APPENDIX G

Table G1: General Cost Estimates

Restoration Need	Approximate Cost	Description
Failed gabion removal, bank regrading, installation of new treatment	$300 – $750/m	Cost will vary based on the complexity of the new treatment (ie. live stakes or vegetated rip-rap)
Repairs for undersized pedestrian bridges	$15,000 – $20,000 per bridge	This will include the use of stone, vegetation and fill to protect the abutments in place. Cost varies based on the amount of materials needed.
New pedestrian bridges	$30,000 per bridge excluding abutments	This is the cost required to purchase a new bridge, additional cost may be required for removal of the previous bridge and some site restoration
Basic restorative plantings (no stone work)	$250-$500/m	This may be used on low risk eroding or slumping banks
Protective treatment for an at-risk exposed manhole	$25,000-$30,000 per manhole	This would require stone protection of the manhole as well as stone which would redirect the flow away from the bank in question. The estimate assumes the work would cover approximately 20m in bank length.
Debris removal and bank re-grading with plantings and potentially stone	$250-$500/m	Removing woody debris or old rip-rap and re-establishing the bank
Outfall repair	$35,000 per outfall	General costing which would include minimal repair work to the structure itself and primarily stone work in the channel and around the structure to properly dissipate flows and reduce scour.
Eroding valley wall repair	$1500-2000/m	Stone and vegetation treatment for toe protection
Repair to undermined bank protection (gabions or concrete)	$150-$250/m	Packing of stone at the base of the structure to minimize scour and protect the structure
Bank repairs with in-channel work to rebuild bed structure	$1250-$2000/m	This type of treatment is needed in bends where erosion has been severe and over widened the channel necessitating a reconstruction of the channel bed in addition to bank work.
Full Section Restoration	$2500-$3500/m	This will include full treatment and reconstruction of channel bed and banks through a specified length of channel. This will vary based on complexity and severity of issues.

APPENDIX H

Appendix H: Considerations at the Detailed Design Stage

1. Introduction

This section was initially developed for the Implementation Plan for the Highland Creek Geomorphic Systems Master Plan Study (HCGSMP; Aquafor Beech Ltd., 2011); its objective was to address City of Toronto (City) design requirements understanding the uncertainties in stream restoration projects based on a riffle-pool concept as the definitive approach to address exposed sanitary sewer pipes caused by bed incision over a 3-5 decade period, and those of other agencies for stream restoration works carried out in valley lands in which natural channel design of MNR (2002) was recognized as a self-compensating set of works: DFO, with respect to fish habitat; TRCA, related to fish habitat, works within hazard lands, archaeological resources on TRCA-owned valley lands; City Forestry and TRCA with respect to natural heritage system and tree protection, and MNR and DFO with respect to rare and endangered species; and, City of Toronto with respect to City designated ESA areas). Where appropriate, the text from the HCGSMP Implementation Plan has been updated, and shaped to the unique character Wilket Creek.

Detailed design requirements for Consultant assignments, routinely used by the City, emphasize needs of Wastewater Treatment Plants and those of other hard infrastructure (streets, water mains etc); the requirements for these assignments have been suitably replaced by material specific to stream requirements, including analyses needed to address the three key areas of habitat biology, loose-boundary hydraulics, and geomorphology.

This section is applicable for the Implementation of all Stream Restoration Plans developed by the City from a Geomorphic Systems Study or the Geomorphic Systems Master Plan Study. This section will guide the Implementation of stream rehabilitation project plans of the Wilket Creek Geomorphic Systems Master Plan (WCGSMP).

2. Detailed Design Drawings

As part of the detailed design process, the following items will need to be presented in the detailed design and construction drawings, which should be accompanied by a detailed design brief that provides appropriate background to the design:

- Detailed design drawings including planform, profile, and sections of treatment within the project site through the extent of treatment;
- Details of the treatment and construction phasing;
- Determination of access route and construction staging;
- Preparation of restoration plan including seeding, sodding, planting, and tree protection details;
- Material quantity estimation;
- Stabilization details.

3. Additional Investigations

While data and mapping have already been compiled for the project area in conjunction with the overall WCGSMP, additional site investigations, data collection, analyses, and mapping will need to be completed to supplement the background information that is identified in the WCGSMP. These additional investigations will inform the detailed design process and include:

- Topographic Survey
- Geotechnical Investigation
- Archaeological Investigation
- Utility Locations
- Existing Sanitary Sewer Crossings
- Vegetation Inventory and Tree Protection/Removal
- Hydraulic Analyses
- Aquatic Habitat Analysis
- Site Access and Staging
- Construction Phasing and Related Notes
- Erosion and Sediment Control
- Restoration Plantings

3.1 Topographic Survey

A detailed topographic survey, supported by available digital topographical information, should be completed of the study area to enable preparation of detailed design and construction drawings, and to support subsequent analyses, as outlined below:

- Topographical information
- Current data of the geometry of the channel including channel cross-section, profile, and planform to characterize existing conditions and to quantify/qualify change that has occurred since the initial data collection of this study.
- Accurate representation of all significant vegetation including type and size
- Location of boreholes
- Confirmation of the location of municipal infrastructure
- Accurate representation of all private utilities
- Detailed topographic data of all affected lands adjacent to the study area (e.g., site access, staging etc.,
- Details of any road crossings (culvert obvert, inverts etc.) including detailed cross-sections at the upstream and downstream ends. Where possible, profile and section data through the crossing should also be surveyed.

3.2 Geotechnical Investigation

A geotechnical investigation should be undertaken to determine the engineering properties of the existing soils. This is of particular importance in areas where the stream has been disturbed during the construction of local infrastructure and in areas where risk is assessed in proximity to valley wall contacts. The number of boreholes that should be advanced to a sufficient depth should be determined by a geotechnical expert. Borehole logs containing appropriate and sufficient data should be prepared. In addition, grain size analysis and proctor density should be conducted on samples obtained from each homogenous stratigraphic unit. Information from the boreholes would enable a determination of stable slope angles and stability of slope materials for planning purposes and enable an assessment of risk upon which decisions regarding restoration strategy are based (e.g., determine whether a perceived risk is an actual risk).

It is recognized that where significant glacial valley erosion has occurred at a river bend contact point with the valley wall, the design approach may involve a minimalist intervention strategy, in which the bank is protected with a structure to a 5-year return period flow level, backfilled, and then Mother Nature allowed to develop a stable angle of repose for the valley wall erosion scar.

3.3 Archaeological Investigation

Due to the possibility that heritage resources will be impacted by the implementation of any of the alternatives that are listed in the report, archaeological investigation is required.

- An Archaeological Assessment, equivalent to a Stage 1 report, has been completed for the Wilket Creek system and is appended. Additional attention to whether a Stage 2 investigation is

required, for any restoration projects defined in this project report, will be required at the detailed design stage, especially for construction staging and access routes.

- Stage 2 investigations will be required in all non-disturbed areas that contain a High Potential for archaeological resources.
- Prior to any construction, site visits will be required to accurately determine the extent of Stage 2 investigations.
- If there is any deviation from the proposed plans, construction or proposed schedule and the lands are TRCA owned, TRCA's Archaeology Resource Management Services are to be contacted to address any potential archaeological concerns.

3.4 Utility Locations

Mapping showing the location of underground utilities such as Enbridge gas lines and City of Toronto water mains will need to be compiled and assessed. The utilities for this area includes, but are not limited to, electricity, natural gas, cable television, telephone, water, sanitary sewer, and storm sewer.

At the time of construction, all utility organizations need to be contacted for as-constructed drawings and field staking of all underground services in the work area, as required by the Ontario Health and Safety Act. Upon completion of the field staking, a topographic survey should be undertaken identifying the location (vertical and horizontal alignment) of these utilities to confirm their location shown in the detailed design drawings.

3.5 Existing Sanitary Sewer Crossings

The City of Toronto has digital mapping of the sanitary sewer network. The location of both the trunk and sub-trunk sanitary sewer network has been compiled in this Study. Where reasonable, relocation of the sanitary sewer or manholes in lieu of bank protection/treatment has been considered in this study. Historic as-built drawings of the sanitary sewers are available.

In locations where the creek is in close proximity to the channel bed or banks, the sanitary sewer should be exposed to confirm a concrete encasement or cradle has been installed and to determine the extent and condition of these concrete works, particularly into the creek bank. If no concrete encasement/cradle exists, the detailed design should consider exposing and protecting the sewer.

There are several locations where raising of the channel bed is proposed to reconnect the channel to the floodplain and to provide cover over the sanitary sewer. Where possible, a minimum 1 m depth of cover over the sanitary sewer crossing is recommended.

3.6 Vegetation Inventory and Tree Protection/Removal

Various studies have been completed that have provided understanding of the terrestrial habitat functions in the Wilket Creek subwatershed, and are reviewed in this Report. The presence of any of MNR's Species at Risk aquatic (in-stream) locations within general project sites have also been identified in this study.

As part of detailed design preparation, a vegetation inventory and assessment may need to be undertaken in the event that vegetation will need to be removed and restored, during the construction activity (e.g., access routes, treatment location). The areal extent of tree removal can be estimated from an air photo with the stream alignment placed on it, and used to estimate tree loss based on rules of thumb for tree density and initiate discussions with resource agencies re compensation for tree removal.

All existing trees in excess of 100mm diameter should be located during the topographic survey and included on the detailed design drawings. Trees affected by construction activities shall be shown on the drawings as requiring removal. Trees close to the work area or those requiring preservation shall be protected using appropriate tree protection fencing which will be included as a detail on the drawings. In addition, the presence of any of MNR's Species at Risk locations (such as Butternut trees) within general project sites will need is also identified; if they need to be removed for purposes of channel restoration, an appropriate compensation will need to be developed.

For some City projects involving short-term stream works (1–3 month long construction), detailed restoration plans, including planting areas for compensation of tree loss, will be defined in the detailed design process. For other projects whose construction extends over one or more years and especially those at a valley segment scale, scale local restoration plans, especially including riparian plantings to strengthen banks, will be implemented from design drawings, but broader scale restoration plans, enhancements to address TRCA's Habitat Implementation Plans (HIP) and the associated PF&R greening strategy may follow one or more years after channel works have been completed.

3.7 Hydraulic Analyses

The existing hydraulic model will need to be updated, based on detailed topographic survey information and appropriate hydraulic analyses. Survey data of any watercourse crossings should also be used to update the hydraulic model, including setting of the upstream inverts based on detailed profile data through the culvert, where this data is available (i.e., if the invert through the crossing is higher than the actual upstream invert, then this higher invert should be used as it will reflect the actual cross-sectional area available through the culvert).

The hydraulic analyses will be instrumental in gaining insight into the velocity, depth, and stress conditions at a site which will inform the selection of appropriate restoration treatment types (e.g., bank treatment) and material sizes. Identification of key water level elevations would help to plan appropriate floodplain elevation, height of valley or bank treatments. A proposed conditions model will enable the design team to evaluate the hydraulic effects and benefits of the detailed design. The data will form the basis for fish passage assessments.

3.8 Design Flows

Several characteristics of low flows and high flows are informative for channel design and understanding flood plain coverage by flood flows and in channel habitat hydraulics, including

- regional flood flow
- 10 year to 100 return period flows
- 5 year return period flow
- 2 year return period flow
- frequency of full bank flow under existing conditions and proposed design conditions
- half bank flow
- baseflow
- 7Q20 flow

3.9 Aquatic Habitat Analysis

Results of hydraulic conditions of the proposed channel design should be used to ensure that fish passage, especially during typical critical stage flows, can occur. The fish passage assessment should consider the ability of target and community fish to negotiate the flow velocity over the length of riffles. Velocity criteria are provided in the following reference:

- Ministry of Transportation of Ontario (MTO), 2006. *Environmental Guide for Fish and Fish Habitat*.

The sizing of substrate material and their long–term stability is a key design parameter used to ensure that riffle materials provide the ecological function for fish habitat while being stable at the designed hydraulic and flow conditions. Hand based calculations (based on formulae) or computer programs are available to define substrate sizes that are stable for design flow conditions, such as:

- CHUTE. See http://www.toolkit.net.au/Tools/CHUTE for further information.

In addition, filling riffles with small grain size material to minimize short circuiting of surface flows is another consideration, where large boulder sized material forms the main source of material used for riffle reconstruction.

Additional information that guides habitat analyses in support of the detailed design process includes:

- field information on community structure (this study and TRCA monitoring data),
- selection of a target species,
- habitat and water quality requirements for different aquatic communities is provided in the WWFMP Aquatic Habitat Tables,
- TRCA's Don River Watershed Aquatic Habitat Management Plan.

It should be noted that a Draft Don River Fisheries Management Plan was updated by TRCA as a part of an update to the Don River Watershed Management Plan, developed to meet the requirements of the Oak Ridges Moraine Act. The Updated Don River Fisheries Management Plan (FMP) was completed through a release of the Updated Draft in 2011/2012. This updated Draft FMP provides some background information to guide design; most of the salient background information was considered in this EA Master Plan study. Watershed – specific, FMPs (Fisheries Management Plans) for other Watersheds such as the Don will provide relevant background information, for their fully urbanized branches. TRCA's Greening Strategy will outline strategies where significant restoration should occur, based on HIP evaluations and the schedule of creek restoration (reconstruction) projects documented in this Concept Design Report. The greening strategy will assist the detailed design team in determining the extent of allochthonous and shading functions that will be provided for the aquatic community, long term.

3.10 Site Access and Staging

Site access for construction equipment, imported materials, and exported fill should be defined for each work area. If a temporary crossing is deemed necessary for a particular site, details of the temporary crossing including estimates of the creek flow must be provided. Staging areas for equipment and materials should also be indicated on the design drawings.

3.11 Construction Phasing and Related Notes

Detailed notes and drawings should be prepared to clearly communicate the anticipated phasing of the construction activities. This will provide locations for rock check dams, pump locations and relevant direction for undertaking the sequence of activities required to construct the detailed design to achieve the intended objectives. It is recognized that, once construction activities proceed on-site, some adjustments to the construction phasing plan may occur.

3.12 Erosion and Sediment Control (ESC)

The key to an effective ESC plan are staging dynamics (see previous section). A detailed erosion and sediment control plan including construction staging shall be prepared. Contact the Toronto and Region Conservation Authority to confirm the 'fisheries' construction timing window for the site, and include this information on the design drawings.

3.13 Restoration Plantings

A restoration planting plan will be required to address the following components:

- Vegetative erosion control of the banks and floodplain,
- Erosion and sediment control of the banks and disturbed overbank area,
- Provision of terrestrial habitat,
- Provision of shading of the creek water to enhance aquatic habitat,
- Establishing a self-sustaining vegetated system in the riparian area.
- Bio-engineering techniques including live staking, live fascines, and bio-logs.

Only native, locally present trees, shrubs, and grasses should be used to restore the site. City Forestry and the Toronto and Region Conservation Authority are typically able to provide a list of species suitable for restoration within the study area.

In conjunction with restoration plantings in the immediately affected construction area, opportunities to further vegetation objectives as outlined within PF&R's and TRCA's Natural Heritage Strategy. Further, since wetland habitats are under-represented in the Don River watershed, and well below the RAP target of 10%, efforts to enhance these wetlands need to be considered at detailed design stage, where these areas are within the area of the stream restoration project.

PF&R and TRCA should be contacted at the outset of the detailed design process to determine what specific restoration strategies are defined in vicinity of the project area that can be addressed through the proposed project restoration works. But since the scheduling of the PF&R and TRCA initiatives will coordinated with the schedule of works in the WCGSMP (i.e. to follow the channel rehabilitation projects, in areas were physical intervention is needed), the two initiatives are mutually complementary.

Re-vegetation of the stream corridor (and watershed) can also be accomplished through many means. The TRCA has a stewardship program and other tools useful for restoration of watercourses within the City of Toronto. Coordination with the City's Parks department should be sought to tie into their naturalization efforts when re-vegetation is required as part of restoration activities. Community stewardship and education programs can also foster re-vegetation efforts.

4. Additional Considerations

In addition to the specific tasks pertaining to preparing detailed design and construction drawings, there are ancillary tasks that need to be considered/undertaken to obtain approvals, and to foster appropriate community relations. These are summarized in this section.

4.1 Work on Private Property

Some of the erosion sites that were documented and identified as priority for restoration occur on private property. A number of municipalities within southern Ontario have undertaken erosion control works on private property as a result of requests from homeowners, municipal desire, court order, or political pressure. These municipalities recognize that while erosion is a natural process, the impacts of development are significant on the erosion process.

General steps followed by municipalities in dealing with private land owners are as follows:

a) Landowner Contact

- Initiate a discussion with landowners to explain what the problem is, and why restorative measures are required
- Obtain approval to undertake work on their property. This will include an agreement noting that:
    - The City is not admitting any liability
    - The property owner will indemnify the City
    - The City does not guarantee the effectiveness of the work to prevent additional erosion
- There is a need for an easement (in cases where public infrastructure is at risk on private property, or where the stream works are deemed to be Municipal infrastructure for which the Municipality is responsible in perpetuity)

b) Funding Sources

- TRCA have a policy of co-funding and land acquisition, where they do works that benefit private property owners / private property

c) Construction of proposed works

- Where the City implements works on Private Property, a temporary and / or permanent easement is required. In addition, a funding agreement may be needed.

d) Inspection of final works including signoff

- Obtain signoff on the items listed under Landowner Contact

e) City Policy

- The City will separately develop policies for treatment and funding of erosion sites on private property.

4.2 Subsequent Class EA Requirements

This study followed the Class Environmental Assessment for the Municipal Water and Wastewater Projects process and is subject to the requirements of the Class Environmental Assessment Act. The Master Planning approach was followed for this study as it was anticipated that a series of projects would be undertaken which are distributed geographically throughout the study area and will be implemented over time. As such, the next major EA related activity would be the update of the Master Plan. The majority of projects are defined as Schedule B projects. Several also contain elements that could be

addressed in advance of the larger project, and these are typically Schedule A projects, or may need to be implemented as Emergency Works.

If a need arises in which a component project within WCGSMP needs to be significantly increased in terms of size and does not simply represent the sum of two or more smaller-scale projects, then an interim update to the Master Plan may be needed. If it becomes apparent that the choice made in the WCGSMP can either be downsized in terms of scope or scale or implemented in different time periods than forecast, no further EA amendments are anticipated for the next decade, other than an update when required.

Key Criteria to be considered in evaluating the options to address EA process considerations include:

- Does the Plan anticipate maximum extent of impacts in the Master Plan; if so, then downsizing the extent of works will lessen an environmental impact.

- Can the impact be suitably mitigated?

- Can the impact be compensated? In terms of Aquatic Habitat, the habitat evaluation indicates that the Projects contained in the Concept Design Report provide a positive benefit. In addition, certain designs such as applying Natural Channel Systems principles for channel realignment projects are recognized as self-compensating, despite the initial construction representing a HADD. In terms of terrestrial vegetation, compensation is recognized as the appropriate tool.

- Does the individual component project create less benefit to habitat, if downsized, or cause an impact by increasing the scale of the project, but commensurately create a larger net benefit?

4.3 Approvals and Permits

Upon completion of the detailed design, the design and supporting documentation will need to be submitted to regulatory agencies for review and approval. Given that the overall concept plan has already been presented and discussed with TRCA, it is expected that comments from this agency will be focused on the actual details of the design and the potential of the design to address the overall goals and objectives of the WCGSMP, and follow the DFO – City Interim Protocol. In addition to TRCA and DFO, approvals may need to be obtained from MNR, MOE and/or Transport Canada. It is obvious that a partnership, rather than a competing plan, should be adopted by all stakeholders.

4.3.1 Toronto and Region Conservation

An Application for Development, Interference with wetlands and alternations to Shorelines and Watercourse Permit is required for any works that take place within valley and stream corridors, wetlands and associated areas of interference and the Lake Ontario waterfront.

The Valley and Stream Corridor Management Program (VSCMP, 1994) is the main policy document used by TRCA to guide the review of permit and development applications. The overall objective of the VSCMP policies is to prevent new development from occurring within areas that may introduce risk to life and property associated with flooding, erosion, and slope instability, or development that is not compatible with the protection of these areas in their natural state. The TRCA is currently consulting on a comprehensive policy update called the Living City Policies (http://www.trca.on.ca/the-living-city/public-consultations/the-living-city-policies.dot). The Living City Policies document is based in part on provincial guidance developed in 2002 (Understanding Natural Hazards, MNR, 2002)

A permit is required from Toronto and Region Conservation (TRCA) if any of the following works are intended to be completed in an area that is under jurisdiction by the Conservation Authority:

a. straightening, changing, diverting or interfering in any way with the existing channel of a river, creek, stream or watercourse, or for changing or interfering in any way with a wetland;
b. development, if in the opinion of the authority, the control of flooding, erosion, dynamic beaches or pollution or the conservation of land may be affected by the development.

Further information regarding TRCA permits is located here: http://trca.on.ca/planning-services-permits/permit-applications/

4.3.2 Department of Fisheries and Oceans

Until implementation of the new Federal Fisheries Act in November 25, 2013, intervention type of erosion projects (e.g., risk to property or infrastructure) result in an harmful alteration, disruption or destruction of fish habitat (HADD), which required a *Fisheries Act* Authorization (see http://www.dfo-mpo.gc.ca/habitat/habitat-eng.htm) and hence compensation may be required. Even under this legislation, it would be expected, that the restoration designs for each project defined in the TMCGSMP are self-compensating since they are intended to improve aquatic and ecological habitat while satisfying the objectives of more permanent channel stabilization and infrastructure protection. The proposed detailed designs would implement measures to minimize adverse effects to the local environment (e.g., hydraulically rougher treatments than usual and the incorporation of large woody material should provide sufficient habitat and prevent the transfer of energy downstream that would otherwise induce more erosion).

Under the Revised Federal ***Fisheries Act*** **,** projects near water still have the same underlying philosophy for their requirements, such as projects avoid causing serious harm to fish unless authorized by the Minister of Fisheries and Oceans Canada. This applies to work being conducted in or near water bodies that support fish that are part of or that support a commercial, recreational or Aboriginal fishery. To protect fish and fish habitat, efforts should be made to avoid, mitigate and/or offset harm.

The major change in the approach post November 25, 2013 is that it is the project proponent's responsibility to ensure that they in compliance with the revised Act, rather than DFO's. In addition, the initial step is for the proponent, with the assistance of a qualified professional Fisheries biologist, to carry out a screening assessment following a Self-Assessment process "Does DFO need to review my project?" provided on the DFO web site (see http://www.dfo-mpo.gc.ca/habitat/habitat-eng.htm). The web site defines exempt projects, and provides guidance on types of water bodies where DFO review is not required and project activities and criteria where DFO review is not required.

During the initial months after implementation of the new Act, the City of Toronto submitted three projects for review to DFO staff. That review and interactions with the DFO biologists indicated a few key points to follow during the Self – Assessment process.

A) Examine the following activities for 'Projects near Water':

1. Water Outfalls (construction or repair to water outfalls)

2. Drainage Channels (Construction and routine clean-out of drainage channels)

3. Water Diversion and Dewatering (use of temporary dams and pumps or diversion channels for construction site isolation purposes)

4. Altering grade below the High Water Mark

5. Habitat Restoration (includes: riparian planting, bank stabilization)

B) The key questions for assessing whether an authorization from DFO is required include:

1. Is a CRA fishery involved?

2. Are you killing fish?

3. Is there destruction of habitat in perpetuity?

4. Is there a permanent alteration of habitat?

Feedback from DFO on the 3 submitted projects indicated that no DFO authorization was required. The three submitted projects were quite comparable to the projects contemplated for Taylor Massey Creek in this study.

It is key that construction activities proceed with all of the provisions and mitigating measures contained in the design package, including best management practices related to staging and to control sediment, erosion, and construction effects in the channel, and fish rescue / removal from any water areas which may develop, to allow construction "in the dry". The latter Best Practice is essential to avoid 'killing' fish during construction, a significant new emphasis in the new Fisheries Act

Where compensation for individual projects (i.e., local works) is a potential tool, discussion of appropriate compensation and the possibility of banking compensation could occur between the City of Toronto, TRCA, DFO, and any other interest groups/stakeholders, especially in light of the comprehensive channel restoration works that are planned by the City which are expected to improve channel stability and enhance aquatic habitat. A habitat banking approach is currently being developed through Aquatic Habitat Toronto for the waterfront within Lake Ontario. There is a possibility of (i) extending waterfront habitat compensation to interior sites, and / or (ii) incorporating watershed habitat into the compensation framework.

4.3.3 Transport Canada: Navigable Waters

From Transport Canada's perspective, a permit for the purpose of undertaking works in *navigable waters* is required when works are expected to interfere with the use of floating vessels. If, however, the works are considered minor, or the watercourse is not considered navigable, then a permit is not required (see the *Navigable Waters Protection Act* in: http://laws-lois.justice.gc.ca/PDF/N-22.pdf and the 'Minor Works and Waters (Navigable Waters Protection Act) Order' at http://www.gazette.gc.ca/rp-pr/p1/2009/2009-05-09/pdf/g1-14319.pdf). Details regarding that which constitutes minor works is summarized below.

> Channel measurements must pass one of the two review processes in order to be classified as minor navigable waters and thus be exempt from the application process. The two review processes are:
>
> 1. Initial Review, either:
>   a) Average depth of the navigable water measured at the high-water level is less than 0.30m; or
>   b) Average width of the navigable water measured at the high-water level is less than 1.20m.
> 2. Secondary Review: The average width of the 200m section is between 1.20m and 3.00m and at least one of the following four conditions are also true:
>   a) The average depth at high-water level is 0.60m or less:
>   b) The slope is greater than 4 percent;
>   c) The sinuosity ratio is greater than 2; or
>   d) There are 3 or more natural obstacles.

Furthermore, the following works are considered "minor works" under the *Minor Works and Waters (Navigable Waters Protection Act) Order*, and also do not require an application: Erosion Protection Works; Pipeline Crossings; Water Intakes; Dredging; and Temporary Works. Again, the definitions of the above are very specific, and the stipulations of each should be read carefully in the Order.

4.3.4 Other Provincially or Federally Owned / Regulated Lands

If works are proposed to be completed within Hydro lands and/or land belonging to CNR or CPR, then permission to complete the works on these lands will need to be attained.

4.3.5 Ministry of the Environment

A certificate of authorization application will need to be submitted to the Ministry of Environment to obtain approval for any Municipal and/or Private Sewage Works. MOE requirements for planning decisions under the Environmental Assessment Act, have been completed in the Master Plan study.

4.3.6 City Granted Easements

Encroachment on any City granted easement (i.e. utility easements, etc) will require written approval from the easement owner prior to construction. The intended installation of the works must also comply with any instructions which will ensure that the proposed works are carried out in such a manner as not to endanger, damage, or interfere with the utility or become a hazard to persons or property.

4.3.7 Internal City/ TRCA Communications

In addition to agency approvals relating to the detailed design, when the projects are undertaken on City owned or City managed property, communication amongst the affected City departments should be undertaken. This ensures that any ancillary objectives (e.g., recreational trails; pedestrian or automobile bridge structures or culverts) are identified and incorporated into the design where possible and/or adjustments to the design are made if necessary. Further, either the City or Toronto and Region Conservation may have input into the construction schedule and project area. Dependent on the undertaking, a permit will be needed from City Forestry to permit for tree removal, and access permit from Transportation Services for Roadway access for construction activities.

4.4 Selection of Preferred Treatment Approach for Creek Bed and Bank Elements

The concept designs for the WCGSMP rehabilitation projects are intended to achieve the various objectives outlined in the EA report. For these designs, the appropriate structures and materials necessary to build the channel and/or to replace failing engineering countermeasures, need to be determined, at the next design stage (refined concept design; detailed design). The precise treatment (e.g., stone type, vegetation type) would be determined by the consultants retained to prepare the detailed design drawings and would require consideration of information contained within this report.

Any channel rehabilitation should seek to further the other restoration goals (e.g., protect risk elements, improve channel stability, enhance terrestrial and aquatic habitats) for the riparian and valley area adjoining the stream reach. Consideration of the overall restoration goals and channel processes will ensure that the preferred treatment approach is effective and sustainable into the future. Background information provided in this EA File Report, provides further understanding of the project sites from a reach, valley segment and watershed perspective. The preferred treatment approach should seek to enhance natural channel form and process and account for implications of future changes in channel position (e.g., migration) and form (e.g., further enlargement due to urbanization).

4.5 Tender/Contract Specification Documents

Once the detailed design drawings have been prepared and appropriate approvals obtained, the restoration designs are typically tendered for bidding by qualified contractors, unless they are implemented by designated City or TRCA staff who have developed and maintain the requisite specialist experience. Items that are included in the tender and contract specification documents include:

- Detailed design drawings sealed by a qualified Professional Engineer
- Bid document including, but not limited to, the bid form, a contract price schedule, and various contractual schedules.
- "Articles of Agreement" document, along with the bid document (forms the bulk of the contract)
- "General and Supplementary Conditions" outlining terms common to most contracts
- "Special Provisions" detailing materials, placement and payment for items such project specific items as silt fences, dewatering, seeding, planting, geotextile, earthworks and supply/placement of armour stone.

4.6 Construction Administration and Supervision

An integral component of the successful implementation of a detailed design is the construction process. Stage 4 of the 7 stage Framework for Stream Corridor Management and Design (MNR, 2002) provides a summary of key elements necessary to effectively construct the proposed works. A summary of key aspects of construction that lead to well-constructed works that achieve the design objectives are provided below.

4.6.1 Construction Administration

- Pre-Construction consultation with consultants (designer) and contractor to define key elements of project prior to implementation. This may occur prior to contractor(s) bidding on the project.
- Experienced contractors (i.e., knowledgeable foreman, experienced machine operators) should be retained.
- The contractor must supply WSIB and OPSF forms for clearance on insurance and site safety and the disposal of any contaminated material excavated from the site.
- Interpret contract drawings and technical specifications for contractor (s) and external agencies.
- Review recommended modification to design during the course of construction.
- Encourage contractor input into erosion and sediment control planning.
- Develop contingency plans in case of wet weather.
- Establish effective lines of communication between all on-site contractors and sub-contractors.
- Perform onsite progress meetings with contractors, consultants, and City.
- Review and recommend payment certificates, Substantial and Total Performance certificates for Construction Lien Act purposes.

4.6.2 Construction Supervision

To ensure that the objectives of the channel design are realized, it is important that someone with experience in channel design and channel construction perform regular construction supervision. On-site supervision by experienced staff should include the following:

- Provide input for construction sequencing, methods and equipment.
- Provide field direction for layout details.
- Materials inspection.
- Enforcement / inspection of erosion and sediment control plans.
- Construction access and egress.
- Ensure environmental protection during construction.
- Document construction proceedings in a daily construction log of contractor's progress, personnel and equipment on-site, material shipments, relevant discussions with the contractor, relevant construction proceedings, climatic conditions, and flow conditions.
- Identify any and all deficiencies in the construction works and advise the contractor to take appropriate corrective measures, follow up on corrective measure, confirm and report the results.

- Substantiate the quality and quantity of completed work.
- Photographic record of construction proceedings including detailed pre-construction log and chronologic progress pictures.
- Review payment certificates and extra work claims.

Specialist supervision by members of the design team (geomorphologist, engineer, biologist, landscape architect) to perform:

- Commissioning and testing of all project components to confirm function in accordance with design requirements.
- Provide field direction for layout details, bioengineering materials and restoration plantings.
- Ensure environmental protection during construction, construction timing, materials testing (where appropriate).

Even when experienced contractors are retained to construct the detailed design, and appropriate on-site supervision is provided, there will be instances when modifications of the design will be required due to on-site conditions or extenuating circumstances. In such cases, members of the detailed design team should be consulted to ensure that any adjustments to the design or change in materials or measures will not jeopardize the overall function and objective of the design.

Full time supervision of the construction process is encouraged where needed or where-ever possible. Specifically, in complex designs and/or working with inexperienced contractors, part time supervision enables a general assessment of work completed, but can result in mistakes that are missed and/or require effort to correct. In cases where the design is simple or the contractor is well experienced part-time supervision may be appropriate. Supervision by members of the design team is encouraged; this ensures that all design features are constructed to the supervisor's satisfaction and any alterations are approved on-site with no delay to the construction process. More often than not, budgetary constraints dictate the availability of a full- or part-time supervisor.

4.6.3 Communication with Stakeholders and the Public

Since channel restoration projects are often of great interest to the public, especially when located in parklands situated within urban areas but physically remote from where people live, communication is important. This could consist of the following:

- Web Site – The City informs the public regarding the proposed works, including construction schedule, anticipated duration of construction, expectations regarding construction traffic, emergency contact information, through construction and notices provided on the City's web site.
- A Construction Notice is published and sent to concerned stakeholders, including nearby residences and businesses, and the Ward Councilor
- Signage to explain nature of works being completed and intended objective, emergency contact information, is provided at entrances to the site
- In complex projects, a more in-depth information package may be developed and provided to local residents and stakeholders.
- It should be anticipated that members of the public who are accustomed to using the trails near stream construction projects will continue to use the trail during construction despite safety fence being placed. Adequate signage is a necessary minimum due diligence defense.

5. Adaptive Management: Monitor, Evaluate, Adjust

5.1 General

The Wilket Creek Geomorphic Systems Master study was completed by following the MNR (2002) Framework for Stream Corridor Management and Design as outlined within Chapter 1 of this Report. Subsequent to completion of the detailed design (Stage 3) and construction (Stage 4), the remaining stages of the MNR Framework should be implemented. These include:

- Stage 5: Monitor
- Stage 6: Evaluate
- Stage 7: Adjust

5.2 Monitoring

5.2.1 Interim Monitoring and Re-prioritization

As noted in this EA File Report, there are several risk elements within a number of the project sites that warrant annual monitoring to assess risk and, if necessary, to undertake remedial action to protect infrastructure or property.

In addition, each of the priority restoration sites should inspected annually (or as needed due to geomorphic processes) and be re-assessed on a 3 to 5-year rotation basis to ensure consistency with new priorities for erosion control and infrastructure protection. It is recommended that the field inventory be completed at least every 5 years to determine whether there are any new erosion sites that pose a risk to public health and safety or whether previously identified sites should receive greater priority for restoration. The detailed field mapping and corresponding photographic inventory that are available from the WCGSMP Database, together with tri-annual City lead inspections of all Creeks, will be an invaluable tool in identifying locations of erosion sites and ascertaining qualitative changes in erosion appearance.

During the intervening years between implementation plan updates, monitoring of erosion sites can occur informally by various interest groups including professionals, managers of the system, and residents. Through routine work along the watercourses, each of these interest groups may be encouraged to report any specific erosion concerns to the City to ensure that significant risks to public health and safety are identified early on. This will minimize risk and promote incorporation of softer restoration approaches than if the risk is imminent and requires a 'harder' solution.

5.2.2 Project Performance

Project performance monitoring is intended to enable early detection in the event of failure; such monitoring is a typical requirement of regulatory agency authorizations and is likely to be undertaken by the detailed design team. Costs for project performance monitoring would typically be absorbed by the City.

Monitoring of restoration projects is recommended to enable adaptive environmental management (AEM) which recognizes that managed ecosystems are complex and inherently unpredictable, and that predictions of channel response are uncertain. In AEM, the uncertainties of system responses are embraced and attempts to structure management actions as 'weak' experiments from which learning is a critical product (CVC, 2004). AEM strives to move Management from reactive to proactive through the feedback-learning loop (Figure 1.2), and by incorporating explicit forecasts of channel response based on the hypothesis of effect approach. Implementing adaptive management can be considered to be a cycle consisting of a number of steps which are repeated: develop/implement a solution; monitor for effectiveness; develop/adapt new solutions; implement and monitor again. Overall, this will benefit the City of Toronto by resulting in lower expenditures on water resources projects than current budgeting that is completed on a "crisis" basis.

In practical terms, adaptive management strives to manage natural river processes to reduce risk of flooding and erosion, rather than trying to control these processes whenever a site specific problem reaches an unacceptable level of risk. Key benefits of an adaptive management approach are:

- The river system retains its natural characteristics and processes resulting in a healthier environment for plants, animals, fish, birds and people;
- the total cost of river management, including addressing flooding and erosion hazards, is reduced;
- a naturalized river and valley system provides more human "quality of life" benefits - recreation and aesthetics.

As already noted, monitoring is a common requirement within regulatory agency authorizations to undertake restoration works. Such monitoring is typically completed by the design team and provides insight into success or failure of implemented restoration works. This knowledge should be used in subsequent restoration plans to promote the use of approaches that are effective and sustainable.

5.2.3 Monitoring Plan Development

The nature of the proposed concept restoration design varies for each project site and was developed with consideration of local valley segment and broader drainage network process understanding. Thus, rather than prescribing a fixed monitoring plan that is to be applied to each project site, guidance with respect to developing a monitoring plan is provided instead as outlined within the MNR (2002) Framework.

Development of a monitoring plan is key to undertaking Stages 5, 6, and 7 of the Framework for Adaptive Management and Design. The monitoring plan can be used to determine whether the restoration works have been successful and what, if any, adjustments to the works are required to achieve the project goals.

The development of a monitoring plan can be divided into the following five steps:

- Step 1: define the goals of the restoration works
- Step 2: determine specific monitoring questions
- Step 3: create the program to answer the monitoring questions
- Step 4: interpret the results from the monitoring program
- Step 5: modify the monitoring program as required

The general principles for these monitoring plans are presented below while specific monitoring plans must be developed at the detailed design stage.

Step 1: Define the Goals

The goals for the restoration works have been previously defined in the Environmental Assessment report and in the Implementation Plan. Detailed goals for each valley segment are presented in Table 9.1 of the EA report.

Step 2: Determine Monitoring Questions

A series of questions will need to be established to determine whether the restoration works have been successful in achieving the project goals. Example questions are provided below by category.

Aquatic Habitat

- Did aquatic habitat improve as a result of the restoration works?
- Have fish recolonized upstream reaches as a result of the restoration works?
- Have the restoration works resulted in bank conditions which will support vegetative communities appropriate for improved fish habitat?

Geomorphology

- Has the rate of bed lowering been reduced as a result of the restoration works?
- Has the rate of bank erosion been reduced as a result of the restoration works?

Infrastructure

- Is the risk to public health and safety been reduced as a result of the restoration works?

Stormwater Management

- Has water quality improved as a result of implementing stormwater management?
- Have downstream peak flows been reduced as a result of implementing stormwater management?

Additional questions may be developed during the detailed design stage to address the specifics of individual projects.

Step 3: Create Monitoring Program

The details of the monitoring program need to be decided upon.

- Which parameters should be monitored?
- What are the appropriate thresholds of probable concern for each of the parameters?
- How many sampling sites will be required and where should they be located?
- What is the frequency of sampling required?
- Is comparative monitoring required and if so, what will be used as reference sites?
- What time period is appropriate for the monitoring program?

The parameters to be selected for monitoring and the location of the sampling sites will be based on the objectives of the study and the questions to be answered, as developed in Stages 1 and 2. Availability of funds for monitoring and the time available for monitoring will also be instrumental in determining the scope of the monitoring program.

Step 4: Interpret Results

The data collected during the monitoring program must be analyzed and the results used to determine whether the objectives of the restoration works were achieved. As well, thresholds of probably concern (TPC) should be evaluated to determine whether they were appropriate. If required, these TPCs should be adjusted and collected data reassessed based on the adjusted TCPs. As well, new TCP values should be applied in future monitoring phases.

Step 5: Modify Monitoring Program

Results from the monitoring program should be considered to determine whether the data were able to answer the questions outlined in Step 2. If not, the monitoring program should be modified for the next phase of monitoring to ensure that it is relevant. As well, the results of the data should be interpreted to determine whether the monitoring program should be modified for future phases. For instance, if the results show that the design is functioning as intended, a lower level of effort for future phases of monitoring may be appropriate.

5.2.4 Evaluation

The results of the monitoring program must be used to determine whether the designed restoration works have achieved the project goals or whether modifications to the design are required or to the overall concept design.

5.2.5 Adjustment

If required, adjustments to the design must be identified and undertaken. It may be determined that objectives were achieved on a local scale but not on a watershed scale. Modifications to the approach taken on future projects should be identified at this stage to promote success of future works.

5.2.6 Institutionalizing AEM

The ultimate challenge will be to institutional the AEM process, appropriately funded, where a key outcome spans new staff, and where learning is explicitly recognized and feed-back provided into new project designs.

5.3 Summary

Completing Stages 5, 6 and 7 of the MNR (2003) Framework for Adaptive Management and Design for River and Stream Corridors should be undertaken following construction of the channel works identified for each project. This enables a determination of whether the project site is functioning as intended with respect to protecting infrastructure and the public, enhancing aquatic habitat and promoting channel stability. A monitoring program will need to be developed for each specific project to ensure that it is tailored to enable an evaluation of that project's restoration goals and strategy.

Evaluation of monitoring results will provide insight into whether the concept design approach is effective and the strategies are achieving their goal. Adjustment of the concept design and or strategies may be undertaken if necessary to ensure that the objective of protecting infrastructure and the public, while also improving aquatic habitat and channel stability are ultimately achieved.