Wetlands in London, Ontario: Lessons Learned from 905 Sarnia Wetland and Recommendations for the Future

DRAFT 2

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Background: Wetlands preserve ecological processes and function providing critical ecosystem and human services (OWES, 2014). Wetlands provide watershed protection, preserve biodiversity, and are important regulators of natural (C, N and water) cycles. They attenuate floods, provide economically valuable products, improve water quality and are important carbon stores contributing to climate resiliency. Despite their importance, in southern Ontario there has been a loss of 70% of wetland areas and in London wetland loss is greater than 85%.

The London Plan provides protection of all wetlands, however [it] does permit relocation/recreation of non-provincially significant wetlands in certain circumstances (see Policy 1334), even though wetland relocation or offsetting has proven to be overall unsuccessful at protecting wetlands in the US and Canada (Pouton and Bell, 2017).

Best Practises: Four Checklists

Checklist 1. Studying the Wetland Prior to Moving it: Baseline Conditions

The decision to move a wetland should only be made after the wetland site has been carefully studied. **This means studied for two to three years.** It is critical that there is in-depth knowledge of the site prior to inform any decisions regarding relocation of the pre-existing wetland. Such knowledge is also critical to ensuring a successful relocation and providing knowledge of pre-existing (baseline) conditions of the wetland for monitoring. The following questions should be addressed:

1. **How long has the wetland existed?**
2. **What is the bathymetry (area, water depth) of the wetland?**
3. **What is the sediment type and depth of the wetland?**
4. **What species live in the wetland?** A minimum of a two or three season survey, depending on whether the wetland is ephemeral, will be required to identify what is living in the wetland. Specifics of which surveys will be included will be determined at the EIS scoping meeting, but should include reptiles, amphibians, birds, fish, aquatic vegetation, including floating, submerged and emergent macrophytes and algae, and macro invertebrates. The latter have been shown to be useful indicators of wetland ecosystem health and are useful in biomonitoring (Anamaet et al., 2005; Spieles and Mitsch, 2000; USEPA, 2002). Surveys need to be balanced with minimizing disturbance to wildlife. Therefore, it will be important to assume that there is more there than identified by surveys to avoid surprises such as occurred at 905 Sarnia.

5. **What is the quality and character of the wetland waters, and surficial and groundwaters flowing into the wetland?** Water temperature and chemistry measurements are required to determine the pre-existing (baseline or pre-disturbance) conditions of the wetland. Water chemistry should be done following an approved design that captures both spatial and seasonal variability. This should include, at a minimum, pH, specific conductivity, TDS, nutrients (i.e., TP and TN), but could also include major ions, metals, organic pollutants etc.
6. **What is the relative importance of groundwater versus surficial flows to the wetland?** To understand the wetlands hydrologic budget, and particularly whether it is groundwater fed, a hydrogeological report must accompany the other surveys.
7. **What is the function of the wetland?** Assess the function of the wetland in terms of impact on flood management, water purification (removal of fertilizers), drought alleviation and mitigation of climate change.

Checklist 2. Site Selection for Relocation

Wetland site location must be carefully considered and informed by the studies done in section 1 above. In some cases, there must be a net gain to wetland function and the overall Natural Heritage System (Policy 1334 states where a wetland is between 0.1 ha and 0.5 ha, replacement may be considered at less than a one-to-one land area basis if there will be a net gain to wetland function and the overall natural heritage system). The following provides a checklist of critical considerations for site selection:

1. **Site selection is based on the availability of land and on policies that require the restored or created wetland to be in close proximity of a wetland loss** (usually due to migration considerations).
2. **Site selection must consider both present and future land uses**. Site selection is exceedingly important in terms of influencing the structure and function of the wetland and guaranteeing its longevity. It is imperative that once a wetland has been moved for one project, that "relocated" or offset wetland should not then itself become subject of another development project and be relocated again.
3. **Select a site with similar water depth**. The floor of the new wetland should be excavated such that it has varying depths to encourage the growth of various types of vegetation. New vegetation will grow in water depths of 1 metre or less. To achieve the ideal ratio of vegetation and open water, Ducks Unlimited advises that approximately 25 percent of the created wetland area be 1 m or more in depth. Excavating some deeper areas will allow some areas to remain free of vegetation and provide habitat for native fish.
4. **Select a site with a larger catchment and wetland area than the wetland being replaced**. To address the problem that restoration or re-creation projects rarely, if ever, produce an equally biodiverse and functional wetland, multipliers are employed to determine the scope of an offset project. Since wetlands are particularly valuable, the offset multiplier for wetlands is usually higher compared to other areas. *The London Plan* 1402 (3) states that "[replacement ratios greater than the one-for-one land area [are] required to mitigate the impacts of the proposed works" (*The London Plan*, 1402). Given the extent of wetland loss in London and the high ecological value they provide

the suggested multiplier ratio would be 3:1 for the loss or disturbance to a low to medium value wetland; and 4:1 for a high value wetland, particularly one that provided habitat for SAR species. Studies show that larger wetlands recover faster than smaller ones, and that smaller restored or created wetlands often become more isolated. Moreover, their lack of connectivity to larger systems greatly hinders the ability of local biota to restore the wetland to pre-impact functioning (Moreno-Mateos et al., 2012).

5. **Site investigations for the new wetland must include during spring runoff** to better understand water flows, and to calculate a more accurate estimate of the catchment area.
6. **Plan a wetland with an irregular shape.** Ducks Unlimited suggests that the new wetland be irregularly shaped such that it closely resembles a natural wetland (as opposed to a storm pond), providing coves to shelter species.
7. **A topographic survey is recommended to provide more accurate data about surface flow.** Should the survey determine that the site has less than 0.6 m drop, then excavating a basin is advised to ensure adequate surface flows to maintain the wetland.
8. **Test the soil/sediments at the potential site**. Wetlands are characterized by impermeable soils/sediments. Fine-textured soils/sediments -- not sandy or gravelly -- are suitable. Should the soil for the new site not prove suitable, clay soils can be brought in to line the basin so that the wetland can hold water. Although a created wetland may be structurally similar to a natural wetland, its hydrology may differ greatly if the permeability of the substrates is different (Kentula, 2002). Often the soils in created wetlands contain less organic matter than natural wetlands, which may affect plant growth. Using soils from a "donor" wetland or the impacted wetland to help create the new wetland may be able to increase the soil organic matter and provide the nutrients necessary for plant species, microbes and invertebrates (Kentula, 2002). Microbes in the wetland play a crucial role in biogeochemical reactions which cause nutrient cycling and sustain other higher plants and animals (Bodelier and Dedysh, 2013).
9. **The new wetland should be located near a significant woodland or other natural feature (i.e. stream) such that it is not isolated and can be an integral part of the natural landscape.**
10. **Select a site with similar hydrogeology to the original wetland (as identified in 1.2 and 1.5) to ensure similar water chemistry and water quality (as identified in 1.4) to safeguard the relocated species**. Ideally the new wetland site will be located in close proximity to the original site, or when that is not possible within the same watershed.
11. **Site selection will require a hydrogeologic survey of the new site to demonstrate that a wetland can be sustained**. These include inflows and outflows of groundwater and surface water, the resulting water levels and the timing and duration of soil saturation and flooding (Kentula, 2002).
12. **Site selection must ensure that the water quality of the wetland is maintained**. If there are chemical inputs from the surrounding area, these can overwhelm a wetland. Chemicals can alter the productivity and composition of the plant community of the wetland, possibly favouring nuisance species, and they may harm animal species that cannot survive and breed in chemically altered waters. For example, avoid locating a

wetland near roads where de-icing salts are used or near a golf course where fertilizers are used.

Checklist 3. Conditions for development

After the decision to create a new wetland is developed, the location determined, the following elements should be discussed with the proponent and included in the conditions of development (checklist 4 includes many details useful to this section):

1. **Timeline**. Timing is critical and there needs to be an agreed upon timeline with consideration of the development timelines, stabilization period, timing of species transfers (see below for additional information).
2. **An accepted report on baseline conditions**: including any direct sampling required such tadpole counts, "mucking about in the muck for turtles" – (it is also acceptable to assume such wildlife is present so that no in wetland sampling will be required).
3. **Width of buffer and composition of buffer vegetation** (see additional details below).
4. **Transfer protocols for wildlife and plants (terrestrial and aquatic).**
5. **Agreed to indicators of successful relocation.**
6. **Pre-construction requirements.** Development buildout requirements including but not limited to customized erosion and sedimentation controls and monitoring of the site, timing of species transfers (e.g., waiting for aquatic vegetation to be established), avoiding the establishment of invasive species including but not limited to phragmites and goldfish.
7. **Post construction compliance /adaptive monitoring**. This should include, but not be limited to duration, frequency, and reporting.
8. **Amount of any holdbacks or securities**. These are required to ensure successful implementation of the relocation of the wetland.
9. **There should be a requirement that any changes to the timeline or development phasing be subject to approval of the City.**
10. **Other conditions based on the preliminary work noted in previous steps may be required by the City.**

Checklist 4. Planning and Construction of the New Wetland Site

Planning and careful construction is critical to the success of the wetland and should include the following considerations:

1. **The construction of the new wetland site must be undertaken by a person with experience who has the required wetland knowledge base.** Ducks Unlimited may be a useful resource. See https://storymaps.arcgis.com/stories/c6d9fdf598b246dfbb21feca516fa6d4
2. **Considerations during the design phase should be based on the information and knowledge reported in stage 1.**
3. **Relocate the organic salvaged marsh surface (or SMS) from the impacted wetland to the new wetland.** The SMS contains a seed bank of marsh vegetation that could prove immensely beneficial to establishing a healthy and ecologically diverse wetland. SMS provides suitable chemical substrate for wetland seed germination and survival, as well as moist physical substrate (Hunt et al., 1996).

4. **Remove perimeter soil from new wetland site before spreading the excavated soil.** This new site perimeter soil should be removed from the site as it may alter the chemistry of the transferred wetland soil.
5. **Use small and lightweight excavation equipment employed during the project and avoid as much of the perimeter area as possible**; a narrow alleyway to the excavation area will help prevent significant soil compaction.
6. **The newly established wetland should be surrounded by a pollinator habitat and other habitat enhancements (ex. nesting boxes, snakes)**. For example, strategically placing branches or logs in and around the wetland will provide basking areas for frogs, turtles and ducklings.
7. **Plants for the re-created wetland should be native, fast colonizing and drought resistant to account for fluctuations in weather and climate and should closely to resemble those of similar, local wetlands**. Where possible, plants should be transferred from the original wetland to the new location. A variety of submergent and emergent plants should be planted, including a variety of shrubs and trees in the buffer areas to provide habitat for species as well as to ensure that water quality in the wetland is maintained. In the early years, the wetland must be closely monitored to ensure that invasive species are not permitted to colonize the area, particularly *Phragmites*.
8. **The Critical Function Zone (CFZ) is an important factor that should be included in any wetland relocation project**. The CFZ describes non-wetland areas within which biophysical functions and attributes directly related to the wetland occur. This could, for example, be adjacent upland grassland nesting habitat for waterfowl (that use the wetland to raise their broods). The CFZ could also encompass upland nesting habita**t** for turtles that otherwise occupy the wetland, foraging areas for frogs and dragonflies, or nesting habitat for birds that straddle the wetland-upland ecozone (e.g. Yellow Warbler). A groundwater recharge area that is important for the function of a wetland but located in the adjacent lands could also be considered part of the CFZ.
9. **Relocated wetlands require buffers** -- undisturbed vegetation adjacent to a wetland – to ensure a healthy wetland (Ducks Unlimited Canada (B)). Buffers provide habitat, food, corridors and breeding areas for species while also reducing the harmful effects of nearby development or activities on wetlands. A buffer of 20-50 meters beyond the CFZ will decrease sedimentation and improve water quality, while a buffer that extends beyond 50 meters is best for wildlife and water quality (Ducks Unlimited Canada (B)). The minimum buffer width will depend on the size of the wetland, the purpose of the buffer, the land use of the surround area, the soil type (less permeable soil will require larger buffers) and slope (Ducks Unlimited Canada (B)). For instance, a smaller, deeper, excavated wetland with minimal wildlife or hydrological value could require a buffer of only ten metres, while a wetland where the slope of the land is greater than 5 percent would require a buffer greater than 20 meters (Ducks Unlimited Canada, (B)). All these factors should be considered together when determining the buffer size. The buffer should consist of diverse, multi-layered vegetation, incorporating trees and shrubs. In all instances of created wetlands and their associated buffers, the vegetated buffer areas must be managed and maintained over the long-term to ensure that they are providing the maximum benefit to the wetland (Ducks Unlimited Canada (B)).

10. **Species transfers must be carefully planned and appropriate timelines developed to ensure that relocation of species occurs after the pond has stabilized and is occurring in a "safe" season to avoid interference of breeding species.** Species transfer should not occur until a year has passed since the creation of the new wetland to allow the environment to settle and to ensure that the water quality and nutrients can safely support wildlife. The planning phase should also consider timelines for species moves. For example, as learned from Sarnia 905, establishing appropriate aquatic vegetation ahead of the introduction of other species is critical. Monitoring of the site should confirm ideal conditions before any species transfers take place.
11. **Species transfer should occur slowly.** Species transfer should not occur during a single day or even week, but should be carried out over an extended period of time - and slowly - to ensure minimal negative impact and to increase the possibility of capturing more individuals from the original wetland site. Options for manual transfer for species include baited minnow trapping, dip netting, seine netting and hand picking. Once the individuals are captured, they are transferred to the new wetland in buckets. If insufficient resources are available to do manual transfers of species, other options are possible. For instance, if the new wetland site is sufficiently close to the old one, a trench could be dug from one site to the other to allow species to transfer naturally. Alternatively, the new wetland location could be situated near a stream or other water source to allow species to populate the created wetland on their own.
12. **Timing of the transfer is crucial**. The breeding time of certain species (i.e. the Western Chorus frog) as well as the schedules of burrowing animals (i.e. crayfish) must be accounted for throughout the process.
13. **Wetland relocation plans need to be carefully coordinated with development plans.** This will have to be planned and coordinated with the development construction plans. For example, fences, pathways and landscaping that might impact the new wetland must be completed efficiently to ensure wetland success.
14. **Appropriate signage is in place at the start of wetland construction to prevent invasive species.** Such signage should include education and by-law enforcement with respect to the release of exotic species into wetlands.

Checklist 5. Monitoring the New Wetland Site

A recent review done to inform Ontario policy on wetland offsetting, recognized that relocated wetlands can take up to 30 years to fully establish (Maron et al., 2012). With this in mind, long-term monitoring is a critical part of wetland relocation. All wetland relocations must include a monitoring plan which are required to be included in the conditions of development. This recommendation is critical given the lack of evidence that such altered and/or created wetlands recover full functionality and the long lags associated with wetlands' maturation. Before the monitoring process begins, developers and the City must clearly define what a "successful" relocation or restoration would entail for each *individual* project and outline a clear set of objectives for inclusion in the conditions of development. For example, under Policy 1334, the City may consider the replacement of wetlands rather than in situ protection where the features and functions of the wetland may be provided elsewhere **and would enhance or restore** (highlighting ed.) the Natural Heritage System.

Monitoring plans should be based on:

1. **Defining what a "successful" relocation or restoration would entail for each *individual* project and outline a clear set of objectives.** For instance, even if a site has revegetated, it could be functionally inadequate, and/or the plant composition may differ from the initial targets.
2. **Establishing methods to employ to determine the success of wildlife transfer and establishment.** Monitoring plans include measures of success and failure, and accountability and consequences for failed wetlands based on baseline conditions identified in Section 1.
3. **Monitoring plans that include surveys and measurements identical to those done in section 1 should be done at a minimum 1, 3 and 5 years after the establishment of the wetland and compared to the baseline conditions determined in section 1.**
4. **Monitoring plans that include remediation plans.** For example, if monitoring indicates that certain populations are in decline, additional individuals can be transferred into the compensation wetland (e.g. import tadpoles or broadcast more native seeds).
5. **Monitoring plans that include a rapid detection and rapid response** for problems such as invasive goldfish. Rapid detection may provide an opportunity for citizen science.
6. **Monitoring plans that consider nutrient controls.** For example, yard fertilizers could contribute unwanted nutrient loads to wetlands.

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