+	*Medicago sativa*	Alfalfa
+	*Melilotus alba*	White Sweet-clover
+	*Melilotus officinalis*	Yellow Sweet-clover
+	*Trifolium pratense*	Red Clover
+	*Vicia cracca*	Bird Vetch
	GERANIACEAE	GERANIUM FAMILY
+	*Geranium robertianum*	Herb Robert
	OXALIDACEAE	WOOD-SORREL FAMILY
	Oxalis stricta	Yellow Wood-sorrel
	ANACARDIACEAE	CASHEW FAMILY
	Cotinus coggygria	Smoke-tree
	Rhus radicans ssp. negundo	Poison-ivy
	Rhus typhina	Staghorn Sumac
	ACERACEAE	MAPLE FAMILY
	Acer negundo	Manitoba Maple
+	*Acer platanoides*	Norway Maple
	Acer rubrum	Red Maple
	Acer saccharinum	Silver Maple
	Acer saccharum	Sugar Maple
	BALSAMINACEAE	TOUCH-ME-NOT FAMILY
	Impatiens capensis	Spotted Jewelweed
	RHAMNACEAE	BUCKTHORN FAMILY
+	*Rhamnus cathartica*	Common Buckthorn
	VITACEAE	GRAPE FAMILY
	Parthenocissus inserta	Virginia Creeper
	Vitis riparia	Riverbank Grape
	TILIACEAE	LINDEN FAMILY
	Tilia americana	Basswood
	ONAGRACEAE	EVENING-PRIMROSE FAMILY
	Circaea quadrisulcata	Enchanter's Nightshade
	APIACEAE	CARROT FAMILY
	Cicuta maculata	Spotted Water-hemlock
+	*Daucus carota*	Wild Carrot, Queen Anne's Lace
	CORNACEAE	DOGWOOD FAMILY
	Cornus stolonifera	Red-osier Dogwood
	OLEACEAE	OLIVE FAMILY
	Fraxinus americana	White Ash

	Fraxinus nigra	Black Ash
+	*Syringa vulgaris*	Common Lilac
	ASCLEPIADACEAE	MILKWEED FAMILY
	Asclepias syriaca	Common Milkweed
	CONVOLVULACEAE	MORNING GLORY FAMILY
+	*Convolvulus arvensis*	Field Bindweed
	HYDROPHYLLACEAE	WATERLEAF FAMILY
	Hydrophyllum virginianum	Virginia Waterleaf
	LAMIACEAE	MINT FAMILY
+	*Leonurus cardiaca*	Motherwort
	SOLANACEAE	NIGHTSHADE FAMILY
+	*Solanum dulcamara*	Bittersweet
	SCROPHULARIACEAE	FIGWORT FAMILY
+	*Verbascum thapsus*	Common Mullein
	PLANTAGINACEAE	PLANTAIN FAMILY
+	*Plantago major*	Broad-leaved Plantain
	RUBIACEAE	MADDER FAMILY
+	*Galium mollugo*	Bedstraw
	Galium palustre	Marsh Bedstraw
	Galium triflorum	Sweet-secented Bedstraw
	CAPRIFOLIACEAE	HONEYSUCKLE FAMILY
	Lonicera sp	Honeysuckle species
	Viburnum trilobum	Highbush-cranberry
	DIPSACACEAE	TEASEL FAMILY
+	*Dipsacus sylvestris*	Teasel
	CUCURBITACEAE	GOURD FAMILY
	Echinocystis lobata	Wild Cucumber
	ASTERACEAE	ASTER FAMILY
+	*Achillea millefolium ssp. millefolium*	Yarrow
	Ambrosia artemisiifolia	Common Ragweed
+	*Arctium minus*	Common Burdock
	Aster spp.	Aster
+	*Centaurea maculosa*	Spotted Knapweed
+	*Chrysanthemum leucanthemum*	Ox-eye Daisy
+	*Cichorium intybus*	Chicory
+	*Cirsium arvense*	Canada Thistle
+	*Cirsium vulgare*	Bull Thistle
	Erigeron philadelphicus	Philadelphia Fleabane
	Eupatorium maculatum	Spotted Joe-Pye-Weed

+	*Inula helenium*	Elecampane
	Lactuca scariola	Prickly lettuce
	Matricaria maritima	Scentless chamomile
	Senecio sp.	Tall Meadowrue
	Solidago flexicaulis	Zig-zag Goldenrod
	Solidago spp.	Goldenrod
	Sonchus arvensis	Field Sow-thistle
+	*Taraxacum officinale*	Dandelion
+	*Tussilago farfara*	Sweet Coltsfoot

+ denotes non-native species

Background Information

Fish Community sampled from tributaries of the West Humber River within the vicinity of the study area.

	Station Code	102*		152	123	149		151 (599*)			212 (573*)		220	HU015WM
Scientific Name	Common Name	1978	1987	1987	1994	1984	1985	1984	1985	1999	1987	1999	1994	2001
Ambloplites rupestris	rock bass	2	7	X		X	X							
Catostomus commersoni	white sucker	1	8	X	X	X	X	8	5		12	X	X	X
** *Clinostomus elongatus*	redside dace		1	X	X	X	X	2	2		3	X	X	X
Cottus bairdi	mottled sculpin							X	3	X				
Culaea inconstans	brook stickleback											X		
Etheostoma caeruleum	rainbow darter		3	X				7	5	X				X
Etheostoma exile	iowa darter	9												
Etheostoma flabellare	fantail darter	1	12	X		X	X	8	2	X				X
Etheostoma nigrum	johnny darter	3	8	X		X	X	2	23	X	8	X		X
Hypentelium nigricans	northern hog sucker	4			X					X			X	
Lepomis gibbosus	pumpkinseed						X							
Micropterus dolomieui	smallmouth bass												X	
Micropterus salmoides	largemouth bass		8								1			
Notemigonus crysoleucas	golden shiner													X
Notropis cornutus	common shiner	5	14	X			X	13	7		9	X	X	X
Notropis heterodon	blackchin shiner	11												
Notropis heterolepis	blacknose shiner	1												
Notropis umbratilis	redfin shiner	1												
Phoxinus eos	northern redbelly dace				X									
Pimephales notatus	bluntnose minnow	56	51		X	X	X	3	1	X	1		X	X
Pimephales promelas	fathead minnow	7				X	X	1	3	X	3	X		
Rhinichthys atratulus	blacknose dace	15	15	X	X	X	X	62	35	X	21	X	X	X
Semotilus corporalis	creek chub	4	6	X	X	X	X	40	18	X	18	X	X	X

Legend:

* MNR (Aurora District) records for the West Humber River tributaries.

** Redside Dace is listed as a threatened species in Ontario (MNR 2000).

TRCA/MNR Station Reference Number and Description of Sample Location:

123 - Located on Airport Road north of Castlemore Road

149 - Located on Old School Road west of Torbram Road

151/599 - Located just upstream of Mayfield Road between Torbram Road and Airport Road

152/102 - Located on Countryside Drive just east of Airport Road

212/573 - Located on Torbram Road south of Countryside Drive

220 & HU015WM - Located 3.4km southwest of Tullamore between Airport Road and Goreway Drive

Note: Stations 123, 149, 151, 212 and HU015WM was cross-checked and confirmed with the ROM database (Erling Holm, November 2003).

APPENDIX II

SEDIMENT AND EROSION CONTROL MEASURES

Ontario Provincial Standard Specification (OPSS) 577
"Construction Specification for Temporary Erosion and Sediment Control Measures"

AND

Standard Mitigation Measures for Road Improvement Projects

Standard Mitigative Measures for Road Improvement Projects

Timing Issues

Any instream work associated with the road work (i.e. culvert extensions) must be timed to avoid instream work during those times that are critical to critical life stage activities of fish. In particular spawning and egg incubation times must be avoided and a construction window put in place that recognizes this. Local OMNR offices can advise on the specific timing restrictions for the project area.

Every effort should be made to minimize the amount of time that it actually takes to complete instream construction activities. Careful planning with respect to materials, required equipment and manpower will ensure that the instream work can be completed in as short a time as possible.

Instream work should typically take place during low flow periods (typically July and August) when the amount of water that has to be diverted around the excavation can be limited.

Planning Issues

The limits of vegetation clearing should be clearly demarcated to avoid over clearing of vegetation beyond the limits of the improved alignment. This can be accomplished using stakes but fencing is preferred to provide a physical reminder to construction crews of the limits.

No vehicles or construction equipment should ford any watercourse or work within the watercourse unless otherwise agreed to with the agencies and specified in the contract.

Vehicular maintenance and refueling should be conducted at a minimum distance of 30m from any watercourse. Materials should be on hand to contain a fuel spill or other chemical spill should it occur.

Depending on the nature of the improvements a fisheries act authorization may be required for culvert extensions and or replacements. The local Conservation Authority will screen the project on behalf of DFO and advise as to whether such an authorization is required. If required, the authorization must be in place prior to the crossing proceeding.

Regular monitoring of all mitigative measures must be undertaken to ensure that mitigation is being carried out as planned and that mitigative measures (i.e. erosion and sediment control features) are functioning effectively. A trained construction inspector can undertake the routine, day to day, monitoring duties. Depending on the sensitivity of the stream involved, agencies may require that a biologist be present during critical

activities such as stream crossings or vegetation clearing in proximity to an area of known sensitivity.

Erosion and Sediment Control

In areas where roadside filling is required in vicinity of a watercourse or wetland silt fence should be installed on both sides of the fill area and should extend for a minimum distance of 30m on either side of the limits of filling. This will serve to intercept any sediment runoff from the work area and prevent movement of sediment into the stream.

Any activities that may result in sediment runoff (i.e. filling, and pulverizing) in the vicinity of sensitive watercourses should be planned to avoid wet weather events. Weather forecasts should be consulted to ensure that the amount of time required for the activity is available with a reasonable chance for good weather. This avoids concerns with respect to excess sediment runoff from the construction area.

Vegetation in the vicinity of creek crossings should not be pre-stripped in advance of the construction in the area. Pre-stripping vegetation results in bare soil that is vulnerable to erosion and may result in sedimentation of the stream.

Any stockpiled soil materials should be located away from watercourses tarped and/or corralled with silt fencing to avoid erosion and subsequent sediment runoff.

The contractor should be required to file an erosion and sediment control plan with the contract administrator before the crossing can proceed. This plan should specify the methods and materials to be used to ensure that erosion control is maximized and sediment is prevented from reaching the stream.

The tender documents for the project should clearly lay out the specification that the contractor is expected to adhere to regarding erosion and sediment control. In addition to site-specific specifications in the tender documents, the inclusion of "Ontario Provincial Standard Specification OPSS 577 – Construction Specification for temporary Erosion and Sediment Control Measures" should form the basis for tender document specification with respect to erosion and sediment control. Numerous Ontario Provincial Standard Drawings (OPSD) of erosion and sediment control devices are also available as follows and can be included in the tender.

<u>Sediment Containment</u>

OPSD 219.110 - Light Duty silt barriers
OPSD 219.100 - Light Duty Straw Bale Barrier
OPSD 219.120 - Heavy Duty Straw Bale barrier
OPSD 219.130 - Heavy Duty Silt Fence Barrier
OPSD 219.220 - Excavated Sediment Trap
OPSD 219.260 - Turbidity Curtain

Flow Directing

OPSD 219.140 - Berm Barrier
OPSD 219.150 - Sandbag Barrier

Erosion Control

OPSD 219.01 - Erosion Control Blankets

Velocity Control

OPSD 219.180 - Straw Bale Flow Check
OPSD 219.190 - Silt Fence Flow Check
OPSD 219.200 - Sandbag Flow Check
OPSD 219.210 - Temporary Rock Flow Check

For construction in the vicinity of a sensitive stream, if the stream is of sufficient depth and size, it may be necessary to consider (agencies may require) some type of instream sediment control device to be placed downstream of the road construction area to trap any sediment that may enter the watercourse. A complete analysis of the options available for instream sediment control is provided in:

Trow Consulting Engineers Ltd. 1996. *Instream Sediment Control Techniques Field Implementation Manual.* Ontario Ministry of Natural Resources, Northeast Science and Technology. FG-007. 109 p.

Rehabilitation

Following any instream disturbance (i.e. culvert replacement) it will be necessary to rehabilitate the streambed to mimic pre construction conditions, to the extent possible. If the stream has a rocky bottom a mix of rock of the same size range as the natural streambed material should be used. If possible, the natural overburden material should be stripped before construction and stockpiled for reuse during streambed rehabilitation.

Highly organic materials should not be used to rehabilitate the streambed even if they were excavated from the streambed. Rock should be used as an alternative.

When streambed rehabilitation is undertaken the materials should be placed so as to match the existing slope of the streambed. This will avoid creation of flow impediments and changes to the fluvial integrity of the channel.

If stream banks are disturbed they should be revegetated as soon as possible following completion of the crossing. Species of shrubs and grasses native to the area should be used. To ensure that soil remain in place while the shrubs mature a straw or similar fibre mat should be put in place and over seeded with a native grass mixture. Matting with seed impregnated is commercially available.

High slope stream banks may require a harder treatment such as rip rap when it is felt that traditional revegetation alone might not provide the slope stability and protection from erosion required. An engineering analysis of slope stability will result in a recommendation in this regard.

Consideration of how instream construction (i.e. culvert extension, realignment or replacement) may affect the hydraulics of the channel is important. If road construction activities will result in increased velocities in the vicinity of the crossing, consideration must be given to provide adequate shoreline stabilization and choosing bed materials of a size sufficient to withstand the change in hydraulics.

ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION

METRIC
OPSS 577
FEBRUARY 1996

CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES

TABLE OF CONTENTS

577.09.01.02	Light Duty Channel Flow Checks Straw Bale Flow Checks Silt Fence Flow Checks Sandbag Flow Checks Temporary Rock Flow Checks
.03	Excavated Sediment Traps Chutes Dewatering Traps
.04	Turbidity Curtains Coffer Dams
.05	Sediment Removal
577.09.02	Plan Quantity Measurement
577.10	BASIS OF PAYMENT
577.10.01	Light Duty Sediment Barriers - Item Light Duty Straw Bale Barriers - Item Light Duty Silt Fence Barriers - Item Heavy Duty Sediment Barriers - Item Heavy Duty Straw Bale Barriers - Item Heavy Duty Silt Fence Barriers - Item Berm Barriers - Item Sandbag Barriers - Item Light Duty Channel Flow Checks - Item Straw Bale Flow Checks - Item Silt Fence Flow Checks - Item Sandbag Flow Checks - Item Temporary Rock Flow Checks - Item Excavated Sediment Traps - Item Chutes - Item Dewatering Traps - Item Turbidity Curtains - Item Coffer Dams - Item
.02	Sediment Removal - Item

577.01 SCOPE

This specification describes the requirements for the installation, maintenance and removal of erosion and sediment control measures and the removal of sediment accumulated by the control measure.

577.02 REFERENCES

This specification refers to the following standards and publications.

Ontario Provincial Standard Specifications, Construction:

OPSS 206 Grading

Ontario Provincial Standard Specifications, Material:

OPSS 1004 Aggregates - Miscellaneous
OPSS 1801 Corrugated Steel Pipe Products
OPSS 1840 Polyethylene Pipe Products
OPSS 1860 Geotextiles

Canadian General Standards Board:

CAN/CGSB-148.1 M85 - Methods of Testing Geotextiles and Geomembranes

577.03 DEFINITIONS

For the purposes of this specification the following definitions apply.

Earth: means earth as defined in OPSS 206.

Downstream: means downhill and down-gradient.

Inflection point: means the point where a turbidity curtain changes angle to a significant degree.

Upstream: means uphill and up-gradient.

577.05 MATERIAL

577.05.01 Straw Bales

Straw bales shall consist of wheat or oat straw, shall be dry, firm, tightly tied in at least two places, show no evidence of straw or tie decay, and be free of sediment. They shall be of standard agricultural rectangular conformation and dimensions, approximately 600 mm x 600 mm x 1200 mm.

577.05.02 Geosynthetics

577.05.02.01 Geotextile

Geotextile shall conform to the requirements of OPSS 1860. It shall be free of holes, tears, and punctures.

577.05.02.02 Silt Fence Geotextile

Geotextile utilized as silt fence geotextile shall be a woven, Class I geotextile, having a width of 1.0 m minimum. It shall have a filtration opening size (FOS) of 840 μm maximum, meeting CAN/CGSB 148.1, Method 10.2.

577.05.02.03 Temporary Rock Flow Check Geotextile

Geotextile utilized in temporary rock flow checks shall be a woven, Class II geotextile. It shall have a filtration opening size (FOS) of 300 μm maximum, meeting CAN/CGSB 148.1, Method 10.2.

577.05.02.04 Turbidity Curtain Geosynthetic

Turbidity curtain geosynthetics shall have a grab tensile strength of 990 N minimum, meeting CAN/CGSB 148.1, Method 7.3. and be one of geotextile or geomembrane.

Geotextile shall be a woven material. The filtration opening size (FOS) shall be 300 μm maximum, meeting CAN/CGSB 148.1, Method 10.2.

Geomembrane shall be a low-permeability synthetic material or a geotextile impregnated with electomeric spray.

577.05.03 Stakes

Stakes shall be of sufficient strength to satisfy control measure performance and maintenance requirements.

Stakes for light duty sediment barriers and anchoring straw bales shall be a minimum of 1.2 m in length. Stakes for all other control measure applications shall be a minimum of 1.5 m in length.

577.05.04 Control Measure Support Material

Control measure support shall be a separate product, or one bonded to silt fence geotextile; it shall have a minimum sheet width of 750 mm, if in sheet form, and shall provide support for the entire length of the control measure without sagging.

577.05.05 Sandbags

Sandbags shall be made from heavy gauge plastic, agricultural burlap, or silt fence geotextile. Heavy gauge plastic shall contain stabilizers or inhibitors resistant to deterioration by ultra violet radiation. Sandbags shall be approximately 450 mm by 350 mm by 150 mm when filled. Sandbags shall be filled with sands or gravelly sands, containing little or no silt or clay.

577.05.06 Turbidity Curtain Hardware

577.05.06.01 Floatation

Turbidity curtain floatation shall be a material which has sufficient bouyancy to provide the curtain with continuous support, and a minimum of 50 mm freeboard.

577.05.06.02 Load Lines

Turbidity curtain load lines shall be 8 mm steel cable, or 19 mm nylon or polypropylene rope.

577.05.06.03 Ballast

Turbidity curtain ballast shall be 8 mm steel chain.

577.05.06.04 Anchors

Turbidity curtain anchors shall be mushroom or kedge anchors with a minimum mass of 34 kg for firm mud bottoms, or self burying Danforth anchors with a minimum mass of 5 kg for sandy bottoms.

577.05.06.05 Mooring Buoys

Turbidity curtain mooring buoys shall have provision for the mooring line to be securely attached and be sufficiently buoyant to remain afloat under normal load conditions.

577.05.06.06 Mooring Lines

Turbidity curtain mooring lines shall be 19 mm nylon or polypropylene rope.

577.05.06.07 Adjustment Lines

Turbidity curtain adjustment lines shall be 13 mm nylon or polypropylene rope.

577.05.07 Flow Check Rock

Rock utilized in temporary rock flow checks shall conform to the requirements for riprap and gabion stone specified in OPSS 1004.

577.05.08 Chutes

577.05.08.01 Corrugated Pipe

The corrugated pipe chutes shall be metal or plastic,

non-perforated, 300 mm in diameter and shall conform, respectively, to the requirements of OPSS 1801 and OPSS 1840.

577.05.08.02 End Sections

End sections utilized at the inlet and outlet of chutes shall conform to the requirements of OPSS 1801.

577.07 CONSTRUCTION

577.07.01 Operational Constraints

577.07.01.01 Dewatering

Dewatering effluent shall be controlled to prevent passage of sediment into a water body. Discharge of dewatering effluent to dewatering traps shall be controlled to avoid exceeding trap capacity and to limit scour or washout.

577.07.01.02 Chutes

Where chutes are specified, the chute and associated berm barrier shall be constructed in the same day.

577.07.02 Light Duty Sediment Barriers

The work shall consist of the installation, maintenance and removal of light duty sediment barriers.

Light duty sediment barriers are light duty straw bale barriers or light duty silt fence barriers.

Where the contract specifies light duty sediment barriers, the option of selecting either of the light duty sediment barriers or any combination of these control measures shall exist. Where the contract specifies either one of light duty straw bale barriers or silt fence barriers, there shall be no option of substitution for the control measure.

Light duty sediment barriers shall include, at each end of the barrier, a minimum 2 m end-run angled upstream to direct runoff to the main-run of the barrier.

Light duty sediment barriers shall include protection placed against the downstream side, at the low points of the barrier, so that any overflow of the barrier is prevented from causing soil scour and erosion.

Light duty sediment barriers shall be installed and maintained in place without gaps, and without undermining, to prevent sediment passage from the upstream to the downstream side of the barrier.

577.07.02.01 Light Duty Straw Bale Barriers

Light duty straw bale barriers shall be constructed of a single row of anchored straw bales.

Straw bale ties shall not be placed in contact with the ground.

Where straw bale barriers are to be installed on earth surfaces, a trench measuring 750 mm wide by 75 mm deep shall be excavated at the location specified for the barrier. The bales shall be placed in the trench and staked, and the remaining trench space shall be backfilled and compacted to existing grade.

Where straw bale barriers are to be installed on sod, erosion control blanket, or existing turf, they shall be placed and staked so that there are no gaps between the bales and the underlying cover.

The ends of adjacent bales shall be placed tightly against one another without gaps.

Each bale shall be firmly secured in place by two stakes. The stakes shall be spaced 150 mm from each end of the bale. Stakes shall be driven through the bales without breaking the bale ties or otherwise disturbing bale firmness and shape. Stakes shall be driven flush with the top of the bales.

Straw bale barriers shall be maintained such that bales remain firm, intact, of original shape, and without decay.

Maintenance shall include the replacement of each bale at intervals not exceeding 45 days.

577.07.02.02 Light Duty Silt Fence Barriers

Light duty silt fence barriers shall be constructed of silt fence geotextile supported on stakes.

The stakes shall be spaced a maximum of 2.3 m apart, and shall be driven vertically into the ground to a minimum depth of 600 mm.

A trench measuring 200 mm wide by 200 mm deep shall be excavated to anchor the geotextile along its entire length.

The geotextile shall be attached firmly, without sagging, to the upstream side of the stakes, and shall extend into the trench a minimum of 300 mm. It shall be placed without gaps or breaks along its length. Where the geotextile is joined to provide a continuous run, the ends shall be securely fastened and overlapped a minimum of 500 mm.

The trench shall be backfilled and compacted to existing grade to hold the base of the geotextile firmly in place. The completed silt fence shall have a minimum height of 600 mm above the ground surface.

577.07.03 Heavy Duty Sediment Barriers

The work shall consist of the installation, maintenance and removal of heavy duty sediment barriers.

Heavy duty sediment barriers are heavy duty straw bale barriers, heavy duty silt fence barriers, berm barriers, or sandbag barriers.

Where the contract specifies heavy duty sediment barriers, the option of selecting any of the heavy duty sediment barriers or any combination of these control measures shall exist. Where the contract specifies any one of heavy duty straw bale barriers, heavy duty silt fence barriers, berm barriers, or sandbag barriers, there shall be no option of substitution for the control measure.

Heavy duty sediment barriers shall include, at each end of the barrier, a 2 m end-run angled upstream to direct runoff to the main-run of the barrier.

Heavy duty sediment barriers shall include protection placed against the downstream side, at the low points of the barrier, so that any overflow of the barrier is prevented from causing soil scour and erosion.

Heavy duty sediment barriers shall be installed and maintained in place, without gaps, and without undermining, to prevent sediment passage through or under the barrier.

577.07.03.01 Heavy Duty Straw Bale Barriers

Heavy duty straw bale barriers shall be constructed of a light duty straw bale barrier, with the addition of control measure support installed on stakes.

In addition to the requirements for light duty straw bale barriers the following shall apply.

a. The 1.5 m stakes control measure support shall be spaced a maximum of 2 m apart, and shall be driven vertically into the ground to a minimum depth of 900 mm.

b. The control measure support shall be attached on the upstream side of the 1.5 m stakes.

c. The straw bales shall be placed firmly against the upstream side of the control measure support.

577.07.03.02 Heavy Duty Silt Fence Barriers

Heavy duty silt fence barriers shall be constructed of silt fence geotextile and control measure support installed on stakes.

Control measure support shall extend the entire height and length of the installed silt fence, without gaps or breaks. The control measure support shall be attached on the upstream side of 1.5 m stakes.

The requirements for light duty silt fence barriers shall apply with the following exceptions.

a. The geotextile shall be attached to the upstream side of the control measure support.

b. Stakes shall be spaced a maximum of 2 m apart, and be driven into the ground to a minimum depth of 900 mm.

Heavy duty silt fence barriers shall be maintained vertical, without tears and without sagging.

577.07.03.03 Berm Barriers

Berm barriers shall be constructed of earth material placed in windrows to a minimum height of 600 mm above the surface on which they are placed. The upstream slope of the barrier shall be 1.5:1 maximum. The downstream slope of the barrier shall be 4:1 maximum.

Berm barriers shall be maintained at specified height and slope, and without sloughing and slumping.

577.07.03.04 Sandbag Barriers

Sandbag barriers shall be constructed of three layers of sandbags. The bottom layer shall consist of three rows of bags, the middle layer shall consist of two rows of bags, and the top layer shall consist of one row of bags. The bags within each row shall be placed with the sides of the bags butted tightly against one another without gaps. The ends of sandbags in adjacent rows shall be butted tightly against one another without gaps.

The sandbags in each row shall be uniformly staggered to one another. The sandbags in each layer shall uniformly overlap the layer below.

Where sandbag barriers are to be installed on earth surfaces, a trench 75 mm deep, and sufficiently wide to accommodate three sandbags laid end to end, shall be excavated at the location specified for the barrier. The

sandbags shall be placed, and the remaining trench space shall be backfilled and tamped to existing grade.

Where sandbag barriers are to be installed on sod, erosion control blanket, existing turf, or bedrock, they shall be placed so that there are no gaps between the sandbags and the underlying surface.

Sandbag barriers shall be maintained with bags untorn and firmly seated.

577.07.04 Light Duty Channel Flow Checks

The work shall consist of the installation, maintenance and removal of light duty channel flow checks.

Light duty channel flow checks are straw bale flow checks, silt fence flow checks, or sandbag flow checks

Where the contract specifies light duty flow checks, the option of selecting any of the light duty flow checks or any combination of these control measures shall exist. Where the contract specifies any one of straw bale flow checks, silt fence flow checks, or sandbag flow checks, there shall be no option of substitution for the control measure.

Light duty flow checks shall include protection placed against the downstream side, at the lowest point of the flow check, so that any overflow of the flow check is prevented from causing soil scour and erosion.

Light duty channel flow checks shall be installed and maintained in place, without gaps, and without undermining, to prevent sediment passage through or under the flow check.

577.07.04.01 Straw Bale Flow Checks

Straw bale flow checks shall be constructed of a double row of bales. The requirements for light duty straw bale barriers shall apply, with the exception of end-runs and with the addition of the following.

a. Where straw bale flow checks are to be installed on earth surfaces, the trench shall be 1500 mm wide.

b. The two rows of bales shall be butted tightly beside one another without gaps.

c. The bales in the two rows shall be uniformly staggered to one another, so that the ends of the upstream row of bales are adjacent to the centres of the downstream row of bales.

d. The ends of the flow check, at ground level, shall be higher than the top of the lowest point of the flow check.

e. The upstream row of bales shall be one bale longer than the downstream row.

577.07.04.02 Silt Fence Flow Checks

Silt fence flow checks shall be constructed of silt fence geotextile and control measure support installed on stakes.

The requirements for heavy duty silt fence barriers shall apply with the following exceptions and additions.

a. Stakes shall be spaced a maximum of 1 m apart.

b. Stakes shall be placed at the centre of V-shaped ditches and at the point where side slopes meet the bottom of channels and trapezoidal-shaped ditches.

c. The ends of the flow check, at ground level, shall be higher than the top of the lowest point of the flow check.

d. The completed silt fence flow check at its lowest point shall have a height of 375 mm minimum and 500 mm maximum above the ground surface.

e. End runs are not required.

Silt fence flow checks shall be maintained vertical, without tears and without sagging.

577.07.04.03 Sandbag Flow Checks

The requirements for sandbag barriers shall apply, with the following modifications.

a. End-runs are not required.

b. The ends of the flow check, at ground level, shall be higher than the top of the lowest point of the flow check.

577.07.05 Temporary Rock Flow Checks

The work shall consist of the installation, maintenance and removal of rock flow checks.

Rock flow checks shall be constructed of geotextile and two lifts of rock.

A first lift of rock shall be plied across the ditch or channel to a height of 450 mm above the lowest point

of the ditch or channel. The upstream slope of the flow check shall be 1.5:1 maximum. The downstream slope of the flow check shall be 4:1 maximum. The top of the first lift shall be of sufficient width to accommodate the second lift of rock.

A trench measuring 200 mm wide by 200 mm deep shall be excavated across the entire length of the upstream side of the flow check.

Geotextile shall be placed:

a. 300 mm into the trench;

b. over the first lift of rock; and

c. up the side-slopes of the ditch or channel to the fullest extent covered by the completed flow check.

The trench shall be backfilled to existing grade to hold the geotextile firmly in place.

A second lift of rock shall be placed over the exposed geotextile and first lift of rock to form a spillway and anchor the geotextile as follows:

a. The minimum depth of rock over the geotextile shall be 100 mm.

b. The tops of the sides of the completed flow check shall be a minimum of 700 mm above the lowest point of the ditch or channel.

c. A level spillway measuring 150 mm deep shall be formed in the top of the flow check so that it extends from the upstream to the downstream side, and its crest is centred over the lowest portion of the ditch or channel. Where rock flow checks are to be installed in V-shaped ditches, the spillway crest shall extend 300 mm on either side of the centre of the ditch. Where rock flow checks are to be installed in channels or trapezoidal-shaped ditches, the spillway crest shall extend to the greater of the following:

    1. 300 mm on either side of the centre line of the ditch; or

    2. to the point where the side slopes meet the bottom of the channel or ditch.

Rock flow checks shall be installed and maintained in place, without gaps, and without undermining, to prevent sediment passage through or under the flow check.

577.07.06 Excavated Sediment Traps

The work shall consist of the installation, maintenance and removal of excavated sediment traps.

Excavated sediment traps shall be constructed as a single control measure, consisting of an excavated basin and either a light duty channel flow check or temporary rock flow check. The flow check shall be constructed approximately 1 m downstream of the excavated basin.

The excavated basin shall have a minimum depth of 1 m below the existing ground surface as measured at the lowest point of the channel at the downstream end.

The bottom of the excavated basin shall be horizontal, shall have a length measuring 20 m maximum, and shall have a width which is a minimum of one half the length. The sides of the excavated basin shall be no steeper than 0.5 : 1.

A temporary fence shall be erected around the sediment trap to restrict public access.

Excavated sediment traps shall be installed and maintained to prevent sediment passage from the upstream to the downstream side of the excavated trap, and so that the majority of the sediment is collected in the excavated basin.

577.07.07 Chutes

The work shall consist of the installation, maintenance and removal of chutes. The berm barrier constructed in association with the chute is not part of this work.

Chutes shall be constructed as a single control measure, consisting of corrugated pipe, two end sections, and an excavated sediment trap constructed at the outlet end of the pipe.

The pipe inlet shall be placed through a berm barrier in such a manner that flow is directed to the pipe inlet without scouring of the berm. The toe plate of the inlet end section shall be fully imbedded into the ground surface. The inlet end section shall have a minimum grade of 3% towards the pipe opening.

The pipe outlet shall be placed such that the outlet end section discharges into the excavated sediment trap, and so that the toe plate of the outlet end section is fully imbedded into the edge of the trap.

The pipe shall be firmly secured to the slope.

Protection shall be placed below the pipe outlet end section to prevent scour of the excavated trap.

Pipes shall be maintained in place, without gaps, and without undermining, so that water is conveyed from the upstream side of the berm and collected in the sediment trap.

577.07.08 Dewatering Traps

The work shall consist of the installation, maintenance and removal of dewatering traps.

Traps for dewatering shall be constructed as a single control measure, consisting of an excavated basin, surrounded by a light duty sediment barrier, with a temporary rock flow check at the point of water outlet.

The excavated basin shall have a minimum depth of 1 m below the existing ground surface. The bottom of the excavated basin shall have a maximum length and width of 20 m. The sides of the excavated basin shall be no steeper than 0.5 : 1. The shape of the dewatering basin may be varied to suit site characteristics.

The sediment barrier and temporary rock flow check shall be installed a minimum of 1 m from the edges of the excavated basin.

Installation of the sediment barrier shall conform to the requirements for light duty sediment barriers with the following exceptions:

a. end runs are not required; and

b. the temporary rock flow check shall be located at the low point of the barrier.

The spillway height in the temporary rock flow check shall be adjusted so that it is 75 mm lower than the top of the adjacent barrier. The temporary rock flow check shall be constructed at the point where the top of the sediment barrier is lowest. The geotextile used in the flow check shall overlap the light duty sediment barrier a minimum of 500 mm.

Traps for dewatering shall be installed, operated and maintained to prevent sediment passage beyond the perimeter of the trap.

577.07.09 In-Water Controls

The work shall consist of the installation, maintenance and removal of in-water controls, which for the purposes of this specification may be either Turbidity Controls or Coffer Dams.

577.07.09.01 Turbidity Curtains

Turbidity curtains shall consist of turbidity curtain geosynthetic, load line, flotation, ballast, anchors, mooring buoys, mooring lines, adjustment lines, and tie-downs.

Turbidity curtains shall be constructed as follows.

a. A sleeve shall be formed and heat-sealed or sewn along the entire top edge of the turbidity curtain geosynthetic, to contain the floatation and load line in the sleeve. The floatation shall provide support along the length of the turbidity curtain.

b. A sleeve shall be formed and heat-sealed or sewn along the entire bottom edge of the turbidity curtain geosynthetic, to contain the ballast in the sleeve. Breaks may be made in the sleeve to facilitate pulling, provided they are a minimum 100 mm in size and spaced at minimum 3 m intervals.

c. Where turbidity curtain geosynthetic is joined to provide a continuous run, the sections shall be connected to provide a continuous seal and prevent the escape of turbid water between the sections.

d. The turbidity curtain, as prepared for installation, shall be of sufficient width to account for water depth and wave action.

e. Adjustment lines shall be placed at maximum intervals of 10 m, and to encircle the turbidity curtain from top to bottom.

f. The turbidity curtain shall be prepared for installation by furling and tying with furling ties every 1.5 m for the entire length of the curtain.

g. Anchor locations shall be established as is necessary to maintain the turbidity curtain in place and functioning.

Turbidity curtains shall be installed to prevent sediment passage, from the area enclosed by the curtain, to the remaining water body. Turbidity curtains shall be installed and maintained in a manner that avoids entry of equipment, other than hand-held equipment or boats, to the remaining water body. The sequence of installation is as follows:

a. Tie-downs shall be provided to firmly anchor the turbidity curtain to the shoreline at locations specified.

b. One end of the furled curtain shall be firmly attached to the upstream or up-current tie-down.

c. The furled curtain shall be launched and shall be placed as specified.

d. The remaining end of the furled curtain shall be attached to the downstream or down-current tie-down.

e. Each anchor shall be attached to the turbidity curtain load line with a mooring line.

f. At inflection points, mooring buoys shall be attached to the mooring line at a distance of 1 m from the load line.

g. The furling ties shall be released to allow the turbidity curtain ballast to sink to its maximum depth.

h. The location and depth of the ballast shall be adjusted as necessary by using the adjustment lines.

Equipment is permitted in the work area enclosed by the turbidity curtain.

Turbidity curtains shall be operated and maintained in the specified location, with the entire top edge above the water surface. The curtain shall be free of tears and gaps, and the bottom edge of the curtain is to be continuously in contact with the water course bed so that sediment passage from the area enclosed is prevented.

Any folds in the turbidity curtain which form next to the floatation collar shall be regularly monitored and freed of collected sediment.

577.07.09.02 Coffer Dams

Coffer dams shall be installed and maintained in a manner that:

a. isolates the work area from the water body;

b. avoids entry of equipment, other than hand-held equipment or boats, to the remaining water body; and

c. prevents release of sediment and debris to the water body.

Equipment is permitted in the work area enclosed by the coffer dam.

577.07.10 Monitoring

To ensure that erosion and sediment control measures are in effective working order, their condition shall be monitored prior to any forecast storm event and following a storm event.

577.07.11 Maintenance

All measures installed under the terms and conditions of this specification are to be maintained in an effective, functioning and stable condition.

577.07.12 Sediment Removal

The work shall consist of the removal and management of accumulated sediment.

Sediment that is accumulated by sediment barriers, channel flow checks, excavated traps, sediment interceptors, and dewatering traps, shall be removed in a manner that avoids escape to the downstream side of the control measure and avoids damage to the control measure. Sediment shall be removed to the level of the grade existing at the time of the control measure installation and shall conform to the following:

a. For light duty sediment barriers and light duty channel flow checks, accumulated sediment shall be removed once it reaches the lesser of:

   1. a depth of one-half the effective height of the control measure, which for channel flow checks, shall be determined relative to the lowest point of the flow check; or

   2. a depth of 300 mm immediately upstream of the control measure.

b. For heavy duty sediment barriers, heavy duty channel flow checks, excavated traps, sediment interceptors, and dewatering traps, accumulated sediment shall be removed once it reaches one-half the effective height or depth of the control measure.

c. For all control measures, accumulated sediment shall be removed as necessary to perform maintenance repairs.

d. Accumulated sediment shall be removed immediately prior to the removal of the control measure.

Sediment removed shall be managed as excess earth material.

577.07.13 Control Measure Removal

Ditch, channel, permanent slope, and any other embankment cover specified elsewhere in the contract to be placed within the area controlled by the temporary erosion and sediment control measure, shall be in place prior to the removal of such temporary control measure.

Temporary erosion and sedimentation control measures shall be removed and associated excavations backfilled and compacted when, in the opinion of the Contract Administrator, the measures are no longer required.

Erosion and sedimentation control measures shall be removed in a manner that:

a. avoids entry of equipment, other than hand-held equipment or boats, to any watercourse; and

b. prevents release of sediment and debris to any watercourse.

Prior to removal, the area enclosed by turbidity curtains and coffer dams shall be cleaned of all debris, and for coffer dams, accumulated sediment shall be removed.

Any seeding and mulching, temporary cover, sodding, other surface application, or original turf cover disturbed by removal or backfilling of erosion and sedimentation control measures and removal of accumulated sediment, shall be brought to final grade and restored.

577.09 MEASUREMENT FOR PAYMENT

577.09.01 Actual Measurement

577.09.01.01 Light Duty Sediment Barriers
Light Duty Straw Bale Barriers
Light Duty Silt Fence Barriers
Heavy Duty Sediment Barriers
Heavy Duty Straw Bale Barriers
Heavy Duty Silt Fence Barriers
Berm Barriers
Sandbag Barriers

Measurement will be by the metre of barrier installed, from end to end, following the contours of the ground.

577.09.01.02 Light Duty Channel Flow Checks
Straw Bale Flow Checks
Silt Fence Flow Checks
Sandbag Flow Checks
Temporary Rock Flow Checks

For measurement purposes a count will be made of the flow checks installed.

577.09.01.03 Excavated Sediment Traps
Chutes
Dewatering Traps

For measurement purposes a count will be made of the excavated sediment traps, chutes, and dewatering traps installed. Component parts will not be counted separately for payment.

577.09.01.04 Turbidity Curtains
Coffer Dams

For measurement purposes a count will be made of the Turbity Curtains and Coffer Dams installed, by location.

577.09.01.05 Sediment Removal

Measurement will either be by the volume of sediment excavated in cubic meters, or by the number of hours required for excavation of sediment, as specified in the Contract.

577.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement will be based on the units shown in the clauses under Actual Measurement.

577.10 BASIS OF PAYMENT

577.10.01 **Light Duty Sediment Barriers - Item**
Light Duty Straw Bale Barriers - Item
Light Duty Silt Fence Barriers - Item
Heavy Duty Sediment Barriers - Item
Heavy Duty Straw Bale Barriers - Item
Heavy Duty Silt Fence Barriers - Item
Berm Barriers - Item
Sandbag Barriers - Item
Light Duty Channel Flow Checks - Item
Straw Bale Flow Checks - Item
Silt Fence Flow Checks - Item
Sandbag Flow Checks - Item
Temporary Rock Flow Checks - Item
Excavated Sediment Traps - Item
Chutes - Item
Dewatering Traps - Item
Turbidity Curtains - Item
Coffer Dams - Item

Payment at the contract price for the above tender items shall be full compensation for all labour, equipment and material required to do the work. Partial payments will be made on the following basis:

a. 50% for initial installation;

b. 30% for maintenance, and

c. 20% for removal.

Payment for the item Coffer Dams shall be in addition to dewatering requirements which may be specified elsewhere in the Contract.

577.10.02 **Sediment Removal - Item**

Where the contract provides a tender item for sediment removal, payment at the contract price shall be full compensation for all labour, equipment and material to perform the work.

Where the contract does not provide quantities in support of sediment removal, and where sediment removal is directed to be performed, payment shall be made according to Extra Work provisions of the contract.