



Guideline for Determining Ecosystem Compensation

(After the decision to compensate has been made)

June 2018



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How to Read this Document

The “Guideline for Determining Ecosystem Compensation” presents an approach for replacing natural features lost through the development and/or infrastructure planning processes after the decision to *compensate* has been made. This Guideline consists of four sections, a glossary, references, and four appendices.

Section 1: An introduction provides an overview of the context, rationale, roles and applicability of TRCA and other participants in compensation, and outlines principles that establish the intent of the Guideline.

Section 2: Outlines an approach for determining compensation requirements that attempts to replicate, to the extent possible and without significant delay or *lag time*, the same *ecosystem structure* and associated level of *ecosystem functions* that are to be lost, in both the private land development process and the public infrastructure process.

Section 3: Lists and describes important considerations in planning and implementing a compensation project.

Section 4: Explains the TRCA habitat restoration planning and implementation approach.

Glossary: Provides definitions of terms used in the Guideline.

References: Lists documents sourced in the development of the Guideline

Appendix A: Lists and illustrates typical restoration plans and details by ecosystem type.

Appendix B: Describes the method of calculating *basal area*.

Appendix C: Provides information on individual tree replacement ratios.

Appendix D: Illustrates and describes examples of compensation options.

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1.0 Introduction

As the *Toronto region* continues to grow, increased stress is placed on natural heritage systems and on their ability to provide the same benefits to the population. Conservation in an urban context is challenging because of the finite space available to fit all basic needs of communities, including homes, workplaces, amenities, infrastructure and natural features and areas. Issues at the larger scale, such as global climate change, add to the complexity of addressing the local challenges. These pressures should result in increased support for conservation; however, despite a strong protective policy and regulatory regime, natural features and the functions and services they provide continue to decline within the *Toronto region*.

Within this context, ecosystem compensation becomes an important tool to help ensure that the critical *ecosystem functions* and *services* lost through development and infrastructure are restored back on the landscape for the betterment of communities.

Toronto and Region Conservation Authority (TRCA) and our municipal partners are dedicated to the protection, restoration and enhancement of the *natural system*, its features and functions, and the valuable *ecosystem services* that the system provides to the *Toronto region*. Our agencies' ecological restoration programs and the strong environmental objectives and policies contained in municipal official plans, and in TRCA's Living City Policies, clearly demonstrate this commitment.

Compensation and Policy

In accordance with the Provincial Policy Statement and Provincial Plans, municipal official plans contain policies for the protection of natural features and areas, natural hazards and water resources. However, through the planning and development process, non-provincially significant natural features that are not protected by any other provincial or federal regulation may be permitted to be impacted by the planning approval authority. In addition, features may be impacted through the installation or expansion of public infrastructure through the environmental assessment process.

In updating their official plans' environmental policies, some municipalities have included policy provisions that address the limited instances where *impacts* to a local natural heritage feature are permitted on condition that compensation is provided to make up for the loss of the feature. Similarly, TRCA recognizes that *impacts* to natural features, in specific circumstances where avoidance and mitigation are not feasible, may be permitted through the planning and development process, as stated in Section 7.4.2 of The Living City Policies:

“...if a natural feature itself cannot be protected, TRCA may recommend compensation. However, compensation is a management tool that should only be used as a “last resort”, being an option only where federal, provincial and municipal requirements do not protect the feature, and only after all other options for protecting the feature have been evaluated.

TRCA will always advocate first for the protection of natural features and the full natural system. However, when the planning or environmental assessment approval processes permit losses to the natural system, compensation can be a mechanism for replicating ecosystem services.”

Further, policy 7.4.2.1 in The Living City Policies document states:

“It is the policy of TRCA:

- c) To recommend that when development or infrastructure cannot fully protect a natural feature or any other component of the Natural System, compensation for lost ecosystem services be provided.
- d) To recommend that the decision to pursue compensation referred to in policy 7.4.2.1 (c) be subject to:
 - i. the Natural System not being protected by any other applicable federal, provincial, or municipal requirement(s);
 - ii. all other efforts to protect the Natural System being exhausted first;
 - iii. it taking place in consultation with the municipality and the landowner;
 - iv. it taking place at the appropriate level of the planning and development process for maximizing options for enhancement to the Natural System, e.g. MESP, Environmental Assessment.”

The following guiding statements from The Living City Policies provide further direction on the application of compensation.

“Compensation should:

- Only be considered once the protection hierarchy has been applied – avoid/minimize/mitigate first;
- Where feasible, take place in proximity to where the loss occurs;
- Be informed by current knowledge of TRCA’s ecosystems and watershed strategies and any applicable municipal strategies;
- Strive for no loss of ecosystem services;
- Be carried out in a transparent and timely manner;
- Be based on an adaptive management approach incorporating monitoring and evaluation, where appropriate.”

The excerpts from TRCA’s policy document make it apparent that natural feature *impacts* and associated compensation are not the preferred option in environmental management, and are only considered under limited circumstances when *impacts* cannot be avoided.

To help replace losses to the *natural system* that are determined in the planning or environmental assessment processes to be unavoidable, TRCA, municipalities and willing landowners, have used ecosystem compensation. This has typically occurred when the natural features in question are not protected by federal, provincial or municipal policy, or when draft approvals to remove features are grandfathered from previous policy regimes. Even for new applications where features are protected in official plan policy, they can be vulnerable in the absence of any clear provincial designation. *Impacts* to the *natural system* can be even more pronounced in the case of infrastructure, as the constraints of linear alignments often restrict the ability to avoid the *natural system* or specific natural features.

Compensation Should Not Be the “Default”

In addition to using the existing policy framework to protect the *natural system* and eliminate losses to the extent possible, TRCA, in partnership with municipalities, works to strengthen

protection policies, advocates for integrated community design, and continually highlights the importance of *natural systems* to the well-being of communities. TRCA will continue to use a “protection first” approach to *natural system* management. The development of the Guideline does not in any way diminish TRCA’s commitment, or the commitment of its member municipalities, to the protection of the features, functions and services of the *natural system*. Accordingly, the establishment of the Compensation Guideline does not negate the need for development and infrastructure applications to apply the *mitigation hierarchy*. In other words, compensation scenarios should not be the default for land use proposals in TRCA watersheds.

Setting Principles and Standards

To date, the application of compensation has resulted in some success at replacing lost natural features and the *ecosystem functions* they provide. However, there are a number of challenges, such as the limited availability of land for restoration, the *risk* and complexity associated with restoration, lengthy negotiations, lack of transparency, inconsistent results and, in many instances, an inability to fully replace the lost *ecosystem functions* and land base. Some of these challenges are difficult, if not impossible to fully address. However, it is intended that establishing a Guideline that sets principles and standards will help to address many of them. The principles and standards established herein are intended to ensure that compensation remains a last resort and that all efforts for protection on site are exhausted prior to contemplating removals. Standards of practice can also help ensure that compensation restoration projects are adequately financed and successfully implemented for the long term.

Municipal and Other Public Agency Adaptation

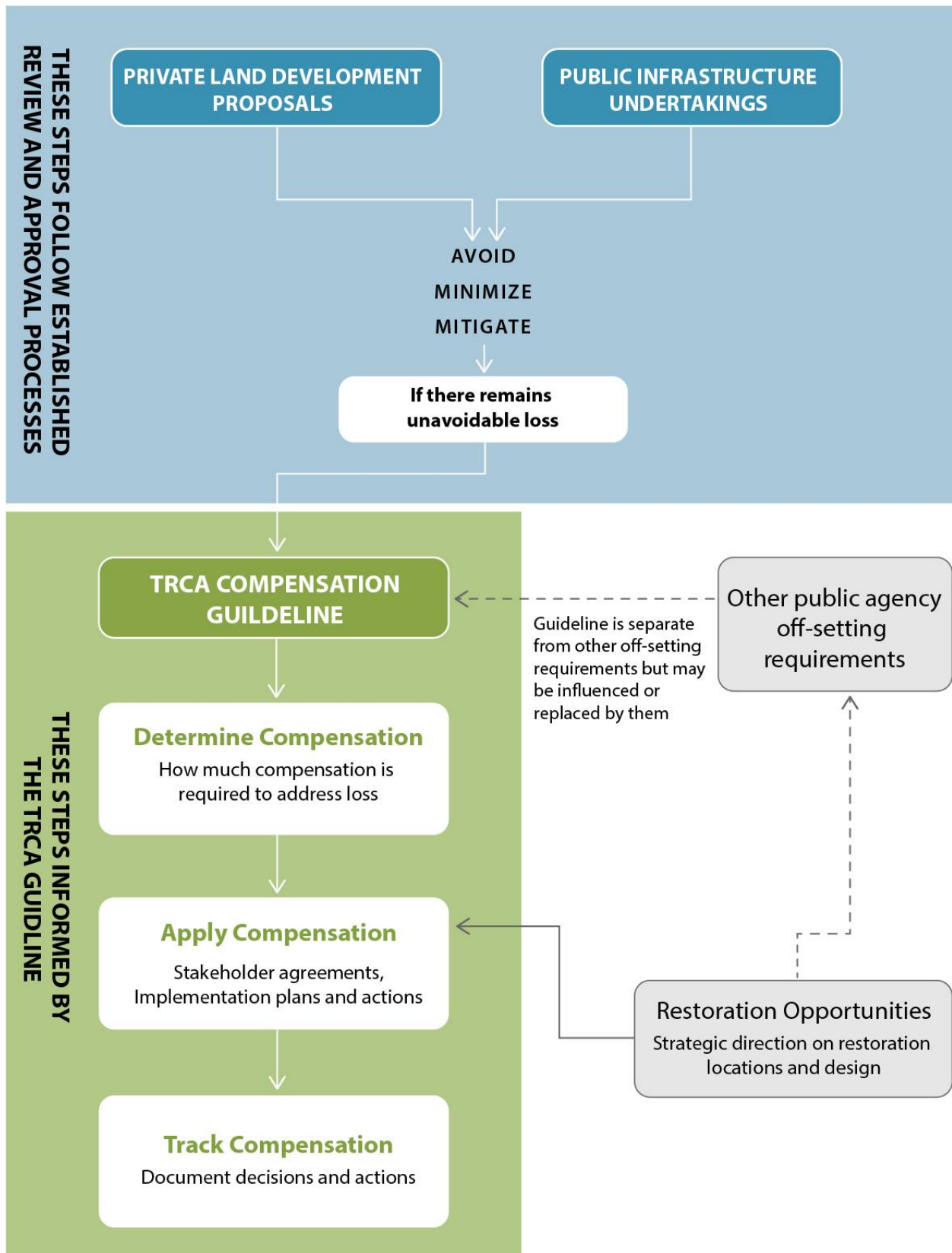
It is recognized that each municipality may have their own unique objectives and approaches to ecosystem compensation. This Guideline outlines the important principles and methods needed for successful compensation outcomes, while also recognizing that municipalities or other public agencies may wish to adapt these to their own needs.

Compensation and Review and Approval Processes

The following figure (Figure 1) demonstrates where compensation might fit within the existing review and approval processes for development and infrastructure, as well as illustrates how the Guideline is a tool to be used only after the decision to allow *natural system* loss has been made. It should be noted that TRCA’s Living City Policies (LCP) recommends that this decision take place at the appropriate level of the planning and development process for maximizing options for enhancement to the *natural system* (generally the higher levels of those processes), e.g. the Master Environmental Servicing Plan (MESP) for private development, and the Environmental Assessment for infrastructure. TRCA’s MESP Guideline (2015), Infrastructure policies in the LCP (in sections 7 and 8), and any applicable provincial and municipal standards should be referenced for natural heritage information requirements at these stages.

As indicated by the box on the lower left in Figure 1, the Guideline has been organized to address each technical aspect of the compensation approach, from determining what is required to replace the impacted ecosystem, to strategic application of compensation, to monitoring and tracking outcomes.

Figure 1: Compensation and Review and Approval Processes



1.1 Purpose and Scope of the Guideline

The purpose of this Guideline is to provide guidance on how to determine the total amount of compensation required to replace lost or altered ecosystems in a repeatable and transparent manner, after it has been decided that compensation is required. The Guideline is written to assist planners, ecologists, landscape architects, landowners and other practitioners and interested parties in understanding how compensation for ecosystem losses can be implemented. Promoting strategic and effective implementation of compensation restoration, the Guideline attempts to provide a standard and consistent approach, informed by science and decades of experience in the application of natural heritage planning and ecological restoration.

Ecosystem Structure, Functions and Services

This Guideline determines requirements for replacing the structure and the land base of a natural feature lost to development or infrastructure. Once established and over time, the restored *ecosystem structure* provides renewed *ecosystem functions*, which provides the foundation for the provision of *ecosystem services*. There are a number of *risks* and uncertainties associated with attempting to replace complex ecosystems. The re-establishment of similar *ecosystem functions* and associated services is far from certain and can take a significant amount of time. Adhering to the standards in this Guideline (along with long term protection, management, and the passage of time) can lead to the replacement of similar *ecosystem functions* and *services*. In some instances, over a longer time frame, there may be the opportunity to realize a gain in these functions and services.

What the Guideline Is Not

The Guideline does not provide guidance on when removals are appropriate with associated compensation. Rather, this determination is made through the planning, environmental assessment or permit processes, and guided by policy addressing compensation, where such policy exists.

This Guideline does not replace, or in any way negate the requirements of other legislation applicable to *impacts* to species or ecosystems at the municipal, provincial or federal levels. Protection, and ideally enhancement of the existing *natural system* remains a primary goal of natural heritage systems planning. The intent of this Guideline is not to weaken this goal or diminish the ability to protect ecosystems *in situ*.

The Guideline is not suggesting any modifications to the existing planning, environmental assessment or permitting processes leading up to the decision to allow ecological *impacts* with compensation. However, the decision will be better informed by the information in the Guideline given that it articulates what is warranted when the decision is made.

The Guideline cannot be used to determine compensation requirements for built types of *green infrastructure* such as low impact development stormwater management facilities.

1.2 Roles of Municipalities, TRCA and Proponents in Compensation Planning

Municipalities

Municipalities are the approval authorities under the *Planning Act* and may or may not have official plan policies, by-laws, or other mechanisms for requiring compensation or other forms of ecosystem replacements. As approval authorities, municipalities can refuse or approve *impacts* to natural features as part of a planning application. Once that decision has been made, municipalities share with TRCA the assessment of compensation projects proposed by private development proponents.

As proponents of their own public infrastructure projects, municipalities may put forward their own compensation projects in order to replicate lost *ecosystem structure* as described in 2.1. Section 2.2.1 of this Guideline speaks to municipal infrastructure projects and special considerations for lost land base. For all municipal projects affecting TRCA Regulated Areas and/or TRCA-owned or managed lands, municipalities and TRCA routinely work together to achieve provincial, municipal and TRCA shared objectives for natural heritage systems planning and sustainable communities.

TRCA

As a conservation authority, TRCA is a public commenting body under the planning (delegated with representing the provincial interest for natural hazards) and environmental assessment (EA) processes, acting as a resource management agency and service provider to approval authorities. In its regulatory role, TRCA is the decision maker for permits issued under section 28 the *Conservation Authorities Act*. Finally, TRCA is a major landowner in the GTA, owning over 18,000 hectares of land.

All of TRCA's roles are described in more detail in section 3.0 of The Living City Policies. Compensation sections 7.4.2.1 and 7.4.4.1 in The Living City Policies guide TRCA in these roles in the development and infrastructure planning review processes. TRCA staff also use the policies in Section 8.0 of The Living City Policies to guide recommendations to the Authority for approval or refusal of permit applications under the section 28 regulation.

In participating in the review of applications under the *Planning Act* and *Environmental Assessment Act*, TRCA ensures that applicants and approval authorities are aware of any Regulation requirements, where applicable. Further, TRCA assists in the coordination of these applications to avoid ambiguity, conflict and unnecessary delay or duplication in the process. Although permission under the section 28 Regulation may not be sought or issued for many years after approval of a planning application or environmental assessment, in order to support a proposal under the planning or environmental assessment process, TRCA needs to ensure that the requirements under the Regulation can likely be fulfilled at the time a permit application is received.

Once a decision has been made by the approval authority to remove a component of the *natural system* within the planning, EA, or TRCA permit process, and the *impact* and/or the compensation project falls within a TRCA regulated area, TRCA as a regulator, may process a permit application for the works.

Federal and Provincial Agencies and the TRCA Voluntary Review Process

For provincial and federal infrastructure providers that may be exempt from local planning and permits, TRCA's *Voluntary Review Process* is not affected by the Compensation Guideline except to provide further technical guidance where compensation is agreed to for public

infrastructure projects not subject to TRCA's Regulation. As in current practice, these public agencies and TRCA will work together to achieve shared objectives for sustainable infrastructure planning.

Private Proponents

As a proponent of private development directed to *compensate* for an *impact* through the above noted processes, landowners must be willing to provide and implement a compensation project that will adequately address the loss of the impacted *ecosystem*, its functions and the lost *natural system* land base. The implementation plan must be designed, installed, monitored and maintained in accordance with any conditions or agreements established between the proponent and the public agencies, and be guided by section 3.0 and the restoration typicals of the Guideline's Appendix A. Alternatively, private proponents must be willing to provide cash-in-lieu of a compensation project to allow the municipality and/or TRCA to secure land and to design and implement an ecosystem restoration plan that will achieve the same.

All Parties

Ultimately, it is the responsibility of all parties involved to determine the most ecologically effective and appropriate approach to compensating for an *impact*, in accordance with the principles in this Guideline and based on the specific circumstances of a land use proposal. The Guideline is a technical support tool to assist all parties in this determination.

1.3 Applicability of the Guideline

The Guideline can be applied to all new applications or undertakings that come before TRCA on or after June 22, 2018, and to any existing applications or undertakings currently before TRCA that have not been approved as of June 22, 2018. Further, the Guideline can be applied to any natural feature (e.g., forests, woodlands, wetlands, thickets and meadows) that has been determined through review of applications and undertakings for development planning, infrastructure or TRCA permits to require compensation. Restoration or enhancement areas that fall within the *natural system*, that may not already contain natural features, can also have the land base portion of the Guideline applied to them if determined to require compensation through the above noted processes (also see sidebar on *Buffers/Vegetation Protection Zones*).

Buffers or Vegetation Protection Zones

While the Guideline can apply to natural features or restoration and enhancement areas, it does not apply to *buffers* or vegetation protection zones. *Buffers* are not addressed within the Guideline at this time due to the complexity and difficulty in replacing their intended functions.

The primary role of *buffers* is to help safeguard natural features from negative effects associated with adjacent land use. Attempting to *compensate* for loss of a *buffer* by restoring an ecosystem elsewhere on the landscape does not address this primary function and would leave the subject natural feature susceptible to degradation. Further, a restored natural feature, such as a woodland or a wetland, would have a *buffer* applied to it once the lands adjacent to the feature are proposed for development.

TRCA will develop additional guidance on the establishment, protection and management of *buffers*, including revisiting the issue of compensation for *buffers*, as we collectively learn from the ongoing application of the Guideline. Nonetheless, if municipal policy requires compensation for loss of a feature and its *buffer*, TRCA could work with the municipality in applying the land base portion of the Guideline similar to restoration and enhancement areas.

Green Infrastructure

Compensation requirements determined through the use of this Guideline should be applied to the re-establishment of natural ecosystems and not used to install or otherwise improve engineered *green infrastructure* or community amenities. Nor does the Guideline apply to individual trees located in parks or along road sides not associated with natural features.

Other Compensation/Off-Setting Programs

For *impacts* to individual park, yard or street trees, municipalities may have by-laws containing provisions for tree replacements. TRCA will continue to support the application of these municipal mechanisms by providing technical guidance in their application, coordinating with municipal staff to avoid duplication, and assist in the development of new or updated by-laws as needed. In this way, the two separate processes of the Guideline and individual tree replacement programs work together for a comprehensive approach to restoring losses.

Where municipalities have official plan policies for compensation, the Guideline can be used as technical guidance in meeting these policies, however, it is recognized that each municipality may have their own unique objectives and approaches to ecosystem compensation. This Guideline outlines the important principles and methods needed for successful compensation outcomes, while also recognizing that municipalities may wish to adapt these to their own needs, e.g., application of the Guideline to *buffers*.

Some provincial infrastructure providers are developing their own framework for compensation in consultation with TRCA that may be different from TRCA's Guideline, but be based on the same principles. In this case, the provincial compensation program would prevail over the TRCA Guideline (also see *TRCA Voluntary Review Process*).

Another mechanism for restoring lost habitat is the Ministry of Natural Resources and Forestry's (MNR) Overall Benefit Permit (OBP) process under the *Endangered Species Act*. Where an OBP is required, TRCA defers to MNR for their requirements under their species-specific permit process. However, there may be cases where a portion of the *impact* to habitat is compensated through one mechanism while the remaining *impact* is compensated through a different mechanism. For example off-setting required through the *Endangered Species Act* may address *impacts* to one particular species but may not *compensate* for all of the lost structure and function provided by the impacted ecosystem. In these cases, determining what is required to *compensate* for the remaining *impact* can be accomplished through the Guideline.

This Guideline does not contain provisions for determining compensation requirements for the loss of fish habitat and defers to provincial and federal ministries (e.g., Fisheries and Oceans Canada) that direct compensation for *impacts* to aquatic species and their habitat. For direction on addressing any type of alteration, restoration or removal of a headwater drainage feature, the Evaluation, Classification and Management of Headwater Drainage Features Guideline (TRCA and CVC, 2014) should be used.

1.4 Principles of the Guideline

The following principles represent the intent of the Compensation Guideline. These principles are similar to the points describing compensation in The Living City Policies' text box on what compensation "should be". However, since the adoption of The Living City Policies, TRCA's development of the Guideline has allowed TRCA to refine those points into the following principles; they helped direct the development of the Guideline and provide guidance on its application.

1. Compensation must be considered only as a last resort within the established *mitigation hierarchy* of: Avoid, Minimize, Mitigate, Compensate.
2. The compensation process should be transparent helping to ensure accountability of all parties involved.
3. The compensation process should strive to be consistent and replicable.
4. Compensation outcomes should strive to fully replace the same level of lost *ecosystem structure* and *function* in proximity to where the loss occurs, and where possible, achieve an overall gain.
5. Compensation should be directed to on-the-ground ecosystem restoration and be informed by strategic watershed and restoration planning.
6. Implementation of compensation should be completed promptly so that *ecosystem functions* are re-established as soon as possible after (or even before) losses occur.
7. The compensation process should use an adaptive management approach incorporating monitoring, tracking and evaluation to gauge success and inform program improvements.

2.0 Components of a Compensation Project

In determining what will be required to *compensate* for an *impact*, some important components that must be considered are the location of the compensation project, and who will undertake the project. For example, the project may be located:

- On-site - compensation occurs on the same site that the ecosystem *impact* is taking place;
- Off-site - compensation occurs in a different location from where the *impact* is taking place.

Similarly, the compensation may be installed by:

- the Proponent - contractors hired by the proponent to plan, design, prepare the site, undertake the restoration work, and monitor and maintain the restored ecosystem, as detailed within the Restoration Typical(s) in Appendix A, as applicable, and in accordance with sections 3.2 and 3.3;
- TRCA - TRCA's restoration ecology staff plan, design, prepare the site, undertake the restoration work, and monitor and maintain the restored ecosystem;
- a public agency other than TRCA - the municipality or other public body may choose to plan, design, prepare the site, undertake the restoration work, and monitor and maintain the restored ecosystem, in accordance with Sections 3.2 and 3.3 and the applicable Restoration Typical(s) in Appendix A;

In the instances that the proponent or another public agency will be undertaking the compensation project, TRCA will review the proposed compensation project to ensure the intent of the Guideline is being adhered to and the quality of the restoration plan is acceptable, as detailed in the Appendix A Restoration Typical(s) for goals, preparation, design, monitoring, contingencies, etc., and in accordance with Sections 3.2 and 3.3 of the Guideline.

Cash-in-Lieu and Land Base Calculations

In the instances that TRCA or another public agency implements a compensation project, private proponents provide funds to TRCA or the public agency in lieu of undertaking the compensation project themselves. The amount of the cash-in-lieu is based on the cost to restore the impacted ecosystem's structure as outlined in Section 2.1 and the cost of replacing its land base as outlined in Section 2.2.

Public Infrastructure and Land Base

Where the proponent is a municipality undertaking a public infrastructure project with compensation, Section 2.2.1 should be referenced. Section 2.2.1 describes that for public infrastructure projects there may be special circumstances where the application of the land base portion of compensation is considered in a different way.

Combining Approaches

There may also be a combination of two or more of the options outlined above, e.g., partial restoration off-site by TRCA, and partial restoration on site by private proponent. Whichever approach is decided upon, the approach should meet the intent of this Guideline including the

principles in section 1.4, the implementation guidance outlined in Section 3.0, and the detailed preparation, design and monitoring in the applicable Restoration Typical(s) in Appendix A.

On-site Compensation Preferred

In most cases, on-site compensation is the preferred option as it is in proximity to where the loss occurs; it also removes the complexity of finding new lands in proximity to the loss. On-site compensation should be explored as a priority option prior to contemplating off-site options. Ideally, the implementation guidance in Section 3.0 should be adhered to when determining the appropriateness of on-site compensation.

2.1 Replicating Ecosystem Structure

Ecosystems are complex and dynamic systems. Regardless of the approach to determining the level of compensation required, attempts to replace lost *ecosystem structure and functions* will fall short in many instances, at least in the short term. Understanding this limitation, the Guideline establishes an approach that attempts to replicate, to the extent possible and without significant delay or *lag time*, the same *ecosystem structure* and associated level of *ecosystem functions* that are to be lost.

The ability to re-establish generally the same structure in a reasonable time frame is in part dependent on the type of ecosystem being restored. Some functions of some ecosystem types such as cultural meadows and some marshes can be established relatively quickly since their rate of vegetation growth does not have a significant *lag time*. This is not to suggest that these ecosystem types are less complex or less important than others, or that restoration of these ecosystems is without *risk* and uncertainty. It simply recognizes that the vegetation in non-treed ecosystems can be established relatively quickly.

It takes much longer to re-establish treed ecosystems due to their long developmental periods and the inability to plant fully grown trees. This Guideline attempts to partially address this issue by prescribing that the loss of a mature forest requires replacement with a larger, young forest.

Vegetation and Soil

Using *vegetation type* to guide compensation requirements does not fully account for other ecosystem components such as soil structure. TRCA recognizes this gap and will work to modify the Guideline as new knowledge is gained.

This Guideline uses *basal area* to establish ecosystem restoration replacement ratios (in hectares). *Basal area* is a standard forestry measurement, is included in the *Ecological Land Classification for Southern Ontario*, and is a widely used standard practice easily determined using simple equipment (See Appendix B: Calculating Basal Area). *Basal area* is the common term used to describe the cross-sectional area occupied by tree stems. Stand *basal area* is defined as the total cross-sectional area of all stems in an ecosystem measured at breast height (1.3 m), and expressed as a unit of land area (m²/ha). In general terms, older and higher functioning treed ecosystems will have a greater *basal area*. *Basal area* also loosely equates to, and can be used as a surrogate for, above ground *biomass* within a treed ecosystem. *Biomass* in turn correlates to some of the *ecosystem functions* that a treed ecosystem is able to provide.

Therefore, attempting to re-establish the same *basal area* in the newly restored treed ecosystem as was lost, helps, in part, to ensure that the same level of some *ecosystem functions* is maintained.

Dead Trees

For the purposes of the Compensation Guideline, dead trees are included in the *basal area* calculations. Dead trees contribute to the function of forested ecosystems and therefore should be considered in assessing the feature that is being lost. This in turn informs the restoration requirements to replace the lost feature. This is particularly relevant at this time, given that a number of ash trees are dying due to the Emerald Ash Borer.

The objective for treed ecosystems is to re-establish the same level of *basal area* within 10 years of implementing the compensation restoration. Based on the survival and growth rates of previous TRCA restoration projects, it is typical to achieve a *basal area* of 5 m²/ha at the 10-year mark. Therefore, as an example, in order to achieve *basal area* equivalency at the 10-year mark (5m²/ha) for an impacted site with an average *basal area* of 25 m²/ha, a 5:1 restoration ratio must be used. In other words, 5 hectares of new habitat must be restored for every one hectare removed. Table 1 (below) is used to determine the compensation ratios for various *basal area* categories.

As stated earlier, some ecosystems such as marshes and meadows and their associated functions can typically be re-established relatively quickly upon restoration. Due to a lack of trees, these types of features will have a low *basal area* (less than 10m²/ha) and would therefore have a compensation ratio of 1:1 as follows from the first row of Table 1. Points A to E that follow outline the procedure for calculating replacement ratios.

Table 1: Compensation ratios based on basal area of impacted site

	Basal area range (m ² /ha)	Average basal area (m ² /ha)	Lag time factor – Basal area of 10 year old restoration site (m ² /ha)	Compensation Ratio (ha:ha)
1	0 – 10	5	5	1:1
2	10.1 – 20	15	5	3:1
3	20.1 – 30	25	5	5:1
4	30.1 -50+	40	5	8:1

2.1.1 Procedure for Determining Replacement Ratios with Basal Area

- A. Determine the *vegetation type(s)* for the area being impacted using the *Ecological Land Classification for Southern Ontario* (ELC) system. If more than one ecosystem type is being impacted, then the *vegetation type* must be determined for each.

- B. Determine the amount (in hectares) of each *vegetation type* being removed.
- C. Determine the *basal area* for each *vegetation type* being impacted. (See Appendix B: Calculating Basal Area). If only a portion of the feature is being removed, the average *basal area* should be calculated based on the entire feature, and not just the portion being removed. This average will then be used in D below.
- D. Using Table 1, determine the compensation ratio for each *vegetation type* being removed. If the *vegetation community* has few or no trees, it will have a *basal area* of 10m²/ha or less and can therefore be replaced at a 1:1 ratio.
- E. Based on the amount of each *vegetation type* being removed and the compensation ratio for each, determine the total size of the restoration required for each *vegetation type*.

In some instances, there may be particular *ecosystem functions* provided by the impacted ecosystem that are identified and required through the planning or infrastructure review process to be addressed as part of the restoration implementation. These conditions may influence the ecosystem restoration requirements. Additional information is provided in Section 3.2 regarding project-specific requirements.

Hydrologic Function

The compensation direction outlined in this Guideline may not account for all of the hydrological functions the impacted ecosystem may have been providing. Additional measures, either on-site or off-site, may be required to address implications to hydrology and/or stormwater management and to satisfy applicable water resource management policies.

Land Area Required for Restoration

In some cases, the size of the required ecosystem restoration to re-establish similar levels of functions will be larger than the area that was removed. In cases where ecosystem restoration requirements are greater than the required land base compensation, additional restoration can occur on other lands previously identified and protected for restoration purposes as part of the *natural system* (see illustrative examples of on-site and off-site compensation in Appendix D).

Scattered Mature Trees within a Natural Feature

There may be circumstances that warrant quantifying *impacts* to individual trees located within an ecosystem. An example of this is a temporary *impact* to a cultural meadow with scattered mature trees. In these situations, the meadow habitat can be re-established relatively quickly post- *impact*. However, it may also be deemed necessary to *compensate* for the loss of the mature trees. In these circumstances, an alternative to the *basal area* approach is warranted for calculating compensation requirements. Appendix C provides information that can be used to guide tree replacement ratios for individual trees where municipal tree by-laws do not apply.

2.2 Replicating the Land Base

TRCA's Terrestrial Natural Heritage System Strategy identified the need for the *Toronto region* to not only protect natural features and areas, but to expand on them through restoration and connect them within the landscape. The overall size of *natural systems* plays an important role in determining the *ecosystem functions* they provide. Larger *natural systems* are more biodiverse, provide greater levels of *ecosystem functions* and are better able to withstand the stresses of urbanization and climate change. It is therefore critical to ensure that any losses to the land area of the *natural system* due to removals of forests, wetlands or other ecosystems be addressed by adding new lands to the *natural system* such that the overall physical extent of the *natural system* is not reduced.

Loss of land removed from the *natural system* can be compensated at a 1:1 ratio. In other words, one hectare of land base removed can be compensated for by adding one hectare of land back into the *natural system*, either on the same site or off-site. Lands identified for addition into the *natural system*, either on the development site or elsewhere on the landscape, must be configured in such a way as to improve the overall ecological function of the *natural system*. Additional direction on land base configuration is provided in Section 3.0.

When replicating land base for off-site compensation projects, there are two important considerations:

- The new lands should be located as close to the original location as possible (see section 3.2. for more discussion on this) to help ensure the restored *ecosystem functions* and *services* remain accessible to the local community. Methods of calculating the land value must consider the cost of securing or acquiring land within the same municipality and sub-watershed as the land removed.
- Secondly, lands secured for compensation should be located outside of (but connected to) the identified *natural system* of the municipality so that they can ultimately be added to the system to make up the loss. Securing or purchasing land for compensation that is already identified as part of the *natural system* would result in a net loss to the overall area of the *natural system*.

Cash-in-lieu

When an impacted feature cannot be compensated for on-site and another parcel of land is not readily available off-site, in order to *compensate* for the lost land base associated with the *impact*, the proponent provides cash-in-lieu that reflects the *market value* of the developable land being gained. The *market value* of the development site can be determined either through recent comparable sales data (i.e., similarly designated and zoned development parcels with no pre-existing encumbrances, located within 2km of the subject site) or preferably by an appraisal.

Two options for determining the cash-in-lieu cost to be conveyed are as follows:

- Applying the per hectare *market value* of the development site to the area of land being removed from the *natural system*.
- Calculating the difference between the pre-existing *market value* of the development site and the *market value* of the development site after the ecosystem has been removed.

Other methods of calculating land costs could be supported, subject to the satisfaction of TRCA property services staff. In any case, fair *market value* of the development site must be determined using generally *accepted appraisal principles*.

Appraisal costs and other fees associated with determining land base replacement costs will be the responsibility of the proponent. If there is a disagreement on values, TRCA may, at its discretion, procure its own appraisal with the costs borne by the proponent.

2.2.1 Land Base and Municipal Infrastructure Projects

Infrastructure projects are completed by a number of different agencies/proponents making a standard approach to land base compensation difficult. TRCA will work with proponents within the various planning processes to help ensure land base compensation is appropriately considered and that the principles of the Guideline are addressed.

Both investment in infrastructure and the protection of *natural systems* contribute to the public good. The environmental assessment process for public projects helps to ensure investments in infrastructure minimize *impacts* to natural features and the functions they provide. However, as stated in The Living City Policies, when *impacts* cannot be eliminated, compensation action should be taken to ensure the public benefits provided by the *natural system* are not diminished.

The requirements for a compensation project as outlined in the Guideline represent the best available practice for restoration of lost features and for "adding back" to the *natural system*. In its roles as a public commenting body under the planning and environmental processes, as a regulator, and at times as a landowner, TRCA routinely works with public infrastructure providers to seek compensation to the extent feasible for lost features due to infrastructure projects (new or upgrades) that cannot avoid natural areas, or are already located within them.

The Guideline provides guidance to further aid in these review and approval processes by detailing the costs to restore features and providing a rationale as to why the land base of the *natural system* is critical to its continued function. The full land base requirements determined by the Guideline for a feature lost to infrastructure may not be achievable given that municipalities typically own right-of-way lands sized only to accommodate the infrastructure itself with little surplus land remaining, (see Municipal Infrastructure diagrammatic example in Appendix D). In these cases, the land area removed from the *natural system* from all infrastructure projects can be tracked by TRCA and the municipality, and compiled together so that cumulative losses to the land base of the *natural system* can be quantified. Municipalities and TRCA can work together to understand how these cumulative losses are impacting the function of the *natural system* and explore avenues to offset these losses through existing municipal land acquisition and ecological restoration programs or other means.

Single infrastructure projects that involve the removal of large portions (multiple hectares) of the *natural system*, or when TRCA-owned lands are impacted, may warrant discussions regarding compensating land base on a case-by-case basis.

3.0 Application of Compensation

Once the municipality, the proponent and TRCA agree to the specifics of the compensation project, the final decision is documented; the need for legal agreements is determined, and a land securement (if applicable) and ecosystem restoration implementation plan are established.

3.1 Agreements

Agreements will differ from situation to situation, dependent on the compensation approach applied and on which party will undertake the implementation. Examples of agreements may be within: the conditions of draft plan approval for a subdivision, a site plan agreement, or the commitments of an Environmental Assessment. Alternatively, there may be a stand-alone agreement for the compensation plan signed by all the parties (proponent, municipality and conservation authority). The parties involved in compensation decisions will ultimately determine the terms and conditions of any subsequent legal agreements. The following are factors to be considered when contemplating agreements:

- Agreements of conditional approval should cite that current costs to restore and current land values (at the time of receipt of the funds) should be used in calculating the compensation funds.
- Compensation funds transferred to a public agency must be applied to installation of the agreed upon ecosystem type, including land acquisition (when applicable), helping to ensure the funds are directed to the replacement of lost *ecosystem functions* and *services*.
- Funds (when being transferred to a public agency) should be received prior to removal of features.
- A timeline for implementation may be determined in order to ensure the ecosystem is replaced as soon as possible and ideally before the *impact* occurs.
- If the proponent implements compensation actions, a security should be held until the warranty's expiration. Warranty periods will vary but should be consistent with the determined monitoring period. Security amounts will also vary depending on perceived *risks* and complexity of restoration actions. Phased release of securities may be negotiated depending on the nature of the project to ensure development applicants undertake the required compensation work.
- If upon review by senior leadership at TRCA it is found that an agreement is not being followed, the proponent will be advised in writing and TRCA staff may cash the security and use the funds to undertake the necessary work. This ensures that the appropriate funding is available should the applicant fail to undertake or complete the agreed upon compensation.

In addition to the considerations listed above, there may be circumstances that warrant additional measures to help reduce *risk* to an acceptable level. The following provide some possible actions:

- Requiring greater financial securities to support possible mitigation measures and contingencies;
- Requiring financial securities to be held for longer periods of time to ensure establishment of newly restored ecosystems;
- Increasing the size of the ecosystem required to be restored; and
- Use TRCA to undertake ecosystem restoration, land securement, monitoring and any remedial works required.

3.1.2 Agreements and Public Agencies as Proponents

Securities/letters of credit are generally not applied where the proponent is another public agency such as a municipality. As per current practice, TRCA and the public proponent will work together, in a transparent and consistent manner, to agree on the best approach to implementing compensation that meets the principles of the Guideline. Nonetheless, if implementation is being undertaken by a public agency, that agency (municipality, TRCA or other) accepts responsibility for the effective implementation and monitoring of the compensation works, unless otherwise arranged between agencies. For example, in the case of public-private partnerships, securities may be required.

3.2 Implementation of the Compensation Project

Once the appropriate amount of compensation has been determined and agreed to by the parties involved, the next step is the development and execution of a land securement (if applicable) and ecosystem restoration implementation plan. The execution of the plan will be dependent on the location of the compensation and who will complete the works. However, regardless of these, some fundamental considerations apply, including project-specific information, ecosystem restoration principles, and broader TRCA or municipal program direction. In addition to the guidance outlined here in section 3.2, TRCA has developed a number of tools to help identify restoration sites and guide ecosystem restoration decision making, as referenced in section 4.0 of the Guideline.

Compensation actions should result in a reinvestment into local ecosystem restoration and the lands required for those works, and should be guided by strategic watershed management and restoration planning documents and priorities. Compensation actions should be directed to new projects (or extensions of existing projects) that require investment and resources.

Project-Specific Requirements:

Some compensation projects may have specific requirements and deliverables associated with them as part of the compensation agreement. These could include restoration of a particular ecosystem type or the need to re-use soil or woody material or perform a plant rescue from the lost ecosystem. In addition, the impacted ecosystem may have been providing a particular function that warrants consideration in the design and implementation of the restoration works. For example, habitat for a particular species or group of species may need to be incorporated into restoration projects to help address the loss of this habitat as a result of the ecosystem removal. These requirements must be adhered to, planned for, and documented through implementation.

Ecosystem Type:

In most instances, it will be appropriate to restore the same ecosystem type as was lost, e.g., restoring a forest for losing a forest. However, there may be other cases where this is not achievable due to the specific site conditions of the restoration location, or not desirable based on strategic restoration priorities. Site conditions including soil type, drainage, exposure and aspect will dictate which ecosystem types are suitable for a particular location. Additional guidance to help refine the restoration goals and ecosystem type to be restored can be based on the type of restoration that best achieves the *natural system* strategies and municipal objectives. There may also be site-specific/file-specific circumstances that dictate special technical direction that deviates from a typical “like for like” approach. Nevertheless, in all cases, the type of feature to be restored will be guided by TRCA, provincial and municipal natural heritage objectives, restoration programs and strategic ecosystem management priorities.

Considerations for Location and Siting:

Proximity to Loss

The location of the compensation project (both land securement and ecosystem restoration) should be within the same geographic area as the ecosystem that was removed (same neighbourhood, subwatershed, or municipality). This helps to ensure that the restored *ecosystem functions* and *services* contribute to the same area. For those circumstances where land acquisition is part of the required compensation, the lands to be acquired and the land to be restored do not need to be on the same site. There may be instances where previously identified and secured lands can be restored to address the ecosystem restoration component of the compensation and separate lands acquired to address the land base compensation component. However, they should both be located within the same geographic area as the impacted site. The appropriateness of the location for ecosystem restoration may also be influenced by the requirement to restore a particular ecosystem type or to achieve a specific natural heritage objective.

Contiguous to the Natural System

In addition, the newly acquired land must be located outside of, but generally proximate to, the currently protected *natural system*. This is required to ensure that lands acquired add new area to the system to *compensate* for the lands removed, helping to maintain the overall size of the *natural system*.

Land Ownership and Designation

Lands secured for compensation should be placed in public ownership and designated and zoned in an environmental protection category. They should also be in proximity and preferably contiguous to currently held public lands and be accessible, enabling their effective long term protection and management.

Land Availability

In highly urbanized watersheds adding lands to the *natural system* may not always be feasible due to the limited availability of land. In these cases, the municipality, TRCA, and the proponent can work together to find lands that are perhaps within the *natural system* but are in need of restoration in order to *compensate* for permitted losses. However, this should be the exception to the rule, given that this scenario would result in a net loss in the amount of land within the *natural system*. Alternatively, lands can be secured outside of the impacted municipality but within the upper portion of the same watershed, helping to ensure that the downstream municipality will benefit from many of the *ecosystem services* in the long term.

Ecosystem Connectivity

When determining the location of restoration areas and land securement, *ecosystem connectivity* must be considered and maximized to the extent possible; for example, where east-west connectivity could enhance cross-watershed functions.

Ecosystem Configuration

Ecosystem restoration should be configured in such a way as to improve the size and shape of the natural heritage system, improving both the local *ecosystem function* and the larger *natural system* as a whole. Newly restored ecosystems must also be situated to help ensure they are protected from the effects of adjacent land uses.

Considerations for Monitoring and Maintenance:

Monitoring outcomes are a critical component of the compensation process. Regardless of who is implementing the work it is the responsibility of the implementer to undertake the monitoring and any required remedial actions. Key to achieving the goals of the agreed upon compensation plan, is ensuring the success of the individual project, which in turn will help guide improvement of the overall compensation program over time.

Monitoring should be undertaken at the 1, 3, and 5-year points after construction and or planting is complete, in order to allow for early detection and correction of any planting or construction failures. Documentation should be uploaded into the TRCA compensation database, if implemented by TRCA, or provided to the public agency overseeing proponent-led implementation for review.

Monitoring and maintenance will typically be the responsibility of those undertaking the restoration work. This responsibility will be confirmed and documented as part of the agreements outlined in section 3.1. Monitoring reports will be written to document project results. Where projects are not functioning as designed and approved, investigations will be undertaken to understand why. Further, modifications may be required to ensure that the project is successful; the need for these can be stipulated in an agreement and assured through securities held by the public agencies (see also section 3.1 Agreements). Monitoring and maintenance often constitutes a learning process that can inform future compensation decisions and implementation plans.

As a standard best management practice, a 25% planting replacement cost should be built into all project budgets regardless of who is implementing the work. This planting replacement contingency is informed by the experience of TRCA and reflects typical restoration replanting rates. This cost is listed in the budget items for all planting typicals as outlined in Appendix A.

3.3 Documenting the Compensation Project

For each compensation project, the specific actions proposed to address the required compensation must be documented in a report by those implementing the work (or an agent acting on their behalf). The report must document how the:

- Principles in section 1.4 have been adhered to;
- Required compensation has been determined in accordance with section 2.0; and,
- Direction in section 3.0 has been followed.

In addition, the report must document the following:

- A description of the impacted ecosystem;
- A brief description of the proposed compensation location(s) and a rationale for their selection;
- A proposed work plan;
- Detailed design drawings;
- Construction phasing plan;
- Monitoring plan; and,
- Any other relevant details as required through agreements between the proponent and the approval authority based on site-specific/file-specific circumstances.

Ultimately, the documentation must show that projects are designed to take advantage of existing site conditions and will provide the agreed to deliverables.

Compensation Project Review

TRCA Planning Ecologists, with input from TRCA Restoration Ecologists, the municipality and any other relevant review agencies, will use the details contained in Appendix A to guide the review of proposed compensation restoration projects helping to ensure the comprehensiveness and appropriateness of the restoration designs. As per the usual plan review process, all comments from the TRCA technical review team will be conveyed to the proponent by the TRCA Planner on the file.

4.0 TRCA Strategic Restoration Implementation

TRCA has developed a comprehensive ecological restoration program and has been successfully implementing restoration projects across the TRCA jurisdiction for many years.

The Guideline recognizes and supports others' approaches to implementing compensation as long as the intent of the Guideline is met. In many circumstances, TRCA will be well suited to manage compensation implementation actions due to expertise in ecological restoration and the established restoration program. This has proven to be the case for many compensation projects over the last several years.

For those cases where the parties involved have identified TRCA as the most effective agency to undertake compensation restoration and/or land securement actions, TRCA will follow a transparent and consistent approach, ensuring accountability and ultimately successful outcomes. This approach will employ a number of tools and processes including strategic site selection tools, a Restoration Opportunities Database, project implementation expertise, TRCA's Greenlands Acquisition Project 2016-2020 (where applicable), and a project tracking database.

Additional details on TRCA's approach to managing compensation actions can be found within the following TRCA strategic documents, available on request from TRCA staff – Restoration Opportunities Planning Primer and Integrated Restoration Prioritization: A Multiple Benefit Approach to Restoration Planning. In addition to scenarios where TRCA undertakes compensation restoration, these tools are available to help inform restoration actions by municipalities, other public agencies, as well as private proponents and their consultants.

Glossary

Accepted appraisal principles	Refers to the Canadian Uniform Standards of Professional Appraisal Practice, 2018 (as amended) by the Appraisal Institute of Canada.
Basal area	Basal area is the common term used to describe the cross sectional area of a tree measured 1.3 metres above the ground. Stand Basal Area is the total cross-sectional area of all stems in an ecosystem typically expressed in m ² per hectare.
Biomass	Biomass is biological material derived from living, or recently living organisms; the accumulation of living or recently living matter within an ecosystem.
Buffer	A strip of permanent vegetation that helps alleviate the negative effects of development on natural features and functions and can include a non-vegetated erosion access allowance (also see definition for erosion access allowance in The Living City Policies) required to manage a natural hazard. <i>Buffers</i> may also be referred to as vegetation protection zones.
Compensate	The replacement of a lost/altered natural feature or area and its functions.
Ecological Land Classification System for Southern Ontario	The Ministry of Natural Resources and Forestry's Southern Ontario system of classification of lands from an ecological perspective; an approach that attempts to identify and classify ecologically similar areas; published in 1998, and as may be updated from time to time.
Ecosystem functions	The natural processes, products or services that living and non-living environments provide or perform within or between species, ecosystems, and landscapes. These may include biological, physical, and socio-economic interactions.
Ecosystem services	The benefits to humans and other species, provided by nature.
Ecosystem structure	The biotic (living) and abiotic (non-living) form and composition (e.g. dominant plant species, size of vegetation, soil type and topography) of ecosystems that give each ecosystem its own definition and function.
Green infrastructure	Natural vegetation, vegetative technologies, soil in volumes and qualities adequate to sustain vegetation and absorb water, and supportive green technologies that replicate <i>ecosystem functions</i> and that collectively provide society with a multitude of environmental, social and economic benefits.

Headwater Drainage Features	Ill-defined, non-permanently flowing drainage features that may not have defined bed or banks; they are zero-order intermittent and ephemeral channels, swales and rivulets, but do not include rills or furrows. Headwater drainage features that have been assessed through TRCA's Evaluation, Classification and Management of Headwater Drainage Features Guideline, as "protection" and "conservation" are subject to TRCA's Regulation; those assessed as "mitigation" may be subject to TRCA's Regulation.
Impact(s)	Removal or partial removal of a component of the <i>Natural System</i> .
In Situ	In the context of ecosystem compensation, in situ refers to maintaining the subject ecosystem and its associated functions and services in its current location.
Lag Time	In the context of this Guideline, lag time refers to the time required for a newly restored ecosystem to reach a similar level of function as the impacted ecosystem it is attempting to replace.
Market Value	The most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress. (Appraisal Institute of Canada)
Mitigate	The prevention, modification or alleviation of negative effects on the environment. It also includes any action with the intent to enhance beneficial effects.
Mitigation Hierarchy	Avoid, minimize, <i>mitigate</i> , <i>compensate</i> .
Natural Cover	Land occupied by naturally and culturally occurring native or non-native vegetation that is not characterized as agricultural or urban land uses.
Natural System	The natural system is comprised of water resources, natural features and areas, natural hazards, and restoration areas of <i>potential natural cover</i> and/or <i>buffers</i> (The Living City Policies, 2014).
Risk	In compensation, the potential for the replication of <i>ecosystem structure</i> or <i>function</i> to fail. Risk increases with ecosystem complexity or specific conditions difficult to reproduce.

Toronto region	TRCA’s watershed-based jurisdiction, made up of nine watersheds and the Lake Ontario shoreline, from Etobicoke Creek watershed in the west, to Carruthers Creek watershed in the east, and made up of all or parts of the following municipalities: Toronto, Durham, York, Peel, Mono, Adjala-Tosorontio, Caledon, Brampton, Mississauga, Aurora, King, Vaughan, Richmond Hill, Markham, Whitchurch-Stouffville, Uxbridge, Pickering and Ajax.
Vegetation Type/ Vegetation Community	An ecosystem as described by its vegetation composition and form. For example, an oak-maple forest. The level of mapping detail for the “Vegetation Type” is defined by the <i>Ecological Land Classification System for Southern Ontario</i> .
Voluntary Review Process	TRCA’s review process for infrastructure projects by federal or provincial agencies exempt from TRCA’s section 28 Regulation under the <i>Conservation Authorities Act</i> .

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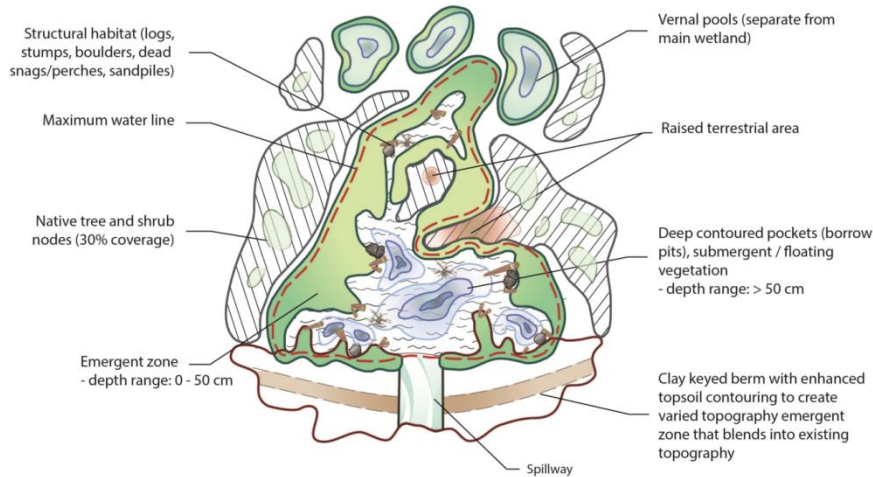
Toronto and Region Conservation Authority. 2014. The Living City Policies for Planning and Development in the Watersheds of the Toronto and Region Conservation Authority

Appendix A: Restoration Typicals

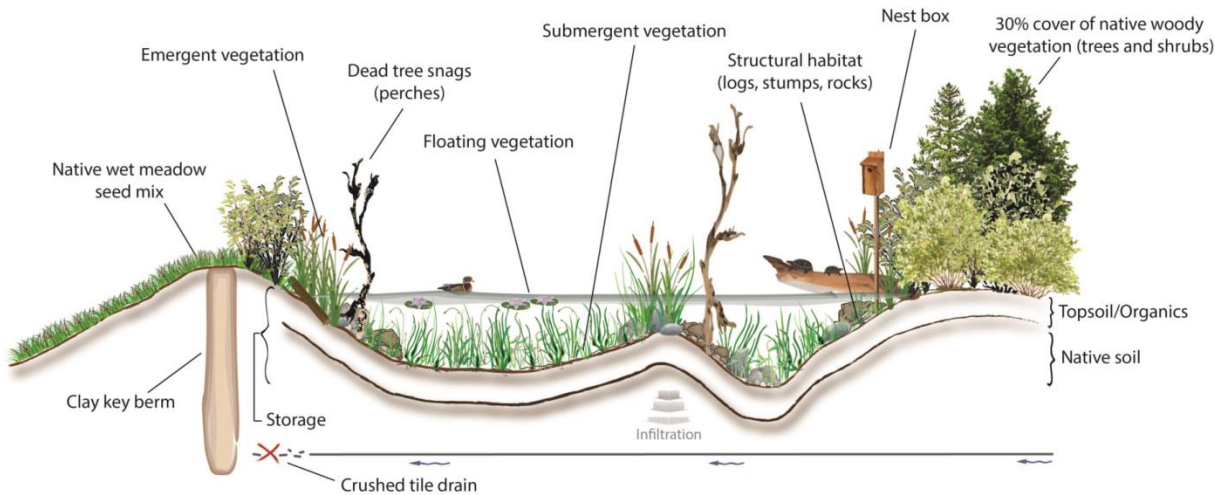
The following information provides typical project design details for the planning, implementation, maintenance and monitoring of restoration projects. Standard planting densities are also included for the relevant ecosystem types. TRCA staff will use these standards in their review of proposed compensation projects. These are typical restoration design standards and will need to be adapted for site-specific conditions and agreements.

*Typical Budget Items and Costs – although typical budget items are listed for each restoration type, the costs for each item are not. The costs are subject to market price changes (e.g., for fuel, materials, etc.), and are therefore not listed. For the most current costs, please contact TRCA staff.

Marsh Wetland



WETLAND TYPICAL: TOP VIEW



WETLAND TYPICAL: CROSS SECTION

Restored marsh wetland, post-implementation (young planting)



Project Goals:

- Restore ecosystem form and function
- Restore soil and soil processes
- Restore natural hydrologic processes
- Enhance and restore natural cover and critical habitat

Details:

Project planning and development (permits, survey, detailed design and project mgmt.), site preparation (sediment & erosion control, etc.), berm construction, wetland topography contouring and grading, habitat structure installation, planting and seed application.

- 0.7 ha aquatic (50% of wetland footprint planted with aquatic plugs (2,250 plugs)
 - 0.28 ha open water/submergent plantings (10% or 225 plugs)
 - 0.42 ha emergent vegetation plantings (40% or 2,025 plugs)
- 0.3 ha terrestrial (100% planted with trees & shrubs (1,000 pots))

Suggested plant species:

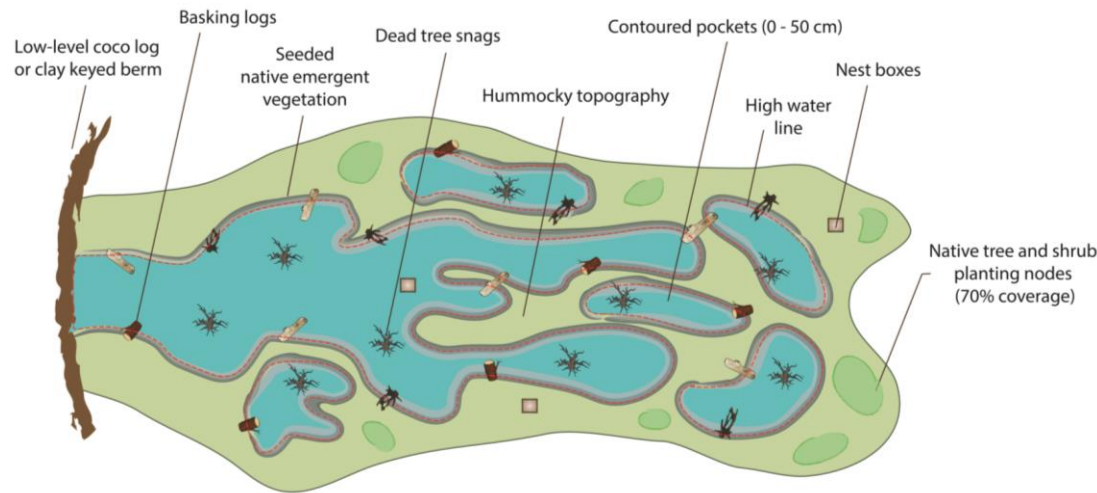
Plant native early successional riparian tree and shrub species and wet tolerant conifer species. Based on specific site conditions and existing vegetation, species might include: red osier dogwood, nanny berry, cottonwood, birch, balsam poplar, tamarack and E. white cedar.

Marsh Wetland Typical *Budget Items (1 ha)		
Construction	Notes	*Costs
Planning and Design	Permits, survey, archaeology, engineering, and project design	
Equipment	2 days of site preparation and 8 days of construction (Truck, trailer, excavator, loader, water pump)	
Materials	Aggregate, erosion and sediment control, filter cloth, round stone, woody debris, (50 kg) cover crop, and habitat structures	
Labour	2 days of site prep, 10 days of construction, 1 day each for start up and tear down	
Contingency	10%	
Terrestrial Planting		
Equipment	Truck, trailer, ATV	
Materials	300 potted (2 gal) coniferous, 200 potted (2 gal) deciduous, 500 shrubs potted (2 gal), (6 kg) native seed, and mulch	
Labour	Plan design and installation	
Contingency	10%	
Plant Replacement	25% replacement of material	
Aquatic Planting		
Equipment	Truck, trailer, ATV	
Materials	2,250 plugs planted	
Labour	Plan design and installation	
Contingency	10%	
Plant Replacement	25% replacement of material	
Planning		
Project Management	Initiating, planning, executing, controlling, and closing	
Monitoring	3 visits (year 1, 3 and 5) with reporting	

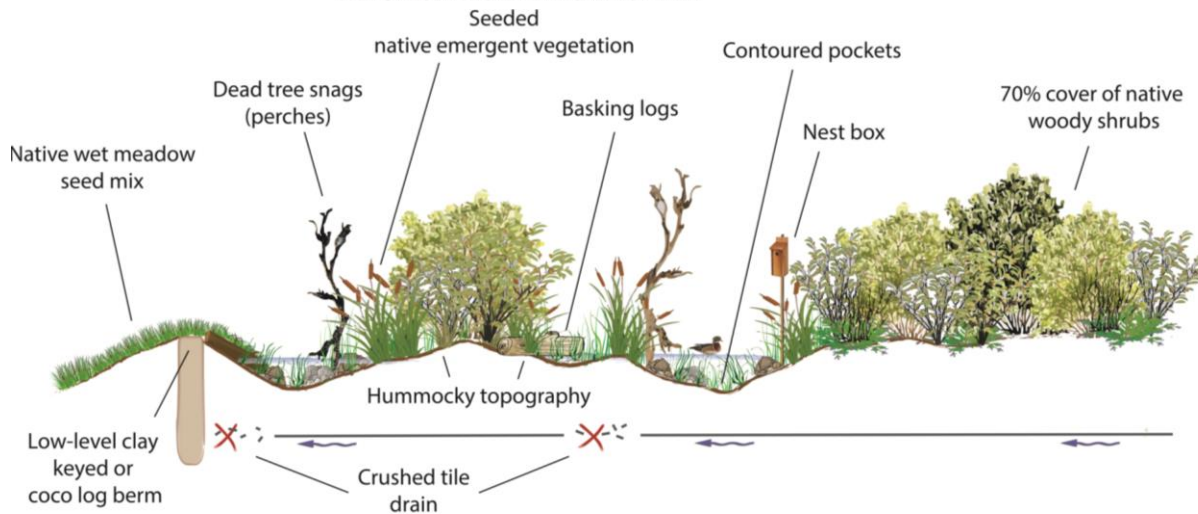
- Features to include in design:
- Reversal of altered hydrology (crushed tile drains, burying straightened ditches)
 - Varying topography including shallow water (0 - 50 cm depth) and open water/deep pockets (50 - 200 cm depth)
 - Proper and stable water level control
 - Proper erosion and sediment control methods
 - 10 - 20 Habitat structures (dead trees, snags, basking logs, log perches, sand piles, nest box, etc.)
 - Site preparation for planting and removal of invasive species
 - Native terrestrial, emergent and submergent vegetation
 - 100% of terrestrial buffer (10 m wide) planted with woody vegetation (1,000 pots)
 - Terrestrial planting of shrubs in 50 groups of 10 at 1 m spacing
 - Terrestrial planting of trees in 50 groups of 10 at 2.25 m spacing
 - 50% of aquatic area planted (2,250 emergent and submergent plugs at 6 inch spacing)
 - Native wetland/wet meadow seed mix for disturbed soils

*Typical Budget Items and Costs – although typical budget items are listed for each restoration type, the costs for each item are not. The costs are subject to market price changes (e.g., for fuel, materials, etc.), and are therefore not listed. For the most current costs, please contact TRCA staff.

Wet Shrub Thicket Wetland



WET SHRUB THICKET TYPICAL: TOP VIEW



WET SHRUB THICKET TYPICAL: CROSS SECTION



Project Goals:

- Restore ecosystem form and function
- Restore soil and soil processes
- Restore natural hydrologic processes
- Enhance and restore natural cover and critical habitat

Details:

Project planning and development (permits, survey, detailed design and project mgmt.), site preparation (sediment & erosion control, etc.), berm construction, wetland topography contouring and grading, habitat structure installation, planting and seed application.

- 0.3 ha aquatic
- 0.7 ha terrestrial (50% of area planted with shrubs (3,500 pots))

Suggested plant species:

Plant native early successional riparian shrub species, such as willow, red berry, high bush cranberry and button bush.

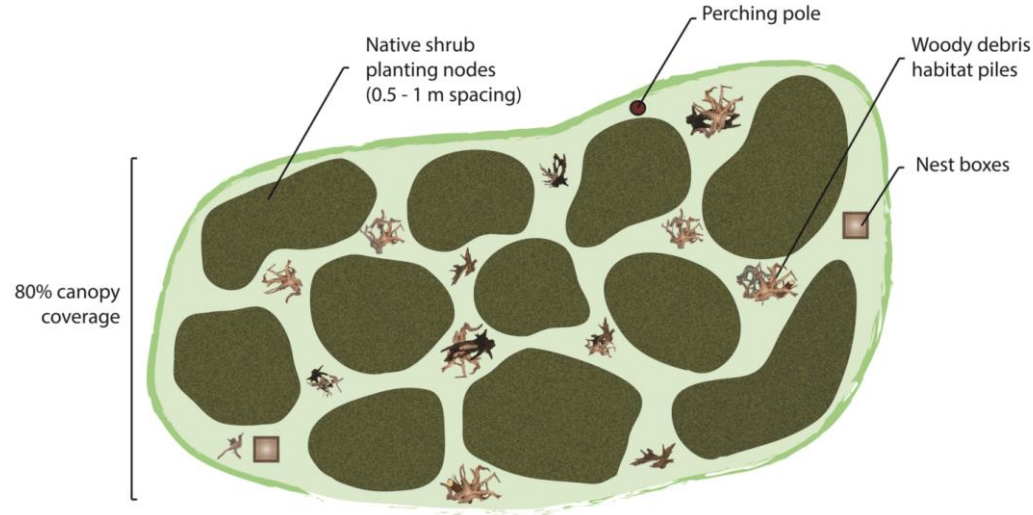
Wet Shrub Thicket Typical *Budget Items (1 ha)		
Construction	Notes	*Costs
Planning and Design	Permits, survey, archaeology, engineering, and project design	
Equipment	2 days of site preparation and 6 days of construction (Truck, trailer, excavator, loader, water pump)	
Materials	Aggregate, erosion and sediment control, filter cloth, round stone, woody debris, and habitat structures	
Labour	2 days of site prep, 6 days of construction, 1 day each for start up and tear down	
Contingency	10%	
Tree and Shrub Planting		
Equipment	Truck, trailer, ATV	
Materials	3,500 shrubs potted (2 gal), (50 kg) cover crop, (6 kg) of native seed, and mulch	
Labour	Plan design and installation	
Contingency	10%	
Plant Replacement	25% replacement of material	
Planning		
Project Management	Initiating, planning, executing, controlling, and closing	
Monitoring	3 visits (year 1, 3 and 5) with reporting	

*Typical Budget Items and Costs – although typical budget items are listed for each restoration type, the costs for each item are not. The costs are subject to market price changes (e.g., for fuel, materials, etc.), and are therefore not listed. For the most current costs, please contact TRCA staff.

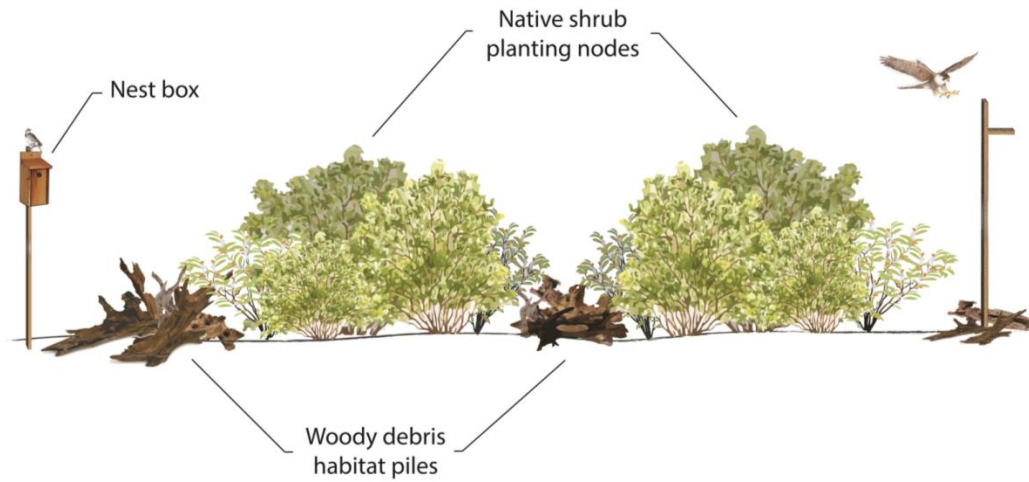
Features to include in design:

- Reversal of altered hydrology (crushed tile drains, burying straightened ditches)
- Proper and stable water level control
- Proper erosion and sediment control methods
- Varying/hummocky topography including shallow open water (0 - 50 cm depth)
- 20 - 30 Habitat structures (dead trees, snags, basking logs, log perches, nest boxes, etc.)
- Site preparation for planting and removal of invasive species
- Native terrestrial and emergent vegetation
- 50% of terrestrial planting area planted with shrubs in 350 groups of 10 at 1 m spacing (3,500 potted shrubs)
- Native wetland/wet meadow seed mix for disturbed soils

Shrub Thicket Planting



SHRUB THICKET TYPICAL: TOP VIEW



SHRUB THICKET TYPICAL: CROSS SECTION



Project Goals:

- Restore ecosystem form and function
- Restore soil and soil processes
- Restore natural hydrologic processes
- Enhance and restore natural cover and critical habitat

Details:

Project planning and development (detailed design and project mgmt.), site preparation, essential wildlife structures and/or bird boxes installation, 0.8 ha, 50% planted with shrubs (4,000 pots) and mulch application.

Suggested plant species:

Plant native early succession shrub species, based on specific site conditions and existing vegetation, species might include grey dogwood, alder, purple flowering raspberry, serviceberry and elderberry.

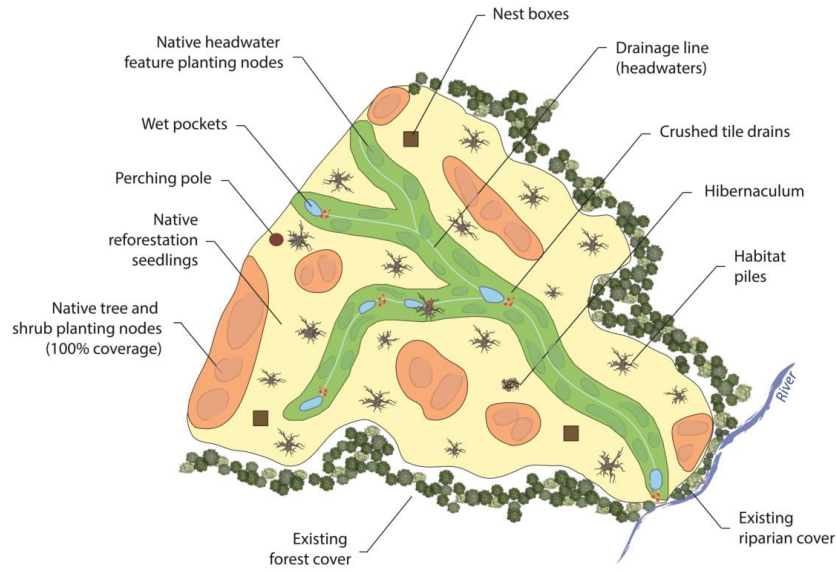
Shrub Thicket Planting Typical *Budget Items (1 ha)		
Site Preparation	Notes	*Costs
Equipment	4 days of equipment time for minor grading, tilling, seeding (Truck, trailer, tractor, tractor Implements, ATV)	
Materials	(50 kg) cover crop	
Labour	Plan design and construction	
Contingency	10%	
Planting		
Equipment	Truck, trailer, ATV	
Materials	4,000 shrubs potted (2 gal), (4 kg) of native seed, and mulch	
Labour	Plan design and installation	
Contingency	10%	
Plant Replacement	25% replacement of material	
Habitat Installation		
Equipment	4 days of equipment time for minor grading and structure installation. (Tractor, tractor Implements, ATV)	
Materials	4 days of installation (Bird boxes and woody debris)	
Labour	Plan design and installation	
Contingency		10%
Planning		
Project Management	Initiating, planning, executing, controlling, and closing	
Monitoring	3 visits (year 1, 3 and 5) with reporting	

Features to include in design:

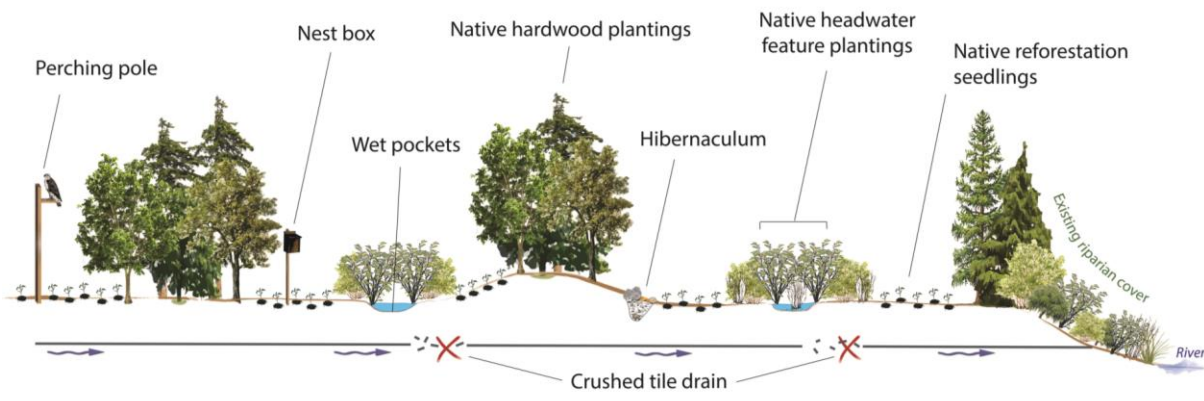
- Reversal of altered hydrology (crushed tile drains, burying straightened ditches)
- Proper erosion and sediment control methods
- 10 - 20 Habitat structures (log perches, large woody debris, nest boxes, etc.)
- Site preparation for planting and removal of invasive species
- 50% of terrestrial planting area planted with shrubs in 400 groups of 10 at 1m spacing (4,000 potted shrubs)
- Native meadow seed mix for disturbed soils

*Typical Budget Items and Costs – although typical budget items are listed for each restoration type, the costs for each item are not. The costs are subject to market price changes (e.g., for fuel, materials, etc.), and are therefore not listed. For the most current costs, please contact TRCA staff.

Enhanced Reforestation



ENHANCED REFORESTATION TYPICAL: TOP VIEW



ENHANCED REFORESTATION TYPICAL: CROSS SECTION



Project Goals:

- Restore ecosystem form and function
- Restore soil and soil processes
- Restore natural hydrologic processes
- Enhance and restore natural cover and critical habitat

Details:

Project planning and development (detailed design and project mgmt.), site preparation, wildlife structures and/or bird boxes installation, 100% of area planted with trees and shrubs, with a mulch application for potted material.

Suggested plant species:

Planting early to mid-successional tree and shrub species Based on specific site conditions and existing vegetation, species might include elderberry, sumac, dogwood, birch, E. white cedar, white pine, poplar and spruce.

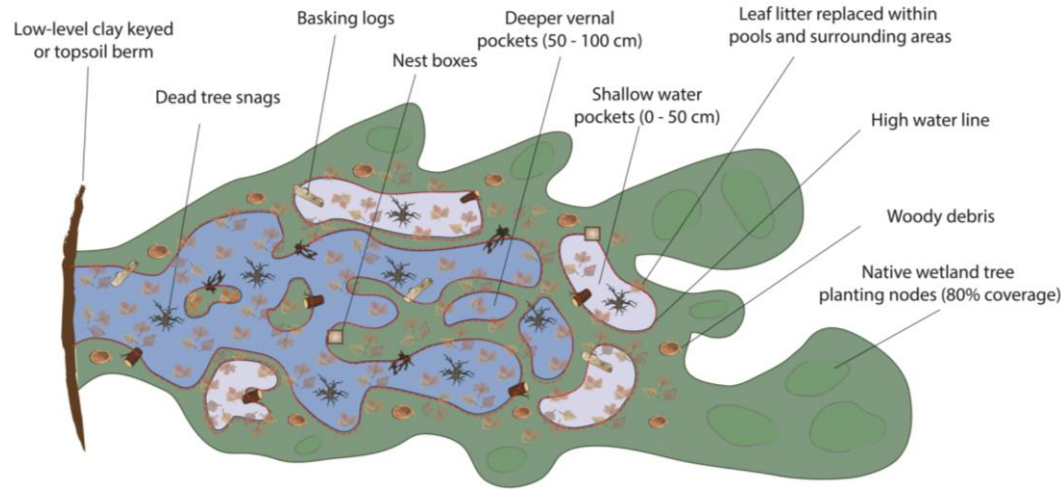
Enhanced Reforestation Planting Typical *Budget Items (1 ha)		
Site Preparation	Notes	*Costs
Equipment	4 days of equipment time for minor grading, tilling, seeding. (Truck, trailer, tractor, tractor Implements, ATV)	
Materials	(50 kg) cover crop	
Labour	Plan design and construction	
Contingency	10%	
Planting		
Equipment	Truck, trailer, ATV	
Materials	1,000 bareroot tree seedlings; 1,000 shrubs potted (2 gal), 500 conifers potted (2 gal), 500 deciduous potted (2 gal), (4 kg) native seed, and mulch	
Labour	Plan design and installation	
Contingency	10%	
Plant Replacement	25% replacement of material	
Habitat Installation		
Equipment	4 days of equipment time for minor grading and structure installation. (Truck, trailer, tractor, tractor Implements, ATV)	
Materials	4 days of installation (Bird boxes and woody debris)	
Labour	Plan design and installation	
Contingency		10%
Planning		
Project Management	Initiating, planning, executing, controlling, and closing	
Monitoring	3 visits (year 1, 3 and 5) with reporting	

Features to include in design:

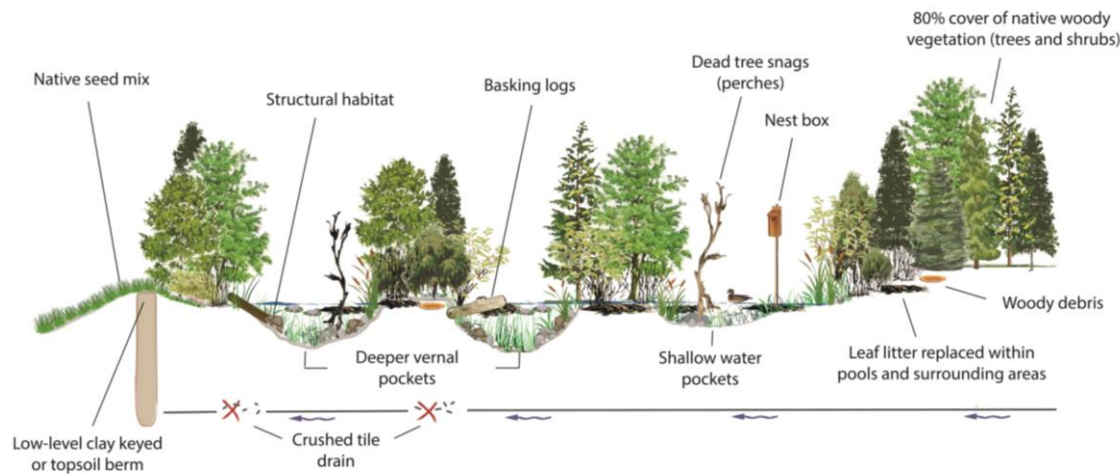
- Reversal of altered hydrology (crushed tile drains, burying straightened ditches)
- Proper erosion and sediment control methods
- 20 - 30 Habitat structures (log perches, large woody debris, hibernacula, nest boxes, etc.)
- Site preparation for planting and removal of invasive species
- 100% woody vegetation (native trees and shrubs, including bareroot seedlings) planted.
- Shrubs planted in groups of 10 at 1 m spacing (1,000 pieces)
- Bareroot trees scatter planted at 1.7 m spacing (1,000 seedlings)
- Potted trees planted in groups of 10 at 2.45 m spacing (1,000 pots)
- Native meadow seed mix for disturbed soils

*Typical Budget Items and Costs – although typical budget items are listed for each restoration type, the costs for each item are not. The costs are subject to market price changes (e.g., for fuel, materials, etc.), and are therefore not listed. For the most current costs, please contact TRCA staff.

Forested Wetland



FORESTED WETLAND TYPICAL: TOP VIEW



FORESTED WETLAND TYPICAL: CROSS SECTION

Restored forested wetland, implementation year



Project Goals:

- Restore ecosystem form and function
- Restore soil and soil processes
- Restore natural hydrologic processes
- Enhance and restore natural cover and critical habitat

Details:

Project planning and development (permits, survey, detailed design and project mgmt.), site preparation (sediment & erosion control, etc.), subtle regrading to create low level control berm, wetland topography contouring and grading, enhanced wildlife habitat and/or bird box installation, seed application.

- 0.2 ha aquatic
- 0.8 ha terrestrial (100% of area planted with trees and shrubs (2,440 pots))

Suggested plant species: Plant native early successional riparian tree and shrub species and wet tolerant conifers. Based on specific site conditions and existing vegetation, species might include red osier dogwood, alder, silver maple, birch, E. white cedar, tamarack and white spruce.

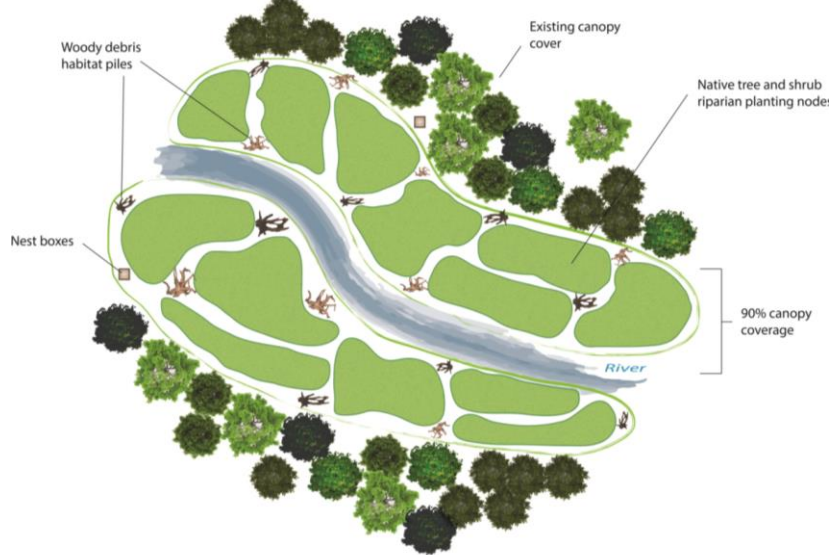
Forested Wetland Typical *Budget Items (1 ha)		
Construction	Notes	*Costs
Planning and Design	Permits, survey, archaeology, engineering, and project design	
Equipment	2 days of site preparation and 6 days of construction (Truck, trailer, excavator, loader, water pump)	
Materials	Aggregate, erosion and sediment control, filter cloth, round stone, woody debris, (50 kg) cover crop, and habitat structures	
Labour	2 days of site prep, 6 days of construction, 1 day each for start up and tear down	
Contingency	10%	
Tree and Shrub Planting		
Equipment	Truck, trailer, ATV	
Materials	640 coniferous potted (2 gal), 600 deciduous potted (2 gal), 1,200 shrubs potted (2 gal), and (6 kg) native seed	
Labour	Plan design and installation	
Contingency	10%	
Plant Replacement	25% replacement of material	
Planning		
Project Management	Initiating, planning, executing, controlling, and closing	
Monitoring	3 visits (year 1, 3 and 5) with reporting	

*Typical Budget Items and Costs – although typical budget items are listed for each restoration type, the costs for each item are not. The costs are subject to market price changes (e.g., for fuel, materials, etc.), and are therefore not listed. For the most current costs, please contact TRCA staff.

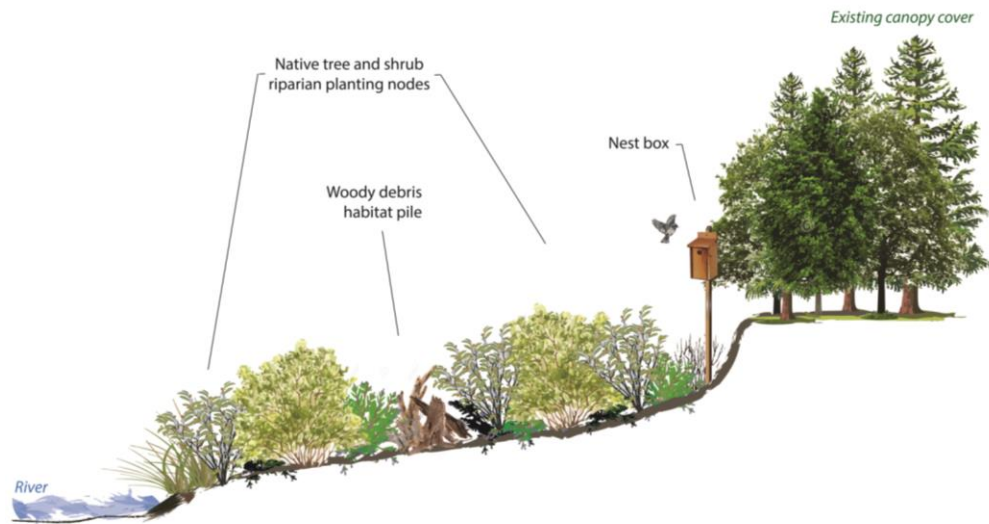
Features to include in design:

- Reversal of altered hydrology (crushed tile drains, burying straightened ditches)
- Proper and stable water level control
- Proper erosion and sediment control methods
- Varying topography including shallow water (0 - 50 cm depth) deeper vernal pockets (50 - 100 cm depth)
- 20 - 30 Habitat structures (basking logs, log perches, nest boxes)
- Site preparation for planting and removal of invasive species
- Terrestrial area planted with 80% woody vegetation (native trees and shrub pots)
- Trees planted in groups of 10 at 2.4 m spacing
- Shrubs planted in groups of 10 at 1 m spacing
- Native wetland/wet meadow seed mix for disturbed soils

Riparian Planting



RIPARIAN PLANTING TYPICAL: TOP VIEW



RIPARIAN PLANTING TYPICAL: CROSS SECTION



Project Goals:

- Restore ecosystem form and function
- Restore soil and soil processes
- Restore natural hydrologic processes
- Enhance and restore natural cover and critical habitat
- Increased stream bank stability
- Reduced erosion/sedimentation

Details:

Project planning and development (permits, detailed design and project mgmt.), site preparation, essential wildlife structures and/or bird boxes installation, 90% of riparian area planted with trees and shrubs (2,650 pots), and mulch application.

Suggested plant species:

Plant native early successional riparian tree and shrub species, to increase stabilization of soils and slopes adjacent to the watercourse, reducing sediment loading in streams. Species selection based on specific site conditions and existing vegetation, species might include sandbar willow, speckled alder, red osier dogwood, silky dogwood, meadowsweet, buttonbush, silver maple, trembling aspen and E. white cedar.

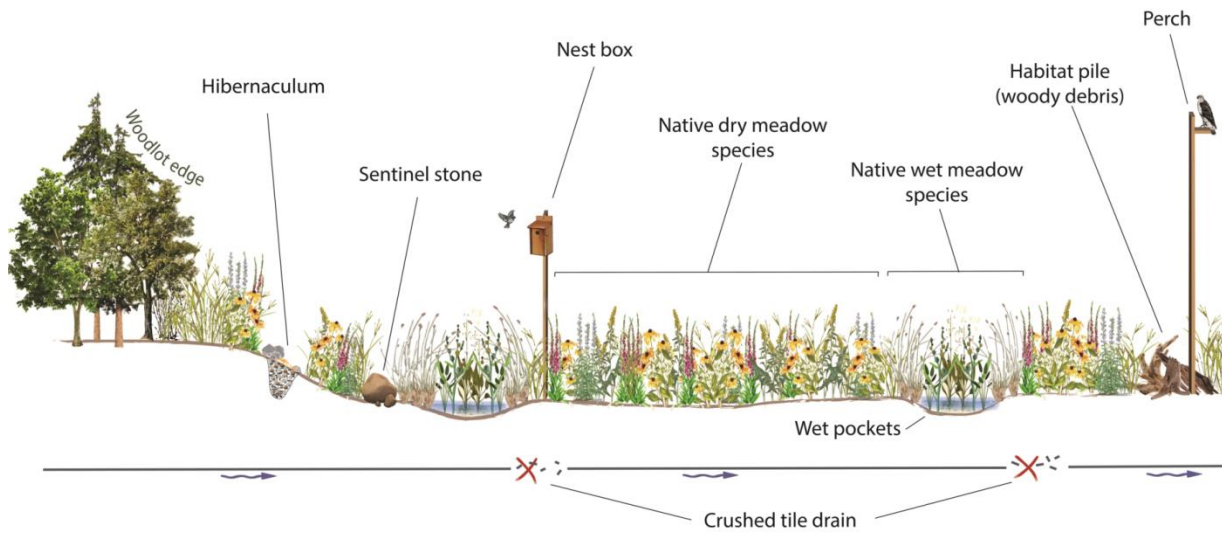
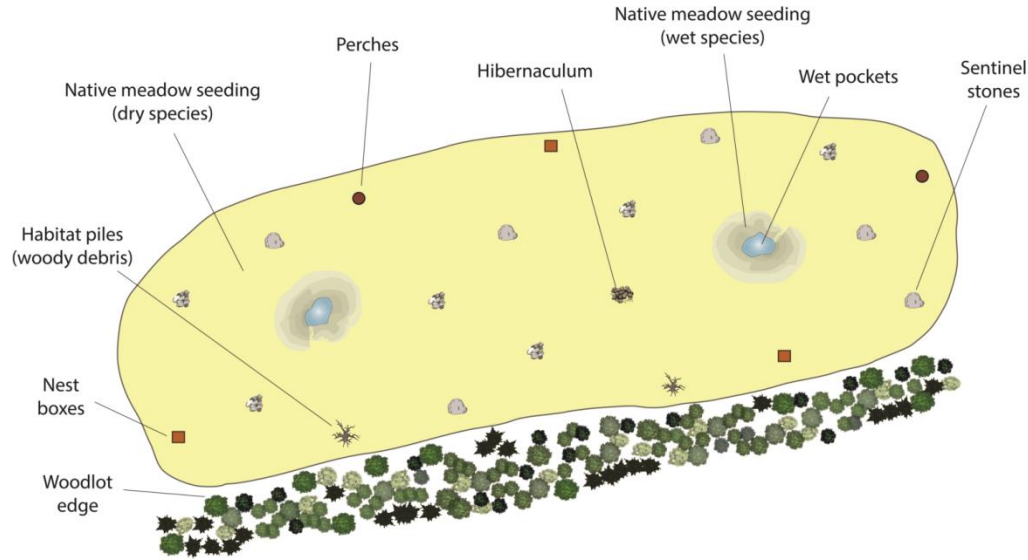
Riparian Planting Typical *Budget Items (1 ha)		
Site Preparation	Notes	*Costs
Equipment	4 days of equipment time for minor grading, tilling, seeding. (Truck, trailer, tractor, tractor Implements, ATV)	
Materials	(50 kg) cover crop	
Labour	Plan design and construction	
Contingency	10%	
Planting		
Equipment	Truck, trailer, ATV	
Materials	650 coniferous potted (2 gal), 700 deciduous potted (2 gal), 1,300 shrubs potted (2 gal), (4 kg) native seed, and mulch	
Labour	Plan design and installation	
Contingency	10%	
Plant Replacement	25% replacement of material	
Habitat Installation		
Equipment	4 days of equipment time for minor grading and structure installation. (Truck, trailer, tractor, tractor Implements, ATV)	
Materials	4 days of installation (Bird boxes and woody debris)	
Labour	Plan design and installation	
Contingency		10%
Planning		
Project Management	Initiating, planning, executing, controlling, and closing	
Monitoring	3 visits (year 1, 3 and 5) with reporting	

Features to include in design:

- Reversal of altered hydrology (crushed tile drains, burying straightened ditches)
- Proper water level control
- Proper erosion and sediment control methods
- 20 - 30 Habitat structures (basking logs, log perches, turtle nesting piles, nest boxes)
- Site preparation for planting and removal of invasive species
- 90% woody vegetation (native trees and shrub pots)
- Trees planted in groups of 10 at 2.4 m spacing (1,350 pots)
- Shrubs planted in groups of 10 at 1 m spacing (1,300 pots)
- Native riparian/wet meadow seed mix for disturbed soils

*Typical Budget Items and Costs – although typical budget items are listed for each restoration type, the costs for each item are not. The costs are subject to market price changes (e.g., for fuel, materials, etc.), and are therefore not listed. For the most current costs, please contact TRCA staff.

Meadow



Project Goals:

- Restore ecosystem form and function
- Restore soil and soil processes
- Restore natural hydrologic processes
- Enhance and restore natural cover and critical habitat
- Enhanced natural corridor connections
- New model for managing hydro corridors

Details:

Planning and development (permits, detailed design and project mgmt.), site preparation that includes tilling, planting a nurse crop, mowing it 4 - 6 times throughout the season. In the spring, mow and spray area, plant seeds and monitor.

Suggested plant species:

Plant native forb and grasses to increase biodiversity and natural cover. Recommended 20% flowers to 80% grasses (percentages can be adjusted based on specific restoration goals).

Native Meadow Typical *Budget Items (1 ha)		
Site Preparation	Notes	*Costs
Equipment	10 days of equipment time for tilling, spraying, seeding. (Truck, trailer, tractor, tractor Implements)	
Materials	Herbicide, sign, posts, (50 kg) cover crop	
Labour	Plan design and site prep	
Contingency	10%	
Construction		
Equipment	7 days of equipment time for spraying, seeding. (Truck, trailer, tractor, tractor Implements)	
Materials	Herbicide, sign, (16 kg) native seed	
Labour	Plan design and installation	
Contingency	10%	
Plant Replacement	25% replacement of material	
Habitat Installation		
Equipment	4 days of equipment time for minor grading and structure installation. (Truck, trailer, tractor, tractor Implements, ATV)	
Materials	4 days of installation (Bird boxes and woody debris)	
Labour	Plan design and installation	
Contingency	10%	
Maintenance		
Equipment	6 days of equipment time for mowing (Truck, trailer, tractor, tractor Implements)	
Materials	Herbicide (spot spray)	
Labour	Plan design and installation	
Contingency	15%	
Planning		
Project Management	Initiating, planning, executing, controlling, and closing	
Monitoring	3 visits (year 1, 3, 5) with reporting	

- Features to include in design:
- One year site preparation for native meadow seeding with removal of invasive species
 - Site grading and reversal of altered hydrology (crushed tile drains, burying straightened ditches)
 - 20 - 30 Habitat structures (Large woody debris piles, log perches, sentinel stones, hibernacula, nest boxes)
 - Native meadow seed mix planted into prepared area.
 - Maintain with a mow and spot herbicide treatment to reduce invasive and/or woody species competition

*Typical Budget Items and Costs – although typical budget items are listed for each restoration type, the costs for each item are not. The costs are subject to market price changes (e.g., for fuel, materials, etc.), and are therefore not listed. For the most current costs, please contact TRCA staff.

Appendix B: Calculating Basal Area

General guidance on how to perform the *basal area* calculation can be sought from the Ecological Land Classification for Southern Ontario Field Guide or the Ontario Tree Marking Guide. The following recommendations are provided in order to standardize the collection and submission of *basal area* calculations related to TRCA Ecosystem Compensation.

Please consult with TRCA staff prior to deviating from the ideal data collection recommendations.

- *Basal area* should be collected from the contiguous ecosystem type (Ecological Land Classification polygon) from which the unavoidable loss or *impact* to natural feature has been identified.
- Use a BAF 2 metric prism.
- Use fixed area plots in circumstances where the prism provides less accuracy (such as in young plantations or dense hardwood stands where it is not possible to distinguish individual stems).
 - In these circumstances circular plots are recommended; for a 200 m² plot the plot radius is 7.99 m.
- A minimum of 3 plots (either prism sweeps or fixed area plots) should be taken within the ecosystem type impacted, with a minimum sample size of 10% coverage.
- Ideally plots are to be located 40 meters from an edge of the polygon to avoid edge bias. At minimum plots should be located so that they do not solely include the edge of the ecosystem type.
- Ideally there should be a minimum of 80 meters between sweeps/plots.
- Where appropriate a grid pattern should be used and marked in the office prior to field data collection.
- The centre of each sweep/plot should be marked on the ground and recorded with GPS, for staff verification, if necessary. This information should be mapped and provided with the data collection sheets to TRCA staff.
- *Basal area* to be recorded by tree species. All dead trees are to be included in the *basal area* calculation.
- Diameter measurements are to be recorded for all borderline trees. A plot radius table can be used to determine whether the tree is in a plot. A Plot Radius Factor Table can be found in Appendix D of the Ontario Tree Marking Guide.

References:

Lee, H.T., W.D. Bakawsky, J.Reily, J. Bowles, M. Puddister, P. Uhlig and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First Approximation and Its Application. Ontario Ministry of Natural Resources, Southcentral science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02.

OMNR. 2004. Ontario Tree Marking Guide, Version 1.1. Ont. Min. Nat. Resour. Queen's Printer for Ontario. Toronto. p. 252

Appendix C: Individual Tree Replacement Table

When the *basal area* approach is not suitable for determining compensation, as may be the case with individual trees where no municipal tree by-laws apply, tree replacement ratios can be a helpful tool. The following provides information on tree replacement ratios as well as typical costing when planting individual trees.

The data collected as part of municipal Urban Forest Studies conducted by TRCA and the i-Tree-Eco analysis model developed by the U.S.D.A. Forestry Service help to provide TRCA-relevant, empirical values for some *ecosystem services* based on tree diameter; these include carbon sequestration and pollution removal. The i-Tree-Eco data, the *basal area* information used for natural feature compensation as well as current municipal tree by-law requirements were all used to inform the suggested tree replacement ratios outlined in Table C-1 below. In general, older or more significant trees are replaced at higher ratios than smaller ones.

Table C-1: Replication Tree (Planting) Ratio by Diameter at Breast Height (DBH)

	DBH Range (cm)	Replication Ratio
1	0 – 10	1:1
2	10.1 – 20	1:3
3	20.1 – 30	1:10
4	30.1 – 40	1:15
5	40.1 – 50	1:20
6	50.1 – 60	1:30
7	60.1 – 70	1:40
8	70.1 +	1:50

Improved efficiency would be achieved if a large number of trees would be implemented under one contract. For the purpose of this Guideline, the following assumptions were made:

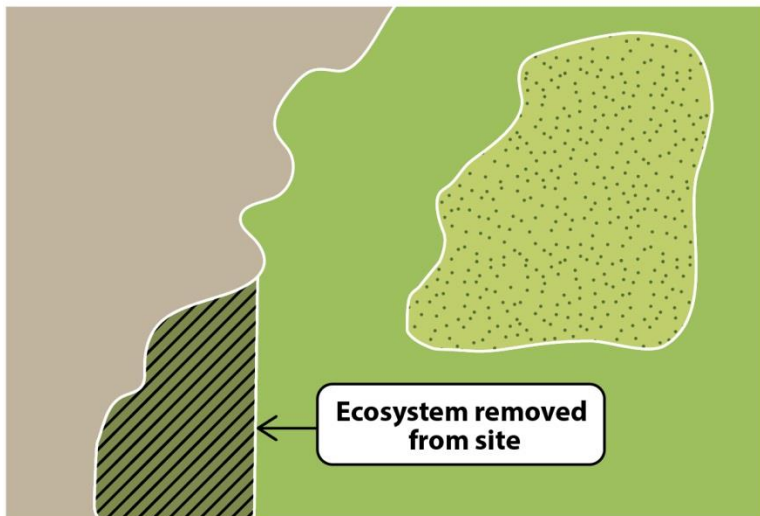
1. Replacement of individual trees will have a replacement requirement of minimum 60 mm wire basket caliper tree;
2. Costing will include maintenance and monitoring with a minimum 2 year warranty; and
3. Costing is based on typical industry standards and planting within parkland settings.

Costs associated with these plantings are subject to market changes for fuel, materials, etc., and are therefore not listed. For the most current costs, please contact TRCA staff.

Appendix D: Compensation Examples

Simple examples are provided in this appendix that help to illustrate application of the compensation approaches described within the Guideline. The examples are not meant to exclude other options of compensation but to demonstrate some of the more common scenarios.

DESCRIPTION OF THE IMPACTED SITE AND ECOSYSTEM PROPOSED TO BE REMOVED







ECOSYSTEM REMOVED







Ecosystem type: Forest

Size of habitat: 1 hectare (ha)

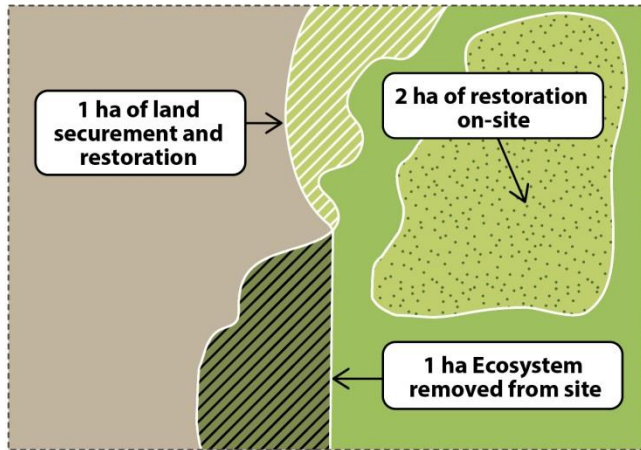
Basal area: 15 m²/ha

LEGEND

-  Natural system
-  Developable area
-  Ecosystem removal
-  Potential restoration area

LEGEND	 Natural system	 Ecosystem removal	 Compensation land area
	 Developable area	 Potential restoration area	 Property boundary

OPTION 1 - ON-SITE COMPENSATION



ECOSYSTEM STRUCTURE

Basal area of 15 m²/ha equates to a replacement ratio of 1:3. Total size of ecosystem restoration required = 1 ha x 3 = 3 ha

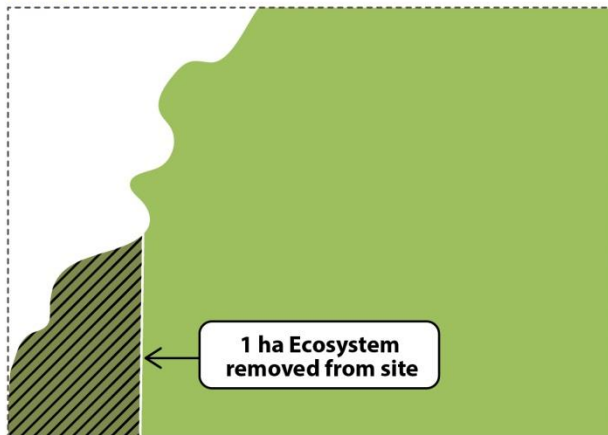
One hectare of restoration can occur on site within the area required to compensate for the lost land base. The remaining two hectares of restoration can occur within the potential restoration area on site.

LAND BASE

Ratio = 1:1 = one ha removed from the natural system = one hectare added back on the same site (as illustrated in light green hatching)

OPTION 2 - OFF-SITE COMPENSATION WITH AGENCY-LED IMPLEMENTATION

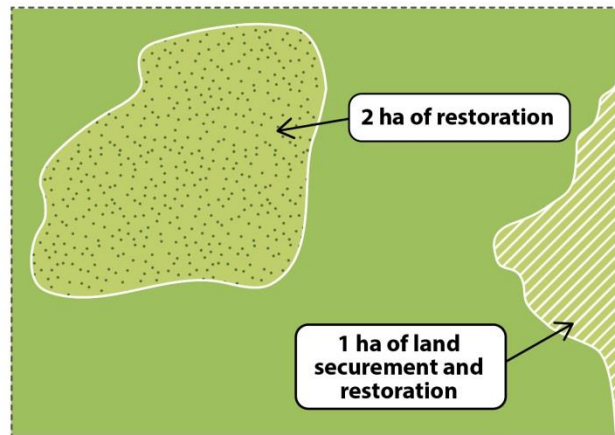
DEVELOPMENT SITE



ECOSYSTEM STRUCTURE

Basal area of 15 m²/ha equates to a replacement ratio of 1:3. Total size of ecosystem restoration required = 1 ha x 3 = 3 ha. If cash-in-lieu option is being used, funds transferred to implementation agency depends on the cost to restore 3 ha of habitat. Cost to restore can be obtained on request.

OFF-SITE LOCATION



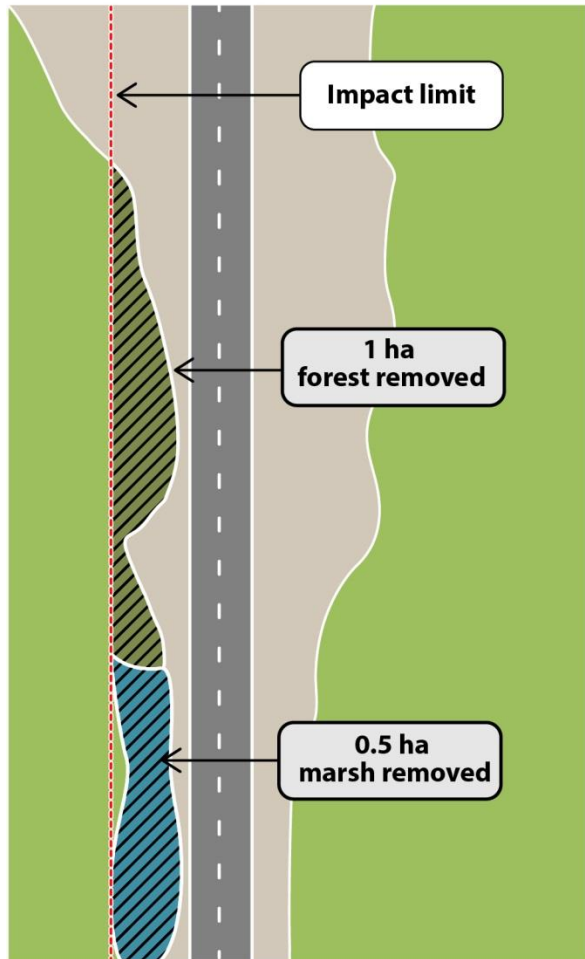
LAND BASE

Ratio = 1:1 = one ha removed from the natural system = one hectare added back off-site. If cash-in-lieu option is being used, land value of one ha determined using guidance from Section 2.2.

TOTAL COST UNDER CASH-IN-LIEU

The total funds to be transferred is the sum of the cost to restore three hectares of habitat and land value for one hectare of land.

MUNICIPAL INFRASTRUCTURE EXAMPLE



ECOSYSTEM REMOVED

Ecosystem type: Forest
Size of habitat: 1 hectare (ha)
Basal area: 15 m²/hectare

Ecosystem type: Marsh
Size of habitat: 0.5 ha

ECOSYSTEM STRUCTURE

Forest

Assuming a forest basal area of 15 m²/ha, a 3ha:1ha replacement ratio is required. One ha of forest removed requires restoration of three ha.

Marsh

Marsh habitat is restored at a 1ha:1ha ratio. Therefore, 0.5 ha of marsh habitat must be restored to address the removal.

Restoration can occur on site to the extent possible with the remaining restoration being implemented elsewhere in proximity to the impact

LAND BASE

Land base compensation does not need to be addressed on an individual project basis. TRCA and the Municipality can track the land area removed from the natural system from all infrastructure projects and work together to explore avenues to off-set these losses through existing municipal land acquisition and ecological restoration programs or other means.