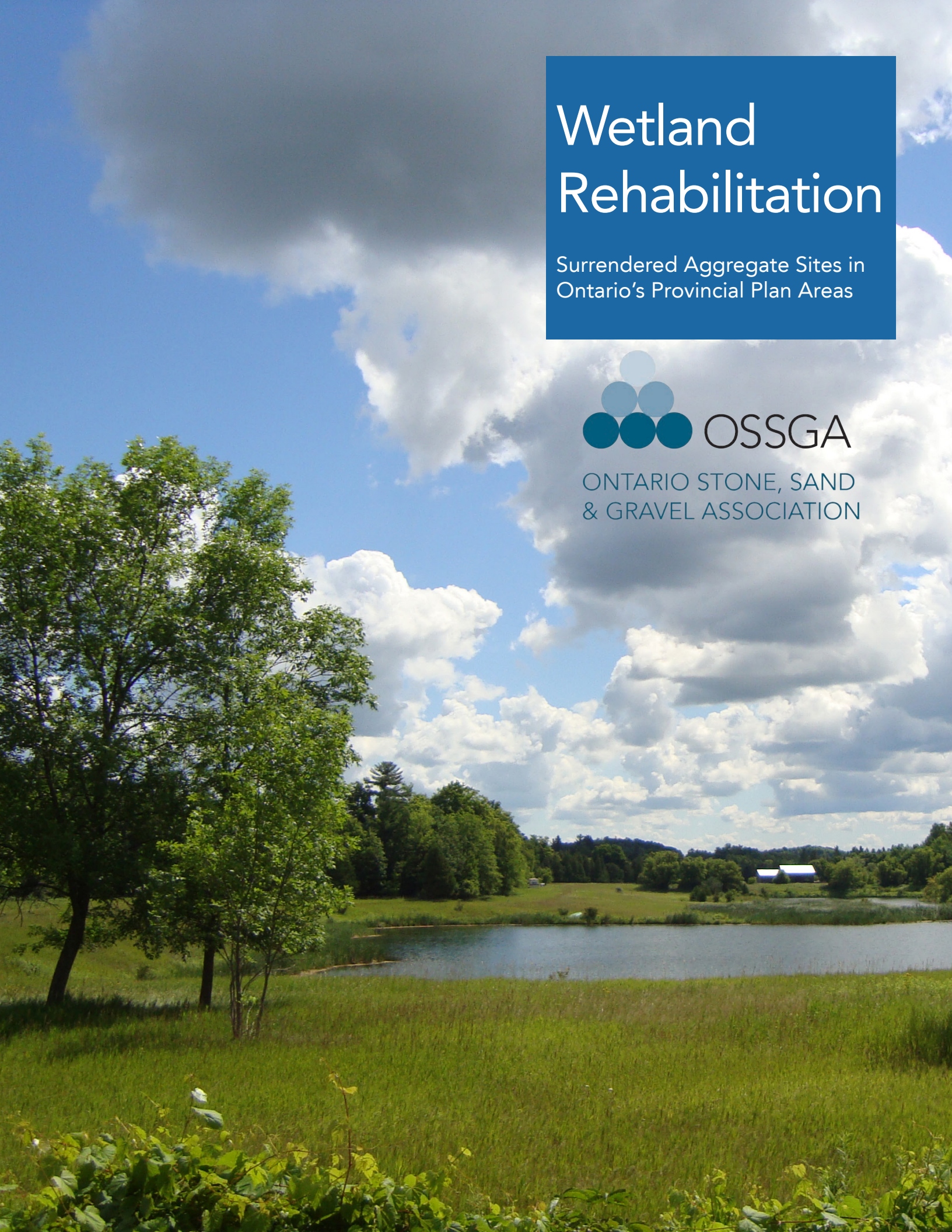


Wetland Rehabilitation

Surrendered Aggregate Sites in Ontario's Provincial Plan Areas

OSSGA

ONTARIO STONE, SAND & GRAVEL ASSOCIATION

Executive Summary

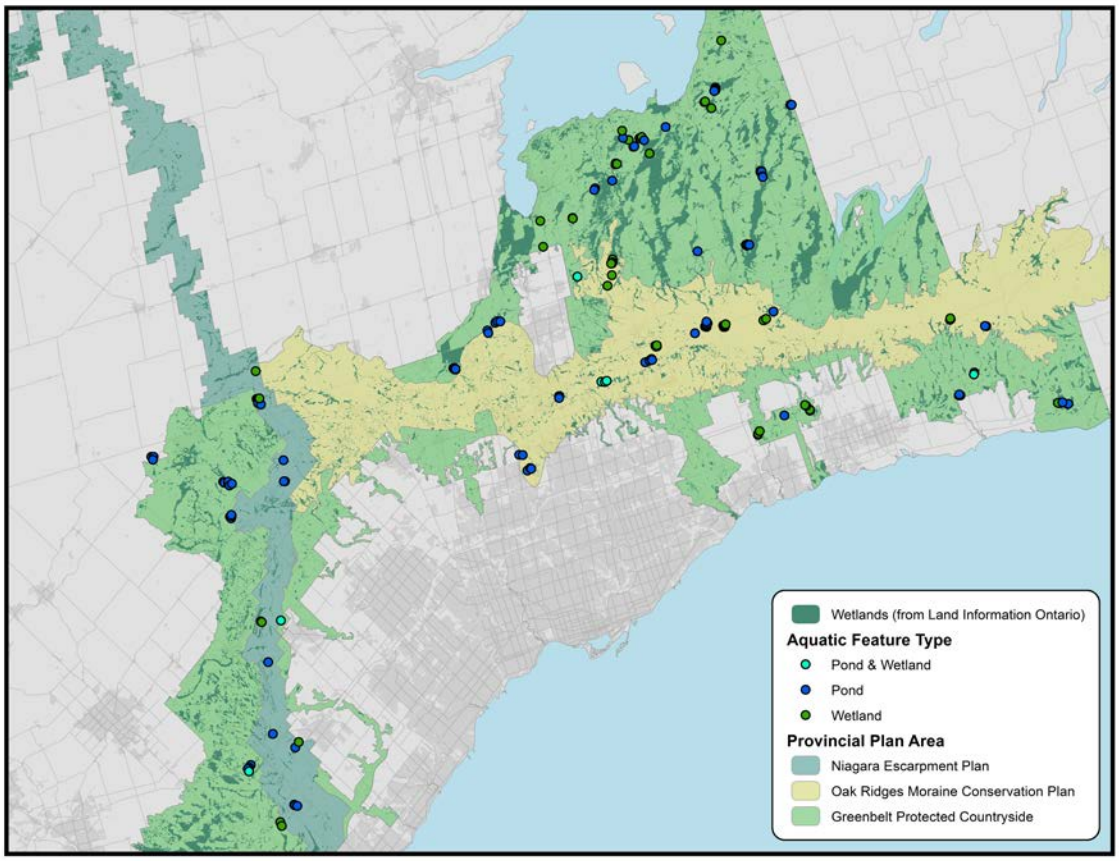
The preservation and restoration of aquatic habitat and wetland ecosystems across Southern Ontario remains an environmental and conservation priority. In the Greater Golden Horseshoe area of Southern Ontario, these natural heritage features have been impacted by previous development, and continue to be threatened by increasing growth and development pressure. One of the objectives of the recent co-ordinated review of the four provincial land use plans (The Growth Plan for the Greater Golden Horseshoe, the Greenbelt Plan, the Oak Ridges Moraine Conservation Plan and the Niagara Escarpment Plan) was to strengthen the protection of natural heritage resources.

Due to the geology of Southern Ontario, high quality aggregate deposits are often found in areas of significant natural heritage and hydrologic values, such as the Oak Ridges Moraine and Niagara Escarpment Plan Area. Given the importance of aggregate resources for supporting the construction and maintenance of Southern Ontario's infrastructure (roads, buildings, bridges etc.), aggregate extraction must continue in a manner that protects and helps to restore natural heritage features and their ecological functions.

In the Province of Ontario, the *Aggregate Resources Act, 1990* (ARA) requires that aggregate licences undergo progressive and final rehabilitation prior to being surrendered. Through the rehabilitation of aggregate extraction sites, there is an opportunity to create and restore natural heritage features, including aquatic ecosystems that contribute to the natural heritage features and hydrologic features and functions of the Greenbelt.

The objective of this study was to use desktop methodologies to determine the amount of aquatic habitat created through aggregate extraction and rehabilitation, within the Greenbelt Plan Area including the Oak Ridges Moraine Plan Area and Niagara Escarpment Plan Area. 68 of 123 (55%) of surrendered aggregate licences within the Plan Areas were found to include 173 rehabilitated aquatic habitat features ranging in size from less than 1 ha to 82 ha. Only aggregate sites that were licenced under the ARA (or its precursor, the *Pits and Quarries Control Act, 1971*) were included in this study. This study found that within the three Plan Areas, aggregate rehabilitation resulted in the creation of 293 ha of aquatic habitat features. In addition, nine rehabilitated aquatic habitat features were found to be part of six different Provincially Significant Wetland (PSW) Complexes. Although most of the created habitat features were quite small (less than 0.2 ha) they were often located adjacent to existing natural heritage features and can contribute to biodiversity and ecological functions on a local and broader landscape level.

This study recommends that additional field work and assessment on rehabilitated aquatic habitat features be undertaken to better classify and assess the ecological and social value of these features.



Contents

1.0 | Introduction

1.1 The Aggregate Industry in Ontario

Mineral aggregate resources are defined in Ontario by the Aggregate Resources Act, 1990 (ARA) as "*naturally occurring, non-renewable materials suitable for construction, industrial, manufacturing and maintenance purposes".* Aggregate resources include gravel, sand, clay, earth/topsoil, shale, and stone which are extracted from pits and quarries.

The majority of stone, sand, and gravel produced in Ontario is used by the public sector for road and highway construction, and maintenance[i]. Additional construction applications include manufacturing, asphalt, concrete and construction fill, which accounts for a significant amount of the aggregate consumed in Ontario. Aggregate is also used in chemical manufacturing processes such as glass and steel manufacturing for architectural applications.

Aggregate resource extraction is a highly-regulated process in Ontario. Legislation, regulations, and policies outline how new licences/permits are established, the operational requirements for existing licences, and the rehabilitation requirements (including progressive rehabilitation and final rehabilitation) once extraction has been completed.

1.2 Aggregate Rehabilitation in Ontario

Aggregate rehabilitation in Ontario is regulated by both Provincial and Municipal regulatory tools. The Provincial Policy Statement (2014) requires that:

s. 2.5.3.1 Progressive and final rehabilitation shall be required to accommodate subsequent land uses, to promote land use compatibility, to recognize the interim nature of extraction, and to mitigate negative impacts to the extent possible. Final rehabilitation shall take surrounding land use and approved land use designations into consideration.

Under the ARA all pit and quarry licences are required to undertake rehabilitation:

48. (1) *Every licensee and every permittee shall perform progressive rehabilitation and final rehabilitation on the site in accordance with this Act, the regulations, the site plan and the conditions of the licence or permit to the satisfaction of the Minister.*

In addition, the Greenbelt Plan (2005), Oak Ridges Moraine Conservation Plan (2001), Niagara Escarpment Plan (2005), and Growth Plan for the Greater Golden Horseshoe (2006) all contain specific policies that require aggregate rehabilitation and outline specific approaches to rehabilitation. For example, the Greenbelt Plan Policy 5.3.2.5.b states that:

"The disturbed area of a site will be rehabilitated to a state of equal or greater ecological value, and for the entire site, long-term ecological integrity will be maintained or restored, and to the extent possible, improved."

In addition, most municipal policy documents (i.e. Official Plans and Zoning By-Laws) also require that pit and quarries undertake rehabilitation once extraction is completed.

As required by the ARA there are two types of aggregate rehabilitation that must be undertaken in pit and quarry licences.

Progressive rehabilitation is defined as:

"rehabilitation done sequentially, within a reasonable time, in accordance with this Act, the regulations, the site plan and the conditions of the licence or permit during the period that aggregate is being excavated"

Final rehabilitation is defined as:

"rehabilitation in accordance with this Act, the regulations, the site plan and the conditions of the licence or permit performed after the excavation of aggregate and the progressive rehabilitation, if any, have been completed"

A pit or quarry licence cannot be surrendered until the Ministry of Natural Resources and Forestry (MNRF) is satisfied that final rehabilitation has occurred in accordance with the requirements of the licenced site plan.

1.3 Aquatic Habitat in Southern Ontario

Across Southern Ontario, the importance of aquatic habitat is recognized and substantial efforts have been made to protect and restore aquatic habitat features, particularly wetlands. In 2014, the MNRF was given a mandate to strengthen policies pursuant to wetland conservation, particularly where wetland losses have been most significant. The Wetland Conservation Strategy for Ontario 2016-2030 is the guiding document produced in response to this mandate and features policy and partnership strategies to implement the conservation of aquatic habitat features. The protection and restoration of aquatic habitat features such as wetlands, swamps, bogs, lakes, ponds etc., is important given the critical ecosystem services that they provide, for both humans and the environment. Some of these services include[ii]:

1. Water quality maintenance
2. Wildlife and fish habitat
3. Flood control & attenuation
4. Soil and bank stabilization
5. Groundwater recharge and discharge
6. Education and recreation opportunities
7. Carbon sequestration and climate change mitigation
8. Food source

9. Cultural and spiritual significance

The loss and conversion of these habitats continues. As of 2002, about 72% of pre-settlement wetlands located in Southern Ontario have been lost, with the greatest loss occurring in south western Ontario, parts of eastern Ontario, the Greater Toronto Area, and Niagara Area[iii]. Pre-settlement wetland extents were calculated using a combination of digital elevation modelling, soil information, quaternary geology and net balance ground water surface flow data. The 1967 Canada Land Inventory Present Land Use, 1982 Land Systems and 2002 Southern Ontario Land Resource Information System (SOLRIS) datasets were used to map the extent of wetland conversion post-settlement. It should be noted that the data excluded wetlands smaller than 10 ha, therefore these estimates are conservative[iv].

Within the Golden Horseshoe, built-up lands (i.e. commercial and residential development) account for the greatest permanent conversion and loss of aquatic habitat features. Outside of the Golden Horseshoe, agriculture, hydro right-of ways, transportation corridors, urban brown fields, and clearings within forest are significant causes of loss of aquatic habitat features[v].

A mapping exercise undertaken by Ducks Unlimited Canada in 2002, determined that about 0.1% of wetlands converted were due to extractive operations; however, the percentage was higher in some counties, including Essex, Haldimand-Norfolk and Ottawa-Carlton[vi].

Overall in Southern Ontario, agricultural drainage accounts for the largest loss of wetland areas[vii]. Aggregate extraction accounts for only a small fraction of the loss and conversion of aquatic habitat features.

The loss of aquatic habitat features, due to urban development and agricultural activities, represents a primarily permanent land conversion. However, in some cases, abandoned agricultural lands are now succeeding back to young woodlands, marshes or swamps. Aggregate extraction differs; because it is an interim land use, progressive and final rehabilitation is required to accommodate subsequent land uses, promote land use compatibility, and mitigate negative impacts[viii]. Through aggregate rehabilitation, it is possible to create and restore aquatic habitat features and there are a number of good examples across southern Ontario, including: the Milton Limestone Quarry/Kelso Quarry Park, in Milton, Burlington Quarry/Kerncliff Park in Burlington, and Snyders Flats in Bloomingdale. Nonetheless, there is a lack of research and data documenting wetland creation resulting from aggregate rehabilitation activities.

1.4 Trends in Aggregate Rehabilitation in Ontario

In 2009, The State of the Aggregate Resource in Ontario Study (SAROS) examined the province's aggregate consumption, demand, future availability, value, recycling, reserves and rehabilitation. Paper 6 examined pit and quarry rehabilitation[x]. This study concluded that there is an absence of data related to the quantity and quality of rehabilitation being undertaken in Ontario. Additionally, the results of the study highlighted that there is a need to better integrate emerging science recommendations with the rehabilitation of pits and quarries in order to achieve greater ecological outcomes. These recommendations can be applied to the rehabilitation of aquatic habitat features, such as the creation of species at risk habitat.

Between 2010 and 2014, researchers from the Ontario, Stone, Sand & Gravel Association assessed the final rehabilitated land use of 701 rehabilitated pits and quarries across southern and eastern Ontario. The most common land uses for the rehabilitated aggregate sites were determined to be: Natural (25%), Agriculture (21%), Open Space (15%), and Water (10%)[xi].

Findings from the SAROS Study indicated that the majority of pre-1990's rehabilitation efforts were relatively simple (i.e. slope and seed), with the primary goal being to return the land to agricultural productivity. Nonetheless, many of the older surrendered licences that employed traditional rehabilitation techniques have evolved into more complex and diverse ecosystems over time.

As a result of growing public concerns regarding the potential impacts of aggregate extraction, the industry has taken initiative to advance rehabilitation efforts towards more innovative approaches that result in the establishment and creation of diverse and highly functional ecosystems. The rehabilitation of pits and quarries can provide opportunities to establish and/or create specialized habitat for species at risk or other common wildlife (e.g. tall grass prairies, wetlands, alvars etc.)[xii]. The creation and enhancement of aquatic habitats such as fens, marshes, open and shallow waters, streams and swamps can be accomplished through the implementation of best management practices that maximize biodiversity potential and provide a habitat for native wildlife in Ontario[xiii].

2.0 | Study Objective

The objective of this study was to determine the total area (in hectares) and number of aquatic habitat features created through the aggregate extraction and rehabilitation within the Greenbelt Plan Area, including the Niagara Escarpment Plan and Oak Ridges Moraine Conservation Plan areas (i.e. "Study Area").

For the purposes of this study, an aquatic habitat feature is defined as:

"an area that is temporarily or permanently flooded annually and may include aquatic habitats such as open and shallow waters and/or wetlands (i.e. fens, marshes, bogs), created through the extraction of aggregate material from a pit or a quarry, but does not include watercourses or swamps."

Surrendered licences that were previously licenced under the *Pits and Quarries Control Act* or the ARA were included

Milton Limestone Quarry/Kelso Quarry Park: Located within the Niagara Escarpment Plan Area, the Milton Limestone Quarry operated from 1958 to 2001, supplying high quality crushed stone for construction use across the GTA. When extraction was completed, the 71 hectare property was donated to Conservation Halton. The rehabilitation of the site includes a large lake with areas of deeper water as well as shallow areas and shoals for fish habitat, varied cliff and slops landforms, and abutting natural areas[ix].

Burlington Quarry/Kerncliff Park: Once the site of the old Nelson Quarry, the 16 hectare site is now a city park located in the middle of Burlington on the Niagara Escarpment. The quarry was rehabilitated to wetland and tall grass prairie habitats and includes a Provincially Significant Earth Science Area or Natural and Scientific Interest (ANSI) and a Regionally Significant Life Science area. Burlington Quarry was awarded the OSSGA Bronze Plaque in 2005 for outstanding rehabilitation.

Snyders Flats: Located in Bloomingdale (Woolwich Township), Snyders Flats is part of the floodplain area of the Grand River. After years of use as an aggregate pit, the property was rehabilitated in partnership with the Grand River Conservation Authority to a functional aquatic ecosystem. Snyder Flats is now a 102 hectare Conservation Area and includes man-made wetland and aquatic habitat including warm water ponds, cool water ponds, shoreline habitat, floodplain meadows, and restored forests.

in this study. Revoked licences were also included in the analysis. Legacy sites located within the study area were not included as part of the desktop review or analysis, nor was progressive rehabilitation that is occurring within active licences. Although active licences undergoing progressive rehabilitation were not included in this study, it is important to recognize that active licences, and the aquatic habitat features created through progressive rehabilitation, contribute to the overall amount of aquatic habitat features created through aggregate rehabilitation.

The scope of this study is limited to a desktop review for identifying and mapping "aquatic habitat features" created through aggregate rehabilitation. No site visits or field assessments were completed as part of this study. It is intended that this study (Part One) be followed-up with field work to undertake a more comprehensive ecologically based assessment and analysis of the aquatic habitat features created through rehabilitation activities (Part Two).

The purpose of this study is to supplement the growing body of research on aggregate rehabilitation in Ontario and to broadly assess the role of aggregate rehabilitation in creating aquatic habitat features in Southern Ontario.

3.0 | Methods & Procedure

3.1 Data Sources & Database Development

This study was conducted by desktop review and analysis using a combination of ESRI ARCMAP 10.2 GIS Software and Google Earth software. Three databases were utilized to locate surrendered ARA licence boundaries:

10. Land Information Ontario (LIO) Aggregate Licences database – "*Aggregate Site Authorized Inactive*";
11. OSSGA Study of Aggregate Site Rehabilitation in Ontario database; and
12. The Ontario Aggregate Resources Corporation (TOARC) rehabilitation inventory database.

Only sites with available licence boundary information were included in this study in order to accurately identify and map aquatic habitat features created through aggregate extraction. The LIO Aggregate Licence database

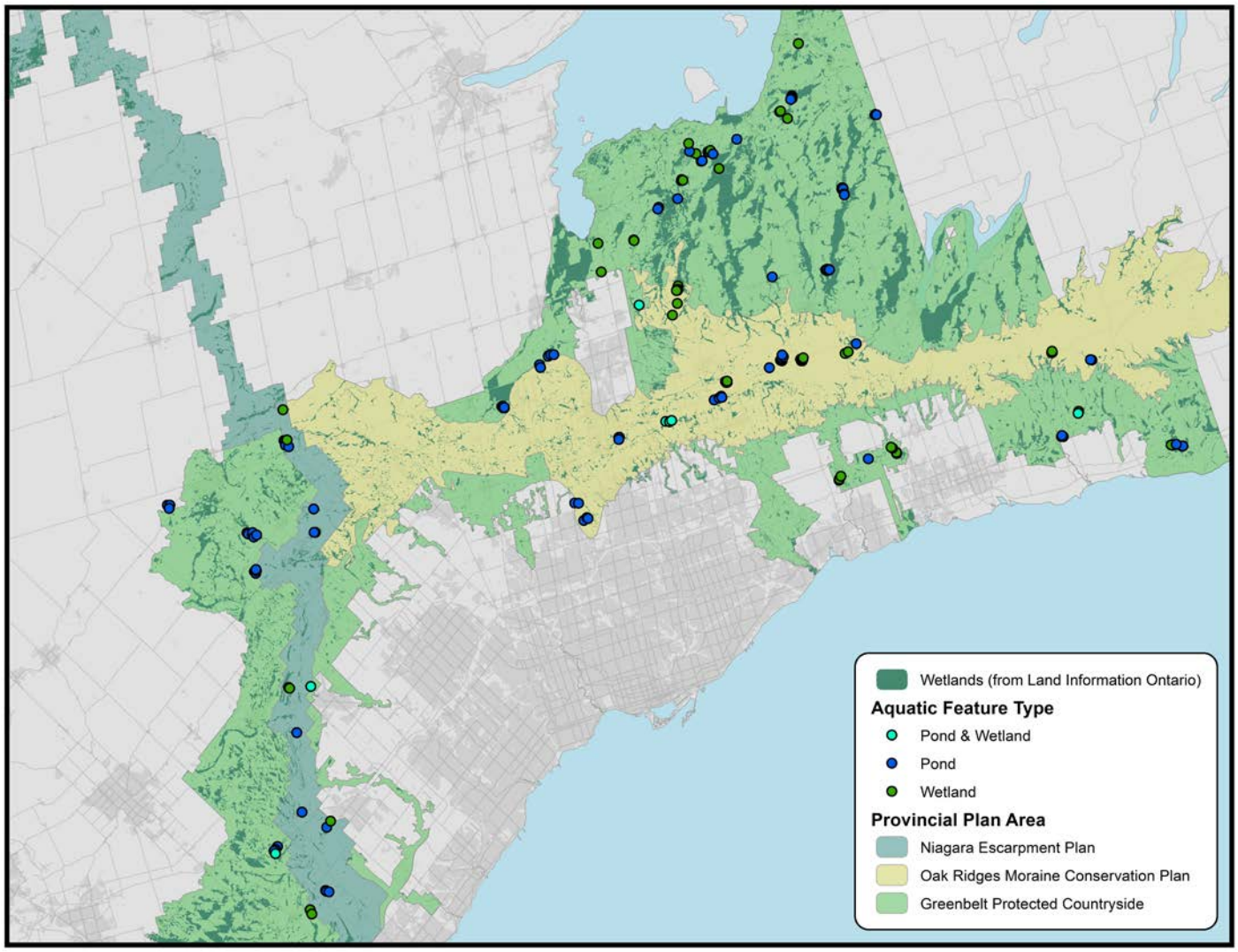


Figure 1: Location of digitized Aquatic Habitat Features

included shapefiles of each licence boundary, but the TOARC and the OSSGA study database did not contain any licence boundary information. For some sites in the TOARC and OSSGA databases, licence boundaries were digitized from Aggregate Resource Inventory Papers (ARIP). Sites from the OSSGA and TOARC databases, where licence boundaries could not be obtained, were excluded from the study due to insufficient data.. A total of 123 surrendered licences were identified for inclusion within this study. Fifty of these licences were located in the Oak Ridges Moraine Conservation Plan area, 20 were within the Niagara Escarpment Plan area, while the remainder were captured within the Greenbelt Plan area.

Table 1: Attribute data

Attribute	**Fields**	**Description**
Object ID	n/a	Unique identifier for digitized aquatic habitat feature
ALPS No.	n/a	The unique identifier under the Aggregate Licensing Permitting System
Aquatic Habitat Feature Classification	Pond; Wetland; Both	A description of the digitized aquatic habitat features
Landscape Connection	Woodland; Wetland; Both	An assessment of aquatic habitat features connectivity within the landscape
Feature Area	n/a	Surface area (in hectares) of the aquatic habitat feature as digitized
Licencee		Name registered on the *Aggregate Resource Act* licence
Pit/Quarry	Pit; Quarry	Extraction method for the licence
Licence Status	Surrendered; Revoked	Licence status from the ALPS system
Date Surrendered	(yyyy-mm-dd);	Date of licence surrender
Provincial Plan Area	Greenbelt; Oak Ridges Moraine; Niagara Escarpment Protection Act; Oak Ridges Moraine;	The Provincial Plan area where the licence is located
Provincial Plan Land Use	Settlement Area; Rural Settlement; Protected Countryside/Natural Heritage System;	The Provincial Plan Land use designation for the licence area
Unlimited Tonnage	Yes; No	Is the tonnage for the licence unlimited?
Annual Tonnage		Total tonnage extracted, per year, under the licence
Lic Area		Total area of the licence boundary
Licence Class	Class B Licence <= 20000 Tonnes; Class A Licence > 20000 Tonnes	*Aggregate Resource Act* classification descriptor
Data Source	TOARC; OSSGA; LIO	Database source for the data used
Site Name		Additional site identifier (local name)
UT Munic		Upper tier municipality where the licence is located
Geog. Town		Geographic township where the licence is located
LT Mun		Lower tier municipality where the licence is located
MNRF District		Ministry of Natural Resources and Forestry district where the licence is located
Lot		Legal lot description of the licence area
Con		Legal concession description of the licence area
Extraction Area		Area (in hectares) that could be extracted for the licence
X Coord		Latitudinal coordinate of the licence
Y Coord		Longitudinal coordinate of the licence

3.2 Attribute Data

The following information was collected for each of the sites included in this study. This information is stored as tabular attribute data in a GIS Shapefile for the digitized aquatic habitat features. This information is also included in Appendix A of this Report. All data compiled in ARCMAP was exported to Microsoft Excel for statistical analysis.

3.3 Digitizing Aquatic Habitat Features

Aerial review of each site was undertaken using ARCMAP 10.2 base mapping (from a variety of sources) and Google Earth imagery (leaf-free and spring photography was used where possible). Appearance of soils (where visible), changes in vegetative communities, and visible open water were all considered during the delineation of the boundary of the aquatic habitat features.

Once digitized, aquatic habitat features were classified as ponds, wetlands, or combined aquatic habitat features. Classifying these features was based on the aerial imagery interpretation only, including: the presence of open-water, depth of water judged by evidence of aquatic vegetation and the water colour visible in the aerial imagery (i.e. a lighter water colour would indicate a shallow aquatic habitat feature), and distinct changes in vegetative communities.

A Pond was defined as appearing to have primarily open water with little to no emergent or shallow plant life. Water colour was the main indicators for deeper open-water, which is significantly more blue/dark than vegetated, shallow water. Additionally, more geometrically shaped (i.e. rectangular and roughly symmetrical) features were classified as ponds because they were assumed to have less transitional area between terrestrial and aquatic habitats.

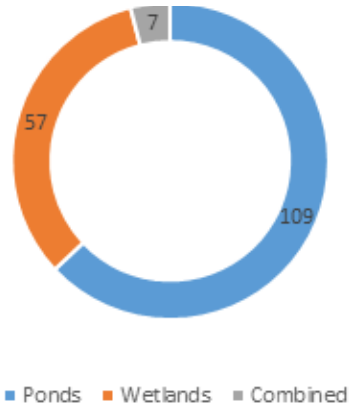
A Wetland was defined as areas of shallow aquatic plant growth, areas where there was evidence of standing water at some point during the year, as well as low lying areas with a definite change in vegetation. Organic shaped (i.e. curvilinear and irregular) aquatic habitat features tended to appear more like wetlands than ponds because of greater transition areas between terrestrial and aquatic habitats.

The classification of Both Pond and Wetland was used where a definite determination of a pond or wetland could not be made by aerial photography or had characteristics of both features.

3.3 Landscape Connectivity

Landscape connectivity was also assessed for each of the digitized aquatic features and recorded in the database. Landscape connectivity was determined to be the presence of adjacent natural heritage features, such as woodlands, located within 120m of the digitized aquatic habitat feature.

Figure 2: Break down of the type of Aquatic Habitat Features digitized in the study area



4.0 | Assumptions & Limitations

The methodology of this study relies primarily on the desktop review and interpretation of aerial imagery to identify and characterize aquatic habitat features. A variety of habitats can be characterized as aquatic habitat features; however not all of these habitats can be accurately identified and characterized from air photo interpretation. For example, wetlands types can include: bogs, fens, swamps, and marshes[xiv]. Some of these wetland types can be identified from air photos (such as marshes) other wetland types (such as swamps) may be entirely forested and not include any open-water areas. These types of aquatic habitat features cannot be identified through air photo interpretation and analysis. It is possible that additional aquatic habitat features may have been created though aggregate rehabilitation and not captured in this study, as they are not visible from aerial photography. Progressive rehabilitation efforts were not included in this study, therefore the actual area of wetlands created through licenced extraction is underestimated in the results.

Figure 3: Aquatic habitat feature classified as a pond

An analysis of aerial photography, as described in section 2.3, was used to digitize and classify the aquatic habitat features created through aggregate rehabilitation. These features were also classified as Pond, Wetland, or Both Pond and Wetland based on the air photo interpretation and background mapping of landscape features as described in Section 3.3. It is possible that some of the aquatic habitat features classified as Wetland may not fit the definition of a Wetland based on the Ontario Wetland Evaluation System (OWES) Southern Manual[xv]. Water depth, soils, and vegetative communities are difficult to assess from aerial photography. The limitation of using aerial photography to accurately identify and classify aquatic habitat features likely creates a bias towards classifying features as ponds and underrepresenting the amount of wetland area created through rehabilitation. Additionally, the size of the digitized aquatic habitat features is based on aerial photograph interpretation; therefore, the size of the digitized features is an approximation only. Finally, it is assumed that all wetlands within the licensed area were created by extraction, however it is possible that they were pre-existing features within the licenced area but outside the limit of extraction.

These assumptions and limitations are due to the desktop methodologies used to analyze and classify aquatic habitat features created though aggregate rehabilitation. Ground truthing is necessary to further assess and determine the specific types and characteristics of the aquatic habitat features created through aggregate rehabilitation and identified in this study. To accurately delineate wetland boundaries, field studies would include an evaluation of vegetation community forms, soils/substrates, percent open water, wildlife observations, and surrounding topography.

5.0 | Results

As shown in Figure 1, 68 out of 123 (55%)surrendered licences within the study area contain aquatic habitat features. Within those 68 licences, a total of 173 aquatic habitat features were analysed. In some cases, one licence included more than one aquatic habitat feature.

Aquatic habitat features that were classified as ponds during aerial photo analysis were found to account for 63% of the total number of aquatic habitat features digitized on surrendered licences. Aquatic habitat features classified as wetlands accounted for 33% of the total number of aquatic habitat features, and aquatic habitat features that were classified as both a pond and/or a wetland were found to be 4% of the total number of aquatic habitat features digitized in the study area (see Figure 2).

5.1 Ponds

The aquatic habitat features that were digitized and classified as pond (see Figure 3 for an example) account for the majority of the surveyed aquatic habitat features in the study area. The total area of the aquatic habitat features digitized and classified as pond is 249.8 ha. The mean surface area of the 109 ponds digitized in the study area is calculated at 2.3 ha, however one exceptionally large outlier (Milton Quarry) of 81.7 ha skewed this figure.

Figure 4: Distribution in the size of the smallest 75% of aquatic habitat features digitized in the study classified as ponds

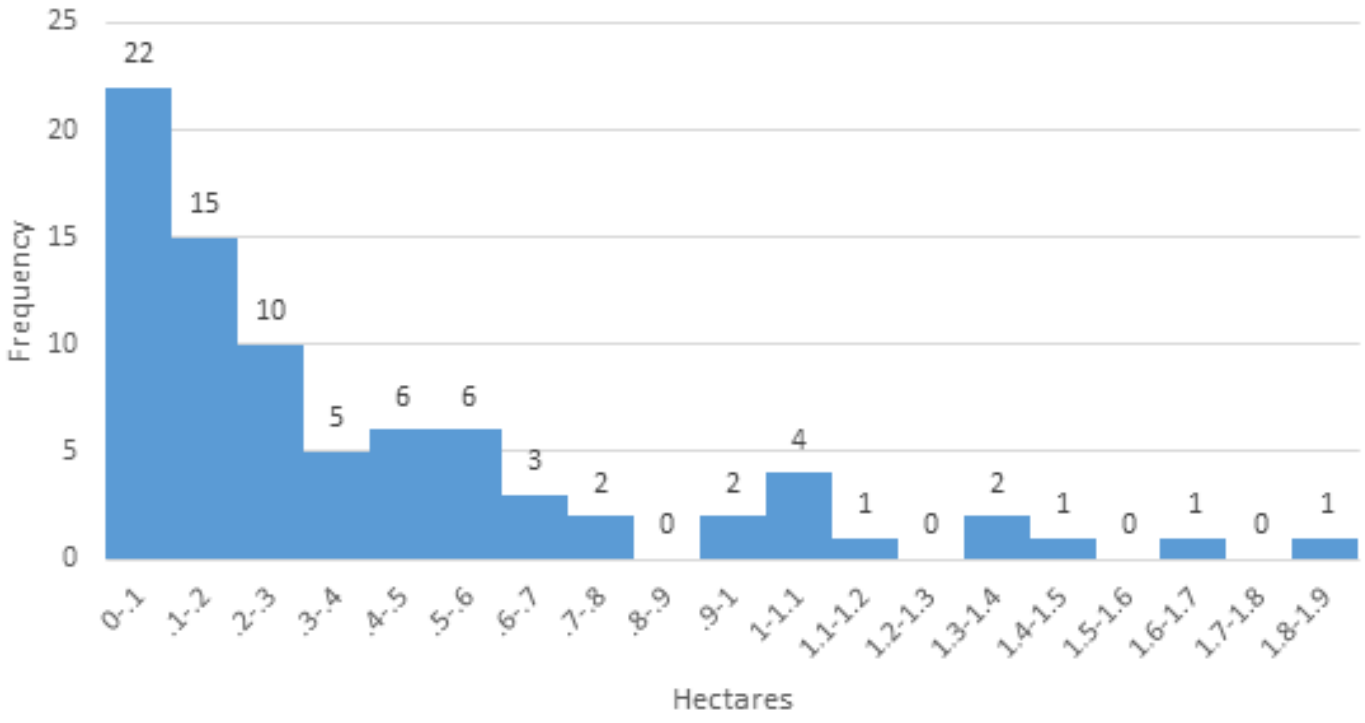


Figure 5: Aquatic habitat feature classified as a wetland

Removing this outlier, ponds are on average 1.6 ha in size and were often observed to be geometric in shape and appear to have deep, open-water areas.

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5.2 Wetlands

A total of 57 aquatic habitat features digitized in the study area were classified as Wetland (see Figure 6 for an example). Wetlands accounted for a smaller percentage of the aquatic habitat features and were generally smaller in size. The total area of the aquatic habitat features digitized and classified as wetlands is 37.8 ha.

Similarly, to the aquatic habitat features that were classified as Pond, features that were classified as Wetland also tended to be small with the majority of features determined to be 0.2 ha or less (see Figure 7). The interpretation of air photos from different times of the year would likely report different area findings due to the impact of seasonal fluctuations on the aquatic features.

Given that the primary methodology used in this study to identify and classify aquatic habitat features was aerial photograph interpretation, the number of sites that are classified as "Wetland" is an approximation only. This desktop analysis should be confirmed with field observations in order to verify results and better identify and classify aquatic habitat features that are created though aggregate extraction and rehabilitation.

5.3 Both Pond and Wetland

Seven aquatic habitat features were identified as being both Pond and Wetland. On average, the size of these features was 0.8 ha. The total area of the aquatic habitat features digitized and classified as both ponds and wetlands is 5.6ha. Field verification of the identified aquatic habitat features could result in a greater number of features being classified as a Pond or Wetland as shallow water and riparian vegetation are difficult to discern from aerial imagery.

5.4 Landscape Connectivity

Figure 6: Distribution in the size of the smallest 75% of aquatic habitat features digitized in the study classified as wetlands

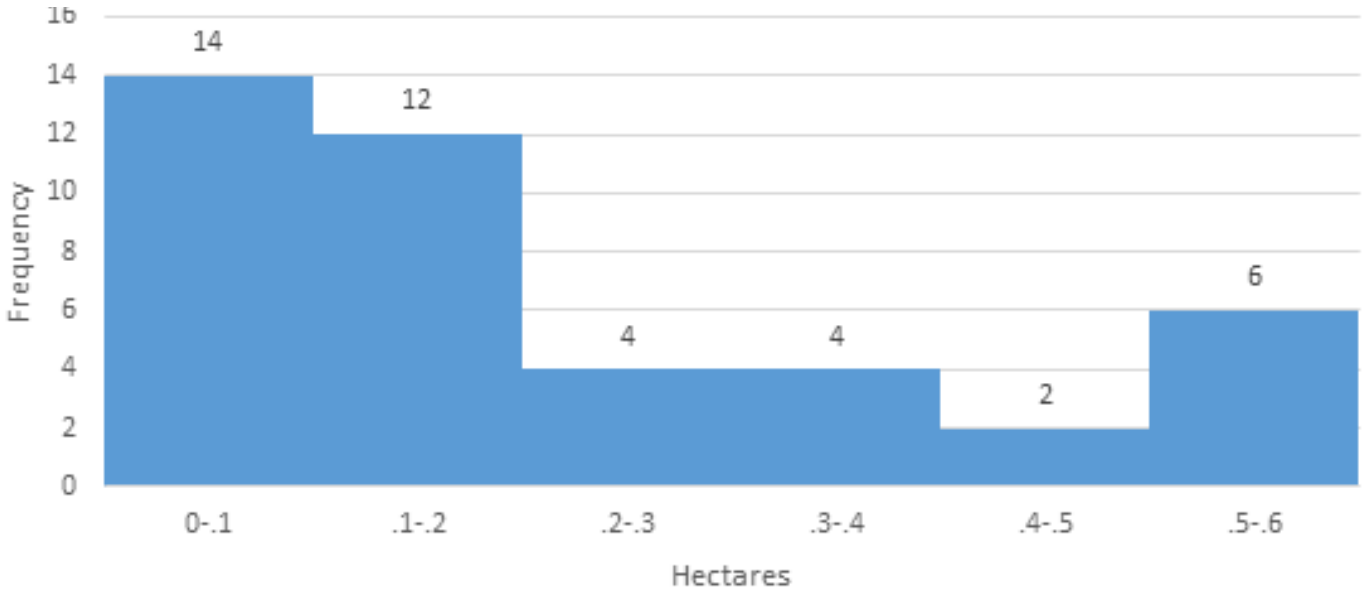

Figure 7: Aquatic habitat feature classified as both a pond and a wetland

As shown in Table 2, out of the total of 173 Aquatic Habitat Features digitized, 60% were found to be connected (within 120 metres) with adjacent natural heritage features. Where landscape connection was observed, aquatic habitat features were connected with adjacent woodlands. No observations of wetland connectivity were recorded. It is assumed that this is because policy and regulatory constraints prevent extraction in close proximity (relative to the size of the aquatic habitat feature) to existing wetlands (provincially significant or not) as well as the difficulty in identifying wetlands from air photo interpretation.

Table 2: Aquatic habitat features landscape connectivity

	Woodland Connectivity	Wetland Connectivity	Woodland & Wetland Connectivity	No Connectivity
Ponds	30	0	23	56
Wetlands	38	0	9	10
Both	4	0	0	3
Total	72	0	32	69

6.0 | Discussion

6.1 Amount of Aquatic Habitat Created Through Aggregate Extraction and Rehabilitation

Overall the total surface area of aquatic habitat features created on surrendered licences through aggregate extraction and rehabilitation within the study area is 293ha. This is the equivalent area of 1,849 NHL sized ice rinks. This total calculated area for the amount of aquatic habitat features created through aggregate extraction and rehabilitation in the study area is likely underestimated. This under-estimation of habitat creation is the result of two key explanations:

1. As detailed in Section 4.0, not all aquatic habitat features include areas of open-water. This study relied on aerial imagery interpretation to identify aquatic habitat features, therefore, the observation of open-water was the primary indicator for the presence of aquatic habitat features. Aquatic habitat features can also include watercourses, vernal pools in woodlands, swamps, and other wetland types that may not be perceptible on aerial photography. It is likely that additional aquatic habitat features have resulted from aggregate extraction and rehabilitation, but have not been captured in this study, as they are not visible from aerial photography.

2. However, aquatic habitat features that are forested are less likely to have been created through aggregate rehabilitation activities, due to the of the complexity and time involved in their creation. Wetland types that include open-water (i.e. ponds) are highly represented in the study, as this type of aquatic habitat feature is quickest and simplest to establish through rehabilitation efforts. Nonetheless, it is possible that forested aquatic habitat features (i.e. swamps) have been created through aggregate rehabilitation or naturally developed on these sites over time through succession, thus; aquatic habitat features with no open-water component (such as swamps) are likely under-represented in this study.

In 2015, there were 3,666 active licences for pits and quarries on private land in areas designated under the ARA, 2,644 aggregate permits on Crown land and 1 wayside permit . This study excludes aquatic habitat features created through progressive rehabilitation on active ARA licences.

6.2 Size of Aquatic Habitat Features Created Through Aggregate Extraction and Rehabilitation

The size of the aquatic habitat features identified in this study area were observed to be relatively small. The majority of the aquatic habitat features that were analyzed and classified as wetlands or ponds were less than 0.2 ha in surface area. While a few large aquatic habitat features did contribute a significant amount of area to the total created surface area, the study results indicated that there is a tendency for small aquatic habitat features (less than 0.2 ha) to be created through aggregate rehabilitation. In addition, clusters of small rehabilitated aquatic habitat features are often found within one licence or in several licences that are located adjacent to each other.

The results of this study indicated that most aquatic habitat features created through rehabilitation are on average around 1.2 ha^2 and clusters of small aquatic features are often created within one licence. Although the ecological function of the identified aquatic habitat features was

not assessed as part of the scope of this study, small wetlands have been shown to support disproportionately large levels of biodiversity, especially for amphibians who require seasonal variation in water levels that are more common in small wetlands[xvii]. The majority of naturally occurring wetlands are small and are extremely valuable for maintaining biodiversity[xviii]. Furthermore, human constructed wetlands can also provide substantial biodiversity enhancement, water quality improvement, and flood control values[xix]. The addition of small wetlands into the landscape, through the extraction and rehabilitation of aggregate sites, can therefore contribute to conservation goals in Ontario.

Interpretation of these results should take into consideration the potential for eutrophication of shallow, smaller ponds (typically not the case with larger lakes), which may result in the succession of ponded areas to wetlands or swamps.

6.3 Landscape Connectivity & Integration

As described in Section 3.4, a desktop assessment of landscape connectivity was included as part of the desktop analysis used in this study. Results of this study show that the majority of small aquatic habitat features in the study area have some degree of landscape connectivity with adjacent lands (i.e. there are natural heritage features, such as woodlands, located within 120m of the digitized aquatic habitat feature). This observation indicates that these features can serve as connections and corridors, adding to diversity of habitat and ecosystem services on a broader landscape level.

6.4 Provincially Significant Wetlands

Nine (9) aquatic habitat features delineated as part of this study, within rehabilitated aggregate sites, were found to be part of six (6) Provincially Significant Wetland (PSW) Complexes (see Table 3 and Figure 9).

All licences were rehabilitated and surrendered, except for ALPS ID #6611 which was revoked. Unfortunately, no information is available regarding the rehabilitation of the revoked licence.

The MNRF defines PSWs as *"those areas identified by the province as being the most valuable. They are determined by a science-based ranking system known as the Ontario Wetland Evaluation System (OWES)"*[xx]. The inclusion of rehabilitated aquatic habitat features as part of a PSW Complex indicates that aggregate extraction and rehabilitation can create and restore natural heritage features that are of significant value. In addition, this finding suggests that rehabilitated aquatic habitat features integrate into the surrounding landscape and contribute notable social and ecological values in a functional manner. All of the identified aquatic habitat features, identified as part of a PSW Complex, are located in the Greenbelt Protected Countryside and identified as part of the Natural Heritage System. Therefore, these areas that were once utilized for aggregate extraction are now recognized as Water Resource Systems with key natural heritage features and key hydrologic features and are now protected features under the Greenbelt Plan.

This is evidence that aggregate extraction and rehabilitation can add significant value to a natural heritage system as well as successfully integrate into the surrounding landscape in a functional manner.

7.0 | Recommendations & Next Steps

To further the analysis and results of this study, the following recommendations and next steps are provided:

1. Once a licence is surrendered, a delegated authority should be responsible for recording and tracking the land-use and condition of the site over time in order to assess the short-term and long-term rehabilitated condition of surrendered licence. Integration with the TOARC e-surrender

Table 3: Aquatic habitat features that are part of PSW Complexes

ALPS Licence ID	Object ID (Aquatic Habitat Feature)	Classification (pond, wetland, both)	Aquatic Habitat Feature Size (ha)	Provincially Significant Wetland
6555	17	Pond	2.06	Cataract Southwest Wetland Complex
6555	19	Pond	1.14	Cataract Southwest Wetland Complex
6555	20	Pond	0.57	Cataract Southwest Wetland Complex
6643	3	Wetland	0.06	Black River Wetland Complex #1
6659	40	Wetland	4.27	Zephyr-Egypt Wetland Complex
3201	66	Wetland	0.94	Clarke Summit Wetland Complex
3177	80	Wetland	0.13	Heber Down Wetland Complex
3177	81	Wetland	0.05	Heber Down Wetland Complex
6611	134	pond	0.57	Pottageville Wetland Complex

database is a potential option.

2. As a follow-up to this study, conduct field-based research to assess and determine the ecological and cultural characteristics of the aquatic habitat features created through the rehabilitation of surrendered aggregate licences in this study area.

3. Undertake additional research on the ecological role of small aquatic habitat features (i.e. design, connectivity, habitat characteristics etc.).

4. Encourage aquatic habitat rehabilitation where topography and soil conditions would support it. Develop Industry Best Management Practices for the creation of a range of sizes and types of aquatic habitat features as part of aggregate rehabilitation.

5. Assess additional surrendered aggregate licences outside of the study area.

8.0 | Conclusions

The findings of this report indicate that aggregate extraction and rehabilitation in Ontario can create aquatic habitat features. A total of 123 previously licenced aggregate sites were assessed in the study area and 68 of these licences included a rehabilitated aquatic habitat feature. The study results reveal that 173 aquatic habitat features were created through aggregate extraction and rehabilitation, resulting in a total surface area of 293 ha.

1. The rehabilitation of surrendered aggregate licences in Ontario results in the creation of aquatic habitat features. These aquatic habitat features provide ecological functions, are often integrated with adjacent natural heritage features, and in some cases, hold ecological and social values that are significant enough to be considered part of PSW Complexes.

2. The study area included an assessment of licences within the Greenbelt Plan area. The study results provide evidence that the rehabilitation of licenced aggregate extraction sites can contribute to the Environmental Protection Vision and Goals of Southern Ontario's Provincial Plans (i.e. Greenbelt, Oak Ridges Moraine Conservation Plan, Niagara Escarpment Plan).

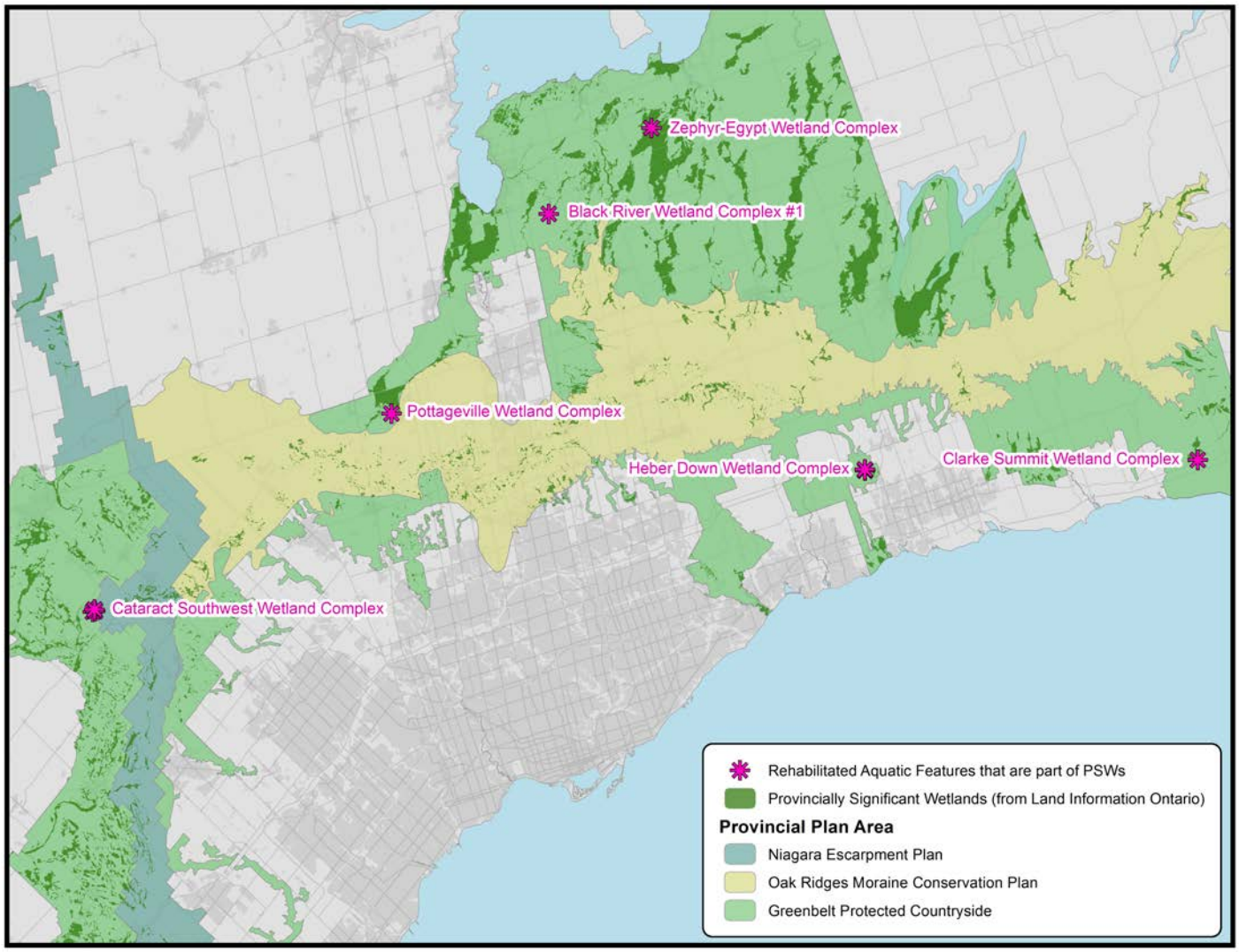

Figure 8: Provincially Significant Wetland Complexes that include Aquatic Habitat Features

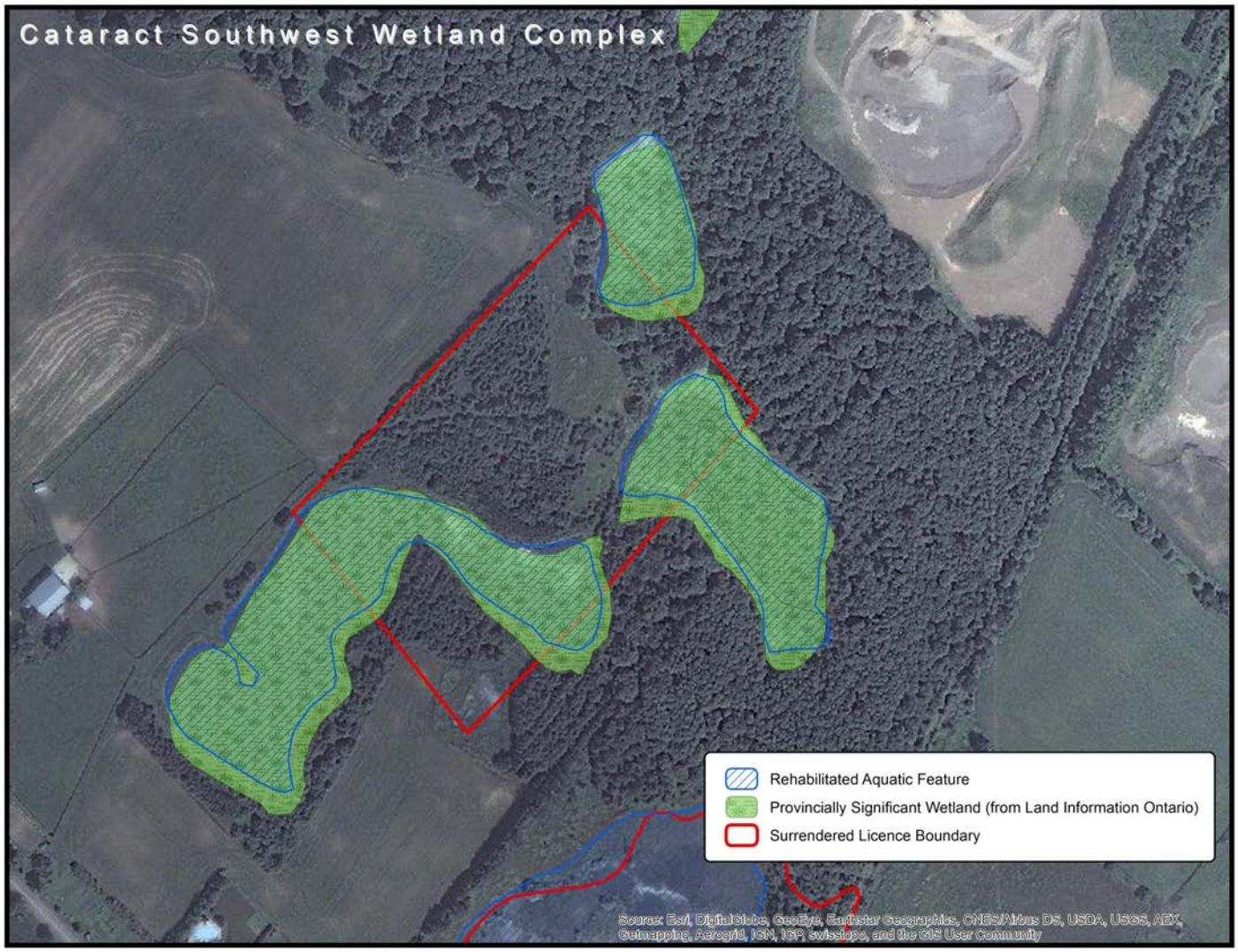

Figure 9: Cataract Southwest Wetland Complex and digitized Aquatic Habitat Features

3. Follow-up field research is needed to substantiate the results of the desktop review undertaken in this study and to further assess the type, and ecological and social functions of the identified aquatic habitat features.

Endnotes

[i]Paper 4: State of the Aggregate Resource in Ontario Study. Prepared for the Ontario Ministry of Natural Resources by LVM-JEGEL. 2009.

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[iii]Ducks Unlimited Canada. (2010). Final Report, Sothern Ontario Wetland Conversion Analysis. Pg. 1.

[iv]Ibid. Page 1.

[v]Ibid. Page 21.

[vi]Ibid, Page. 16

[vii]Bardecki, M.J. (1982). The status of wetlands in southern Ontario. Wetlands 2(1): 262-270.

[viii]Provincial Policy Statement (2014). S. 2.5.3.1. Page 28

[ix]Lowe, S. & Yundt, S. Kelso Quarry Park, from Quarry to Public Conservation Area, in Ontario's Greenbelt. Rock to Road, February 1, 2010. Available at https://www.rocktoroad.com/aggregates/profiles/kelso-quarry-park-1032

[x]Paper 6: Rehabilitation State of the Aggregate Resource in Ontario Study. Prepared for the Ontario Ministry of Natural Resources by Skelton Brumwell & Associates Inc and Savanta Inc. 2009.

[xi]OSSGA Study of Aggregate Site Rehabilitation in Ontario, Part I (2010-2011), Part II (2010-2013), and Part II Addendum (2014)

[xii]Best Practice Guidelines for Aggregate Rehabilitation Projects, Extracting the Benefits for Species At Risk and Rare Habitats. Prepared for the Ontario Aggregate Resources Corporation by Savanta Inc, Gartner Lee Limited, and Azimuth Environmental Consulting Inc. February 2008. Page 1.

[xiii]Ibid. Page 3.

[xiv]Ontario Wetland Evaluation System Southern Manual. 3rd Edition, Version 3.3. Government of Ontario. 2014.

[xv]Ibid. Page 48

[xvi]Aggregate Resources Statistics in Ontario – Production Statistics 2015. The Ontario Aggregate Resources Corporation. 2015

[xvii]Downing, J.A. (2010) Emerging global role of small lakes and ponds: Little things mean a lot. Limnética 9(1):9–24.

[xviii]Marton JM, et al. (2015) Geographically isolated wetlands are important biogeochemical reactors on the landscape. Bioscience 65(4):408–418

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[xx]Ontario Ministry of Natural Resources and Forestry. Significant Wetlands and the Ontario Wetland Evaluation System. Available from: http://www.web2.mnr.gov.on.ca/mnr/Biodiversity/wetlands/Significant_wetlands_and_OWES.pdf

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