Turtle Status Report

Habitat, Populations, Reproduction and Contaminant Assessment In and Near to the Massena/Akwesasne St. Lawrence River Area of Concern (AOC) for Beneficial Use Impairment (BUI) Advancements

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EXECUTIVE SUMMARY

The Turtle Status Report summarizes the findings of field work conducted during summer 2013 to investigate turtle habitat, populations, reproduction and contaminants in and near the St. Lawrence River Massena/Akwesasne Area of Concern (AOC). The 2013 Turtle Study was designed to assist with the evaluation of Beneficial Use Impairments (BUI) for turtles in a project funded by a U.S. Environmental Protection Agency (USEPA) grant (GL-9722130-10) to the St. Regis Mohawk Tribe (SRMT) through the Great Lakes Restoration Initiative (GLRI). A Quality Assurance Project Plan (QAPP) was developed based on the findings of the identified data gaps in the Turtle Interim Status Report to guide this investigation.

Habitat availability and suitability was evaluated through a GIS analysis and a Habitat Suitability Index (HSI) model. Populations were assessed through trap-based rapid assessments (TRA) and visual surveys. Turtles trapped were examined for deformities. Contaminant burdens were assessed in snapping turtle eggs collected inside and outside the AOC and analyzed by Pace Analytical Laboratories using standard EPA methods.

Based on wetlands surveyed in 2013, the amount of wetland habitat inside and outside the AOC did not appear to be a limiting factor for turtle populations. Although, species such as Blanding's turtle are less likely to occur inside the AOC than outside the AOC due to a lack of suitable scrub-shrub habitat. HSI values suggested no difference in the wetlands sampled in terms of their suitability for turtles inside and outside the AOC based on a model developed for snapping turtles.

Turtle trapping results, coupled with additional visual observations, suggested that painted turtles and snapping turtles are common and present inside and outside the AOC, with no obvious differences in turtle populations among sites.

A total of 33 snapping turtle egg clutches were collected inside and outside the AOC and analyzed for contaminants. Total PCBs in snapping turtle eggs from inside the AOC for all river

stems were significantly higher than outside the AOC. Within river stems, total PCBs from the Grasse River inside the AOC was significantly higher than snapping turtle clutches from the Grasse River outside the AOC, but not for other rivers. Overall, PCB concentrations were found to be much lower than total PCB concentrations reported in previous studies. The relatively low level of PCBs detected in snapping turtle eggs in this study could be the result of collecting eggs as much as three kilometers from the tributary rivers of the AOC, and/or the result of remediation activities conducted in the Massena/Akwesasne AOC that may have reduced the availability of contaminants to wildlife. Deformities in snapping turtle hatchlings could not be assessed due to the failure of incubated eggs to hatch.

Specific recommendations for turtle habitat improvement, conservation, and monitoring in the AOC include increasing connectivity of wetlands, reducing road mortality, creating new nesting areas, and restoring wet meadow and scrub-shrub habitats along the lower Grasse River.

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LIST OF ABBREVIATIONS

List of abbreviations used in documents related to the Massena/Akwesasne Area of Concern.

Alcoa	Aluminum Corporation of America
AOC	Area of Concern
BUI	Beneficial Use Impairment
COCs	Contaminants of Concern
COSEWIC	Committee and the Status of Endangered Wildlife in Canada
DDT	Dichlorodiphenyltrichloroethane
GLNPO	Great Lakes National Program Office
GLWQA	Great Lakes Water Quality Agreement
GM	General Motors
GRLI	Great Lakes Restoration Initiative
HIS	Habitat Suitability Index
IJC	International Joint Commission
MCA	Mohawk Council of Akwesasne
ND	Non-detect
NEPARC	Northeast Partners in Amphibian and Reptile Conservation
NTCRA	Non-Time Critical Removal Action
NYPA	New York Power Authority
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSOPRHP	New York State Office of parks, Recreation and Historic Preservation
OMNR	Ontario Ministry of Natural Resources and Forestry
PAHs	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
PCDDs	Polychlorodibenzo-p-dioxins
PCDEs	Polychlorinated diphenyl ethers
PCDFs	Polychlorodibenzofurans
POCs	Persistent organochlorine chemicals
ppb	Parts per billion
ppm	Parts per million
ppt	Parts per trillion
QAPP	Quality Assurance Project Plan
RAC	Remedial Advisory Committee (to the AOC process)
RACER Trust	Revitalizing Auto Communities Environmental Response Trust
RI/FS	Remedial Investigation and Feasible Study
ROD	Record of Decision
SLRRP	St. Lawrence River Remediation Project (Alcoa East)
SRMT	Saint Regis Mohawk Tribe
SRMTED	Saint Regis Mohawk Tribe Environment Division
TDBFs	Total dibenzofurans
TRA	Trap-based rapid assessments
USEPA (EPA)	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOCs	Volatile organic compounds
WHWMA	Wilson Hill Wildlife Management Area

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SRMTED Staff Jay Wilkins and James Costello assisted with turtle egg collection and Amberdawn LaFrance provided contaminant data from the SRMT database to Riveredge Associates for data synthesis, reporting, and comparison. In addition, members of the Mohawk and Massena Communities assisted by providing location information about snapping turtles encountered nesting in the field during 2013 field collection activities to the Saint Regis Mohawk Tribe Environment Division.

Permits for the SRMT investigation into turtles of the AOC were obtained by Riveredge from the New York State Department of Environmental Conservation (NYSDEC), New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP), Mohawk Council of Akwesasne (MCA), and the New York Power Authority (NYPA).

1.0 INTRODUCTION

1.1 Background and Objectives

The international section of the St. Lawrence River was identified as one of five Bi-National Areas of Concern (AOC) by the International Joint Commission (IJC) under the 1987 amended Great Lakes Water Quality Agreement (GLWQA). The Bi-National geographic boundary is delineated as, "*The St. Lawrence River Area of Concern (AOC) includes the waters from the Moses-Saunders power dam to the eastern outlet of Lake St. Francis, including the area upstream of the Snell lock and power dam to the Massena public water supply intake, the Grasse River from the mouth upstream to the first dam, the Raquette River from the mouth upstream to the New York State Route 420 bridge and the St. Regis River from the mouth upstream to the dam at Hogansburg. This includes water shared by the United States, Canada, and the Mohawks of Akwesasne*" (Environment Canada et al. 1994). The boundaries of interest under this Great Lakes Restoration Initiative (GLRI) funded project (GL-9722130) are the upstream and southern portion of the Bi-National St. Lawrence River Area of Concern (AOC), primarily located in St. Lawrence County and the Mohawk Territory of Akwesasne (also called the Massena and/or Massena/Akwesasne AOC). The Massena/Akwesasne AOC includes the Grasse (04150304), Raquette (04150305), and St. Regis (04150306) tributaries, Power Canal on the Grasse River, and portions of the St. Lawrence River itself.

The purpose of this project was to gather data to assist with the evaluation of three Beneficial Use Impairments (BUI) specific to turtles in the Massena/Akwesasne AOC: 1) Degradation of Fish and Wildlife Populations, 2) Bird/Animal Deformities or Reproductive Problems, and 3) Loss of Fish and Wildlife Habitat (Table 1).

Criteria established for fish and wildlife populations include healthy and reproducing populations and a community structure that does not significantly diverge from unimpacted sites that would be expected from the amount of quality of suitable physical, chemical, and biological habitat characteristics. The current status of this BUI is "Unknown/Needs Further Assessment", with no surveys conducted to date to compare populations of turtles inside and outside the AOC.

Criteria for deformities include documentation that wetlands support healthy communities of significant species with no reported deformities (some exceptions apply), and incidence rates of deformities or other reproductive problems in sentinel wildlife species do not exceed background levels of inland control populations. The current status of this BUI is “Unknown/Needs Further Assessment”, with no survey conducted to date to compare reproductive problems and deformities of turtles, inside and outside AOC.

Criteria for loss of fish and wildlife habitat include documentation that amounts and quality of physical, chemical, and biological habitat (including wetlands, riparian and submerged aquatic vegetation, and buffers) are adequate for fish and wildlife management goals. The current status of this BUI is “Impaired”, with no surveys to date to compare turtle habitat inside and outside AOC

There are six species of turtles known to occur within and near the Massena/Akwesasne AOC (Gibbs et al., 2007; Johnson, 2012; G. Johnson, per. obs.; James Costello, SMRTED Environment Division, pers. comm.) (Table 2). The natural history and habitat requirements of these species were detailed in the Turtle Interim Status Report (Harper et al.,2014).

As across much of the northeastern US and eastern Canada, the most frequently encountered of these are the painted turtle (*Chrysemys picta*) and the common snapping turtle (*Chelydra serpentina*) (Ernst and Lovich, 2009), however estimates of abundance are largely lacking from the AOC. The remaining species include the common map turtle (*Graptemys geographica*), wood turtle (*Glyptemys insculpta*), Blanding’s turtle (*Emydoidea blandingii*), and common musk turtle or stinkpot (*Sternotherus odoratus*) and little is known about any of their population parameters within the AOC. All of these turtles are known to occur within 15 miles of the AOC as well (Johnson and Crockett 2009, Johnson 2012, J. Costello, SMRTED Environment Division, pers. comm., SRMT2014). Two other turtles, spiny softshell turtle (*Apalone spinifera*) and spotted turtle (*Clemmys guttata*), are included in Table 2 but are not known to occur within 15 miles of the AOC. However, during Akwesasne’s 2014 Species at Risk Project through Mohawk Council of Akwesasne (MCA) Environment Division, it was noted by Environment Canada’s Canadian Wildlife Service (CWS) wildlife biologist Sylvain Giguère that viable habitat exists for spotted turtle in Akwesasne (C. Lazore, MCA Environment Division, pers. comm. 2015).

STATUS REPORT - TURTLES INSIDE AND OUTSIDE THE AOC

In the spring of 2013, a Quality Assurance Project Plan (QAPP) was developed and approved by SRMT and USEPA (Riveredge Associates, 2013). In summer 2013, field work was conducted to investigate habitat, populations, reproduction and contaminants in turtles. The sampling was designed to investigate the known contaminants of concern (COC) burdens in the eggs of snapping turtles in and near the Massena/Akwesasne AOC, and the potential effects of these contaminants on snapping turtle reproduction. COCs in the Massena/Akwesasne AOC include PCBs, pesticides (chlordane, DDT, dieldrin, endrin, hexachlorobenzene, mirex), dioxins, furans, mercury, aluminum, lead, cadmium, and fluoride (Natural Resource Trustees of the St. Lawrence River Environment, 2013). The sampling matrix for 2013 turtle collections for contaminant analysis was snapping turtle eggs. Snapping turtles were chosen because they are abundant, long-lived, carnivorous, and have often been used as a bioindicator in this and other AOCs.

For population assessment, our focus was on obtaining a measure of relative abundance for painted and snapping turtles, however, with the exception of wood turtles, data were recorded on all species encountered. Wood turtles were excluded because some of their habitat requirements and degree of terrestriality (highly terrestrial) are decidedly different from the other five species (Compton et al., 2002; Walde et al., 2003).

The populations and habitat of turtles was examined through visual surveys and trap-based assessments of wetlands inside and outside the AOC. Combined, this monitoring provided current data on populations, habitat and contaminant concentrations in turtles inside and outside the AOC. These data will assist in Beneficial Use Impairments (BUIs) advancement and delisting efforts.

This status report details the results of this work related to turtles in and near the Massena/Akwesasne AOC. Literature and field data were gathered to address the BUIs as they relate to turtles in and near the AOC (Table 1).

Table 1. St. Lawrence River, Massena/Akwesasne AOC Beneficial Use Impairments, Status and Delisting Criteria for Fish and Wildlife.

Beneficial Use Impairment	Status	Delisting Criteria	Measurement[1]
Degradation of Fish and Wildlife Populations	Unknown/ Needs Further Assessment	Environmental conditions support healthy, self-sustaining communities of desired fish and wildlife at predetermined levels of abundance that would be expected from the amount and quality of suitable physical, chemical, and biological habitat present; AND Fish populations meet applicable Index of Biological Integrity (IBI) and wildlife populations have healthy reproducing populations of eagle, mink, otter, or other species.	Conduct a qualitative habitat assessment. Use experienced field staff to visually estimate wildlife species presence or absence from observed activity or other field log notes. Use quantitative chemical data of tissue burden to compare to adverse health effects threshold levels
Bird/Animal Deformities or Reproductive Problems	Unknown, Needs Further Assessment	Wetlands support healthy communities of significant species and no reports of deformities from wildlife officials. Exceptions may apply to limited background effects; AND Incidence rates, if present, of deformities (e.g. cross-bill syndrome) or other reproductive problems (e.g. egg-shell thinning) in wildlife species do not exceed background levels of inland control populations.	Make visual observations of the presence or absence of anomalies or deformities in hatchlings and record on appropriate data sheets for quantification
Loss of Fish and Wildlife Habitat	Impaired	Amounts and quality of physical, chemical, and biological habitat (including wetlands, riparian and submerged aquatic vegetation, and buffers) are adequate for fish and wildlife management goals (achieved and protected); AND Experts do not identify habitat loss as a cause for non-attainment of Fish and Wildlife management goals.	Conduct a qualitative habitat assessment and complete field data forms Use expert field staff to determine if habitat is cause for non-attainment of species in addition to qualitative assessment above.

Note:

1. Measurements identified in QAPP as additional lines of evidence to achieve data quality objectives (DQOs), and utilize expert field staff to suggest AOC recommendations (Section 5)

Table 2. Turtle species potentially occurring in and near the AOC and their conservation status. E=Endangered, T = Threatened, SC = Special Concern, V = Vulnerable, COSEWIC = Committee and the Status of Endangered Wildlife in Canada, SARA = Species at Risk Act in Canada

Scientific Name	Common Name	New York Status[1]	Species of Greatest Conservation Need (SGCN) in New York?[2]	COSEWIC[3]	Ontario Status[4]	Quebec Status[5]	SARA Status[6]
Chelydra serpentina	Snapping turtle		Y	SC	SC		SC
Emydoidea blandingii	Blanding's turtle	T	Y	T	T	T	T
Chrysemys picta	Painted turtle						
Glyptemys insculpta	Wood turtle	SC	Y	T	E	V	T
Graptemys geographica	Northern map turtle		Y	SC	SC	V	SC
Sternotherus odoratus	Eastern musk turtle or Stinkpot		Y	SC	SC	T	T
Clemmys guttata	Spotted turtle	SC	Y	E	E	*[7]	E
Apalone spinifera	Spiny softshell turtle	SC	Y	T	T	T	T

Notes:

1. New York Status: http://www.dec.ny.gov/animals/7494.html
2. SGCN Status: http://www.dec.ny.gov/docs/wildlife_pdf/sgnc2015list.pdf
3. COSEWIC October 2014 Status: http://www.cosewic.gc.ca/eng/sct0/rpt/csar_fall_2014_e.pdf
4. Ontario Status: https://www.ontario.ca/environment-and-energy/species-risk-ontario-list

5. Quebec Status: http://www3.mffp.gouv.qc.ca/faune/especes/menacees/liste.asp
6. SARA Status: http://www.registrelep-sararegistry.gc.ca/species/schedules_e.cfm?id=1
7. *Listed as “likely” to be designated threatened or vulnerable

Photo 1. Blanding's turtle, a New York State-listed threatened species

1.2 Turtle Cultural Significance to Mohawks

A’nó:wara (turtle) play a fundamental role in Mohawk and Haudenosaunee culture, clanology, ceremony, medicine, artwork via patterns and symbols (including but not limited to; beadwork, baskets, stone carvings, clothing, jewelry, and paintings), and story of creation, amongst other importance. In the Creation Story, earth was created on the back of a turtle (Turtle Island) to protect Skywoman and her unborn child, and to provide her food and medicines as she fell from the Spirit World (NAITC, 1984). There are many parallels in Mohawk culture between turtles as the symbol of life and women’s reproductive health, and sweat lodge ceremonies. Oral prophecies have instructed Mohawk traditional medicine people to collect and use the organs (i.e. liver and heart) to make medicine to treat sicknesses of the future (A.LaFrance, B. Tarbell, L. Herne, and A. Cook, pers. comm., 2014). Therefore, turtles are viewed as being analogous to providing life, critical medicines, and sustainability to people (NAITC, 1984 and 2007). Any real or perceived health risk to turtles in Haudenosaunee and Mohawk culture is considered a risk to the people. There is probably no greater indicator species for Mohawk community culture in the St. Lawrence River International AOC, than the turtle. If tissue (muscle, eggs, organs, shell, etc.) of any kind of the turtle is contaminated, it is perceived as an impairment to all turtle uses and significance (e.g. consumption, ceremony, dance, medicine, and clan health).

The Turtle Clan is ubiquitous throughout all Nations of the Haudenosaunee under the functions of the Council Fire for governance under the Great Law of Peace, and is one of the three Council Clans of the Mohawks (Turtle, Bear, Wolf). Turtle Clan is considered an earth clan, and reminds people to care for, protect, and nurture Mother Earth. In Longhouse, the Turtle Clan is also responsible for hearing the matters of the people (NAITC, 1984). Clans are matrilineal, family units in a Nation, and Clan Mothers and Chiefs are responsible for the matters of the people, consistent with the principles of The Great Law and Ohen:ton Karihwatehkwen (Words that come before all else, or Haudenosaunee Thanksgiving Address). These principles are deeply rooted in environmental sustainability and spirituality, connecting people with animals and creation in a family relationship (i.e. brothers, sisters, elders, grandmother, etc.) (NAITC, 2007). Based on these relationship principles, a toxic impact, or impairment of use of the natural environment is viewed as an insult to the Mohawk family structure.

In the Longhouse, A'no:wara kentáhshonte, snapping turtle, is recognized specifically for its sacred use as a turtle rattle in only a few special ceremonies. The making and preserving of the turtle rattle is done with extreme care and good mind, recognizing the sacrifice the turtle made for ceremony to the Creator. Once such use is during Midwinter Ceremony, honoring and giving thanks to the Creator for the past year and welcoming the new year in the joyous, sacred ritual, The Great Feather Dance (A.LaFrance, B. Tarbell, L. Herne, and A. Cook, pers. comm., 2014).

The box turtle is specifically used for the seed song ceremony, for protection of heirloom seeds for food security, sustenance, and sustainability for the Mohawk (A.LaFrance, B. Tarbell, L. Herne, and A. Cook, pers. comm., 2014). The box turtle is a NY State listed species of concern. The interrelationship importance between turtle presence in its natural environment in sustainable populations, food supply, and the way of the Mohawk people's continuance with traditional practices without fear of contamination for continued use is immeasurable by any metric developed currently by the IJC and/or AOC Remedial Advisory Committee (RAC). The eastern box turtle (*Terrapene carolina*) was not included in the literature review and/or 2013 field study design because it's distribution is not expected in the St. Lawrence River valley in New York State. But anecdotal reports by Mohawks have noted box turtles have been historically observed in wooded pastures and islands in Akwesasne (N. Peters, SRMT Environment Division, pers. comm., 2015). Because the box turtle is a culturally significant species to indigenous communities and used in ceremonies, it has also been reported this turtle can be found within Haudenosaunee Nation territories from historical transport and trade with other Indigenous Nations (P. Pyke-Thompson, MCA Environment Division, pers. comm., 2015).

When evaluating beneficial use impairments, delisting criteria and transboundary impacts, consideration to the use of the species through community culture is vital for understanding, and community perspective for delisting.

Photo 2. Example of a turtle rattle made for use in ceremony. Photo Credit, Joshua (Anenhaienton) Sargent.

1.3 AOC Remediation Summaries

1.3.1 General Remediation Summary

A principal goal of the *Revised Great Lakes Water Quality Agreement of 1978, as amended by Protocol signed November 18, 1987* (1987, GLWQA) is to restore the chemical, physical, and biological integrity of the Great Lakes Ecosystem in the Areas of Concern (AOCs). Primary contaminants of concern in the Bi-National St. Lawrence River AOC include: polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), chlorinated pesticides (including mirex and hexachlorobenzene), dioxins, furans, and metals.

While many remedial successes and contaminant mass reductions (i.e. PCBs, PAHs, dioxins, and metals) have contributed to the restoration of the Massena/Akwesasne AOC since 1995 on the United States side, excessive levels and inventory of PCBs can still be found in sediments in the Grasse River Superfund Site. Fish tissue concentrations are elevated, while fish and wildlife advisories are still in effect in the Massena/Akwesasne AOC. Health risks to Mohawks have been identified through epidemiological studies and subsistence/cultural exposure routes, and NYSDOH has issued Special Consumption Advisories for the Akwesasne Mohawk Nation specific to lake sturgeon and other game consumption (Forti et al., 1995).

Between 1995-2013, a number of remedial efforts have taken place at the Massena, NY Industrial facilities (i.e. Alcoa West, RACER formerly known as General Motors, and Alcoa East formerly known as Reynolds Metals) to contribute to reduction of contaminant mass, contaminated fish tissue concentrations and its associated human and ecological risk reduction, and ecological restoration. The land-based remediation of eighteen contaminated sites at Alcoa West and six contaminated sites at Alcoa East (former Reynolds Metals) was completed in 2001, and fulfills the requirements of the two 1992 Record of Decisions (RODs) for these sites. GM land remediation is on-going and plant demolition began in 2011. The demolition of building structures were completed in 2014 and remediation of site sources is proposed to be completed in 2015. Long-term groundwater remediation and monitoring of the “GM Dump” is yet to be designed, and will be underway in the new future. The remaining summary is specific to river sediments, and/or riverbank and wetland soils in the Massena/Akwesasne AOC that underwent remedial activity as per USEPA Administrative Order or Record of Decision (ROD) Document.

1.3.2 Site specific Remediation Summaries

1.3.2.1 Reynolds Metals Company (now Alcoa East)

Through 1989-1992 remedial investigations and feasibility studies (RI/FS) of the St. Lawrence River adjacent to Alcoa East were conducted with PCB-contaminated sediments identified as the primary contaminants of concern (COCs). Other contaminants identified as present at site included furans, fluoride, aluminum, cyanide, and PAHs found in similar patterns of PCBs at this site on the St. Lawrence River. USEPA issued a 1993 Record of Decision (ROD) that called for dredging of sediments containing contaminants in excess of 1mg/kg (ppm) PCBs, 10mg/kg total PAHs, and 1 ug/kg (ppb) of total dibenzofurans (TDBFs). Area of contamination was 21.8 acres.

In 2001 the St. Lawrence River Remediation Project (SLRRP) dredging commenced following those prescribed clean-up goals to remove 86,000 cubic yards (cy) of contaminated sediments (20,200 lbs of PCBs) in a dredge design divided into 268 “dredge cells” (avg. 0.08 acres each). The ROD estimated 28% of the contaminated sediment inventory on-site included PCBs ≥ 25 mg/kg, with 9 identified Hot Spots (HS) Units delineated into 0.06 acres (2,500ft^2 areas) with PCBs ≥ 500 mg/kg. (USEPA,1993; USEPA, 2008; USEPA, 2012a).

After completion of 2001 dredging efforts, post-dredging verification sampling demonstrated a site-wide average PCB concentration of 0.8 mg/kg PCBs, a 98.6% PCB contaminant reduction. All but 12 of the 268 dredge cells achieved target PCB clean-up goal of 1.0 mg/kg PCB; those 12 cells were capped in 2009 to achieve assumed 100% PCB clean-up goal achievement for risk reduction.

A 90% reduction in PAHs was achieved in 2001, and additional verification sampling conducted between 2002-2006 indicated 76 of the 268 dredge cells were above the 10 mg/kg total PAHs clean-up goal. Fifty-three dredge cells indicated total PAHs >20 mg/kg with a maximum concentration detection at D-118 of 741 mg/kg in fall 2002. In addition to dredge cell D-118, 5 additional dredge cells indicated > 100 mg/kg total PAHs at 285, 241, and 244, 181, and 112 mg/kg for dredge cells A-7, A-16, C-39, D-117, and D-126 respectively. All 53-dredge cells with PAHs> 20 mg/kg were capped in 2009. Twenty-three cells indicated PAHs between 10-20 mg/kg, and these were assumed to have naturally degraded with time due to low molecular weight PAH degradation period (~3years) (USEPA, 2008).

On the 21.8 acre contaminated site, 3.5 acres were capped for achievement of risk reduction goals associated with PCBs and total PAHs. A 100% achievement of clean-up targets for TDBFs was achieved via 2001 dredge, and 2009 capping (USEPA, 2008).

1.3.2.2 Alcoa West

USEPA issued an Administrative Order to ALCOA, Inc. in September 1989 to investigate the nature and extent of hazardous toxic material in the lower Grasse River, Unnamed Tributary, Robinson Creek, and the Power Canal. The lower Grasse River underwent remedial investigation and feasibility studies (RI/FS) from 1990-2013 when a Record of Decision (ROD) was issued

April 2013. Remedial design and pre-monitoring are proposed for 2014, with implementation expected in 2015-2020 (USEPA, 2013a).

In 1995, EPA required Alcoa to conduct a Non-Time Critical Removal Action (NTCRA) due to significantly elevated PCB sediment concentrations in the lower Grasse River identified adjacent to Outfall 001. Removal of ~3,000 cubic yards (cy) of contaminated sediment, boulder, and debris comprising of PCB concentrations ranging from 12 mg/kg-11,000 mg/kg, representative of about 20% (8,000 pounds (lbs)) of the total PCB mass in the river was conducted. PCB average sediment surface concentrations were reduced from 518 to 75 mg/kg (1.1-260 mg/kg range post-dredge sampling) in 1995 (BBL, 1995; USEPA, 2012b; USEPA, 2013a).

In 1998, 10,650 cy of PCB-containing sediments were removed from the Unnamed Tributary, and disposed of in the on-site Secure Landfill.

In most years from the mid-1990s until currently, water column monitoring in the lower Grasse River has been conducted spring through fall. Data trends indicate seasonal patterns with highest concentrations in summer, and lowest in late fall and noticeable decreases over the years (i.e. 115-130 ng/L (ppt) in the mid-90s to 8-20 ng/L 2011 with background concentrations of 0.2-3.0 ng/L. Power canal concentrations averaged 7.9 ng/L in 1998 and 1.9 ng/L in 2002) (USEPA, 2012b).

In 2005, a Remedial Options Pilot Study (ROPS) was conducted to evaluate cost and implementation feasibility of multiple remedial options. An 8-acre area was targeted by Transect 7 (T7) for main channel dredging of sediments ranging from non-detect (ND) to 3,668 mg/kg (ppm) PCBs (with highest concentration at 3.5 ft sediment depth, and a pre-dredge average surface concentration of 3.8mg/kg). A maximum volume of 75,000 cy was proposed for removal. Of that, only 24,400 cy was removed, with 84% of PCB mass targeted successfully removed, but with increased post-dredge average surface concentrations (138mg/kg) due to difficulty from debris and/or hard bottom preventing access to clean underlying material. This area was capped, with post-cap average concentrations of 7.4 mg/kg, 95% reduction post-dredge conditions (Alcoa, 2005 and 2006).

Additional river sediment investigations conducted 1995-2010 identified highest PCB concentrations at depth, and widely distributed throughout the 7.2 river mile stretch. Current conditions indicate approximately 1.7 million cy of sediment with PCBs ≥ 1mg/kg (ppm) over a 325 acre area exist as remaining inventory in the lower Grasse River (USEPA 2012b). The 7.2 river mile study area is broken down by 0.1 mile transect (T1-T72), and main channel and nearshore (water depths of five feet or less during normal summer flow). Current PCB-laden sediment concentration ranges are summarized below:

- ND-3,106 mg/kg PCBs in the Main Channel (T1-T21),
- ND-3,070 mg/kg PCBs in the Nearshore (T1-T21),
- ND-1,063 mg/kg PCBs in Main Channel (T21-T72),
- ND- 313 mg/kg PCBs in the Nearshore (T21-T72)

The 2013 Record of Decision by USEPA calls for 109,000 cy of nearshore PCB-contaminated sediment ≥ 1 mg/kg to be removed, with clean back-fill to grade for nearshore T1-T72 (7.2 miles), a 59-acre armored cap within the upper 2-river miles, and over 225-acres of sand/natural cap over remaining 5-river miles of main channel with PCB concentrations ≥ 1mg/kg.

Site-wide remedial action is based on PCBs only, however initial sediment investigations for Baseline Ecological Risk Assessment also detected VOCs, PAHs, dioxin, furans, aluminum, arsenic, fluoride, and lead in lower Grasse River sediments at variable concentrations and locations (See Section 1.5.2 Sediment Contamination in TRC 1993). Due to the widespread distribution of PCBs throughout the site, it is assumed that by remediating the PCB contamination, all other contaminants bioavailable at site will be remediated as well. EPA established several remedial action objectives. These included a 0.01 mg/kg PCB fish tissue remedial goal designed to be protective of Mohawk health from fish ingestion for the lower Grasse River (USEPA, 2013a).

1.3.2.3 General Motors

The USEPA issued a Record of Decision for the General Motors (Central Foundry Division) for Operable Unit 01 in December 1990. The ROD outlines 1) several major areas for soil remediation of the North and East disposal areas and industrial landfill, 2) sludge and liquid remediation in four unlined industrial lagoons (350,000 gallon, 500,000 gallon, 1.5 million gallon, and 10 million gallon lagoons), 3) contaminated sediments, riverbanks, and associated wetlands of the St. Lawrence River, Raquette River, and Turtle Creek, and 4) contaminated Tribal property and contaminated groundwater (with groundwater flow north and northeast to the St. Lawrence River and Turtle Creek, respectively). Contaminants of concern identified during the 1988 RI/FS at the GM Site include PCBs, PAHs, phenols, and volatile organic compounds (VOCs). PCBs were detected at highest concentrations and frequency, and therefore drove remediation at this site. The ROD identified over 62,000 cy of contaminated river sediments and soil with PCB concentrations above 1 mg/kg located in and along the St. Lawrence River, Raquette River and Turtle Creek (with majority of contaminated sediments ~56,000 cy in St. Lawrence River adjacent to the facility). (USEPA, 1990).

General Motors, St. Lawrence River sediments

During RI/FS the highest concentration of PCBs detected was 5,700mg/kg, and PAHs up to 8.0mg/kg. The 1995 dredging activity on the St. Lawrence River removed 18,000 cy of contaminated sediment. A 1.72-acre cap was placed over the areas that did not achieve the 1.0 mg/kg PCB clean-up goal.

General Motors, Raquette River and bank soils

During RI/FS the highest PCB concentration detected in the Raquette River was 390 mg/kg. In 2002, river bank and sediment removal efforts removed 11,000 cy of soils and 1,400 cy of sediment with respective 10 mg/kg PCB and 1.0 mg/kg PCB clean-up goals successfully achieved.

General Motors, Turtle Cove and associated wetlands/uplands

During RI/FS, approximately 15,000 cy of soil >1mg/kg PCBs was identified to be located on adjacent Tribal Mohawk Property (highest concentration reported of 48 ppm). NYSDEC detected PCBs concentrations as high as 3,101 mg/kg in Turtle Creek, with at least 4 samples >100 mg/kg PCBs.

In 2003, 4,600 cy of highly contaminated soils between the Northeast Industrial Landfill and the Cove were removed. By spring 2005, 18,000 cy of PCB-contaminated sediment and soils from the cove area were excavated in the dry to achieve Mohawk clean-up standard of 0.1 mg/kg (ppm) PCBs. The sediment clean-up goal was based on the 1989 Saint Regis Mohawk Tribal Council Resolution (No. 89-19) promulgated sediment standards for Mohawk territory protection of human and ecological health.

An estimated 700 cy of soils still need to be remediated on Mohawk Upland Properties (soils) with a clean-up goal of 1.0 mg/kg PCBs. Historic samples range from 1.0-10.0 mg/kg PCBs.

2.0 METHODS

2.1 Investigation Area

The Investigation Area included the Massena/Akwesasne AOC and wetlands, rivers, and other habitats adjacent to the AOC. A map of the AOC is depicted in Figure 1 below.

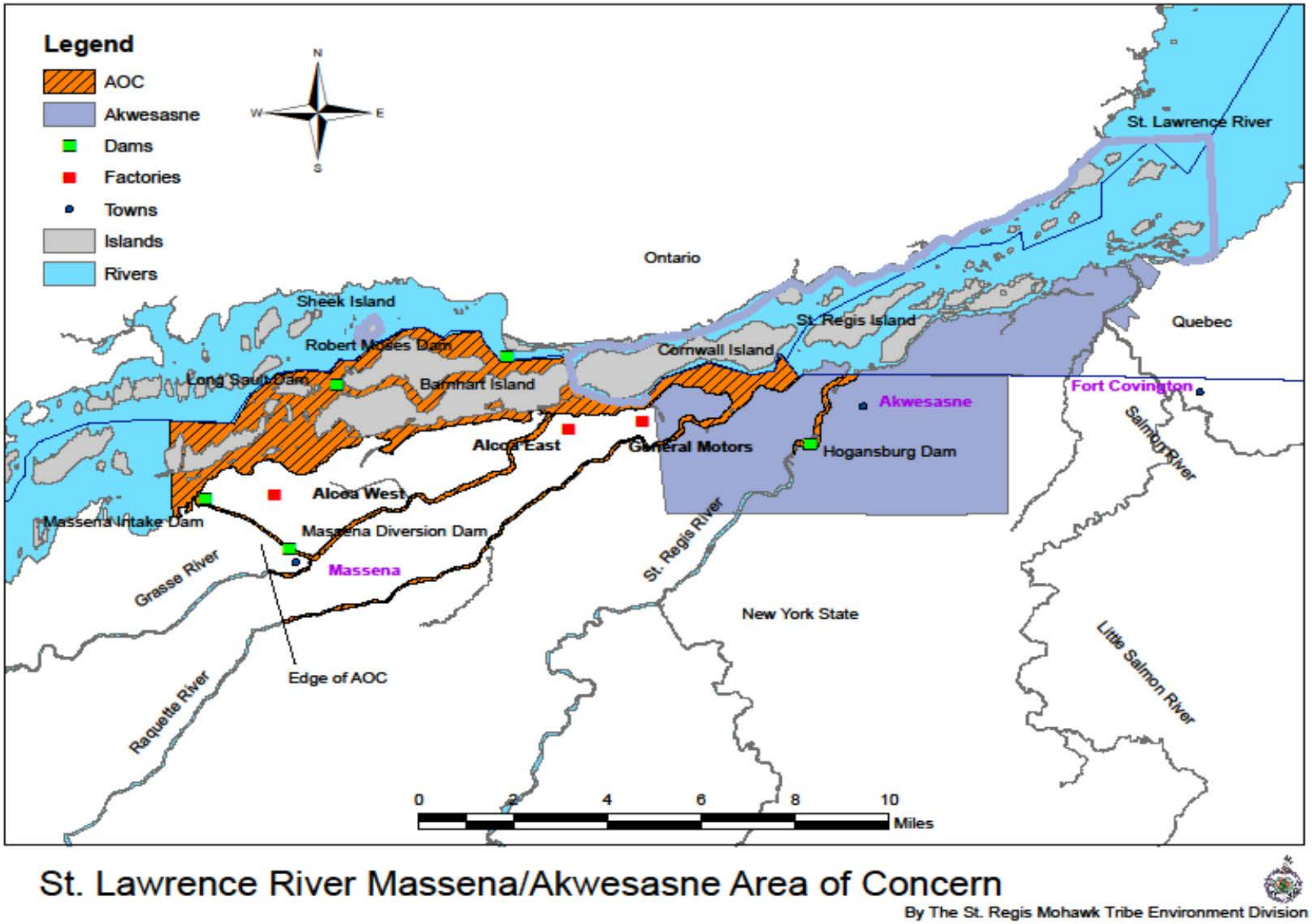

Figure 1. Map of Massena/Akwesasne AOC.

2.2 Field Methods

All field work was conducted with appropriate state, tribal, and federal wildlife permits, and field collection and sample analysis was conducted according to USEPA approved Quality Assurance Project Plan (QAPP) (Riveredge, 2013).

2.2.1 Habitat Evaluation

Wetland habitats likely to be occupied by the five turtle species of interest inside and outside the AOC were evaluated in two ways. First, the relative amount of suitable wetland habitat inside and outside the AOC was evaluated using a GIS analysis. Second, the suitability of selected habitats was evaluated using a Habitat Suitability Index (HSI).

Wetlands inside and outside the AOC were identified for the GIS analysis using National Wetland Inventory databases and maps. These wetlands also were reviewed on Google Earth and ground-truthed in the field as well. The amount of suitable and available wetland habitat for turtles was determined through a GIS analysis using ArcGIS to determine the type of wetlands and total area of wetlands inside and outside the AOC for each of the four river systems (St. Lawrence, Grasse, Raquette, and St. Regis). This analysis was performed for all wetlands adjacent to the major rivers or tributaries of the AOC and along these same tributaries upstream of the AOC. Wetland areas were determined inside and outside the AOC to a distance of 300 m from each tributary. This distance was chosen to examine available turtle habitat in close proximity to the major tributaries of the AOC and the areas known to be affected by contamination in the AOC. The type and area of wetlands inside and outside the AOC based on this measure was calculated and summarized. In addition, wetlands within this zone were ground truthed and selected for additional field investigation. This field investigation was designed to gather on the ground data about specific habitat parameters that are important to turtles, and to use these data in a Habitat Suitability Index (HSI) model to compare relative wetland values inside and outside the AOC.

A Habitat Suitability Index (HSI) was created using the parameter standards for physical and biological quality of snapping turtle habitat published in Graves and Anderson (1987). Although this model was developed for snapping turtles, it is broadly applicable to all turtles due to the broad range of wetland habitats used by snapping turtles that are also used by other turtle species of the investigation area. To evaluate turtle habitat for all species, we evaluated seven parameters (water temperature, current velocity, percent canopy cover, maximum water depth, percent silt in substrate, distance to a small stream, and distance to permanent water) at each wetland inside (n = 4) and outside (n = 4) the AOC. One pair of wetlands was selected for each of the major rivers (St. Lawrence, Grasse, Raquette, St. Regis). For each river, one wetland was selected inside the AOC and one wetland was selected outside the AOC. Specific wetlands selected for further evaluation were selected based on area, water depth, cover, vegetation, and other natural habitat variables. Wetlands inside the AOC and outside the AOC were selected to be generally similar in character to reduce any trapping sample bias in habitat types or in the species and number of individual turtles that might be expected to occur at each site.

In the field, the values for each parameter were input into a habitat suitability index (HSI) formula to create an HSI value which could then be compared among sites. In addition, habitat parameters such as wetland type (emergent, scrub-shrub, forested), average water depth, and dominant plant species were recorded, along with any observations of fish, mammals, and birds. Key habitat features of selected wetlands were qualitatively described to provide an assessment of habitat quality. Physical characterization included visual observation and documentation of wetland features that contribute to the natural structure and function of the wetland. These results were compiled into EcoSummaries for each site, including pictures of the representative habitat. These EcoSummaries were compiled into individual summary forms and are included in Appendix A of this document.

The data used in the HSI model included variables that are considered indicators of important life requisite components for turtles. Values measured in the field were converted o suitability indices provided in Graves and Anderson (1987). These life requisite components, and their suitability index values (SIV), included:

Food component

1. Mean water temperature at mid-depth in midsummer (SIV1)
2. Mean current velocity at mid-depth during summer (SIV2)
3. percent canopy cover of aquatic vegetation in the littoral zone (SIV3)

and the overall component of the model equal to $SI_{food} = (SIV1 \times SIV2 \times SIV3)^{1/3}$

Winter cover component

1. Maximum water depth greater than maximum ice depth (SIV4)
2. % silt in substrate (SIV5)

and the overall component of the model equal to $SI_{winter\ cover}$ = SIV4 x SIV5

Reproduction component

1. Distance to small stream (SIV6)

and the overall component of the model equal to $SI_{reproduction}$ = SIV6

Interspersion component

1. Distance to permanent water (SIV7)

and the overall component of the model equal to $SI_{interspersion}$ = SIV7

Each of these seven components was then included in the overall habitat suitability index which was calculated by the following equation:

$$HSI = (SI_{food} \times SI_{winter\ cover} \times SI_{reproduction})^{1/3} \times SI_{interspersion}$$

The HSI values can then be used to compare sites to determine if these measures of habitat differ from wetland to wetland.

2.2.2 Trapping

The wetlands selected for the habitat suitability model were also trapped to quantify the number of turtles of each species that occur there. Trapping efforts involved trap-based rapid assessments (TRA) designed to assess the population status of these species inside and outside the AOC. We followed a modified protocol developed for a northeast regional monitoring assessment for Blanding's turtles as detailed in the Northeast Partnership for Amphibian and Reptile Conservation (NEPARC) assessment protocol (NEPARC, 2010) which can be viewed at http://northeastturtles.org/NE/home.html.

We selected 8 sites for TRA (4 inside the AOC and 4 outside the AOC; one pair per major river or tributary) that possessed suitable habitat for these turtle species. Snapping and painted turtles will utilize almost any lentic, lotic or wetland habitat available while Blanding's turtles are more selective, preferring shrub/scrub wetlands (Congdon et al., 2008). For all three species, limiting factors may be the availability of suitable terrestrial nesting habitat. Wetlands were selected based on a visual qualitative field based assessment of the available habitat suitability and comparability to the extent possible.

TRAs consisted of five consecutive nights of trapping at each site. Depending on wetland size and configuration, trapping events use a minimum of 10 traps per site. Traps were checked every 24 hours. To facilitate determination of catch per unit effort (CPUE), the total number of traps used and effort expended inside and outside the AOC was the same.

Trapping used a combination of 2.5 foot diameter hoop traps and 24” x 12” Promar collapsible minnow traps. These latter traps have a five-inch opening that will exclude larger snapping turtles, allowing for smaller size classes of all species to be sampled. All traps were baited with sardines in oil and bait was changed at least once during each trapping event. At each site, one to four reference points separated by 100 m were established and two to four traps (even numbers of each trap type) were spaced 40 m apart. To reduce the likelihood of disease transfer, a 10% bleach solution was used to disinfect traps before use and between removal from one site and redeployment at another site.

Each wetland was trapped for a minimum of 50 trap-nights. The number of traps placed in each wetland was determined by the amount of available habitat, with the density of traps being approximately equal in each wetland.

Traps were placed in areas of anticipated turtle movement, such as along travel corridors and near key habitat features such as basking logs, shelter or small channels leading to potential nesting habitat. Traps were set so that a minimum of three inches of the trap was above the water's surface while the trap entrance was submerged. If water level fluctuations were anticipated, trap height above the surface was increased to six inches.

All traps were baited with canned sardines. Sardines were either left in the cans after punching holes in the cans or placed in a plastic bait container which had similar sized holes. The can or container was suspended in the rear of the trap. On each trap check, a comprehensive trap check field sheet that included # of each species trapped and GPS coordinates of trap location was completed. Turtles trapped were sexed and aged. Basic morphometric measurements were recorded and each individual was visually assessed for injuries and/or deformities as well as for presence of prior capture or tagging marks.

2.2.3 Snapping Turtle Egg Collection

Snapping turtle clutches were located by scouting suitable habitat and finding females actively in the process of nesting and by following up reports from the Mohawk and Massena community of turtles actively nesting. Radio announcements, newspaper notices, and flyers were used to request that members of the community report nesting snapping turtles to the offices of SRMTED. Public participation was good, and each report was followed up with a site visit. The location of turtle clutches through scouting and community reporting allowed the determination of the exact time eggs were deposited. Turtle egg clutches were collected within 48 hours of being found. Hand tools were used to excavate nests and investigators wore polyethylene gloves to prevent contamination. Eggs were placed in the position they were found on the excavated soil. Five eggs from each nest of snapping turtle were collected for contaminant analysis. Eggs were divided among five approximately equal groups based on their position in the nest from the top, middle-top, middle, middle-bottom, and bottom of the nest. One egg was selected from each group for contaminant analysis and this process ensured that first and last eggs in the laying sequence were likely to be selected with approximately equal probability. This sampling strategy was used for up to five nests within each of five sampling areas within the AOC, and five sampling points outside the AOC (*i.e*. max collection of 250 eggs from 50 nests). After excavation, one egg from each vertical section of each nest was randomly selected for contaminant analysis and all remaining eggs were carefully placed in plastic food containers (in the orientation they were found) with vermiculite and brought immediately to the lab (or within 24 hours). At all times (from sample collection to laboratory transport and analysis) eggs were maintained under a Chain of Custody Record.

2.3 Laboratory Methods

2.3.1 Contaminant Analysis of Snapping Turtle Eggs

Once at the lab, all turtle eggs were processed in accordance with the standard operating procedure for turtle egg processing as detailed in Appendix G of the Quality Assurance Project Plan (Riveredge, 2013). If debris was present on the exterior of the snapping turtle eggs, the debris was rinsed off in cool water and gently scrubbed with a sponge and then dried and weighed to the nearest 0.01g on a calibrated balance. All instruments and sample jars used during sample preparation for contaminant analysis were chemically clean and sterile. New disposable stainless steel scalpels were used for each sample. Contents of eggs were extracted using No. 21 & 22 scalpel blades and No. 4 handles and then placed in certified clean glass jars. Jars were labeled with nest number, date/time of collection, and sample processor initials. Egg contents were weighed on an analytical balance to the nearest 0.01g. Eggshell fragments from each sample were also collected and wrapped in polyethylene and labeled similarly to sample jars with egg contents. Samples were subsequently frozen and shipped overnight under Chain of Custody to Pace Analytical Services, Inc (Schenectady, NY).

Pace Analytical performed tissue preparation (grinding and homogenization) with their own developed and approved SOPs for tissue preparation, homogenization, extraction, and cleanup (Reference Methods USEPA SW-846). Target analytes for analysis are outlined below in Table 3. Results for all contaminants reported in ng/g (ppb) wet weight (w.w.).

Table 3. Egg analysis analytical methodology.

Analysis	Target Analyte or Compounds	Methodology
PCB Congeners	PCB Congeners (209 congeners)	EPA Method 8082 Comprehensive
Mercury	Total (organic and inorganic)	EPA Method 7471B
Dioxin/Furans	All target analytes including 2,3,7,8 – TCDD, 2,3,7,8 – TCDF, Total PeCDD, Total PeCDF, Total HxCDD, Total HxCDF, Total HpCDD, Total HpCDF, OCDD, and OCDF	EPA Method 1613B
Organochlorine Pesticides	Chlordane, 4,4-DDD, 4,4-DDE, 4,4 DDT, dieldrin, endrin, hexachlorobenzene, Mirex	EPA Method 8081A
Metals	Aluminum, Lead, Cadmium	EPA Method 6010B
Fluoride	Fluoride	EPA Method 300.0 Mod

2.3.2 Incubation of Snapping Turtle Eggs

Snapping turtle eggs were transferred to growth chambers at the State University of New York (Potsdam) laboratory within 24 hours of collection. At the laboratory eggs were examined for intactness and then placed plastic containers filled with vermiculite in the orientation in which the egg was discovered in the field. Incubation was conducted at 27.5°C with 90% humidity. The temperature and humidity was checked every 2-3 days and the water in vermiculite was replaced to maintain constant moisture. Eggs were monitored daily and if any were found to be unviable they were removed from the incubator. Eggs were to remain in the incubator until hatchlings emerged, at which point the date and time of hatch was to be recorded and hatchlings assessed for deformities, followed by the release of the hatchlings at or near the wetland where they were collected. However, all incubations failed and no turtle eggs hatched. The cause of the failure is not known, but could have been related to variations in temperature and/or humidity that were below that required for successful incubation.

3.0 RESULTS AND DISCUSSION

3.1 Achievement of Data Quality Objectives

3.1.1 Field Work

Although most data quality objectives for this study for sampling and analysis and field records met acceptability and performance criteria, the number of snapping egg clutch samples collected did not meet the standards set in the Quality Assurance Project Plan (QAPP) for completeness (Riveredge, 2013). The target number of samples (n=50) was not achieved, nor was the 75% sample size limit (n=38 clutches) for completeness. Only 33 egg samples were collected in the field. As detailed in the QAPP, these samples were selected to be spatially representative and a comparable number of samples were collected inside and outside the AOC, but the overall total number of samples did not reach the 38 needed for 75% completeness. In addition, turtle clutches were not obtained from locations near known sites of industrial contamination, such as Turtle Creek adjacent to the former General Motors site. Snapping turtle egg clutch collection was originally proposed in the QAPP to take place at the eight wetlands surveyed for populations and habitat. However, this would not have resulted in sufficient clutch collection, and the sampling area was widened to include all local wetlands inside and outside the AOC. This resulted in clutches being collected at wetlands some distance from the four rivers of the AOC (St. Lawrence, Grasse, Raquette, and St. Regis). Egg clutches were collected on the shoreline of some rivers, but at distances up to 3,477 meters from other rivers. The average distance of egg clutch collection to one of the AOC tributaries was 724.9 meters (S.D. 975.8 meters). Female snapping turtles move an average of 37-300m from a nesting site, and may make significant (>1km) overland movements according to the life history outlined in the Turtle Interim Status Report (Harper et al., 2014).

Although additional sampling was considered for 2014, it could not be conducted within the constraints of scheduling. However, one additional sample was collected by SRMT Environment in 2014 near Turtle Creek. This sample is not included in the results and discussion for the 2013 study, but is reported as a stand-alone sample in Section 3.5 and Appendix B. The 2013 data will be used to address the main study question as is, recognizing that sample sizes are lower than expected with the resulting loss of statistical power for the analysis. All samples included sufficient sample mass to conduct the analyses proposed in the QAPP, and each clutch was collected and processed in accordance with the handling and custody specifications detailed in the QAPP.

The total number of habitat assessment sites and wetlands selected for trapping (n=8) met the completeness criteria established in the QAPP. Although two wetlands were proposed for the St. Lawrence River inside and outside the AOC (four total), only two were actively investigated. Nonetheless, the completion of surveys in 8 of the 10 wetlands proposed in the QAPP satisfies the required level of completeness.

3.1.2 Laboratory Work

Laboratory instruments were calibrated according to the manufacturers' guidelines and documented as detailed in the QAPP. Data validation was performed and data were determined to be acceptable and usable the project. Field audits were conducted by the Project Manager and the SRMT Program Manager.

All snapping turtle egg samples analyzed by Pace Analytical Laboratories were delivered to the laboratory via overnight shipping and were received at the laboratory intact, properly preserved, and within holding times. Samples were kept in frozen storage at Pace Analytical until analysis. Laboratory quality control samples (spikes and blanks) and field quality control samples were within acceptable limits for the analyses except for the following notes or qualifiers included in the case narratives:

- Chlordane, dieldrin, endrin, aldehyde, and endosulfan sulfate were recovered above acceptable limits in the continuing calibration verification (CCV). Samples are ND for those analytes and bias is not indicated.
- The TCMX (tetrachloro-m-xylene) surrogate was recovered above acceptable limits in five samples. Alternate surrogate was within limits.
- Nine samples tested for p,p' DDE were reported with a Z qualifier indicating there was PCB present in these samples which co-elutes with these pesticide analytes. This Z qualifier indicates chromatographic interference due to polychlorinated biphenyl (PCB) co-elution.
- For metals analysis, in three samples the relative percent difference (RPD) between the sample and the duplicate sample was outside quality acceptance limits.

- Some PCB samples were flagged J, denoting an estimated concentration. The concentration result was greater than or equal to the method detection limit (MDL) but less than the practical quantitation limit (PQL).
- For nine samples, lipids was observed in the method blank sample. All associated positive sample concentration results were flagged (B) to denote the observed contamination.
- For the analysis for polychlorodibenzo-p-dioxins(PCDDs) and polychlorodibenzofurans (PCDFs), one sample was flagged R since the labeled standard recovery was outside (below) the target range. Two samples were flagged P where polychlorinated diphenyl ethers (PCDE) were present and these interfering substances impacted the determinations of PCDF congeners (specifically for 1,2,3,6,7,8-HxCDF).

3.2 GIS Analysis of Habitat

The GIS analysis of available turtle wetland habitat found more habitat available outside the AOC (489.1 acres in 131 wetlands) than inside the AOC (308.5 acres in 118 wetlands) (Table 4). The greater amount of available habitat outside the AOC is due to the occurrence of twice as many acres of palustrine forested wetlands (276.4 acres outside the AOC and 138.1 acres inside the AOC; Table 4) and almost three times as many acres of shrub-scrub wetland (113.1 acres outside the AOC and 42.1 acres inside the AOC) (Table 4). Most of this difference is due to the greater acreage of wetlands associated with the St. Lawrence River outside the AOC, although the number of wetlands is similar (357.0 acres outside and 181.6 acres inside; Table 4). It is important to note only a portion of Akwesasne associated with the tributary rivers on the U.S. side were included in the analysis of turtle habitat. In this instance, when referring to available turtle habitat outside the AOC, it is only in reference to habitat upstream the AOC, and not downstream (i.e. Akwesasne, Snye Marsh, Lac Saint-Francois RAMSAR wetland, etc.). The wetlands outside the AOC along the St. Lawrence River are associated with Croil Island, Coles Creek, and the northern edge of Wilson Hill Wildlife Management Area (WHWMA) (Figure 2). Without the St. Lawrence River, the total acreage of wetlands outside the AOC (132.1 acres) is very similar to the acreage of wetlands inside the AOC (126.9 acres) (Table 4, Figure 3). The total number of wetlands is also similar (47 wetlands outside the AOC and 38 wetlands inside the AOC) (Table 4).

The Grasse River also has more wetlands outside the AOC (Figure 4) than inside the AOC (Figure 5), but the Raquette River (Figures 6 and 7) and the St. Regis River (Figures 8 and 9) have more wetlands inside the AOC than outside the AOC (Table 4).

Inside the AOC, wetland habitat is most limited along the Grasse River (Table 4). Both the number of wetlands and the acreage of these wetlands associated with the Grasse River inside the AOC is three times less than outside the AOC (18.7 acres in 7 wetlands inside the AOC and 62.0 acres in 20 wetlands outside the AOC) (Table 4). In particular, the absence of palustrine scrub-shrub wetlands along the Grasse River inside the AOC (only 0.5 acres in 1 wetland; Table 4) would suggest the absence of Blanding's turtles inside the AOC as well. This species is well documented in scrub-shrub wetlands associated with the St. Lawrence River outside the AOC Riveredge, 2008, 2009, 2010; Johnson and Crockett, 2009).

Overall, based on this analysis of wetlands within 300 m on the AOC rivers, the amount of wetland habitat inside and outside the AOC would not appear to be a limiting factor for turtle populations in general. However, as noted, certain species (e.g. Blanding's turtle) are less likely to occur inside the AOC than outside the AOC due to a lack of suitable scrub-shrub habitat (Table 4).

Table 4. Total area (acres) and number (n) of wetland types inside and outside the AOC by river.

	Wetland Type	Grasse	Raquette	St. Regis	St. Lawrence	Total
Inside AOC	Palustrine Emergent (PEM)	8.6 (4)	37.3 (11)	27.3 (4)	55.1 (25)	128.3 (44)
	Palustrine Forested (PFO)	9.6 (2)	17.2 (7)	18.0 (3)	93.3 (35)	138.1 (47)
	Palustrine Scrub-Shrub (PSS)	0.5 (1)	8.4 (6)	0.0 (0)	33.2 (20)	42.1 (27)
Total		18.7 (7)	62.9 (24)	45.3 (7)	181.6 (80)	308.5 (118)
Outside AOC	Palustrine Emergent (PEM)	5.6 (4)	4.8 (5)	5.4 (3)	83.8 (20)	99.6 (32)
	Palustrine Forested (PFO)	14.1 (5)	26.4 (8)	11.5 (2)	224.4 (47)	276.4 (62)
	Palustrine Scrub-Shrub (PSS)	42.3 (11)	15.8 (7)	6.2 (2)	48.8 (17)	113.1 (37)
Total		62.0 (20)	47.0 (20)	23.1 (7)	357.0 (84)	489.1 (131)

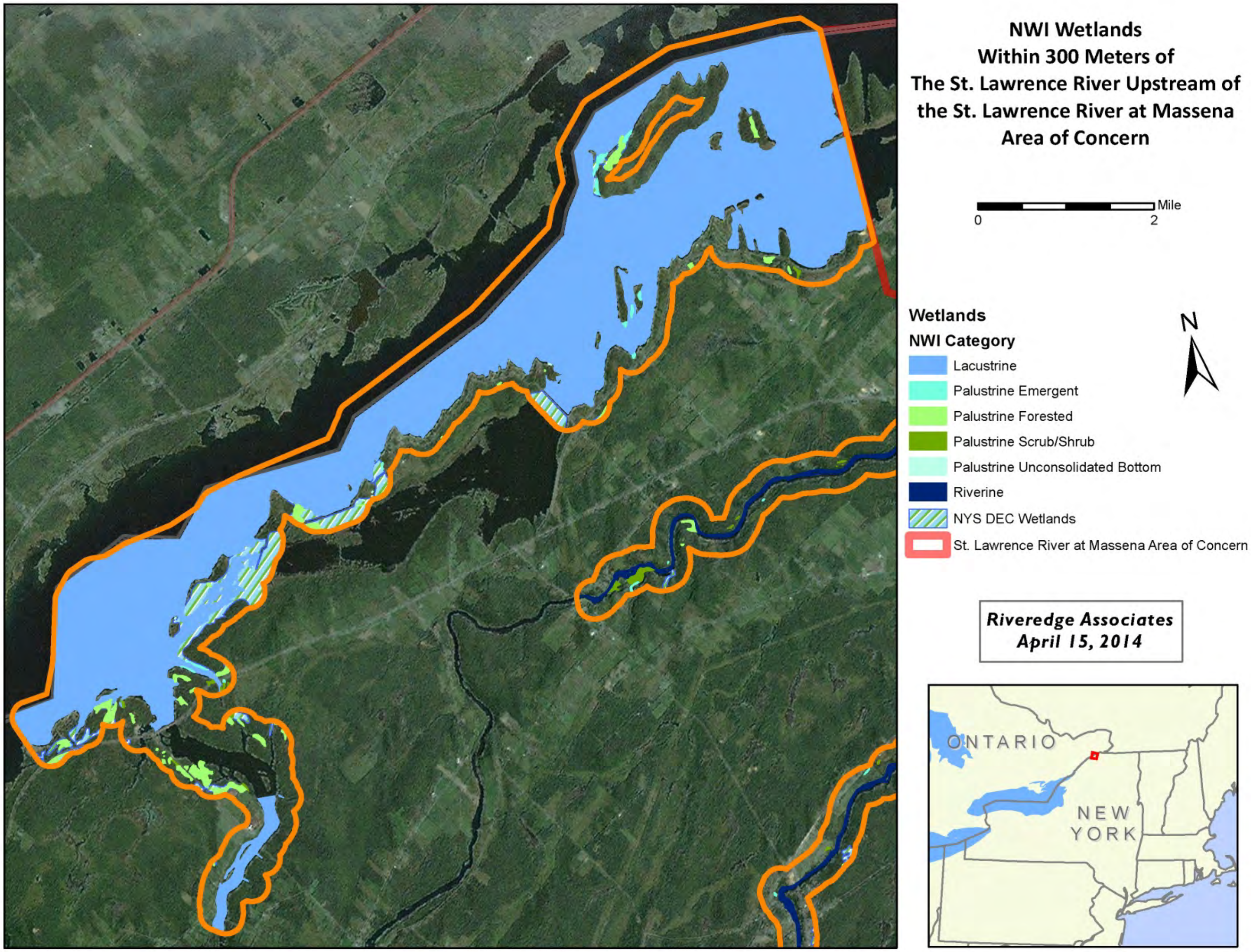

Figure 2. NWI wetlands outside the AOC within 300 m of the St. Lawrence River.

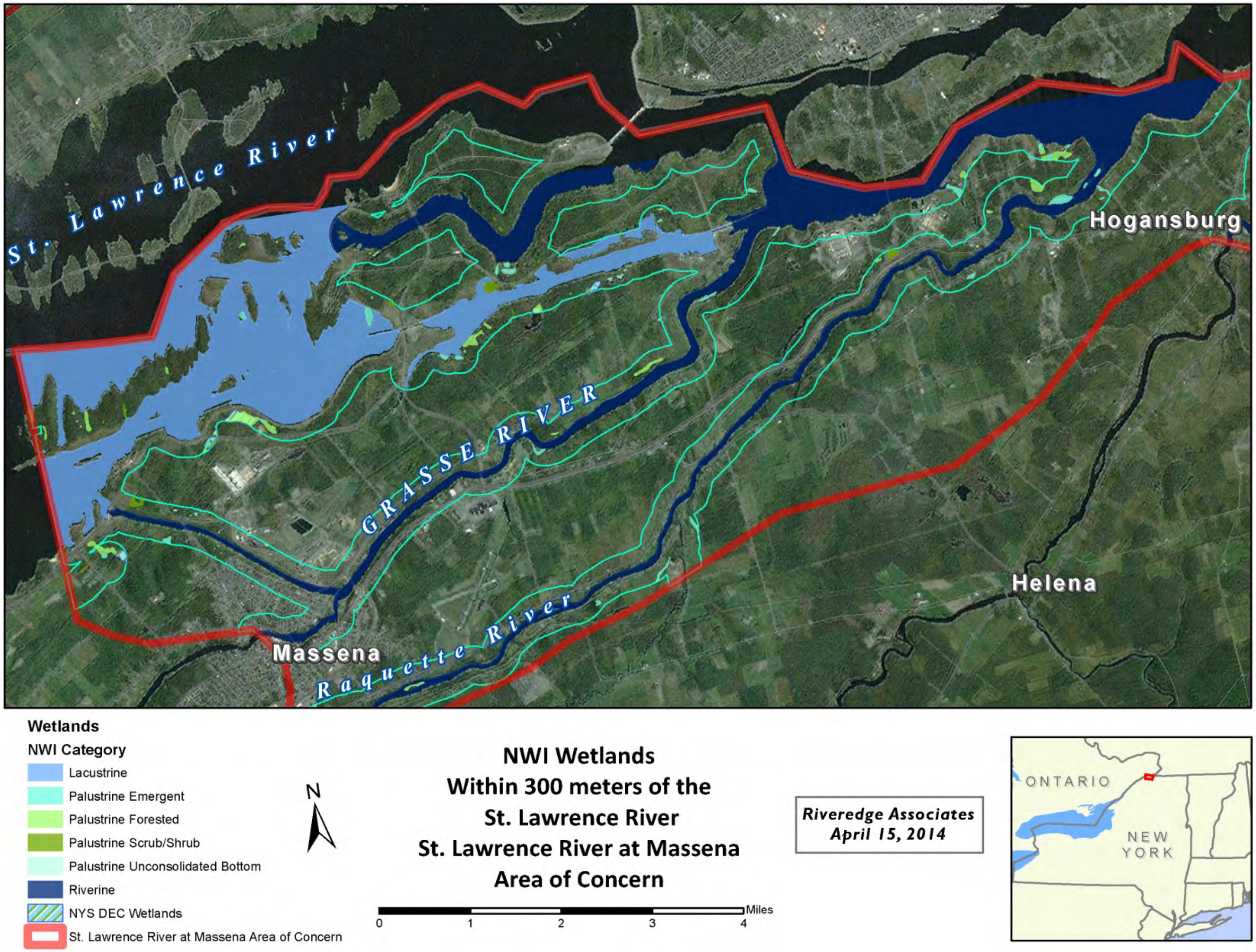

Figure 3. NWI wetlands inside the AOC within 300 m of the St. Lawrence River.

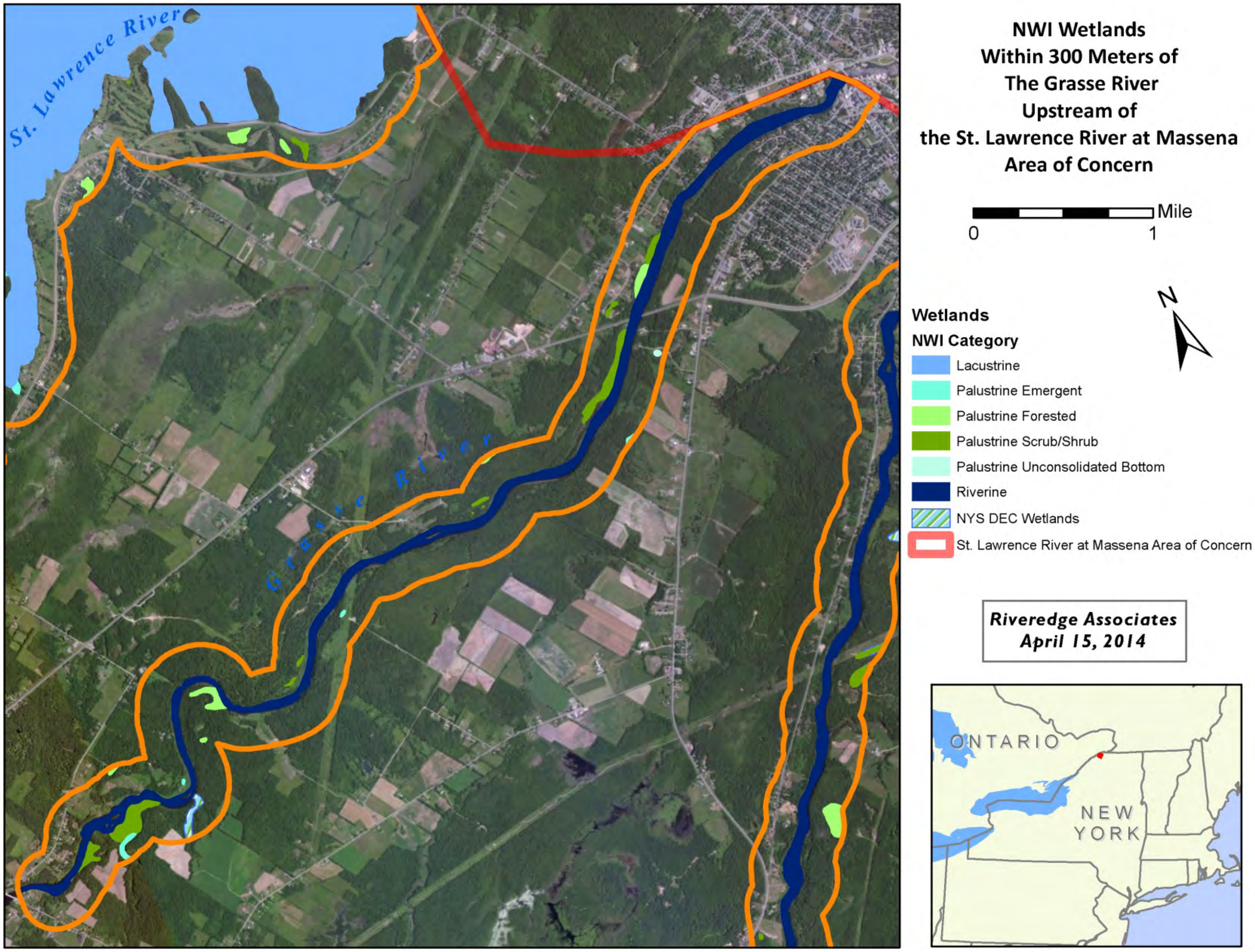

Figure 4. NWI wetlands outside the AOC within 300 m of the Grasse River.

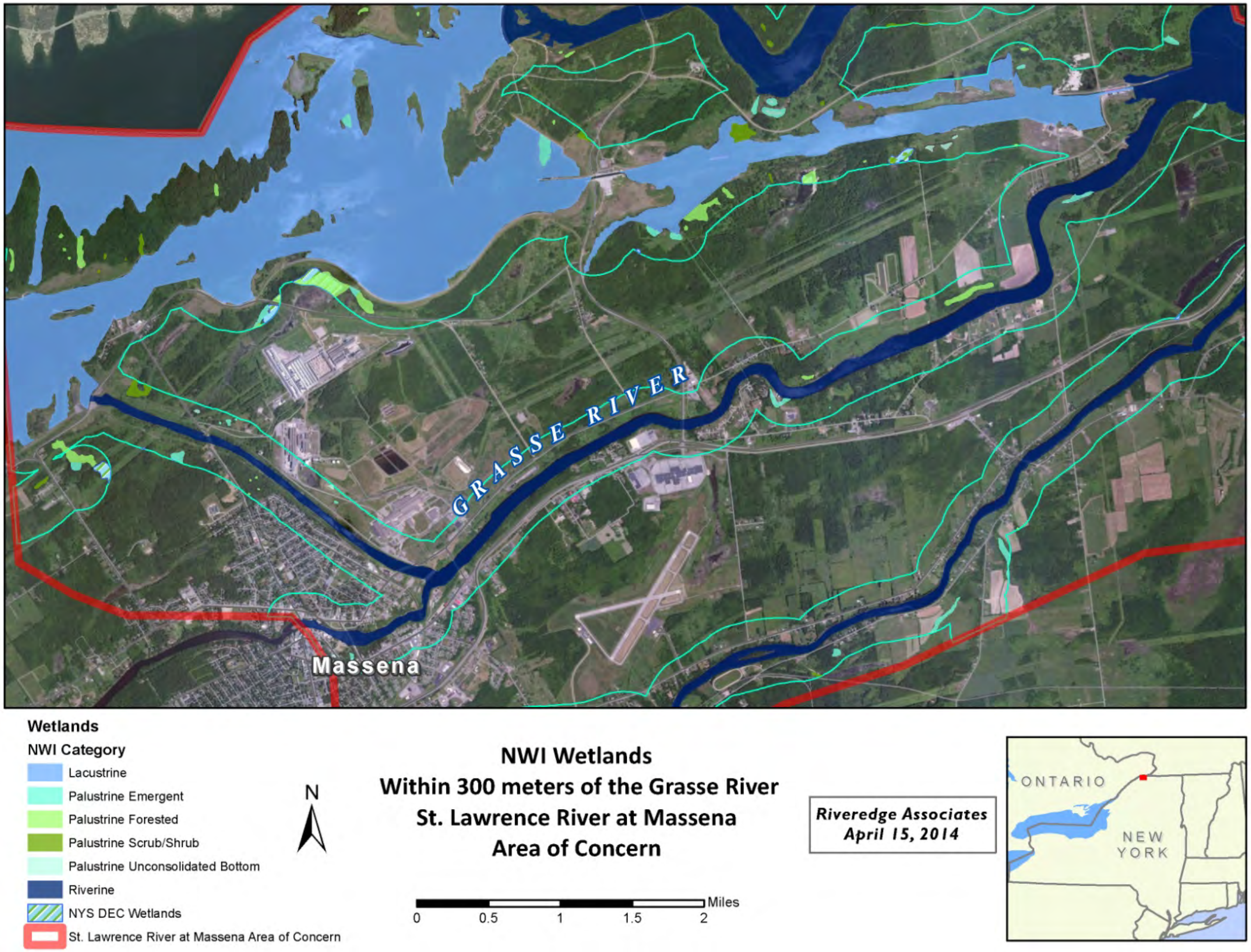

Figure 5. NWI wetlands inside the AOC within 300 m of the Grasse River.

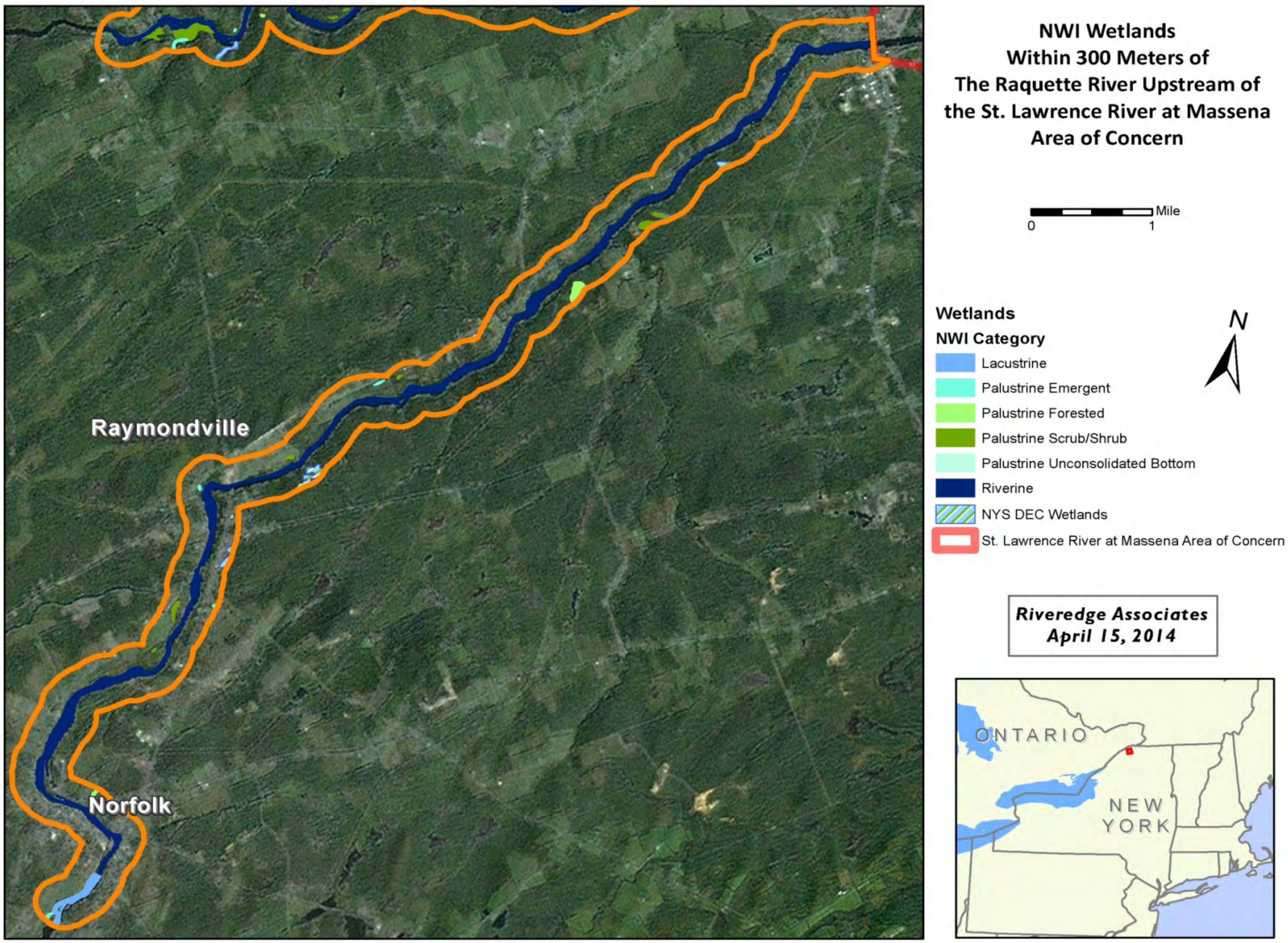

Figure 6. NWI wetlands outside the AOC within 300 m of the Raquette River.

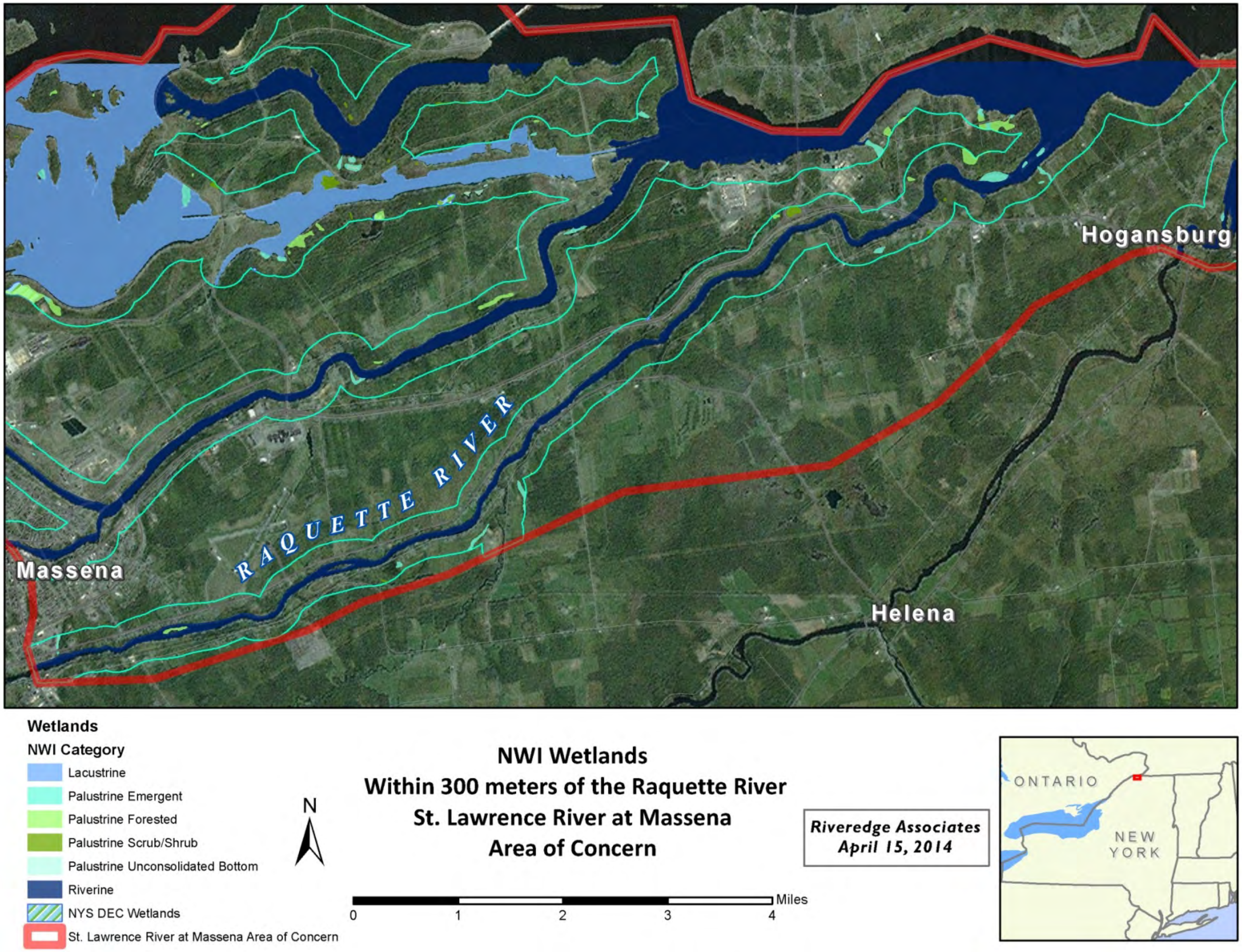

Figure 7. NWI wetlands inside the AOC within 300 m of the Raquette River.

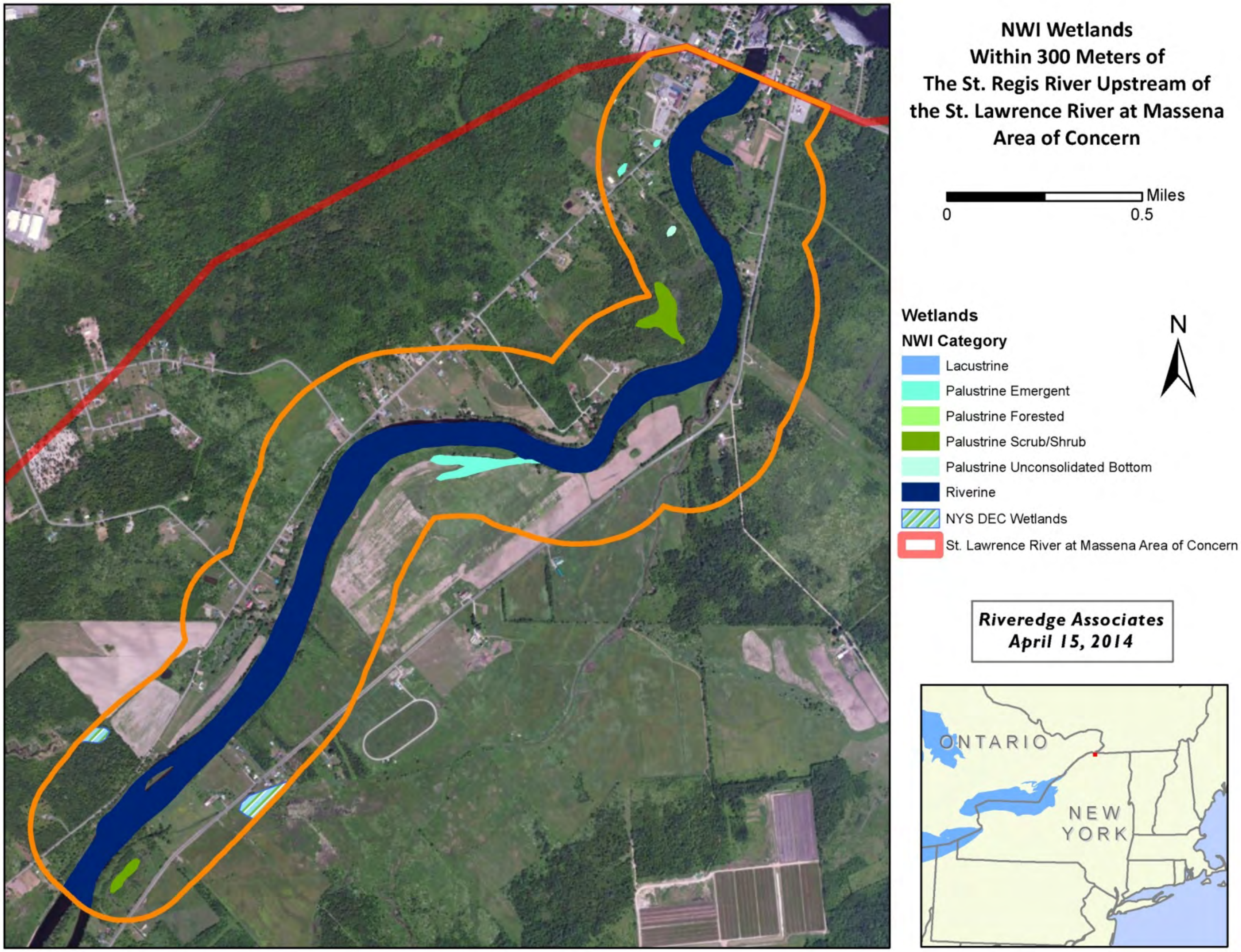

Figure 8. NWI wetlands outside the AOC within 300 m of the St. Regis River.

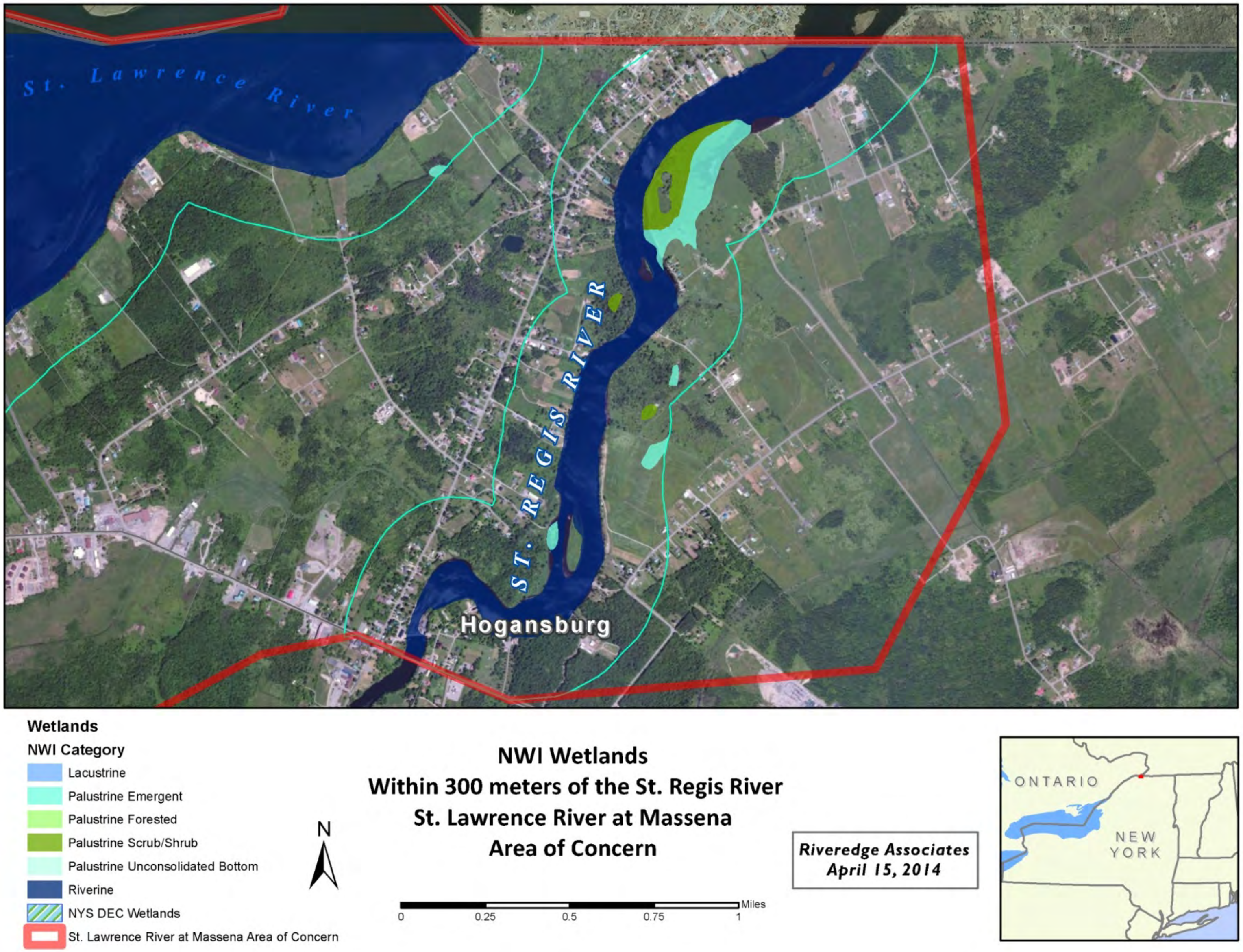

Figure 9. NWI wetlands inside the AOC within 300 m of the St. Regis River.

3.3 Habitat Suitability Index (HSI)

Four wetlands inside the AOC and four wetlands outside the AOC were selected for habitat suitability index surveys and for turtle trapping (Table 5, Figure 10,). Habitat variables such as water depth, temperature, substrate composition, cover, distance to small streams, and other habitat variables important to turtles were measured in the field and input to a habitat suitability index (HSI) model developed by Graves and Anderson (1987) for snapping turtles (see Methods for more details).

Habitat suitability index values for wetlands inside the AOC ranged from 0.44 to 0.58 and averaged 0.51 (S.D.=0.07) (Table 6). Habitat suitability index values for wetlands outside the AOC were very similar, if slightly higher, ranging from 0.53 to 0.62 and averaging 0.54 (S.D.=0.04) (Table 6). Three of the four rivers had wetlands slightly higher in suitability index scores outside the AOC than inside the AOC (St. Lawrence, Grasse, Raquette). The St. Regis wetland inside the AOC scored higher (0.58) than the St. Regis wetland outside the AOC (0.52), although scores were very similar.

The individual components of the HSI model, such as for reproduction and habitat interspersion, had very similar values across the eight wetlands (Table 14). More variation among wetlands for the food component and winter cover component was evident, although the eight wetlands still ranked fairly close together in their aggregate score (Table 14).

Overall, these scores indicate that the eight selected wetlands inside and outside the AOC are very similar based on the HSI model for snapping turtles developed by Graves and Anderson (1987) (Tables 4 and 5, Figures 11 and 12). All have relatively high suitability scores based on field measurements of flow, depth, temperature, substrate composition, distance to permanent water and distance to small streams (Table 7, Figure 12), all components of the environment important to turtles.

These habitat suitability scores indicate that there is no difference in the eight wetlands sampled in terms of their suitability for turtles inside and outside the AOC, based on the HSI model developed by Graves and Anderson (1987) for snapping turtles.

Table 5. Locations of wetlands surveyed for turtle habitat and populations.

Wetland	River	Site Name	Inside or Outside the AOC?	Latitude	Longitude
SL001	St. Lawrence	Turtle Creek	Inside	44.98734 N	74.72331 W
SL002	St. Lawrence	Wilson Hill WMA	Outside	44.91957 N	75.07759 W
GR001	Grasse	AmVets Cove	Inside	44.97653 N	74.78349 W
GR002	Grasse	Dr Travis' Marsh	Outside	44.77712 N	75.11635 W
RQ001	Raquette	Stewart's Cove	Inside	44.98410 N	74.701400 W
RQ002	Raquette	Kuenzler's Cove	Outside	44.76363 N	74.99306 W
SR001	St. Regis	St Regis Cove	Inside	44.99451 N	74.64650 W
SR002	St. Regis	Brasher State Forest Vice Road	Outside	44.82990 N	74.78742 W

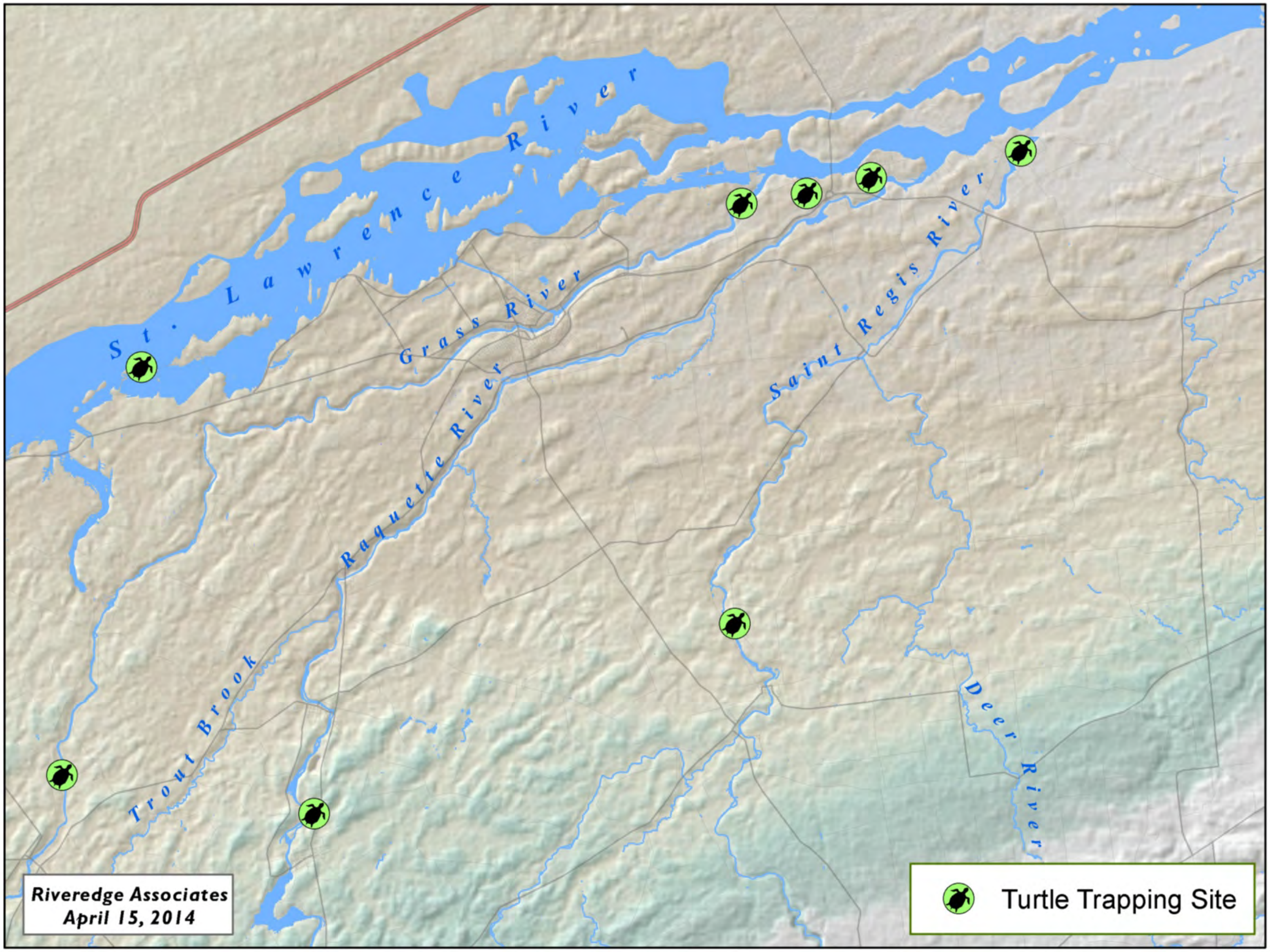

Figure 10. Location map of wetlands surveyed for habitat suitability and trapped for turtles inside and upstream of the AOC.

Table 6. Wetland habitat suitability index scores (within group ranked from high to low).

Wetland	Site Name	SIV Food	SIV Winter	SIV Reproduction	SIV Interspersion	HSI Value
Inside AOC						
SR001	St Regis Cove	0.58	0.35	0.95	1.00	0.58
RQ001	Stewart's Cove	0.54	0.30	1.00	1.00	0.55
GR001	Amvets Cove	0.68	0.15	0.95	1.00	0.46
SL001	Turtle Creek	0.56	0.15	1.00	1.00	0.44
					Average of Inside AOC Wetlands (S.D.)	0.51 (0.07)
Outside AOC						
RQ002	Kuenzler's Cove	0.79	0.30	1.00	1.00	0.62
GR002	Dr Travis' Marsh	0.97	0.20	0.95	1.00	0.57
SL002	Wilson Hill WMA	0.87	0.20	0.95	1.00	0.55
SR002	Brasher State Forest Vice Road	0.59	0.25	1.00	1.00	0.53
					Average of Outside AOC Wetlands (S. D.)	0.57 (0.04)

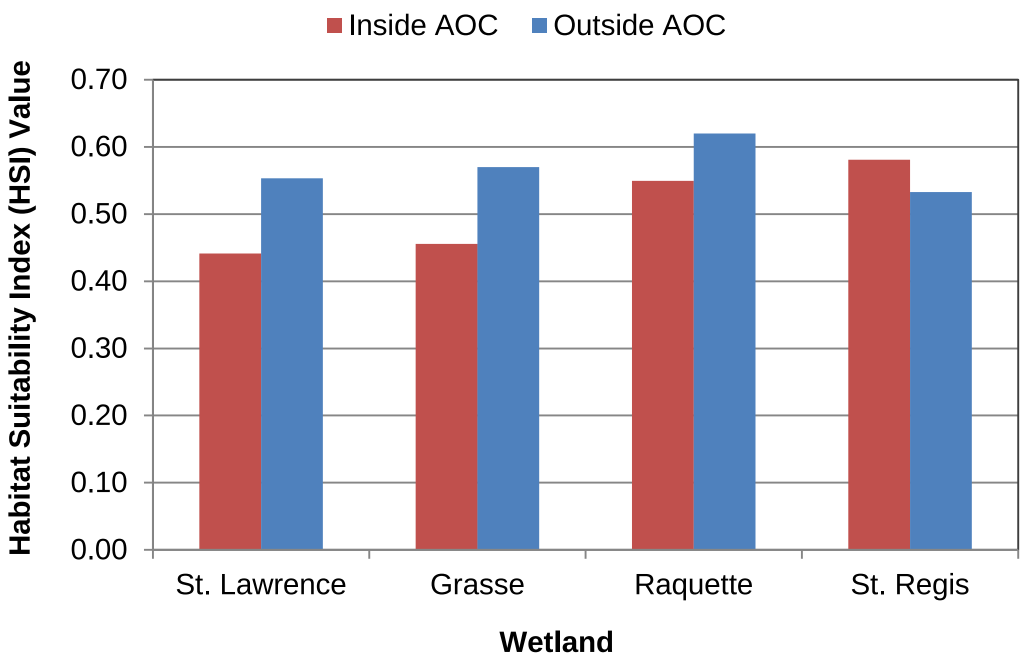

Figure 11. Habitat suitability values for wetlands by river.

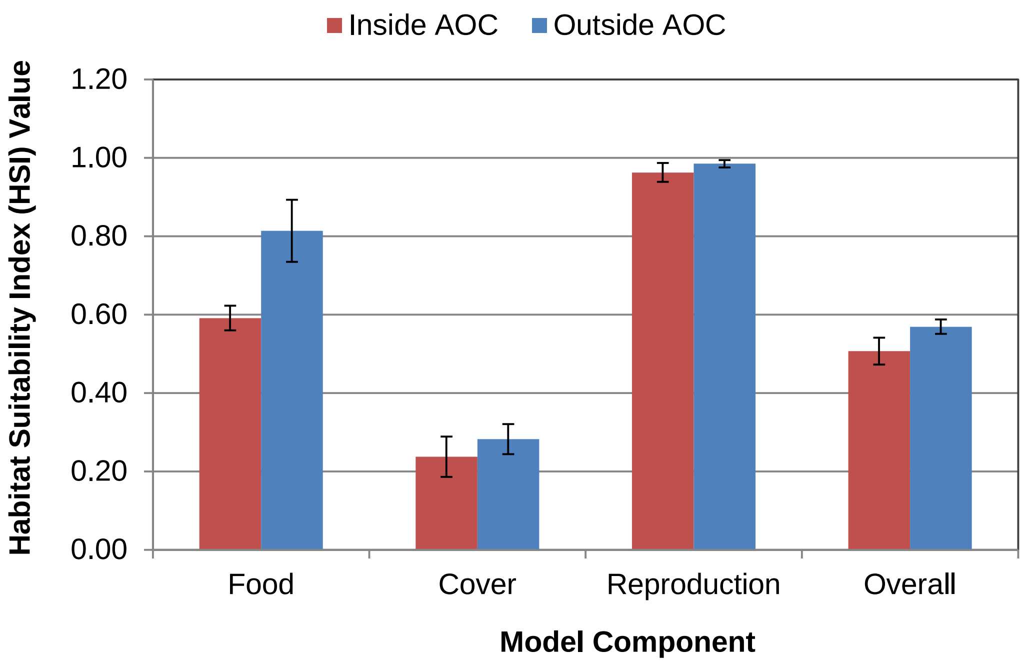

Figure 12. Habitat suitability values for wetlands by model component.

Table 7. Habitat suitability component scores by wetland site (in order from high to low). SIV= Suitability Index value.

Wetland	SIV1	SIV2	SIV3	SIV Food	SIV4	SIV5	SIV Winter	SIV6	SIV Reproduction	SIV7	SIV Inter-spersion	HSI Value
RQ002	0.90	0.90	0.60	0.79	1.00	0.30	0.30	1.00	1.00	1.00	1.00	0.62
SR001	0.30	0.80	0.80	0.58	1.00	0.35	0.35	0.95	0.95	1.00	1.00	0.58
GR002	1.00	1.00	0.90	0.97	1.00	0.20	0.20	0.95	0.95	1.00	1.00	0.57
SL002	0.90	0.90	0.80	0.87	1.00	0.20	0.20	0.95	0.96	1.00	1.00	0.55
RQ001	0.30	0.75	0.70	0.54	1.00	0.30	0.30	1.00	1.00	1.00	1.00	0.55
SR002	0.30	0.98	0.70	0.59	1.00	0.25	0.25	1.00	1.00	1.00	1.00	0.53
GR001	0.90	0.70	0.50	0.68	1.00	0.15	0.15	0.95	0.95	1.00	1.00	0.46
SL001	0.60	0.95	0.30	0.56	1.00	0.15	0.15	1.00	1.00	1.00	1.00	0.44

3.4 Trapping Results

Turtle trapping was conducted at eight wetlands, four wetlands inside the AOC and four wetlands outside the AOC (Figure 13). One wetland was trapped for each river (St. Lawrence, Grasse, Raquette, and St. Regis) inside and outside the AOC (Table 8). Each wetland was trapped for 50-70 trap-nights. In total, 480 trap-nights were conducted in the eight wetlands (Table 8). During these trapping efforts, a total of 238 turtles were trapped for an average catch per unit effort of 0.50 turtles per trap-night (Table 8).

Of the 238 total turtles trapped, 141 were trapped inside the AOC and 97 were trapped outside the AOC (Table 9). By site, the greatest number of turtles trapped was 75 at the St. Regis Cove inside the AOC with 75 turtles, all of which were painted turtles and snapping turtles (Table 9). The next greatest number of turtles captures was 55 at the Grasse River site outside the AOC (Table 9, Figure 13). These sites were also the most productive in terms of catch per unit effort. The most turtles captured per trap-night was the St. Regis Cove site on the St. Regis River inside the AOC with 1.07 turtles captured per trap-night. This site was followed by the Grasse River outside AOC site (Dr. Travis' marsh) with 0.92 turtles per trap-night and the St. Lawrence River inside AOC site (Turtle Creek) with 0.76 turtles captured per trap-night (Table 9, Figure 13).

The most common species, both in terms of total turtles and total turtles per trap-night was the painted turtle with an average of 0.32 turtles captured per trap-night (Table 10). The second most common turtle was the snapping turtle with 0.16 turtles captured per trap-night (Table 10). In total, 152 painted turtles were captured and 70 snapping turtles. Only three musk turtles were captured, and only two each of Blanding's turtles and map turtles (Table 10).

Although painted turtles were approximately equal in captures per trap-night inside the AOC (0.35) and outside the AOC (0.29), they were much less abundant outside the AOC on the St. Regis and St. Lawrence Rivers (Table 10, Figure 14). In contrast, painted turtles were more abundant outside the AOC of the Raquette River, and on the Grasse River, painted turtles were only found outside the AOC, none were trapped inside the AOC (Table 10, Figure 14). This difference in abundance of painted turtles inside and outside the AOC for the Grasse River is likely a result of the low habitat complexity of the American Veteran's marsh (inside the AOC), due, in part, to the lower Grasse River's long history industrial development. In contrast, the upstream reference site on the Grasse River had an incoming stream, sandbar, and much greater habitat complexity and diversity. However, painted turtles were observed on the Grasse River inside the AOC during field surveys and are known to occur there (J. Wilkins, SRMT, personal communication). A similar pattern of abundance was true of snapping turtles. Snapping turtles were more common (captures/trap-night) inside the AOC (0.22) than outside the AOC (0.11) (Table 10). By river, snapping turtles were more common inside the AOC on the St. Regis and St. Lawrence Rivers, about equally abundant on the Grasse River, and more common outside the AOC on the Raquette River (Table 10, Figure 15).

Small sample sizes made the comparison of ages and sex ratios difficult among sites within each species. In general, more male turtles were caught than females, as was previously found in this area by Costello (2011). Juvenile snapping turtles trapped in the Grasse River had similar ages inside the AOC (2-7 years) and outside the AOC (2-11 years). Once snapping turtles become adults, they cannot be reliably aged, although they may live to 40-50 years old.

Map turtles, musk turtles, and Blanding's turtles were uncommon everywhere in the wetlands sampled using this sampling gear. Map turtles are known to occur inside the AOC in all three tributary rivers. While conducting fish surveys with fyke nets, Jay Wilkins of SRMT captured over 30 map turtles at one time May 6, 2013 on the Raquette River inside the AOC (J. Wilkins, SRMT, personal communication).

The presence of beaver lodges may influence the presence of some turtles, since these can serve as important overwintering habitat (Graves and Anderson 1987). The presence of beaver lodges was variable among the wetlands. The St Regis wetland inside the AOC had two active beaver lodges, whereas the St. Regis wetland outside the AOC had little or no current beaver activity in 2013.

The time of year when trapping is conducted can also affect trap success. The two wetlands on the St. Lawrence River were trapped at different times (mid-June and early August) and this could have affected trap success. The wetland inside the AOC was trapped during mid-June when turtles are more active and more likely to be captured (n=38). The wetland outside the

AOC at Wilson Hill Wildlife Management Area was trapped in August and only 5 turtles were captured.

Overall, our turtle trapping results, coupled with additional visual observations, suggest that painted turtles and snapping turtles are common and present inside and outside the AOC, with no obvious difference in turtle populations across all sites. Differences in abundance at specific wetlands on a single river, such as the lack of painted turtles at the Grasse River inside AOC site, were due to the lack of habitat complexity in the wetland, something that could be improved with appropriate management. In areas where our trapping efforts suggested few individuals are present, visual observations indicated a greater abundance than suggested by the trapping data alone. The other three species of turtles (map, musk, Blanding's) are uncommon everywhere, and this can be explained in part by lack of suitable habitat (e.g. Blanding's turtle). However, Blanding's turtles are known to travel long distances, and if larger areas of suitable habitat were present, these turtles would be more likely to persist and become established.


Photo 3. Turtles collected by SRMTED on Raquette River May 6, 2013

Photo 4. Promar trap deployed at sampling site.

Photo 5. Removing turtle from hoop net.

Photo 6. Turtles were photographed (top) and measured (bottom).

Table 8. Turtle trapping sites and trapping results.

Site Code	Site Name	Inside or Outside of the AOC?	Trapping Dates	Total Trap-nights	Total Turtles	Total Turtles/Trap-nights
SL001	Turtle Creek	Inside AOC	10 June - 15 June	50	38	0.76
SL002	Wilson Hill	Outside AOC	30 July - 04 Aug.	50	5	0.10
GR001	Amvets Cove	Inside AOC	30 June - 05 July	60	7	0.12
GR002	Dr Travis' Marsh	Outside AOC	08 July - 13 July	60	55	0.92
RQ001	Stewarts Cove	Inside AOC	10 June - 15 June	60	21	0.35
RQ002	Kuenzler's Cove	Outside AOC	08 July - 13 July	60	25	0.42
SR001	St Regis Cove	Inside AOC	03 June - 08 June	70	75	1.07
SR002	Brasher State Forest Vice Road	Outside AOC	03 June - 08 June	70	12	0.17
			Total and Average	480	238	0.50

Table 9. Number of turtles trapped at each site by species.

Species	Grasse River		Raquette River		St. Regis River		St. Lawrence River		Totals		All Sites
	Inside AOC	Outside AOC	Inside AOC	Outside AOC	Inside AOC	Outside AOC	Inside AOC	Outside AOC	Inside AOC	Outside AOC	
Painted Turtle	0	47	11	15	41	5	31	2	83	69	152
Snapping Turtle	7	8	5	10	34	7	7	1	53	26	79
Musk Turtle	0	0	3	0	0	0	0	0	3	0	3
Blanding's Turtle	0	0	0	0	0	0	0	2	0	2	2
Map Turtle	0	0	2	0	0	0	0	0	2	0	2
Totals	7	55	21	25	75	12	38	3	141	97	238

Table 10. Number of turtles captured per trap-night by species.

Species	Grasse River		Raquette River		St. Regis River		St. Lawrence River		Totals		All Sites
	Inside AOC	Outside AOC	Inside AOC	Outside AOC	Inside AOC	Outside AOC	Inside AOC	Outside AOC	Inside AOC	Outside AOC	
Painted Turtle	0.00	0.78	0.18	0.25	0.59	0.07	0.62	0.04	0.35	0.29	0.32
Snapping Turtle	0.12	0.13	0.08	0.17	0.49	0.10	0.14	0.02	0.22	0.11	0.16
Musk Turtle	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
Blanding's Turtle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.01	0.00
Map Turtle	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Totals	0.12	0.92	0.35	0.42	1.07	0.17	0.76	0.10	0.59	0.40	0.50

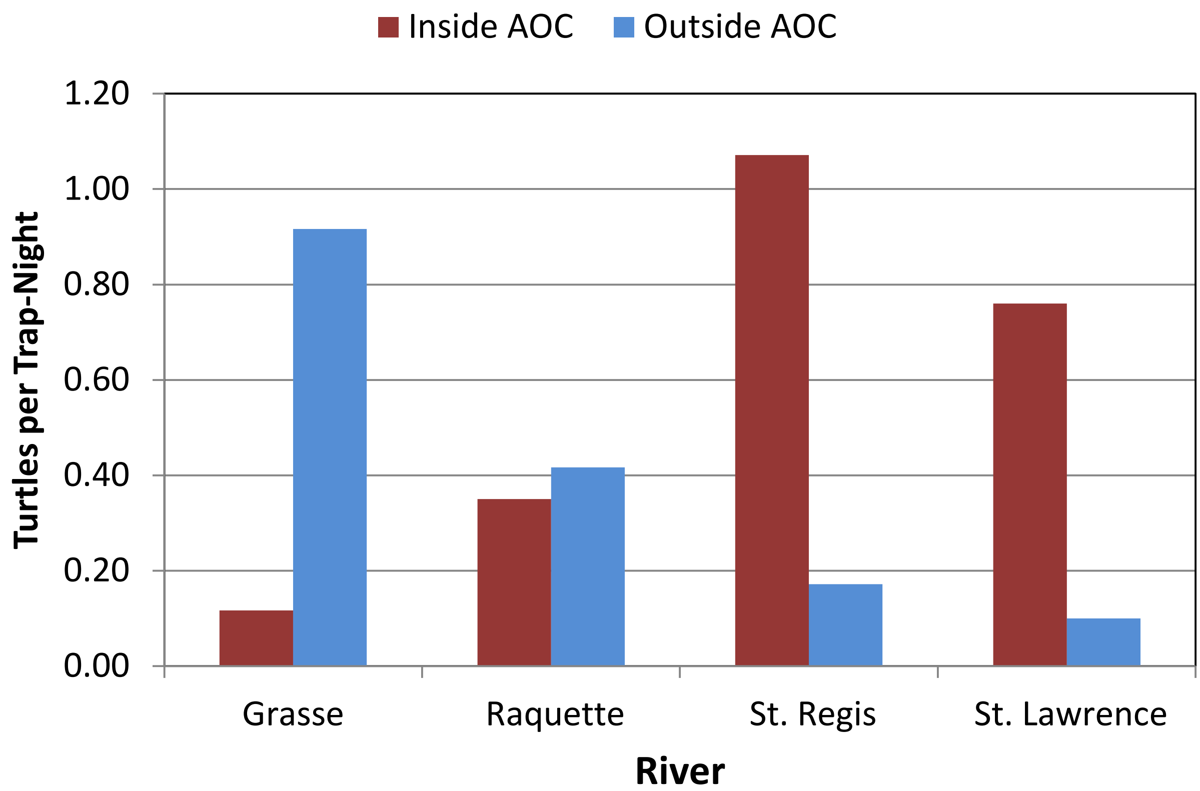

Figure 13. Total turtles trapped per trap-night by river.

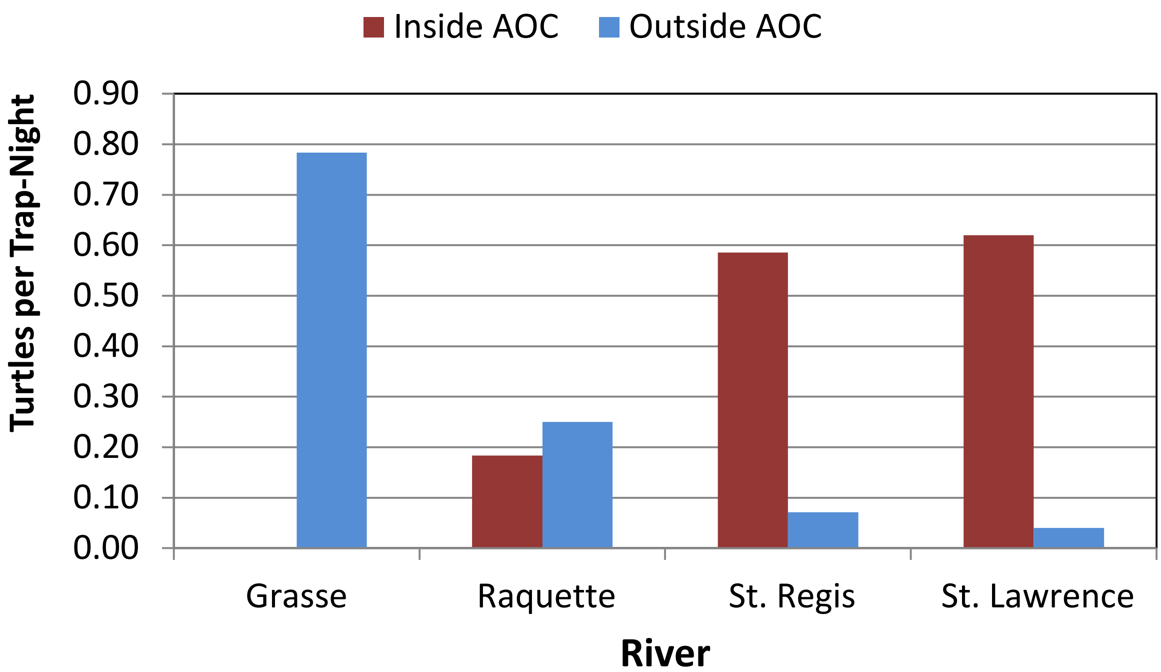

Figure 14. Number of painted turtles trapped per trap-night by river.

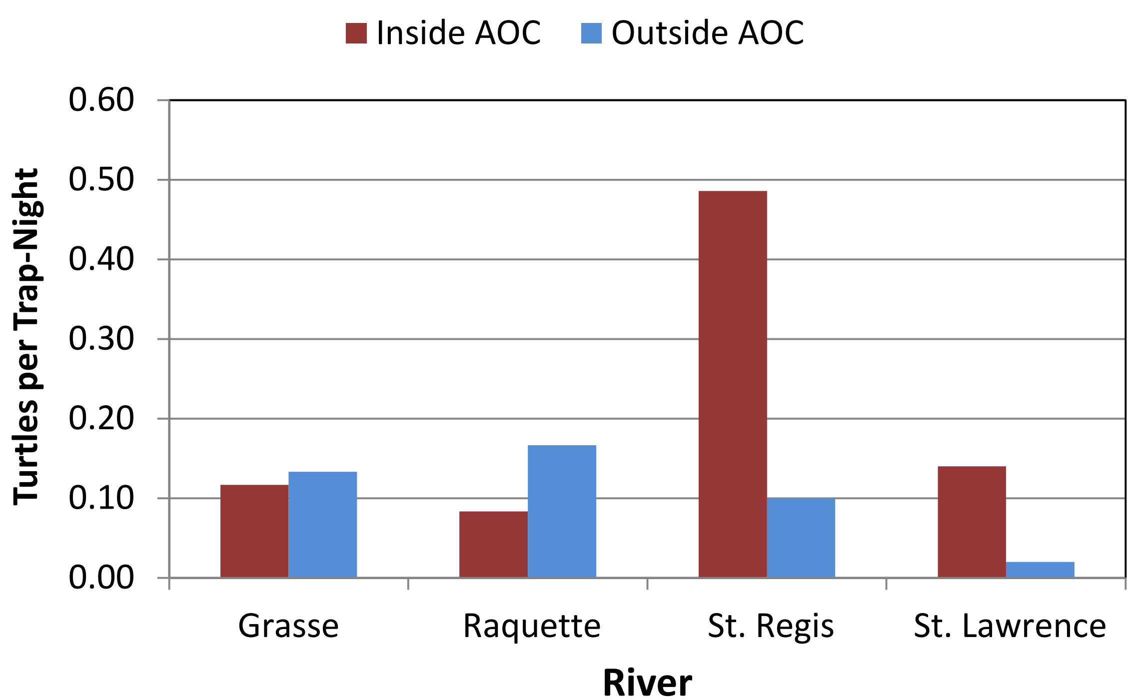

Figure 15. Number of snapping turtles trapped per trap-night by river.

3.5 Contaminant Burdens in Snapping Turtle Eggs

Snapping turtle eggs were collected both inside and outside the AOC (Table 11, Figure 16). A total of 33 egg clutches were collected, processed, and analyzed to determine the contaminant burdens of snapping turtles inside and outside the AOC. Of these 19 clutches were collected inside the AOC and 14 were collected outside the AOC (Table 12). Turtle clutches collected east (downstream) of the mouth of the St. Regis River (Snye) were considered inside the AOC because this area has always been considered an area of transboundary industrial impact (Harper et al., 2014). Thirteen samples were collected inside the AOC and three samples outside the AOC for the St. Lawrence River. Grasse River samples included four each from inside and outside the AOC. Raquette River samples included one inside the AOC and two outside the AOC. St. Regis River samples included one inside the AOC and five outside the AOC (Table 12).

Contaminant data from snapping turtle egg clutches were not normally distributed so a non-parametric approach was selected to assess contaminant burdens and lipids from inside and outside the Massena/Akwesasne AOC. To evaluate overall differences in contaminant burdens and lipids, data were pooled from all river stems (i.e. St. Lawrence, Grasse, St. Regis, Raquette) and classified as 'inside', or 'outside' the AOC. Second, when sample sizes were large enough, differences in contaminant and lipid burdens from *within* each river stem were also compared with the same classification scheme (inside vs. outside the AOC). For PCB analysis, we used Total PCBs but individual congener concentrations are listed in Appendix B. When we obtained values less than the detection limit, they were set at 10% below the detection limit to complete the statistical comparisons (Provencher et al., 2014). In cases where less than 60% of samples had values above the detection limit, only the minimum and maximum values are reported and they were not included in the analysis. In all cases, statistics in tables do not include values set by the investigators during analysis. In all cases to compare contaminants from within and outside the AOC, Wilcoxon tests and Wilcoxon Each Pair were performed with a significance level (alpha) set to 0.05. All results are reported in ng/g (ppb) wet weight (w.w.) (Provencher et al., 2014). In all cases to compare contaminants from inside and outside the AOC, Wilcoxon tests were performed with a significance level (alpha) set to 0.05. All analyses were performed using the statistical package JMP (version 11.0).

Of the 209 PCBs and 40 different contaminants analyzed (Table 13) for all snapping turtle egg clutches (n = 33) ten were detected above the minimum LOQ: Total PCBs, fluoride, mercury, aluminum, two organochlorines (heptachlor epoxide and p,p'-DDE) and four dioxin/furans, (total TCDF, total TCDD, total HpCDD, and OCDD) (Tables 13 and 14). Nine of those were detected inside the AOC, and eight were detected outside the AOC (Tables 14 and 15). The furan TCDF and dioxin TCDD were detected only inside the AOC, while Aluminum was detected only outside the AOC (Table 15).

Total PCBs (209 congeners) in snapping turtle eggs from inside the AOC for all river stems (n = 19; mean = 386.75 ± 101.77 (SE) ng/g) was significantly higher (p = 0.0005) than outside the AOC (n = 14; mean = 41.00 ± 20.51 (SE) ng/g; Table 15). Within river stems, only total PCBs from the Grasse River inside the AOC (n = 4; mean = 653.0 ± 408.5 (SE) ng/g) was significantly higher (p = 0.02) than snapping turtle clutches from the Grasse River outside the AOC (n = 4; mean = 8.34 ± 6.77 (SE) ng/g; Table 14).

The only organochlorine detected across the study area was DDE but the samples were not statistically comparable (inside vs outside the AOC) because it was detected in only n=1 sample outside the AOC (St. Lawrence River; Table 14). Heptachlor epoxide was detected inside the AOC only from the St. Lawrence and Grasse Rivers (Table 14)

For metals, mean total mercury inside the AOC (n = 3) was 108 ± 19 (SE) ng/g, while mean total mercury outside the AOC (n = 4) was 68.6 ± 7.59 (SE) ng/g, but the difference was not significant (Table 15). Aluminum was the only other metal detected in this study, but was only found in the Raquette River outside the AOC (n = 2). The mean level outside the AOC (Raquette River only) was 7,390 ± 1,600 (SE) ng/g (Table 15). The source of this aluminum is not known. No aluminum was used in turtle egg collection or processing.

The only furan detected was TCDF, and was found in one sample from the St. Lawrence River, inside the AOC (Table 15). In addition, the dioxins 2,3,7,8 -TCDD and HpCDD were detected exclusively in the St. Lawrence River stem, with TCDD detected exclusively inside the AOC, and HpDD inside, and outside the AOC (Table 15). The dioxin OCDD was detected inside the

AOC in the St. Lawrence (n = 5), and Grasse rivers (n = 1), and was also detected outside the AOC in one sample from each of the St. Lawrence, Grasse, and Raquette Rivers, but the difference was not significant (Tables 14 and 15).

Inside the AOC, mean Fluoride concentration (n = 5) was 8,660 ± 1,170 (SE) ng/g, while outside the AOC, the mean fluoride concentration (n = 2) was 11,220 ± 1,1490 (SE), but the difference was not significant (Table 15).

The highest levels of mean total PCBs observed in the AOC were found in the Grasse River (653.0 ± 408.5ng/g (SE), and the overall mean of total PCBs in the AOC was 386.75 ± 101.77 SE ng/g (Tables 14 and 15). The highest concentration detected in a 2013 sample was 1,850 ng/g total PCBs at GR033JUN262013ST (Table 11, Figure 16). These concentrations are much lower than total PCB concentrations reported in previous studies over a similar reach of the river (Figure 17) even when accounting for differences in lipid content (see Ashpole et al., 2004; Bishop et al., 1998; and de Solla et al., 2001; Table 16). In fact, mean PCB concentration reported here for the Grasse River is more than three orders of magnitude less than reported for a clutch in Turtle Creek in 1999 (Table 16; de Solla et al., 2001). Similarly, Ashpole et al. (2004) reported PCB concentrations in turtle eggs from the same site (Turtle Creek) sampled one year later (1999) had decreased by as much as 50% also when accounting for differences in lipid content (Table 16, Figure 17).

In the Raquette River, PCB concentrations remained constant in 1998 and 1999, but then declined by as much as 50% between 1999 and 2000 (de Solla et al., 2001; Ashpole et al., 2004) and the authors indicated it was difficult to say if PCBs were declining or remaining constant. We report PCB concentrations in the Raquette River nearly 2 orders of magnitude less than reported in 2000 (Ashpole et al., 2004), which suggests there is a temporal decline.

Overall, the PCB concentrations reported in the present study are more similar to samples collected from outside the Massena/Akwesasne AOC (Table 16) from the reference site at Algonquin Provincial Park, Ontario (Bishop et al., 1998 and Ashpole et al., 2004), and Walpole Island in the St. Clair AOC (Ashpole et al., 2004). However, our sample sizes were relatively small (1 to 4 clutches per site, except for the St. Lawrence; n = 13) and there is high variation in PCBs among clutches as demonstrated in our study, as well as de Solla et al. (2001) and Bishop et al. (1998). Thus it has been recommended that to decrease the coefficient of variation among clutches and more accurately interpret trends, sample sizes should be a minimum of 15 clutches per site (Ashpole et al., 2004). In this study, the field team searched exhaustively for snapping turtle nests at each site, but were unable to find additional nests.

Inside the AOC, we detected Hg in two samples from the St. Lawrence River (116.9 ± 30.2 ng/g), and one sample from the Raquette River at 90.4 ng/g . Ashpole et al. (2004) reported 720 ng/g Hg in the Raquette River in 1999. With the exception of the sample in the Raquette River in 1999, concentrations elsewhere within the region have been relatively low. Ashpole et al. (2004) reported 90 ng/g Hg in the Snye Marsh in 1999, and Bishop et al. (1998) reported a concentration of 140 ng/g within the Akwesasne territory from 1990. Outside the AOC, we detected Hg in the St. Lawrence (n = 2; 87.7 ± 23.3 ng/g), Grasse (n = 3; 66.7 ± 2.99 ng/g) and St. Regis rivers (n = 2; 52.4 ± 2.7 ng/g), similar to Hg concentrations reported in Ashpole et al. (2004) from Coote's Paradise (adjacent to Hamilton Harbor AOC, Lake Ontario) (50 ng/g), and Walpole Island (St. Clair AOC) (110 ng/g) collected in 1999. Overall, Hg in turtle eggs from within and near the AOC are below the known toxic concentration (500 ng/g) for bird eggs (Fimreite, 1971).

The pesticide compound p,p'-DDE was detected in the present study from samples collected inside the AOC from the St. Lawrence (n = 6; 11.33 ± 2.33 ng/g) and Grasse Rivers (n =2; 5.72 ± 1.43 ng/g), and outside the AOC from the St. Lawrence River (n = 1; 7.12 (1); all of which are similar to the concentration reported in Ashpole et al. (2004). However, these concentrations are lower than those reported in AOC samples from Turtle Creek (1998 and 1999) and the Raquette River (1998, 1999, and 2000) reported in de Solla et al. (2001), and Ashpole et al. (2004). We also report detectable amounts of the pesticide heptachlor epoxide from the St. Lawrence and Grasse Rivers inside the AOC only (Table 14), but no other studies report data for this compound.

Total dioxins inside the AOC from samples collected in the St. Lawrence River (0.035 ng/g) and the Grasse River (0.011 ng/g) are higher than samples collected from Turtle Creek in 1999 (0.0056 ng/g) but lower than samples collected from the Raquette River in 1999 (3.2 ± 1.3) and 2000 (3.9 ng/g; Ashpole et al., 2004). Outside the AOC, we detected total dioxins in the St. Lawrence (0.03 ng/g) and Raquette River (0.018 ng/g) and these concentrations are lower than

Bishop et al. (1996) reported for Coote's Paradise, Lake Ontario (0.074 ng/g), but higher than concentrations reported in Ashpole et al. (2004) for Coote's Paradise in 1999 (0.0078) and Walpole Island 1999 (0.0024 ng/g).

In this study, we report total furans detected only inside the AOC from one sample collected in the St. Lawrence River stem (0.0015 ng/g), and this is lower than reported in Ashpole et al. (2004) for Turtle Creek in 1999 (0.058 ng/g) and the Raquette River in 1999 and 2000 (0.0064 ± 0.0005, 0.0050 ng/g, respectively). Outside the AOC, total furans were reported in Bishop et al. (1996) for Coote's Paradise in 1984 (0.013 ng/g), and Ashpole et al. (2004) reported total furans in Coote's Paradise for 1999 (0.0052 ng/g) and Walpole Island (0.0012 ng/g).

The major route of PCB exposure in snapping turtles is through diet and maternal transfer to developing eggs. PCBs are lipophilic and because eggs have a high lipid content (4-7%; see Table 16 for a comparison of lipid content among studies), they are a useful bioindicator of exposure risk (de Solla and Fernie, 2004). High concentrations of PCBs in eggs have been correlated with acute hatching deformities and reduced hatching success although exact concentrations associated with adverse effects are not clear (Bishop et al., 1998; de Solla et al., 2008). Bishop et al. (1998) reported abnormalities in 15% of snapping turtle eggs from seven clutches collected at Akwesasne in 1990 at 3.946 mg/kg (ppm). The levels of PCBs found in turtle eggs exceeded concentrations associated with developmental problems and reduced hatching success in snapping turtles and other species (Bishop et al., 1991, 1998). de Solla et al. (2001) noted that the toxic equivalency (TEQ) of total PCBs, total non-ortho PCBs, and PCDD/PCDFs in snapping turtle eggs from all sites exceeded the Canadian tissue residue guidelines for TEQs (based on Ahlborg et al., 1994) for PCBs of 0.79 ng/kg w.w. (ppt) (Environment Canada 1999 in de Solla et al., 2001). PCB concentrations observed in the Grasse River inside the AOC in this study were similar to concentrations reported for the Snye Marsh (de Solla et al., 2008) where hatchling deformities were noted. In this study, no deformities were found in the seven adult snapping turtles trapped at the Grasse River inside the AOC site. Deformities in hatchlings could not be assessed in this study because all eggs incubated in the laboratory failed.

The lower level of PCBs detected in snapping turtles in this study compared to previous studies could be the result of several factors. First, the snapping turtle egg clutches collected in this study did not come from the immediate vicinity of known hot spots of contamination such as Turtle Creek. Although this area was searched in 2013, no eggs were recovered from this area. One clutch was collected more than three kilometers from the tributary rivers of the AOC, and this clutch and other clutches may not be representative of the tributary rivers of the AOC. Second, the remediation activities conducted in the Massena/Akwesasne AOC may have reduced the availability of contaminants to wildlife, resulting in the lower levels detected in snapping turtle eggs in this study compared to previous studies, many of which collected snapping turtle eggs approximately 20 years before this study. This study was limited to turtle eggs only for reproductive health considerations. Additional studies evaluating contaminant burden to turtle organs and tissue for Mohawk medicinal and consumption use, respectively, should be considered.

Although no samples were collected in 2013 from Turtle Creek, one clutch was collected from Turtle Creek property on June 13, 2014 and submitted for chemical analysis. Due to different years of field collection, it was not included in the reported egg collection locations nor in the statistical analysis of 2013 samples (Table 10, 11, 14 and 15). The sample (SL034JUN132014ST) was analyzed with the same methods and contaminants as listed in Table 3 and 13. Contaminant concentrations detected are considered Inside the AOC (n=1; 1,210 ng/g total PCBs, 3.42 ng/g Heptachlor epoxide, 15.8 ng/g OCDD). All other contaminant results were ND, sample was 5.6% lipids, and individual PCB congener concentrations can be found in Appendix B. Similar to the 2013 Grasse River total and mean PCB results and discussion above, the observed 2014 Turtle Creek total PCB concentrations are much lower than reported in previous studies over a similar reach of the river, but still higher than immediate upstream Outside AOC reference locations (Figure 16) (see Ashpole et al., 2004; Bishop et al., 1998; and de Solla et al., 2001; Table 14 and 16; Appendix B).

Photo 7. Snapping turtle eggs were carefully excavated (top) and collected (bottom) in the field.

Photo 8. Snapping turtle eggs were transported and processed in the lab.

Table 11. Locations of snapping turtle egg collections.

N	Sample ID [1]	Latitude (N)	Longitude (W)	River	Inside or Outside the AOC?
1	SL001JUN062013ST	44.96380	74.87196	St. Lawrence	Inside
2	SL002JUN072013ST	44.99048	74.83553	St. Lawrence	Inside
3	SL003JUN072013ST	44.98974	74.83423	St. Lawrence	Inside
4	SL004JUN072013ST	44.99131	74.83498	St. Lawrence	Inside
5	GR005JUN072013ST	44.92250	74.92847	Grasse	Outside
6	SR006JUN102013ST	44.78112	74.83912	St. Regis	Outside
7	SR007JUN102013ST	44.78091	74.83887	St. Regis	Outside
8	SR008JUN102013ST	44.78097	74.83892	St. Regis	Outside
9	SL009JUN102013ST[2]	45.00169	74.55662	St. Lawrence	Inside
10	SL010JUN102013ST[2]	44.99371	74.55869	St. Lawrence	Inside
11	GR011JUN102013ST	44.96209	74.83898	Grasse	Inside
12	SL012JUN102013ST	44.96766	74.85471	St. Lawrence	Inside
13	SL013JUN102013ST	44.97015	74.85350	St. Lawrence	Inside
14	SL014JUN102013ST	44.96466	74.86583	St. Lawrence	Inside
15	RQ015JUN122013ST	44.96460	74.76836	Raquette	Inside
16	SL016JUN122013ST	44.96748	74.85970	St. Lawrence	Inside
17	GR017JUN122013ST	44.96209	74.85204	Grasse	Inside
18	GR018JUN122013ST	44.93456	74.95634	Grasse	Outside
19	SL019JUN122013ST	44.91795	75.04354	St. Lawrence	Outside
20	GR020JUN122013ST	44.87653	74.99493	Grasse	Outside
21	SL021JUN122013ST	44.92049	75.04589	St. Lawrence	Outside
22	SR022JUN132013ST	44.93679	74.70633	St. Regis	Outside
23	SL023JUN132013ST[2]	45.01810	74.57437	St. Lawrence	Inside
24	SL024JUN132013ST[2]	45.01791	74.57096	St. Lawrence	Inside
25	SR025JUN142013ST[2]	44.99705	74.60786	St. Regis	Inside
26	SL026JUN142013ST[2]	44.99391	74.55857	St. Lawrence	Inside
27	RQ027JUN142013ST	44.85772	74.91977	Raquette	Outside
28	GR028JUN162013ST	44.78106	75.11316	Grasse	Outside
29	SR029JUN172013ST	44.88048	74.73823	St. Regis	Outside
30	SL030JUN172013ST	44.91593	75.06918	St. Lawrence	Outside
31	RQ031JUN232013ST	44.76673	74.99567	Raquette	Outside
32	GR032JUN252013ST	44.98044	74.76919	Grasse	Inside
33	GR033JUN262013ST	44.98039	74.76927	Grasse	Inside
Total turtle egg clutches collected Inside AOC					19
Total turtle egg clutches collected Outside AOC					14

[1] Sample locations on the map figure are abbreviated to the first five characters of the sample ID.
[2]Sample locations collected in the Mohawk Territory of Akwesasne

Table 12. Number of snapping turtle egg clutches collected inside and outside the AOC by river.

River	Inside the AOC	Outside of the AOC
St. Lawrence River	13	3
Grasse River	4	4
Raquette River	1	2
St. Regis River	1	5
Total	19	14

Table 13. List of contaminants tested for in snapping turtle eggs. Those detected noted with "yes." All others not detected in snapping turtle eggs. Details in next table.

	Contaminant	Detected?
	Polychlorinated biphenyls (PCBs, 209 congeners) (n=209)	Yes
	Organochlorine Pesticides (n=23)	
1	Aldrin	
2	alpha Chlordane	
3	alpha-BHC (α-hexachlorocyclohexane, α-benzenehexachloride)	
4	beta-BHC (β-hexachlorocyclohexane, β-benzenehexachloride)	
5	Chlordane	
6	delta-BHC (δ-hexachlorocyclohexane)	
7	Dieldrin	
8	Endousulfan I	
9	Endousulfan II	
10	Endousulfan sulfate	
11	Endrin	
12	Endrin aldehyde	
13	Endrin ketone	
14	gamma Chlordane	
15	gamma-BHC (Lindane, γ-hexachlorocyclohexane)	
16	Heptachlor	
17	Heptachlor epoxide	Yes
18	Hexachlorobenzene	
19	Methoxychlor	
20	p,p'-DDD (dichlorodiphenyldichloroethane)	
21	p,p'-DDE (dichlorodiphenyldichloroethylene)	Yes
22	p,p'-DDT (dichlorodiphenyltrichloroethane)	
23	Toxaphene	
	Dioxins/Furans (n=10)	
24	OCDD (octachlorodibenzodioxin)	Yes
25	OCDF (octachlorodibenzofurans)	
26	Total HpCDD (heptachlorodibenzo-p-dioxin)	Yes
27	Total HpCDF (heptachlorodibenzofurans)	
28	Total HxCDD (hexachlorodibenzo-p-dioxin)	
29	Total HxCDF (hexachlorodibenzofuran)	
30	Total PeCDD (pentachlorodibenzo-p-dioxin)	
31	Total PeCDF (pentachlorodibenzofuran)	
32	2,3,7,8 - TCDD (tetrachlorodibenzo-p-dioxin)	Yes
33	Total TCDD (tetrachlorodibenzo-p-dioxin)	Yes
34	2,3,7,8 TCDF (tetrachlorodibenzofurans)	
35	Total TCDF (tetrachlorodibenzofurans)	Yes
	Mercury, Metals, Other (n=5)	
36	Aluminum	Yes
37	Cadmium	
38	Fluoride	Yes
39	Lead	
40	Mercury	Yes

Table 14. Concentration (ng/g) of contaminants and total lipids (%) in snapping turtle eggs by river and by site inside and outside the AOC. Wilcoxon rank sums test significant differences indicated by * within each river stem.

Contaminant	St. Lawrence River		Grasse River		St. Regis River		Raquette River	
	Inside AOC n = 13	Outside AOC n = 3	Inside AOC n = 4	Outside AOC n = 4	Inside AOC n = 1	Outside AOC n = 5	Inside AOC n = 1	Outside AOC n = 2
PCB congeners								
Total PCBs (209 congeners)	360.54 ± 79.45 (13)	73.40 ± 29.81 (3)	**653.00 ± 408.50 (4)***	**8.34 ± 6.77 (4)***	8.92 (1)	7.13 ± 1.36 (5)	40.30 (1)	142.41 ± 136.60 (2)
Fluoride	6,730 (1)	12,700 (1)	8,990 ± 2,010 (2)		6,570 (1)	9,730 (1)	12,000 (1)	
Metals								
Mercury	116.9 ± 30.2 (2)	87.7 ± 23.3 (2)		66.7 ± 2.99 (3)		52.4 ± 2.7 (2)	90.4 (1)	
Aluminum								7,390 ± 1,600 (2)
Organochlorines								
Heptachlor epoxide	6.25 ± 0.42 (4)		5.62 (1)					
p,p'-DDE	11.33 ± 2.33(6)	7.12 (1)	5.72 ± 1.43 (2)					
Dioxins/Furans								
Total TCDF	0.0015 (1)							
Total TCDD	0.0016 ± 0.00015(2)							
Total HpCDD	0.012 (1)	0.0067 (1)						
OCDD	0.023 ± 0.0067 (5)	0.023 (1)	0.011 (1)					0.018 (1)
Total Lipids (%)	5.34 ± 0.86	4.61 ± 0.29	6.14 ± 0.48	4.81 ± 0.52	4.29	6.23 ± 0.65	6.54	4.83 ± 0.96

Table 15. Average concentrations of contaminants [1] (ng/g) and total lipids (%) in snapping turtle eggs collected from inside and outside the AOC. Significant differences indicated by * and bold type.

	Inside AOC n = 19	Outside AOC n = 14
PCB Congeners		
Total PCBs (209 congeners)	**386.75 ± 101.77 (19)***	**41.00 ± 20.51 (14)***
Fluoride	8,660 ± 1,170 (5)	11,220 ± 1,490 (2)
Metals		
Mercury	108.0 ± 19 (3)	68.6 ± 7.59 (7)
Aluminum	ND	7,390 ± 1,600 (2)
Organochlorines		
Heptachlor epoxide	6.12 ± 0.035 (5)	ND
p,p'-DDE	9.93 ± 1.95 (8)	7.12 (1)
Dioxin/Furans		
Total TCDF	0.0015 (1)	ND
Total TCDD	0.0016 ± 0.00015 (2)	ND
Total HpCDD	0.012 (1)	0.0067 (1)
OCDD	0.021 ± 0.0056 (6)	0.021 ± 0.0025 (2)
Total Lipids (%)	5.52 ± 0.95 (19)	5.28 ± 1.27 (14)

[1] Samples run for 40 contaminants and congener specific PCBs.

Note: Numbers in parentheses indicate sample size when contaminants were not detected in all samples

Table 16. Literature comparison of contaminants (ng/g; ppb) and total lipids (%) in snapping turtle eggs collected between 1988 and 2013.

Site	Year Collected	N	Total PCBs	Total Mercury	p,p'-DDE	Total Dioxins	Total Furans	Total Lipids (%)	Author
Inside AOC									
St. Lawrence River	2013	13	360.54 ± 79.45	116.9 ± 30.2 (2)	11.33 ± 2.33(6)	0.035 (6)	0.002 (1)	5.34 ± 0.86	Current study
Turtle Creek	1998	1	740,000		850			15	de Solla et al. 2001
Turtle Creek	1999	1	61,000		59	0.0056	0.058	5.9	Ashpole et al. 2004
Grasse River	2013	4	653.00 ± 408.50		5.72 ± 1.43 (2)	0.011 (1)		6.14 ± 0.48	Current study
Raquette River	1998	1	6,000		29			6.8	de Solla et al. 2001
Raquette River	1999	5	5,200 ± 2,400	720	51 ± 29	3.2 ± 1.3	0.0064 ± 0.00005	6.9 ± 1.6	Ashpole et al. 2004
Raquette River	2000	3	2,500 ± 2,400		24 ± 12	3.9	0.0050	7.2 ± 0.70	Ashpole et al. 2004
Raquette River	2013	1	40.30	90.4				6.54	Current study
St. Regis River	1998	1	7,000		11			9.7	de Solla et al. 2001
St. Regis River	2013	1	8.92					4.29	Current study
Snye Marsh	1998		2,400 ± 2,100					8.6 ± 3.8	de Solla et al. 2001
Snye Marsh	1999		1,900 ± 1,800	90				5.9 ± 0.8	Ashpole et al. 2004
Akwesasne	1990		4,000 ± 1,400	140 (5)				5.0 ± 0.60	Bishop et al. 1998
Outside AOC									
St. Lawrence River	2013	3	73.40 ± 29.81 (3)	87.7 ± 23.3 (2)		0.03 (2)		4.61 ± 0.29	Current study
Grasse River	2013	4	8.34 ± 6.77	66.7 ± 2.99 (3)				4.81 ± 0.52	Current study
St. Regis River	2013	5	7.13 ± 1.36	52.4 ± 2.7 (2)				6.23 ± 0.65	Current study
Raquette River	2013	2	142.41 ± 136.60			0.018 (1)		4.83 ± 0.96	Current study
Algon. Prov. Park, Lake Sasejewun	1981	6	190 ± 24		27 ± 15			5.5 ± 0.25	Bishop et al. 1996
Algon. Prov. Park, Lake Sasejewun	1999	9	32 ± 17		6.4 ± 7.5			4.9 ± 0.69	Ashpole et al. 2004
Lake Ontario, Coote's Paradise	1984	5	1,300 ± 33		290 ± 60	0.074	0.013	6.0 ± 0.52	Bishop et al. 1996
Lake Ontario, Coote's Paradise	1999	9	1,900 ± 810	50	69 ± 19	0.0078	0.0052	5.7 ± 0.9	Ashpole et al. 2004
Walpole Island (St. Clair AOC)	1999	10	240 ± 270	110	8.8 ± 5.1	0.0024	0.0012	6.1 ± 1.1	Ashpole et al. 2004

Note: Numbers in parentheses indicate sample size when contaminants were not detected in all samples. Blanks mean that the contaminant was not measured or data are not available.

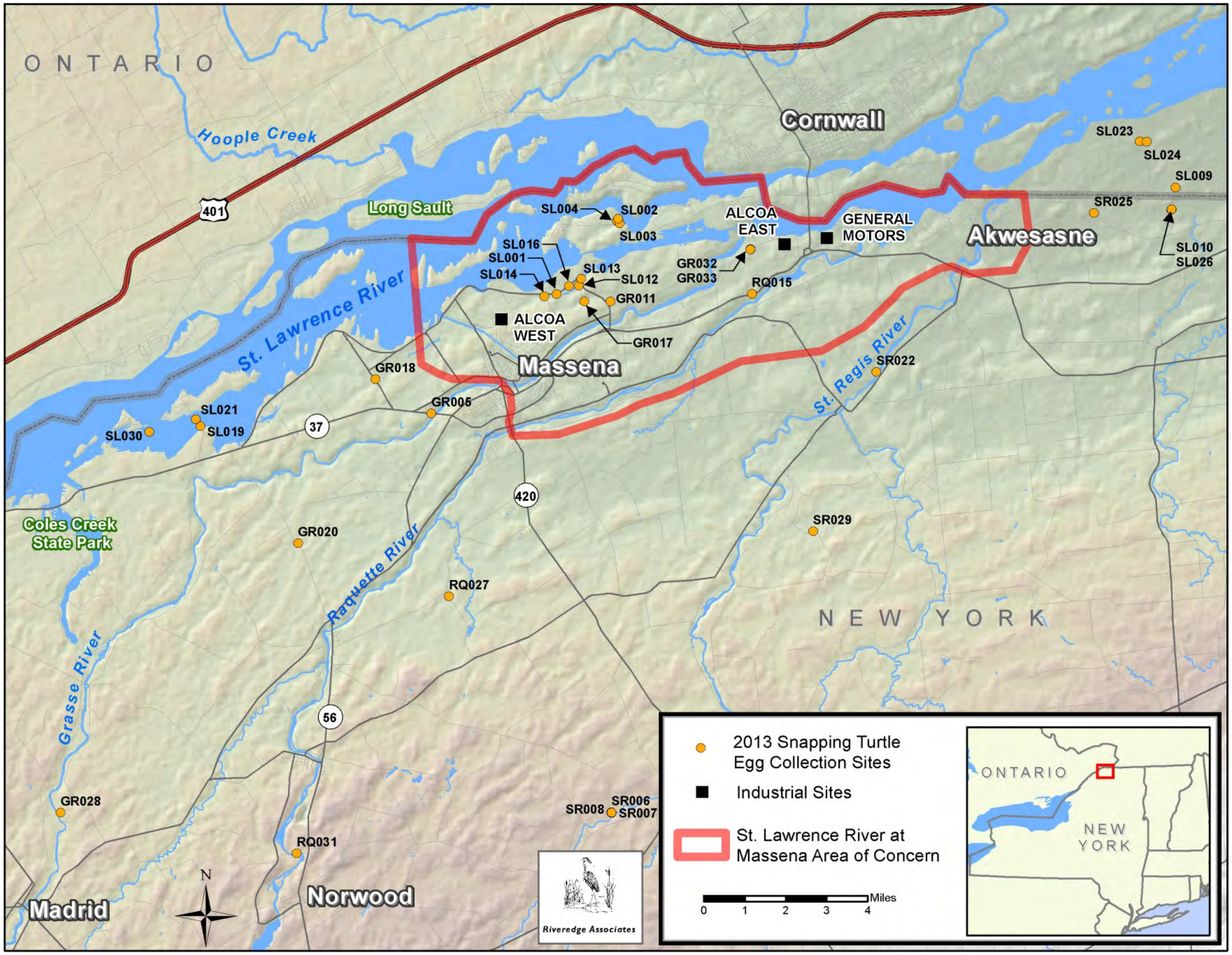

Figure 16. Collection sites of snapping turtle egg clutches analyzed in this study.

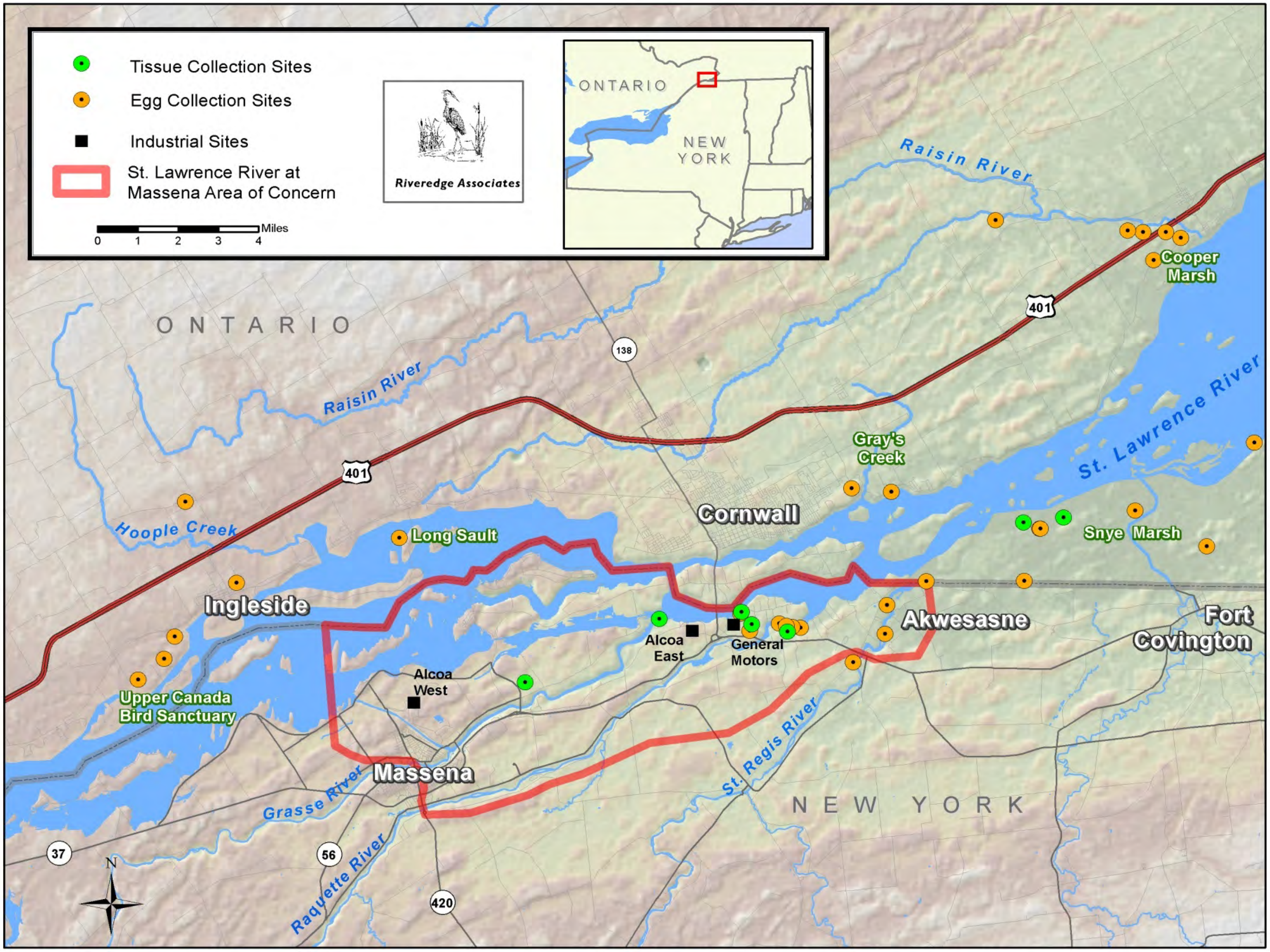

Figure 17. Earlier collection sites (prior to this study) of snapping turtle tissue and egg clutches in and near the AOC.

4.0 LESSONS LEARNED

In general, the field work for this project went very smoothly, although some lessons were learned that may assist others performing similar work in and near the AOC. The primary lessons learned involved the ability to locate nesting turtles, the incubation of turtle eggs in the laboratory, and the methods used for trapping turtles in the field.

In some areas, locating nesting snapping turtles was not difficult, while in other areas, it was exceedingly difficult. The overall number of field hours to locate nests was considerable. In some areas, such as along roadside wetland crossing with culverts, nesting snapping turtles could easily be located with only a few hours effort. In other areas, tens of hours (e.g. 25-50 hours or more) were expended to find a single turtle nest, and in some areas, no turtle nests were found at all. The result was that turtle egg clutches were collected opportunistically in areas some distance from the tributaries of the AOC, and the resulting data may not fully represent turtles in all areas of the AOC. This level of field effort is considerable, and should be allocated over more than a single field season if possible. Because adult turtles are readily available and egg clutches are difficult to collect, future long term trend monitoring should consider evaluating contaminants in turtle blood rather than in turtle eggs.

Once located, the excavation and processing of turtle eggs for analysis was straightforward. However, the incubation of turtle eggs in the laboratory failed. Eggs were originally proposed for incubation at the State University of New York at Oswego, but building renovations made the incubators at this facility unavailable at the time they were needed. Instead, eggs were incubated in growth chambers at the State University of New York at Potsdam. These facilities were also under renovation during incubation. Problems were experienced with regulating humidity, and some egg clutches became covered in fungus and failed. Consultations were conducted in an effort to correct these problems with a herpetologist with previous experience at the Bronx Zoo and previous experience incubating and hatching snapping turtles at SUNY Potsdam. However, no turtle clutches hatched, and the exact reason is unknown. If this work were to be repeated, it may be wise to not put all the egg clutches in a single incubator, but perhaps put smaller numbers of clutches in several incubators to minimize loss in the event of difficulty regulating temperature and humidity.

Trapping turtles in the field went very smoothly and involved the use of both standard hoop traps and the much smaller Promar traps following the standardized sampling methodology of NEPARC (2010). This paired trapping methodology is very efficient, and allows the sampling of deeper water with the floating Promar traps. The smaller traps catch smaller turtles as well and may catch turtle otherwise missed by using hoop traps alone. In addition, the visual surveys provided data on turtle occurrences that could not have been determined by trapping alone.

5.0 RECOMMENDATIONS

The long-term condition and status of turtle populations and habitats in the Massena/Akwesasne AOC should be maintained and monitored in future years to ensure that the findings of this and other reports remain valid. Both short-term multi-year monitoring and long-term turtle contaminant and population trend monitoring would be useful to detect potential future changes in contaminants, populations, and habitats. A comparable (or modified) contaminant study to this one should be conducted upon remedy completion in the Grasse River and Turtle Creek/Mohawk uplands prior to any delisting decision on Massena/Akwesasne AOC. Grasse River remedy is proposed to begin in 2016, with anticipated end date by 2020. Also, contaminant studies that consider target turtle species and organs for Mohawk cultural uses (medicinal, ceremony, and/or consumption) should be considered if field study design, comparison, and data quality objectives determined to be feasible.

Any previously identified data gap from the *Turtle Interim Status Report* not included in 2013 field study should be considered for future monitoring and assessment. For example, "*Blanding's turtle habitat and populations in the Akwesasne wetland complex is not well understood. Populations of map turtle, musk turtle, and wood turtle are poorly known in and near the AOC*" (Harper et al., 2014). As previously noted, this study did not include the Akwesasne Wetland Complex and Lac Saint Francois Ramsar site for habitat evaluation or turtle population assessment. These wetland habitat complexes are part of the larger Bi-National St. Lawrence River AOC, and may provide refugia and/or critical habitat for rare and/or cultural turtle species of interest. "*The ecological health and status of the extensive freshwater wetland fringing the upper St. Lawrence River in the Akwesasne Mohawk Territory is unknown and of high priority for the Akwesasne tribal governments. It is also of special interest to the US Fish & Wildlife Service (FWS) and other environmental managers. The western most extent of the Akwesasne Wetland Complex includes the St. Lawrence River at the Massena Area of Concern (including portions of the Grasse, Raquette, and St. Regis Rivers) and an eastern component, Lac Saint Francois, designated as a 'Wetland of International Importance'*" (McKenna et al., 2006). Collaboration with appropriate tribal resource managers (i.e. SRMT and MCA Environment

Division) would be necessary for appropriate development of cultural uses, target species, and rare species data quality objectives in Akwesasne and surrounding environments.

Such monitoring and management should be conducted in accordance with existing state, federal or Tribal management plans and goals where such plans exist (e.g. Costello, 2011; NEPARC, in preparation). As conditions change in the AOC, care must be taken to mitigate future clean-up operations and restore or enhance the important natural habitat characters of each river. In particular, no net loss of habitat should occur, either through direct impacts, or indirect impacts such as an increase in invasive species.

Existing management plans for turtles include the SRMT (Costello, 2011), the Northeastern U.S. Blanding's Turtle Conservation Plan, the Northeastern U.S. Wood Turtle Status Assessment and Conservation Plan, as well as individual conservation plans for threatened turtles at specific sites (NEPARC 2010, Glenn Johnson, personal communication; and http://www.northeastturtles.org/NE/home.html). In addition, the draft Comprehensive Wildlife Conservation Strategy for New York (NYSDEC, 2005) recommends that habitats in the northeast Lake Ontario-St. Lawrence Basin that contain uncommon turtles of wetlands be secured to ensure species survival. These habitats should be secured through the acquisition of conservation easements for wetlands and adjacent uplands. The Wildlife Conservation Strategy specifically identified the Blanding's turtle along the St. Lawrence Valley as a target species. These management plans provide a conservation framework from which specific local actions can be developed. They do not contain specific target population goals by species, but rather recommend periodic monitoring to determine population trends and to detect any local decline that could be mitigated through conservation actions.

The SRMT management plan for Blanding's turtles and for snapping turtles (Costello, 2011) reviews the threats to turtle species protection, specifically identifying habitat impairment due to road construction, road mortality and nest predation. To protect these turtles, the plan recommends specific preservation techniques such as buffer zones around wetland habitats, nesting site creation and protection, and other mitigation measures (Costello, 2011). Road mortality likely kills more female turtles since they often cross roads in search of nest sites and may even nest along the roads. If mortality is high enough, the sex ratio of local populations could become skewed towards a greater number of males (Costello, 2011). Turtle crossings made with a barrier wall and culvert crossing system may be useful in protecting turtles along roadways. In addition, nesting habitat should be created along the side of the roadway adjacent to the wetlands (Costello, 2011).

Northeast regional turtle conservation plans are being developed for site specific areas by the Northeast Blanding's Turtle Working Group in cooperation with NYSDEC and SUNY Potsdam. Locally, plans will be developed for Louisville, New York and for Coles Creek/Wilson Hill, New York (Glenn Johnson, personal communication). A similar plan should be developed for turtles and their habitats in the Massena/Akwesasne AOC.

These management plans will include recommendations for site-specific population, habitat, and threat assessments, along with conservation goals and actions necessary to protect the species and its habitat. Each plan recommends an assessment of the quality and extent of wetland habitat, nesting habitat, and connecting upland habitat. Threat assessments recommendations include estimates of the severity of habitat loss, habitat fragmentation, road mortality, water level changes, depredation, and other anthropogenic stressors.

Conservation goals of the Blanding's turtle regional conservation plan will include maintaining adequate nesting habitat and ensuring that population trends remain positive or stable over time. One way to achieve this is to improve connectivity among nearby occurrences, possibly including portions of the Grasse River upstream of the AOC. Another method is to reduce road mortality through crossing upgrades, road signs and educational outreach programs. Finally, the plan will recommend that population status should be reevaluated at 5-10 year intervals using standardized population assessment techniques (Glenn Johnson, personal communication).

Turtle conservation can be accomplished by promoting connectivity of wetlands through protected passageways, identifying and protecting habitat, modifying habitat to promote nesting and overwintering areas, and through a public outreach campaign to educate the public on the importance of turtle conservation. Two large wetland areas where this may be particularly possible are the wetlands between the Grasse and Raquette Rivers just west of Alcoa East, and the wetlands south of the Wiley-Dondero canal by Eisenhower Lock that connect to the Grasse River east of County Route 131 (Figure 18).

At present, the turtle populations and habitats of the AOC are characterized by relatively small disjunct wetlands with significant anthropogenic influences. Turtle conservation in the AOC should focus on connecting these habitats and increasing the amount and complexity of available breeding and overwintering habitat. It is possible, if not likely, that large areas of the AOC once contained scrub-shrub and other wetland habitats that have been altered, drained, or lost over time.

Specific habitat improvements include the construction of high quality nesting sites near wetlands. These sites can be sited to minimize the need for turtles to cross roads or attempt to cross impassable barriers in search of suitable nesting habitat. Berms were built of sandy loam soil at the Coles Creek Blanding's Turtle Habitat Improvement Project (Riveredge Associates, 2010). Where road density is high and suitable open nesting habitat is limited, artificial nesting berms could potentially be a valuable habitat improvement tool.

Sand berms could be constructed around wetlands, such as along route 39 (Swamp Road) between Raymondville and Louisville and Turtle Creek, where suitable open nesting habitat may be limited. Another potential site for nesting berms is the area surrounding the newly constructed wetland at Alcoa East, and the large wetland complex to the west, south, and north. It is possible that suitable shrub-scrub wetland habitat may be present in this area for Blanding's turtles as well, a species notably under-represented in the AOC. If possible, the hydraulic connection between the wetlands south of the Grasse River and north and south of the Haverstock Road, west of Alcoa East, and adjacent to Alcoa's newly constructed wetland could be altered to facilitate the movement of turtles between these wetland complexes and allow them to avoid the road crossing (Figure 18). It is possible that this large wetland complex provides a link or migration corridor for turtles between the Grasse River and the Raquette River within the AOC. As such, the crossing of Route 37 represents a significant mortality hazard for moving turtles.

Turtle conservation measures for the St. Regis River could include the consideration of the removal of the dam at Hogansburg. Removal of this structure could facilitate movement of turtles from the lower reaches of the St. Regis River (and St. Lawrence River) to the upper reaches of the St. Regis River above the AOC. This would increase the potential for turtle movement and migration within the St. Regis watershed, and could reunite fragmented populations and habitats. In particular, the wetland at St. Regis Cove (SR001) inside the AOC was found to contain a high density of map turtles, and a map turtle nest was located as well. It is also likely that musk turtles are present here as well, although none were observed or trapped. Removal of the dam could facilitate movement of map turtles to habitats upstream. Dams are a significant barrier to movement for turtles and other species of fish and wildlife on the Raquette River as well.

Of the three tributary rivers in the AOC, the Grasse River is the most altered by anthropogenic factors. The Grasse River inside the AOC differs from the Raquette and St. Regis Rivers by the absence of islands, riffles, rapids, and pools, as well as by the dominance of soft silty sediment and the general lack of sand, gravel and cobble substrates. In addition, the velocity of the river flow in the Grasse River is generally lower and through a deeper, dredged channel. Furthermore, this flow is influenced by the operations of the St. Lawrence Seaway at Snell Lock, which causes backwater reversals with each ship passage and the discharge of water from the Wiley-Dondero Canal. The lower Grasse River has been dredged and channelized. Tributary streams to the lower Grasse River have also been channelized for industrial, agricultural and residential development. Finally, the presence of invasive species such as zebra mussels, Phragmites, reed canary grass and Japanese knotweed is more apparent in and along the Grasse River than either the Raquette or St. Regis Rivers, although invasive species are a conservation concern in all wetlands of the AOC.

As part of Superfund remediation activities, the lower Grasse River nearshores will be dredged and filled, and the main channel capped. While no formal habitat restoration plan has been developed or proposed at this time, these remediation activities provide the opportunity to restore or enhance certain beneficial elements of the habitat complexity that formerly naturally occurred on this river prior to dredging and channeling the river approximately 100 years ago.

The wetlands and streams along the Grasse River may have hydraulic connections to the large wetland complex south of the south of the Wiley-Dondero Canal just east of Eisenhower Lock, which includes some scrub-shrub wetland, black ash swamp, and vernal pools. This wetland may connect to the Grasse River through long channelized creeks that flow south to County Route 42 and then continue south to the Grasse River. Important turtle habitat could be restored in this area through the construction of additional stream meanders, wet meadows, and small ponds along the ditched and channelized feeder streams flowing through the Indian Meadows (Figure 18). The open uplands could be modified to create nesting areas with areas of open soil or sand. The establishment of beaver ponds and muskrat habitat could further create suitable turtle habitat and nesting areas.

These habitats would greatly benefit turtles and other wildlife of the AOC. The Grasse River shorelines, dredged and modified over the last 100 years, could be engineered to provide protected coves with gentle slopes and greater habitat complexity such as deep pools and shallow marshes with large woody debris. The AmVets (American Veterans) wetland on the lower Grasse River surveyed as part of this investigation could be almost doubled in size by constructing a beaded chain pool and channel system to the west of the existing wetland. This wetland appears to have a number of invasive species that are limiting potential turtle wetland habitat. These invasive species could be selectively removed and replaced with native species, promoting more suitable wetland and upland nesting habitat for turtles. At present, the habitat complexity at this site is relatively low, potentially a cause of the lack of painted turtles captured during trapping efforts at this site. Cover could be increased by adding logs and large woody debris, providing suitable basking sites for turtles as well as resting sites for waterfowl.

These site specific habitat improvements will bolster turtle populations and habitats in and near the AOC. The success of these habitat improvements can be measured through periodic monitoring (at least every 5-10 years per NEPARC) for species presence and abundance before and after remediation and restoration to ensure that recovery or restoration goals of the AOC have been achieved. The results of this study and similar studies (Costello, 2011) can be used as a baseline to establish long-term trends.

Finally, a public outreach program would be very useful to promote awareness of turtle conservation. School programs, road signs, and information pamphlets at State Parks, boat ramps, tackle shops, convenience stores and other locations would increase the public's awareness of the importance of turtle conservation in the area. The public should be discouraged from picking up turtles and taking them home as pets, only to release them later in an area that might not have suitable habitat. Some of the occurrence records of Blanding's turtles in the area are thought to be of animals displaced by members of the public (Glenn Johnson, personal communication).

Figure 18. Two large wetland complexes for potential turtle conservation efforts.

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APPENDIX A: Wetland EcoSummaries

Below are wetland EcoSummaries for the following wetlands used for HSI and trapping:

River	Inside or Outside of AOC?	Site Name	GPS Coordinates
St. Lawrence	Inside	Turtle Creek	44.98734 N 74.72331 W
St. Lawrence	Outside	Wilson Hill	44.91957 N 75.07759 W
Grasse	Inside	Amvets Cove	44.97653 N 74.78349 W
Grasse	Outside	Dr. Travis’ Marsh	44.77712 N 75.11635 W
Raquette	Inside	Stewart's Cove	44.98410 N 74.55667 W
Raquette	Outside	Kuenzler's Cove	44.76363 N 74.99306 W
St. Regis	Inside	St. Regis Cove	44.99451 N 74.64650 W
St. Regis	Outside	Vice Road Wetland	44.82990 N 74.78742 W

EcoSummary: St. Lawrence River, Inside AOC (SL001), Turtle Creek

River	In or out of AOC?	Site name	Coordinates	Turtles observed (O) or trapped (T)
St. Lawrence	Inside	Turtle Creek	44.98734N 74.72331W	O: Painted (n=2) T: Painted (n=31), Snapping (n=7)

Turtle Creek is a pond wetland the drains into the St. Lawrence River near Raquette Point in the Akwesasne reservation. This wetland is a pond with a low current velocity funneled into a creek. Beaver activity is the major factor affecting the depth and flow of the main pond and the creek. The entire area surveyed was approximately one acre. The dominant plant species observed was pickerel weed. Grasses (e.g. reed canary grass) surround most of the water, especially along the lower pond and creek, while pickerel weed is the main aquatic vegetation. This vegetation creates a canopy cover of approximately 60 % over the whole trapping area. The distance to small stream was calculated to approximately 77 m. The distance to permanent water was determined to be zero because the trap location was in permanent water. The average water depth for the whole cove was estimated to be 0.9 m and the maximum depth was 2.3 m. Turtle Creek substrate composition was 15% silt. The average air temperature during the trapping period was 21.4°C. The average water temperature during the trapping period was 19.4°C. The overall habitat quality was rated good as a result of two visual rapid assessments. Visual surveys found two painted turtles basking in the trap site area. There were no fish found in traps throughout the 5 night trap period. Birds observed during the trapping period included red-winged black birds, great blue heron, common yellowthroat, eastern kingbird, ring-billed gull, grackle, and green heron. There were obvious signs of recent beaver activity in the area surveyed. The activity of the beavers caused changes in the water level of the pond over a 24 hour period of time.

Habitat Characteristics

Approximate area Surveyed(acres)	Average and maximum water depth (m)	Percent silt	Canopy cover (%)	Distance to stream (m)	Distance to permanent water (m)
1.0	0.9/2.3	15	60	77	0

Trapping Results

Number of hoop net traps	Number of Promar traps	Nights Trapped	Trap-nights	Total turtles caught	Turtles caught per trap-night
5	5	5	50	38	0.76

Habitat Photos

EcoSummary: St. Lawrence River, Outside AOC (SL002), Wilson Hill Wildlife Management Area

River	In or out of AOC?	Site name	Coordinates	Turtles observed (O) or trapped (T)
St. Lawrence	Outside	Wilson Hill	44.91957N 75.07759W	O: Painted (n=1) T: Painted (n=2), Snapping (n=1), Blanding's (n=2)

Wilson Hill is an emergent, shrub-scrub wetland on an island on the South shore of the St. Lawrence River. The current velocity within the wetland is low. The entire area surveyed was approximately less than 10,000 $ft.^2$. The dominant plant species observed was sedge and grasses. This vegetation creates a canopy cover of approximately 80% over the whole trapping area. The distance to small stream was calculated to approximately 80 m. The distance to permanent water was determined to be zero because the trap location was in permanent water. The average water depth for the whole cove was estimated to be 0.6 m and the maximum depth was 1.6 m. Wilson Hill substrate composition was 20% silt. The average air temperature during the trapping period was 23.6°C. The average water temperature during the trapping period was 22.1°C. The overall habitat quality was rated good as a result of two visual rapid assessments. Visual surveys found one painted turtle basking in the trap site area. Fish found during the trapping period were bowfin. Birds observed during the trapping period included marsh wren, yellow warbler, bald eagle, green heron, belted kingfisher, and unidentified ducks. There were obvious signs of recent muskrat activity in the area surveyed.

Habitat Characteristics

Approximate area Surveyed($ft.^2$)	Average and maximum water depth (m)	Percent silt	Canopy cover (%)	Distance to stream (m)	Distance to permanent water (m)
10,000	0.6/1.6	20	80	80	0

Trapping Results

Number of hoop net traps	Number of Promar traps	Nights Trapped	Trap-nights	Total turtles caught	Turtles caught per trap-night
5	5	5	50	5	0.1

Habitat Photos

EcoSummary: Grasse River, Inside AOC (GR001), American Veterans Campground Cove on South Shore

River	In or out of AOC?	Site name	Coordinates	Turtles observed (O) or trapped (T)
Grasse	Inside	AmVets Cove	44.97653 N 74.78349W	O: T: Snapping (n=7)

AmVets Cove is a small river wetland on the south shore of the Grasse River located approximately 1.3 km from the confluence of the St. Lawrence River. This wetland is created by a wide turn in the Grasse River where the bend deposits silt and the flow is lower on the South shore than the opposing North shore. The current velocity in the cove is moderate due to the openly exposed mouth of the cove to the faster current in the main channel of the Grasse. The entire area surveyed was less than 10,000 ft^2. The dominant plant species observed was cattails. The main channel of the river flows alongside the wetland area, thus plants requiring low flow are not present. Vegetation along the shoreline creates about 45% canopy cover over the inlet of the whole trapping area. The distance to small stream was calculated to approximately 190m. The distance to permanent water was deemed zero because the trap location was in permanent water. The average water depth for the whole trapping area was estimated to be 0.5 m and the maximum depth was 1.2 m. Amvets cove substrate composition was 15% silt. The average air temperature during the trapping period was 21.8°C. The average water temperature during the trapping period was 22°C. The overall habitat quality was rated moderate as a result of two visual rapid assessments. Visual surveys found no turtles, most likely as a result of few basking logs in the site. Fish found during the trapping period were sunfish, bowfin, rock bass, and some small crayfish. Birds observed during the trapping period were great blue heron. There were no obvious signs of recent mammal activity in the area surveyed.

Habitat Characteristics

Approximate area Surveyed($ft.^2$)	Average and maximum water depth (m)	Percent silt	Canopy cover (%)	Distance to stream (m)	Distance to permanent water (m)
10,000	0.5/1.2	15	45	190	0

Trapping Results

Number of hoop net traps	Number of Promar traps	Nights Trapped	Trap-nights	Total turtles caught	Turtles caught per trap-night
6	6	5	60	7	0.12

Habitat Photos

EcoSummary: Grasse River, Outside AOC (GR002), Dr. Travis' Marsh

River	In or out of AOC?	Site name	Coordinates	Turtles observed (O) or trapped (T)
Grasse	Outside	Dr. Travis' Marsh	44.77712 N 75.11635 W	O: Painted (n=23), Snapping (n=1) T: Painted (n=47), Snapping (n=8)

Dr. Travis's Marsh is a pond wetland that is separated from the West shore of the Grasse River outside Madrid, NY. This wetland is downhill from farmed land and drains into the Grasse. There is no current velocity in the marsh since it is an independent body of water. The entire area surveyed was approximately 1 acre. The dominant plant species observed was duckweed. Since the water is standing, duckweed flourishes and covers a majority of the water's surface. A combination of the duckweed and the vegetation on the shoreline caused the canopy cover to be 90%. The distance to nearest small stream was approximately 270 m. The distance to permanent water was determined to be zero because the trap location was in permanent water. The average water depth for the whole trapping area was estimated to be 0.8 m and the maximum depth was 1.3 m. Dr. Travis' marsh substrate composition was 38%. The average air temperature during the trapping period was 26.7°C. The average water temperature during the trapping period was 24.2°C. The overall habitat quality was rated very good as a result of two visual rapid assessments. Visual surveys found 23 painted turtles and one snapping turtle. Fish found during the trapping period were bullhead, shiners, and banded killifish. Birds observed during the trapping period included red-winged blackbirds, green heron, eastern kingbird, and marsh wren. There were obvious signs of recent muskrat and beaver activity in the area surveyed.

Habitat Characteristics

Approximate area Surveyed(acres)	Average and maximum water depth (m)	Percent silt	Canopy cover (%)	Distance to stream (m)	Distance to permanent water (m)
1.0	0.8/1.3	38	90	270	0

Trapping Results

Number of hoop net traps	Number of Promar traps	Nights Trapped	Trap-nights	Total turtles caught	Turtles caught per trap-night
6	6	5	60	55	0.92

Habitat Photos

EcoSummary: Raquette River, Inside AOC (RQ001), Stewart's Cove

River	In or out of AOC?	Site name	Coordinates	Turtles observed (O) or trapped (T)
Raquette	Inside	Stewart's Cove	44.98410 N 74.55667 W	O: Painted (n=2), Map (n=12), Snapping (n=1) T: Painted (n=11), Map (n=2), Snapping (n=5), Musk (n=3)

Stewart's Cove is a small river wetland on the Raquette River located approximately one kilometer upstream from the confluence of the St. Lawrence. This cove is created by an island near the north shore where the flow is slower than the main channel of the Raquette River. Although water flowed into the cove from the upstream end, the current velocity in the cove was low. The entire area surveyed was approximately one acre. The dominant plant species observed were pickerel weed, cattails, lily pads and speckled alder. At the mouth of the cove lily pads cover much of the water and further upstream into the cove pickerel weed becomes the densest species observed. Speckled alder grows on the shore and its branches hang over the water. This vegetation creates a canopy cover of approximately 65 % over the whole trapping area. The distance to small stream was calculated to approximately 75 m. The distance to permanent water was determined to be zero because the trap location was in permanent water. The average water depth for the whole cove was estimated to be 0.7 m and the maximum depth was 1.5 m. Stewart's Cove substrate composition was 30% silt. The average air temperature during the trapping period was 18.5°C. The average water temperature during the trapping period was 17.3°C. The overall habitat quality was rated very good as a result of two visual rapid assessments. Visual surveys found two painted turtles, twelve map turtles, and one snapping turtle. Fish found during the trapping period were bowfin, bullhead, and sunfish. Birds observed during the trapping period included red-winged black birds, song sparrow, barn swallow, tree swallow, great egret, great blue heron, and common tern. There were no obvious signs of recent mammal activity in the area surveyed.

Habitat Characteristics

Approximate area Surveyed(acres)	Average and maximum water depth (m)	Percent silt	Canopy cover (%)	Distance to stream (m)	Distance to permanent water (m)
1.0	0.7/1.5	30	65	75	0

Trapping Results

Number of hoop net traps	Number of Promar traps	Nights Trapped	Trap-nights	Total turtles caught	Turtles caught per trap-night
6	6	5	60	21	0.35

Habitat Photos

EcoSummary: Raquette River, Outside AOC (RQ002), Kuenzler's Cove

River	In or out of AOC?	Site name	Coordinates	Turtles observed (O) or trapped (T)
Raquette	Outside	Kuenzler's Cove	44.76363 N 74.99306 W	O: Painted (n=2), Snapping (n=1) T: Painted (n=15), Snapping (n=10)

Kuenzler's Cove is a small river wetland on the Raquette River located in Norwood, NY upstream of the Yaleville dam. This wetland is created by the dam which pushed the river wider into lowlands on the East shore. The current velocity in the cove is low due to the control of the dam immediately downstream. The entire area surveyed was approximately 10,000 $ft.^2$. The dominant plant species observed was cattails. The main channel of the river flows alongside the wetland areas, thus plants requiring low flow are not present. Vegetation along the shoreline creates about 55 % canopy cover over the length of the whole trapping area. The distance to small stream was calculated as approximately 175 m. The distance to permanent water was determined to be zero because the trap location was in permanent water. The average water depth for the whole trapping area was estimated to be 0.6 m and the maximum depth was 2 m. Kuenzler's Cove substrate composition was 30% silt where traps were located. The average air temperature during the trapping period was 23.5°C. The average water temperature during the trapping period was 23.6°C. The overall habitat quality was rated good as a result of two visual rapid assessments. Visual surveys found two painted turtles and one snapping turtle. Fish found during the trapping period were red-finned mullet, sunfish, and walleye. Birds observed during the trapping period included red-winged black birds, great blue heron, belted kingfisher, and unidentified ducks. There were obvious signs of recent muskrat activity in the area surveyed.

Habitat Characteristics

Approximate area Surveyed($ft.^2$)	Average and maximum water depth (m)	Percent silt	Canopy cover (%)	Distance to stream (m)	Distance to permanent water (m)
10,000	0.6/2	30	55	0	0

Trapping Results

Number of hoop net traps	Number of Promar traps	Nights Trapped	Trap-nights	Total turtles caught	Turtles caught per trap-night
6	6	5	60	25	0.42

Habitat Photos

EcoSummary: St. Regis River, Inside AOC (SR001), St. Regis Cove

River	In or out of AOC?	Site name	Coordinates	Turtles observed (O) or trapped (T)
St. Regis	Inside	St. Regis Cove	44.99451N 74.64650W	O: Painted (n=12), Snapping (n=1), Map (n=20) T: Painted (n=41), Snapping (n=34)

St. Regis Cove is a shrub-scrub river wetland on the St. Regis River approximately one kilometer from the confluence of the St. Lawrence River. This cove is created by a peninsula where the inlet to the cove is between the peninsula and the South shore of the St. Regis. This separation from the main channel of the river causes the current velocity within the cove to be low. The entire area surveyed was approximately one acre. The dominant plant species observed were sweet gale, unidentified shrub, lily pads and speckled alder. Shrubs compose hummocks which border between the wetland and shore. The water is open at the mouth of the cove and lily pads are present at the southern end of the cove. This vegetation creates a canopy cover of approximately 75 % over the whole trapping area. The distance to small stream was calculated to approximately 500 m. The distance to permanent water was determined to be zero because the trap location was in permanent water. The average water depth for the whole cove was estimated to be 0.8 m and the maximum depth was 2.1 m. St. Regis cove substrate composition was 35% silt. The average air temperature during the trapping period was 18.6˚C. The average water temperature during the trapping period was 17.9˚C. The overall habitat quality was rated very good as a result of two visual rapid assessments. Visual surveys found twelve painted turtles, twenty map turtles, and one snapping turtle. Fish found during the trapping period were sunfish and bullhead. Birds observed during the trapping period included red-winged black birds, tree swallow, great egret, great blue heron, northern harrier, belted kingfisher, yellow warbler, common tern, and unidentified ducks. There were obvious signs of recent beaver activity in the area surveyed.

Habitat Characteristics

Approximate area Surveyed(acres)	Average and maximum water depth (m)	Percent silt	Canopy cover (%)	Distance to stream (m)	Distance to permanent water (m)
1.0	0.8/2.1	35	75	500	0

Trapping Results

Number of hoop net traps	Number of Promar traps	Nights Trapped	Trap-nights	Total turtles caught	Turtles caught per trap-night
7	7	5	70	75	1.07

Habitat Photos

EcoSummary: Vice Road Wetland, St. Regis River, Outside AOC (SR002)

River	In or out of AOC?	Site name	Coordinates	Turtles observed (O) or trapped (T)
St. Regis	Outside	Vice Road Wetland	44.82990N 74.78742W	O: Painted (n=1), Snapping (n=1) T: Painted (n=5), Snapping (n=7)

Vice Road Wetland is an emergent wetland in Brasher State Forest on the western edge of the St. Regis River. This is a large wetland that is composed of several open areas separated by forest and connected by streams. Old beaver activity dammed up the streams causing ponds, but the beaver constructions have not been maintained recently. Therefore the flow is moderate and the water levels are lower than in previous years. The entire area surveyed was approximately one acre. The dominant plant species observed were grasses, sedges, and speckled alder (*Alnus incana*). This vegetation creates a canopy cover of approximately 65 % over the whole trapping area. The distance to small stream was calculated to approximately 70 m. The distance to permanent water was determined to be zero because the trap location was in permanent water. The average water depth for the whole cove was estimated to be 0.7 m and the maximum depth was 1 m. Many areas were shallower than expected due to the old beaver dams that were no longer holding back water. The substrate composition at the Vice Road wetland was 25% silt. The average air temperature during the trapping period was 15.6˚C. The average water temperature during the trapping period was 17.4˚C. The overall habitat quality was rated good as a result of two visual rapid assessments. Visual surveys found one painted turtle and one snapping turtle. Fish found during the trapping period included numerous bullheads. Birds observed during the trapping period included red-winged black birds, yellow warbler, great blue heron, and American bittern. There were obvious signs of beaver activity in the area surveyed, but none of it was recent.

Habitat Characteristics

Approximate area Surveyed(acres)	Average and maximum water depth (m)	Percent silt	Canopy cover (%)	Distance to stream (m)	Distance to permanent water (m)
1.0	0.7/1.0	25	65	70	0

Trapping Results

Number of hoop net traps	Number of Promar traps	Nights Trapped	Trap-nights	Total turtles caught	Turtles caught per trap-night
7	7	5	70	12	0.17

Habitat Photos

APPENDIX B: Concentrations of PCB Congeners in Snapping Turtle Eggs

Appendix B. Concentrations of PCB Congeners (mg/kg) in snapping turtle eggs collected from within and outside the Massena/Akwesasne AOC.

River	St. Lawrence River																
Sample ID and Congener	SL001JUN062013ST	SL002JUN072013ST	SL003JUN072013ST	SL004JUN072013ST	SL009JUN102013ST	SL010JUN102013ST	SL012JUN102013ST	SL013JUN102013ST	SL014JUN102013ST	SL016JUN122013ST	SL019JUN122013ST	SL021JUN122013ST	SL023JUN132013ST	SL024JUN132013ST	SL026JUN142013ST	SL030JUN172013ST	SL034JUN132014ST
IUPAC 001	ND	0.00731	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 013	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 017	ND	ND	0.000948	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 021	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 022	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 023	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 024	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 025	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 026	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 027	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 028	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

River	St. Lawrence River																
Sample ID and Congener	SL001JUN062013ST	SL002JUN072013ST	SL003JUN072013ST	SL004JUN072013ST	SL009JUN102013ST	SL010JUN102013ST	SL012JUN102013ST	SL013JUN102013ST	SL014JUN102013ST	SL016JUN122013ST	SL019JUN122013ST	SL021JUN122013ST	SL023JUN132013ST	SL024JUN132013ST	SL026JUN142013ST	SL030JUN172013ST	SL034JUN132014ST
IUPAC 029	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 030	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 031	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 032	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 033	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 034	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 035	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 036	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 037	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 038	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 039	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 040	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 041	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 042	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 043	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 044	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 045	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 046	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00334
IUPAC 047	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 048	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 049	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 050	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 051	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 052	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 053	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 054	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 055	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 056	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00392

River	St. Lawrence River																
Sample ID and Congener	SL001JUN062013ST	SL002JUN072013ST	SL003JUN072013ST	SL004JUN072013ST	SL009JUN102013ST	SL010JUN102013ST	SL012JUN102013ST	SL013JUN102013ST	SL014JUN102013ST	SL016JUN122013ST	SL019JUN122013ST	SL021JUN122013ST	SL023JUN132013ST	SL024JUN132013ST	SL026JUN142013ST	SL030JUN172013ST	SL034JUN132014ST
IUPAC 057	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 058	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 059	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 060	0.000394	0.00522	0.00422	0.000903	ND	ND	0.000544	0.00115	0.00129	0.000782	ND	ND	0.00323	0.00341	ND	0.000404	0.00256
IUPAC 061	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 062	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 063	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 064	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 065	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 066	0.00116	0.0122	0.0117	0.000982	0.000373	ND	0.00104	0.00443	0.000704	0.00381	ND	0.000546	0.00416	0.0164	ND	0.00205	0.00343
IUPAC 067	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 068	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 069	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 070	0.00114	0.0113	0.0103	0.00202	ND	0.000279	0.00143	0.00317	0.00179	0.00247	0.000522	0.000569	0.00641	0.00887	0.000311	0.00129	0.004
IUPAC 071	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 072	ND	ND	0.000585	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 073	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 074	0.000537	0.00532	0.00483	0.000951	ND	ND	0.000673	0.00149	0.00084	0.00116	ND	ND	0.00302	0.00417	ND	0.000609	ND
IUPAC 075	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 076	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 077	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 078	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 079	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 080	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 081	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 082	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 083	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 084	ND	0.00159	0.00125	ND	ND	ND	ND	ND	ND	0.00032	ND	ND	0.000879	0.00118	ND	ND	0.00288

River	St. Lawrence River																
Sample ID and Congener	SL001JUN062013ST	SL002JUN072013ST	SL003JUN072013ST	SL004JUN072013ST	SL009JUN102013ST	SL010JUN102013ST	SL012JUN102013ST	SL013JUN102013ST	SL014JUN102013ST	SL016JUN122013ST	SL019JUN122013ST	SL021JUN122013ST	SL023JUN132013ST	SL024JUN132013ST	SL026JUN142013ST	SL030JUN172013ST	SL034JUN132014ST
IUPAC 085	0.000779	0.00614	0.00448	0.000974	ND	ND	0.000706	0.00134	0.000654	0.000822	ND	ND	0.00314	0.00502	ND	0.00133	ND
IUPAC 086	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 087	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 088	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 089	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 090	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 091	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 092	0.000335	0.00389	0.00239	ND	ND	ND	0.000537	ND	ND	0.000388	ND	ND	0.00148	0.00272	ND	0.000737	ND
IUPAC 093	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 094	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.000358	ND	ND	ND	ND	ND
IUPAC 095	ND	0.00111	0.00175	0.00028	ND	ND	ND	ND	ND	ND	ND	ND	0.00059	0.00076	ND	0.000388	ND
IUPAC 096	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 097	ND	ND	ND	ND	ND	ND	ND	0.0012	ND	0.000587	ND	ND	ND	0.00206	ND	ND	ND
IUPAC 098	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 099	0.0029	0.0328	0.0414	0.00594	0.000965	0.000362	0.00429	0.0219	0.00591	0.0148	0.0013	0.000997	0.0148	0.0258	0.000669	0.00427	0.0466
IUPAC 100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 101	ND	0.00242	0.00144	0.00034	ND	ND	ND	ND	ND	ND	ND	ND	0.000992	0.00158	ND	0.000374	ND
IUPAC 102	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 103	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 104	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 105	0.00458	0.0514	0.0468	0.00962	0.00131	0.000485	0.00497	0.0322	0.0163	0.0161	0.00214	0.00225	0.032	0.0326	0.000886	0.00566	0.06
IUPAC 106	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 107	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 108	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 109	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 110	ND	0.00179	0.00121	0.000295	ND	ND	ND	ND	ND	ND	ND	ND	0.00101	0.00116	ND	0.0003	ND
IUPAC 111	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 112	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

River	St. Lawrence River																
Sample ID and Congener	SL001JUN062013ST	SL002JUN072013ST	SL003JUN072013ST	SL004JUN072013ST	SL009JUN102013ST	SL010JUN102013ST	SL012JUN102013ST	SL013JUN102013ST	SL014JUN102013ST	SL016JUN122013ST	SL019JUN122013ST	SL021JUN122013ST	SL023JUN132013ST	SL024JUN132013ST	SL026JUN142013ST	SL030JUN172013ST	SL034JUN132014ST
IUPAC 113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 114	0.000309	0.00575	0.00433	0.00108	ND	ND	0.00046	0.00279	0.00204	0.0014	ND	ND	0.00344	0.00253	ND	0.00038	0.00691
IUPAC 115	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 116	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 117	ND	0.00108	0.00079	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.000554	0.000886	ND	ND	ND
IUPAC 118	0.01	0.13	0.109	0.0266	0.00393	0.00149	0.0148	0.0869	0.0513	0.0403	0.00771	0.00591	0.0787	0.0721	0.004	0.0147	0.151
IUPAC 119	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 120	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 121	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 122	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 123	ND	0.00308	0.00284	0.000703	ND	ND	ND	0.00181	0.00139	0.00102	ND	ND	0.00178	0.00169	ND	ND	0.00627
IUPAC 124	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 125	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 126	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 127	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 128	0.002	0.017	0.0164	0.00374	0.000538	ND	0.0029	0.0147	0.0097	0.00696	0.00103	0.001	0.0115	0.0103	ND	0.00263	0.0261
IUPAC 129	0.00142	0.00589	0.00558	0.00126	ND	ND	0.00125	0.00616	0.00348	0.0028	0.000358	0.000361	0.00318	0.00334	ND	0.00105	0.0102
IUPAC 130	0.000417	0.00209	0.00156	0.000282	ND	ND	0.000333	0.00205	ND	0.000901	ND	ND	0.000995	0.00219	ND	0.000668	ND
IUPAC 131	ND	0.00187	0.00105	ND	ND	ND	ND	0.00123	ND	0.000559	ND	ND	0.000875	0.00243	ND	0.000594	ND
IUPAC 132	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 133	0.000617	0.00449	0.00372	0.000849	ND	ND	0.00087	0.00424	0.00339	0.00191	ND	ND	0.00316	0.00295	ND	0.000522	0.0109
IUPAC 134	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 135	ND	0.00189	0.00283	0.000344	ND	ND	0.000338	0.00243	ND	0.00126	ND	ND	0.000985	0.00274	ND	ND	0.00968
IUPAC 136	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 137	0.000443	0.00494	0.00489	0.00104	ND	ND	0.000806	0.00501	0.00272	0.0023	0.000315	0.000281	0.00318	0.00284	ND	0.000701	0.00912
IUPAC 138	0.0189	0.0785	0.0744	0.0168	0.00258	0.000514	0.0167	0.0822	0.0464	0.0373	0.00477	0.00481	0.0424	0.0445	0.00131	0.014	0.136
IUPAC 139	ND	0.000901	0.000762	ND	ND	ND	ND	ND	ND	0.000313	ND	ND	ND	0.000557	ND	ND	ND
IUPAC 140	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

River	St. Lawrence River																
Sample ID and Congener	SL001JUN062013ST	SL002JUN072013ST	SL003JUN072013ST	SL004JUN072013ST	SL009JUN102013ST	SL010JUN102013ST	SL012JUN102013ST	SL013JUN102013ST	SL014JUN102013ST	SL016JUN122013ST	SL019JUN122013ST	SL021JUN122013ST	SL023JUN132013ST	SL024JUN132013ST	SL026JUN142013ST	SL030JUN172013ST	SL034JUN132014ST
IUPAC 141	0.000388	0.000978	0.000644	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00102	ND	0.000525	ND
IUPAC 142	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 143	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 144	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 145	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 146	0.001	0.0113	0.0103	0.00211	0.000288	ND	0.00109	0.00707	0.00358	0.00353	0.00047	0.000493	0.00703	0.00716	ND	0.00124	0.0132
IUPAC 147	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 148	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 149	0.000712	0.00331	0.00204	0.000407	ND	ND	0.000545	ND	ND	0.000362	ND	ND	0.00148	0.00227	ND	0.000091	ND
IUPAC 150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 151	0.00144	0.00345	0.00227	0.00027	ND	ND	0.000556	0.00131	ND	0.000798	ND	0.000298	0.00157	0.00383	ND	0.000944	ND
IUPAC 152	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 153	0.0393	0.124	0.111	0.0282	0.00475	0.000907	0.0342	0.128	0.0842	0.0608	0.00609	0.00561	0.0532	0.0474	0.00218	0.0195	0.0963
IUPAC 154	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 155	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 156	0.0019	0.012	0.0113	0.00241	0.000318	ND	0.00293	0.0107	0.00697	0.00493	0.000736	0.00057	0.00724	0.00638	ND	0.00166	0.0208
IUPAC 157	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 158	0.00153	0.00557	0.00701	0.00096	ND	ND	0.000864	0.00866	0.0027	0.00398	0.000324	0.000842	0.00279	0.0044	ND	0.00112	0.0139
IUPAC 159	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 160	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 161	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 162	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 163	0.00331	0.0137	0.013	0.00295	0.000451	ND	0.00292	0.0144	0.00812	0.00653	0.000835	0.000842	0.00741	0.0078	ND	0.00245	0.0238
IUPAC 164	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 165	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 166	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 167	0.00113	0.00587	0.0053	0.00118	ND	ND	0.00163	0.00624	0.00375	0.00316	0.000405	0.000307	0.00305	0.00261	ND	0.00101	0.0105
IUPAC 168	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

River	St. Lawrence River																
Sample ID and Congener	SL001JUN062013ST	SL002JUN072013ST	SL003JUN072013ST	SL004JUN072013ST	SL009JUN102013ST	SL010JUN102013ST	SL012JUN102013ST	SL013JUN102013ST	SL014JUN102013ST	SL016JUN122013ST	SL019JUN122013ST	SL021JUN122013ST	SL023JUN132013ST	SL024JUN132013ST	SL026JUN142013ST	SL030JUN172013ST	SL034JUN132014ST
IUPAC 169	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 170	0.0115	0.026	0.0221	0.00545	0.00107	ND	0.0108	0.0297	0.0221	0.0125	0.00163	0.00171	0.0142	0.0136	0.00038	0.00439	0.0579
IUPAC 171	0.00226	0.00492	0.00449	0.0011	ND	ND	0.00177	0.00481	0.0043	0.00266	0.0004	ND	0.00312	0.0031	ND	0.000842	0.0114
IUPAC 172	0.00229	0.00464	0.00386	0.000857	ND	ND	0.00103	0.00746	0.0023	0.00316	0.000278	0.000561	0.0023	0.00331	ND	0.00123	0.00856
IUPAC 173	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 174	0.0012	0.00482	0.00434	0.000817	ND	ND	0.000586	0.00275	0.00108	0.00149	0.000302	ND	0.00204	0.00233	ND	0.00108	0.00381
IUPAC 175	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 176	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 177	0.00267	0.00483	0.00399	0.00057	ND	ND	ND	0.00772	0.000796	0.00294	ND	ND	0.00184	0.00521	ND	0.00141	0.00602
IUPAC 178	0.00336	0.0079	0.00641	0.00148	ND	ND	0.00239	0.00926	0.00586	0.00402	0.000412	0.000557	0.00532	0.00587	ND	0.00143	0.0197
IUPAC 179	0.00037	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 180	0.0407	0.0761	0.0654	0.0169	0.00391	ND	0.0361	0.0968	0.0694	0.04	0.00516	0.00601	0.0377	0.037	0.00112	0.0152	0.162
IUPAC 181	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 182	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.000382	ND	ND	ND	ND	ND	ND	ND
IUPAC 183	0.00868	0.0175	0.0159	0.00347	0.000648	ND	0.00657	0.0219	0.0156	0.0098	0.00101	0.00106	0.00809	0.00784	ND	0.00279	0.0453
IUPAC 184	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 185	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 186	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 187	0.0125	0.0248	0.0245	0.00367	0.000413	ND	0.00551	0.0287	0.00478	0.0135	0.00117	0.00248	0.0107	0.0218	ND	0.00586	0.041
IUPAC 188	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 189	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 190	0.00276	0.00552	0.00471	0.00129	0.000565	ND	0.00227	0.00633	0.00479	0.00274	0.000488	0.000638	0.00395	0.00386	0.000321	0.000865	0.0116
IUPAC 191	0.000424	ND	0.000761	ND	ND	ND	ND	0.00113	0.000793	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 192	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 193	0.00214	0.004	0.00344	0.00089	ND	ND	0.0019	0.0051	0.00365	0.0021	ND	0.000316	0.00198	0.00195	ND	0.000801	0.00854
IUPAC 194	0.0101	0.0128	0.0115	0.00332	0.000561	ND	0.00895	0.0198	0.0144	0.00721	0.000853	0.00114	0.00641	0.00752	ND	0.00348	0.033
IUPAC 195	0.00267	0.00459	0.00295	0.000774	ND	ND	0.0022	0.0059	0.00472	0.00194	ND	ND	0.00294	0.00301	ND	0.000593	0.011
IUPAC 196	0.00476	0.00559	0.00494	0.00113	ND	ND	0.00398	0.00965	0.00655	0.00377	0.000303	0.0003	0.00315	0.00329	ND	0.00123	0.0179

River	St. Lawrence River																
Sample ID and Congener	SL001JUN062013ST	SL002JUN072013ST	SL003JUN072013ST	SL004JUN072013ST	SL009JUN102013ST	SL010JUN102013ST	SL012JUN102013ST	SL013JUN102013ST	SL014JUN102013ST	SL016JUN122013ST	SL019JUN122013ST	SL021JUN122013ST	SL023JUN132013ST	SL024JUN132013ST	SL026JUN142013ST	SL030JUN172013ST	SL034JUN132014ST
IUPAC 197	ND	0.00169	0.00159	0.00034	ND	ND	0.000414	0.00151	0.000984	0.000696	ND	ND	0.00102	0.000901	ND	ND	0.00293
IUPAC 198	0.000749	0.000826	0.000726	ND	ND	ND	0.000467	0.00138	0.000763	0.000613	ND	ND	ND	ND	ND	ND	ND
IUPAC 199	0.0142	0.0157	0.0138	0.00318	0.0011	ND	0.00888	0.0262	0.0145	0.0117	0.00165	0.00288	0.00795	0.00991	ND	0.00495	0.0372
IUPAC 200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 201	0.000575	ND	ND	ND	ND	ND	ND	0.000917	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 202	0.00341	0.00409	0.00357	0.00102	ND	ND	0.00247	0.00611	0.00383	0.00287	0.000381	0.000537	0.00232	0.00239	ND	0.00106	0.00842
IUPAC 203	0.0103	0.0082	0.00762	0.00168	ND	ND	0.00719	0.0158	0.0112	0.00578	0.000472	0.000549	0.00503	0.00497	ND	0.00197	0.0272
IUPAC 204	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 205	0.000295	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 206	0.00548	0.00406	0.00395	0.00144	ND	ND	0.00409	0.00836	0.00497	0.00342	0.000556	0.000795	0.00202	0.00215	ND	0.00212	0.0123
IUPAC 207	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 208	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.00994
IUPAC 209	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total PCBs	0.24	0.818	0.735	0.163	0.0238	0.00404	0.205	0.77	0.455	0.356	0.0421	0.0451	0.428	0.478	0.0112	0.133	1.21

River	Grasse River								Raquette River			St.Regis					
Sample ID and Congener	GR005JUN072013ST	GR011JUN102013ST	GR017JUN122013ST	GR018JUN122013ST	GR020JUN122013ST	GR028JUN162013ST	GR032JUN252013ST	GR033JUN262013ST	RQ015JUN122013ST	RQ027JUN142013ST	RQ031JUN232013ST	SR006JUN102013ST	SR007JUN102013ST	SR008JUN102013ST	SR022JUN132013ST	SR025JUN142013ST	SR029JUN172013ST
IUPAC 001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 013	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 018	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.000296	ND	ND	ND	ND	ND	ND	ND
IUPAC 019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 020	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 021	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 022	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 023	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 024	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 025	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 026	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 027	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 028	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

River	Grasse River								Raquette River			St.Regis					
Sample ID and Congener	GR005JUN072013ST	GR011JUN102013ST	GR017JUN122013ST	GR018JUN122013ST	GR020JUN122013ST	GR028JUN162013ST	GR032JUN252013ST	GR033JUN262013ST	RQ015JUN122013ST	RQ027JUN142013ST	RQ031JUN232013ST	SR006JUN102013ST	SR007JUN102013ST	SR008JUN102013ST	SR022JUN132013ST	SR025JUN142013ST	SR029JUN172013ST
IUPAC 029	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 030	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 031	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 032	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 033	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 034	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 035	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 036	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 037	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 038	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 039	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 040	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 041	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 042	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 043	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 044	ND	ND	ND	ND	ND	ND	ND	0.00404	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 045	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 046	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 047	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 048	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 049	ND	ND	ND	ND	ND	ND	ND	0.00203	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 050	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 051	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 052	ND	ND	ND	ND	ND	ND	ND	0.00234	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 053	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 054	ND	0.00209	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 055	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 056	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

River	Grasse River								Raquette River			St.Regis					
Sample ID and Congener	GR005JUN072013ST	GR011JUN102013ST	GR017JUN122013ST	GR018JUN122013ST	GR020JUN122013ST	GR028JUN162013ST	GR032JUN252013ST	GR033JUN262013ST	RQ015JUN122013ST	RQ027JUN142013ST	RQ031JUN232013ST	SR006JUN102013ST	SR007JUN102013ST	SR008JUN102013ST	SR022JUN132013ST	SR025JUN142013ST	SR029JUN172013ST
IUPAC 057	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 058	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 059	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 060	ND	0.000875	0.000685	ND	ND	ND	0.000427	0.00389	0.000477	ND	0.000548	ND	ND	ND	ND	ND	ND
IUPAC 061	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 062	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 063	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 064	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 065	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 066	ND	0.00226	0.0011	ND	ND	ND	0.000679	0.0116	0.0014	ND	0.00135	ND	ND	ND	ND	ND	ND
IUPAC 067	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 068	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 069	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 070	ND	0.00221	0.0012	0.00034	ND	0.000305	0.000872	0.0122	0.000975	ND	0.00101	ND	ND	0.000282	ND	0.000376	ND
IUPAC 071	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 072	ND	ND	ND	ND	ND	ND	ND	0.00498	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 073	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 074	ND	0.00104	0.000564	ND	ND	ND	0.00041	0.00573	0.000459	ND	0.000476	ND	ND	ND	ND	ND	ND
IUPAC 075	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 076	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 077	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 078	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 079	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 080	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 081	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 082	ND	ND	ND	ND	ND	ND	ND	0.00171	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 083	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 084	ND	ND	ND	ND	ND	ND	ND	0.00156	ND	ND	ND	ND	ND	ND	ND	ND	ND

River	Grasse River								Raquette River			St.Regis					
Sample ID and Congener	GR005JUN072013ST	GR011JUN102013ST	GR017JUN122013ST	GR018JUN122013ST	GR020JUN122013ST	GR028JUN162013ST	GR032JUN252013ST	GR033JUN262013ST	RQ015JUN122013ST	RQ027JUN142013ST	RQ031JUN232013ST	SR006JUN102013ST	SR007JUN102013ST	SR008JUN102013ST	SR022JUN132013ST	SR025JUN142013ST	SR029JUN172013ST
IUPAC 085	ND	0.00145	0.000479	ND	ND	ND	0.000362	0.0106	0.00033	ND	0.000938	ND	ND	ND	ND	ND	ND
IUPAC 086	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 087	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 088	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 089	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 090	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 091	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 092	ND	0.000995	ND	ND	ND	ND	ND	0.0145	ND	ND	0.000488	ND	ND	ND	ND	ND	ND
IUPAC 093	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 094	ND	ND	ND	ND	ND	ND	ND	0.00147	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 095	ND	ND	ND	ND	ND	ND	ND	0.00303	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 096	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 097	ND	ND	ND	ND	ND	ND	ND	0.00228	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 098	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 099	0.000406	0.00596	0.00318	0.000602	ND	0.000515	0.00115	0.0541	0.00195	ND	0.0034	0.000272	ND	0.000275	ND	0.000471	ND
IUPAC 100	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 101	ND	ND	ND	ND	ND	ND	ND	0.00696	ND	ND	0.00072	ND	ND	ND	ND	ND	ND
IUPAC 102	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 103	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 104	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 105	0.000382	0.0139	0.00511	0.00103	ND	0.000604	0.00264	0.0661	0.00353	0.000307	0.00672	ND	0.000416	0.000456	0.000632	0.000724	ND
IUPAC 106	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 107	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 108	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 109	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 110	ND	ND	ND	ND	ND	ND	ND	0.00427	ND	ND	0.000636	ND	ND	ND	ND	ND	ND
IUPAC 111	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 112	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

River	Grasse River								Raquette River			St.Regis					
Sample ID and Congener	GR005JUN072013ST	GR011JUN102013ST	GR017JUN122013ST	GR018JUN122013ST	GR020JUN122013ST	GR028JUN162013ST	GR032JUN252013ST	GR033JUN262013ST	RQ015JUN122013ST	RQ027JUN142013ST	RQ031JUN232013ST	SR006JUN102013ST	SR007JUN102013ST	SR008JUN102013ST	SR022JUN132013ST	SR025JUN142013ST	SR029JUN172013ST
IUPAC 113	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 114	ND	0.0015	0.000346	ND	ND	ND	ND	0.00542	ND	ND	0.000446	ND	ND	ND	ND	ND	ND
IUPAC 115	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 116	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 117	ND	ND	ND	ND	ND	ND	ND	0.00187	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 118	0.00196	0.0468	0.0133	0.00333	0.000736	0.00221	0.00847	0.175	0.0105	0.00225	0.0224	0.00151	0.00184	0.0017	0.00209	0.00339	0.00193
IUPAC 119	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 120	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 121	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 122	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 123	ND	0.00117	0.000303	ND	ND	ND	ND	0.00305	ND	ND	0.000329	ND	ND	ND	ND	ND	ND
IUPAC 124	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 125	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 126	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 127	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 128	ND	0.00908	0.00243	ND	ND	ND	0.000942	0.0302	0.000974	ND	0.00583	ND	ND	ND	0.00034	ND	ND
IUPAC 129	ND	0.00355	0.00173	ND	ND	ND	0.000279	0.0109	ND	ND	0.00235	ND	ND	ND	ND	ND	ND
IUPAC 130	ND	0.000897	ND	ND	ND	ND	ND	0.00587	ND	ND	0.000761	ND	ND	ND	ND	ND	ND
IUPAC 131	ND	ND	ND	ND	ND	ND	ND	0.00238	ND	ND	0.000337	ND	ND	ND	ND	ND	ND
IUPAC 132	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 133	ND	0.00252	0.000701	ND	ND	ND	ND	0.0307	ND	ND	0.000874	ND	ND	ND	ND	ND	ND
IUPAC 134	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 135	ND	0.000561	ND	ND	ND	ND	ND	0.0123	ND	ND	0.000277	ND	ND	ND	ND	ND	ND
IUPAC 136	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 137	ND	0.00336	0.000423	ND	ND	ND	ND	0.0104	ND	ND	0.00164	ND	ND	ND	ND	ND	ND
IUPAC 138	0.000911	0.0474	0.023	0.00226	0.000695	0.00126	0.00372	0.145	0.00365	0.000717	0.0313	0.00106	0.00131	0.00101	0.00141	0.00112	0.000617
IUPAC 139	ND	ND	ND	ND	ND	ND	ND	0.00173	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 140	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

River	Grasse River								Raquette River			St.Regis					
Sample ID and Congener	GR005JUN072013ST	GR011JUN102013ST	GR017JUN122013ST	GR018JUN122013ST	GR020JUN122013ST	GR028JUN162013ST	GR032JUN252013ST	GR033JUN262013ST	RQ015JUN122013ST	RQ027JUN142013ST	RQ031JUN232013ST	SR006JUN102013ST	SR007JUN102013ST	SR008JUN102013ST	SR022JUN132013ST	SR025JUN142013ST	SR029JUN172013ST
IUPAC 141	ND	ND	ND	ND	ND	ND	ND	0.0024	ND	ND	0.000861	ND	ND	ND	ND	ND	ND
IUPAC 142	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 143	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 144	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 145	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 146	ND	0.00306	0.00112	ND	ND	ND	0.000579	0.0145	0.000775	ND	0.00148	ND	ND	ND	ND	ND	ND
IUPAC 147	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 148	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 149	ND	0.000956	0.000396	ND	ND	ND	ND	0.0139	ND	ND	0.00171	ND	ND	ND	ND	ND	ND
IUPAC 150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 151	ND	0.00134	0.000361	ND	ND	ND	ND	0.0187	ND	ND	0.00162	ND	ND	ND	ND	ND	ND
IUPAC 152	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 153	0.00127	0.0874	0.0579	0.00333	ND	0.00174	0.00678	0.207	0.00357	0.00137	0.0539	0.0018	0.00173	0.00188	0.00289	0.00144	0.00116
IUPAC 154	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 155	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 156	ND	0.00723	0.00242	ND	ND	ND	0.000756	0.0234	0.00068	ND	0.00466	ND	ND	ND	0.000305	ND	ND
IUPAC 157	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 158	ND	0.00236	0.000938	ND	ND	ND	ND	0.0102	0.000303	ND	0.00227	ND	ND	ND	ND	ND	ND
IUPAC 159	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 160	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 161	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 162	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 163	ND	0.00829	0.00403	0.000395	ND	ND	0.000651	0.0254	0.000639	ND	0.00549	ND	ND	ND	ND	ND	ND
IUPAC 164	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 165	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 166	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 167	ND	0.0043	0.00169	ND	ND	ND	0.000309	0.0103	0.000381	ND	0.00266	ND	ND	ND	ND	ND	ND
IUPAC 168	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

River	Grasse River								Raquette River			St.Regis					
Sample ID and Congener	GR005JUN072013ST	GR011JUN102013ST	GR017JUN122013ST	GR018JUN122013ST	GR020JUN122013ST	GR028JUN162013ST	GR032JUN252013ST	GR033JUN262013ST	RQ015JUN122013ST	RQ027JUN142013ST	RQ031JUN232013ST	SR006JUN102013ST	SR007JUN102013ST	SR008JUN102013ST	SR022JUN132013ST	SR025JUN142013ST	SR029JUN172013ST
IUPAC 169	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 170	ND	0.0207	0.0153	0.000639	ND	0.000278	0.00168	0.0859	0.00142	ND	0.0164	ND	0.000364	0.000339	0.000706	0.00035	ND
IUPAC 171	ND	0.00381	0.00264	ND	ND	ND	ND	0.0182	ND	ND	0.00266	ND	ND	ND	ND	ND	ND
IUPAC 172	ND	0.00415	0.00138	ND	ND	ND	ND	0.0161	ND	ND	0.00249	ND	ND	ND	ND	ND	ND
IUPAC 173	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 174	ND	0.00183	0.000353	ND	ND	ND	ND	0.00609	ND	ND	0.0012	ND	ND	ND	ND	ND	ND
IUPAC 175	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 176	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 177	ND	0.00138	0.000563	ND	ND	ND	ND	0.0178	ND	ND	0.00223	ND	ND	ND	ND	ND	ND
IUPAC 178	ND	0.00599	0.00324	ND	ND	ND	ND	0.043	ND	ND	0.0025	ND	ND	ND	ND	ND	ND
IUPAC 179	ND	ND	ND	ND	ND	ND	ND	0.00403	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 180	0.000406	0.0707	0.0509	0.00213	ND	0.000815	0.00514	0.244	0.00442	0.000869	0.0449	0.000961	0.00131	0.000712	0.00217	0.000609	0.000503
IUPAC 181	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 182	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 183	0.00035	0.0148	0.01	0.000571	ND	ND	0.000776	0.0577	0.000707	ND	0.00867	ND	ND	ND	0.000311	0.000453	ND
IUPAC 184	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 185	ND	ND	ND	ND	ND	ND	ND	0.00147	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 186	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 187	ND	0.00877	0.00555	0.00108	ND	0.000467	0.000639	0.0722	0.000996	ND	0.00686	ND	ND	ND	0.00032	ND	ND
IUPAC 188	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 189	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 190	ND	0.00377	0.00382	0.000278	ND	ND	0.000346	0.0236	0.000377	ND	0.00356	ND	ND	ND	ND	ND	ND
IUPAC 191	ND	ND	0.000383	ND	ND	ND	ND	0.00307	ND	ND	0.000613	ND	ND	ND	ND	ND	ND
IUPAC 192	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 193	ND	0.00372	0.00268	ND	ND	ND	ND	0.0128	ND	ND	0.00236	ND	ND	ND	ND	ND	ND
IUPAC 194	ND	0.0143	0.00843	0.000405	ND	ND	0.00103	0.0752	0.00102	ND	0.00784	ND	ND	ND	0.000355	ND	ND
IUPAC 195	ND	0.00384	0.00267	ND	ND	ND	ND	0.0242	ND	ND	0.00204	ND	ND	ND	ND	ND	ND
IUPAC 196	ND	0.00692	0.00367	ND	ND	ND	ND	0.0279	ND	ND	0.00254	ND	ND	ND	ND	ND	ND

River	Grasse River								Raquette River			St.Regis					
Sample ID and Congener	GR005JUN072013ST	GR011JUN102013ST	GR017JUN122013ST	GR018JUN122013ST	GR020JUN122013ST	GR028JUN162013ST	GR032JUN252013ST	GR033JUN262013ST	RQ015JUN122013ST	RQ027JUN142013ST	RQ031JUN232013ST	SR006JUN102013ST	SR007JUN102013ST	SR008JUN102013ST	SR022JUN132013ST	SR025JUN142013ST	SR029JUN172013ST
IUPAC 197	ND	0.00102	0.000341	ND	ND	ND	ND	0.0033	ND	ND	0.000657	ND	ND	ND	ND	ND	ND
IUPAC 198	ND	0.000891	0.000461	ND	ND	ND	ND	0.003	ND	ND	0.000362	ND	ND	ND	ND	ND	ND
IUPAC 199	ND	0.0169	0.00875	0.000599	ND	ND	0.000338	0.057	0.000334	ND	0.00688	ND	ND	ND	0.000711	ND	ND
IUPAC 200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 201	ND	ND	ND	ND	ND	ND	ND	0.0021	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 202	ND	0.00446	0.00198	0.000321	ND	ND	ND	0.0129	ND	ND	0.00121	ND	ND	ND	ND	ND	ND
IUPAC 203	ND	0.0109	0.0061	ND	ND	ND	ND	0.0482	ND	ND	0.00419	ND	ND	ND	ND	ND	ND
IUPAC 204	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 205	ND	ND	0.000328	ND	ND	ND	ND	0.00277	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 206	ND	0.0059	0.00249	0.000367	ND	ND	ND	0.0154	0.000359	ND	0.00188	ND	ND	ND	ND	ND	ND
IUPAC 207	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 208	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IUPAC 209	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total PCBs	0.00568	0.468	0.255	0.0177	0.00179	0.00819	0.039	1.85	0.0403	0.00581	0.279	0.0056	0.00697	0.00665	0.0122	0.00892	0.00421