

D. Summary of Salmon River Watershed Natural Resource Viability Analysis

This section summarizes the findings of Salmon River Watershed Viability Analysis (McGee 2008), which was conducted to assess the current condition of the seven natural resource targets in the watershed. The following text presents the Key Ecological Attributes (KEAs – those aspects of each target that, if missing or altered, would lead to loss of that target over time) that were identified for each conservation target; quantifiable indicators that can be used to rank the current condition of a KEA; and a qualitative ranking (Excellent, Good, Fair, and Poor) of each KEA's current condition, based upon a given indicator. In many instances, quantifiable information was unavailable for several of the viability indicators within the watershed, and guidance was not readily available for ranking current condition of many indicators even when they could be quantified. See McGee (2008) for more detailed consideration of available data used to inform the rankings, and for rationale regarding the ranking criteria for each of the indicators. Tabular summaries of the KEA viability rankings follow the narratives for each of the conservation targets.

1. FRESHWATER ESTUARY AND DUNES

FRESHWATER ESTUARY

KEA - Size

Indicator – Freshwater estuary area (acres)

Current Condition - Good

Total wetland area of the system is approximately 271 acres, consisting of ~132 acres of open water, 27 acres of forested/shrub wetland, and 112 acres of emergent wetland. Wetland community types vary based upon lake water levels, along with erosion and deposition of sand and gravel by the river. Lake Ontario water levels are currently maintained between 74.5-75.0 m. It is likely that estuarine wetlands were filled in the past prior to federal and state wetland regulations in order to develop along the shores. However, activities that would further reduce habitat beyond current conditions are unlikely due to NYSDEC and US Army Corps of Engineers regulations.

KEA - Plant Communities

Two different marsh communities occur in the freshwater estuary (Edinger et al. 2002, Howard 2006); shallow emergent marshes occur in areas where water depths range from 0.5 to 3 feet during flooding, but are typically exposed during dry periods in late summer; and deep emergent marshes where water depths fluctuate seasonally from ~0.5 to 6.5 feet, but where soils rarely dry out.

The marsh communities within the freshwater estuary provide substrate, cover and food for a variety of birds, fish, mammals and invertebrates, and stabilize river bottom substrate. Many state-protected marsh birds breed, nest, hunt and forage in beds of aquatic plants that occur in these marshes.

*Indicator – Total Cover Aquatic Vegetation**Current Condition - Good*

Abundance of resident fish, invertebrates and breeding birds are directly related to habitat quality. No information is available on the natural range of variation in aquatic vegetation of the freshwater estuary. Harman et al. (2000) reported that aquatic plants occurred in a patchy distribution across the freshwater estuary and that, in their judgment, total coverage was good. McKenna (unpublished data) randomly sampled vegetation at 35 stations in the freshwater estuary and found total percent cover averaged 35% and ranged from 0 to 100%.

*Indicator – Invasive Plant Species Frequency and Abundance**Current Condition – Good to Fair*

Invasive species are those nonnative organisms whose introduction to an ecosystem causes or is likely to cause economic or environmental harm (New York State Invasive Species Task Force 2005). Many invasive plant species are competitive or weedy plants that are able to displace others, thereby reducing diversity of other plants and organisms that rely on a diverse assemblage of plants.

The exotic, invasive species purple loosestrife (*Lythrum salicaria*), Eurasian milfoil (*Myriophyllum spicatum*), curly pondweed (*Potamogeton crispus*) and European frog-bit (*Hydrocharis morsus-ranae*) occur within the freshwater estuary (Harman et al. 2000; Howard 2006). Given the boating activity within the freshwater estuary and level of establishment by invasive plants within the Great Lakes, potential exists for invasives to reduce diversity and ecosystem functions of the freshwater estuary. The total cover of purple loosestrife, Eurasian milfoil and curly pondweed was estimated at 1-6% by Harman et al. (2000) and Howard (2006). Eurasian milfoil occurred in 17% of random samples (McKenna, unpublished data).

KEA - Fish Communities

The Salmon River freshwater estuary is a warm water fishery that supports a variety of game fish species and forage species for several shore birds. Furthermore, it serves as a concentration area for migratory salmonines during annual spawning runs. Fish communities are assembled from populations in both the river and Lake Ontario. Maintenance of a diverse and productive fishery is vital for the viability of the system.

*Indicator – Fish Species Richness**Current Condition - Good*

Species richness is an important indicator of ecosystem health in that it reflects the potential complexity of food webs and often increases a community's capacity to prevent the establishment of invasive species. Greater fish richness provides for more diverse consumption of food types, thereby controlling population growth of a wide variety of plants, algae and invertebrates. In turn, diverse forage fish support a greater variety of bird, fish and mammal predators.

There are no quantitative accounts of historic species richness of the freshwater estuary, however more recent surveys exist that can provide a baseline for future monitoring. Two recent, unpublished and ongoing surveys of the freshwater estuary fish communities (J. McKenna, unpublished, 1996-2003; NYSDEC Rare and Endangered species survey, 1997) together recorded 44 species between 1996 and 2003. A 1977 survey collected 43 fish species near the river's mouth (FERC 1996). By comparison, fish species richness in the summers of 2001-2002 in nearby protected embayments of southeastern Lake Ontario (Blind Sodus, Little Sodus, Floodwood, North Sandy Pond, Colwell) ranged from 20-43 (Meixler et al. 2005). Regional fisheries managers believe the freshwater estuary possesses a good level of species richness.

Indicator – Index of Biotic Integrity

Current Condition – Good

Carlson et al. (2006) developed an index of biotic integrity (IBI) to describe the overall condition of fish community composition in 35 bays along the eastern and southern shores of Lake Ontario. The Salmon River Freshwater Estuary received the highest IBI score (41) of all 35 bays included in that study.

Indicator – Invasive Species Densities

Current Condition – Sea lamprey, Good

NYSDEC fisheries managers considered the sea lamprey (*Petromyzon marinus*) to be the most invasive fish species in the lower Salmon River and its freshwater estuary. Lampreys are parasitic and attach themselves to other fish with their suction-disk mouths and feed on the host fish's bodily fluids. Introduction of sea lampreys to the Great Lakes has caused declines in lake trout and whitefish populations. They spawn in tributary streams. Lampreys are present but not abundant in the freshwater estuary. They comprised only 0.1% of the fish collected during a NYSDEC sample for Rare and Endangered species in 1997. The freshwater estuary is included in the Great Lakes Fisheries Commission lamprey treatment program and is treated on a 4-yr cycle (D. Bishop, NYSDEC personal communication)

Current Condition – Common Carp, Good

Common carp (*Cyprinus carpio*) is another potentially invasive fish species known to inhabit the freshwater estuary and other tributaries of Lake Ontario. Fisheries managers currently do not believe that this species poses a substantial threat to biodiversity in the freshwater estuary.

KEA - Rare and Endangered Species

Several wildlife species of concern are known to occur within the freshwater estuary.

Indicator – Numbers of black tern breed pairs

Current Condition – Fair

Black terns (*Chidonias niger*) are endangered insectivorous birds that nest within the freshwater estuary. They nest colonially, often with clusters of up to 11-50 nests in the same area of marsh. Nests are usually placed 11-50 m apart but can range from 1 to 600 m. Territories are defended to about 2 m from the nest. Nests are small collections of aquatic vegetation usually built on floating substrates of matted or decaying marsh vegetation, or on other features that provide a platform (US Fish and Wildlife Service 2007). The carrying capacity for nesting pairs of black terns is not known for the Salmon River freshwater estuary. The New York Natural Heritage program (Howard 2006) reported the number of nesting pairs (unspecified) has been lower than in recent years, but habitat availability is still excellent. Heavy development potential harassment by boaters may represent potential stresses for this species.

Indicator – Numbers of pied-billed grebe breeding pairs

Current Condition – Good to Fair

Pied-billed grebes (*Podilymbus podiceps*) are threatened in New York. This species breeds on seasonal or permanent ponds or bays with dense stands of emergent vegetation. It feeds on fish in open waters and among aquatic vegetation. It constructs its nest on floating vegetation (Cornell Lab of Ornithology 2007). The carrying capacity for nesting pairs is not known for this location. The NY Natural Heritage Program reported one to two pairs in 2001 with at least four pairs encountered in 2005 (Howard 2006). Habitat of emergent vegetation is abundant with nearby open bay and channels.

Indicator – Numbers of least bittern breeding pairs

Current Condition – Good to Fair

Least bittern (*Ixobrychus exilis*) is a threatened species that breeds on seasonal or permanent ponds or bays with dense stands of emergent vegetation. It feeds on fish in open waters and among aquatic vegetation and constructs its nest on floating vegetation (Cornell Lab of Ornithology 2007). The carrying capacity for nesting pairs has been determined for least bitterns in this system. The NY Natural Heritage Program reported at least two pairs of least bitterns were present at the freshwater estuary in 2005 (Howard 2006). The area of suitable habitat (emergent marsh, with open channel and bay) is large.

Indicator – Number of sedge wren breeding pairs

Current Condition - Unranked

Sedge wrens (*Cistothorus platensis*) are threatened in New York. This species inhabits margins of wetlands dominated by grasses and sedges, and other damp grassland habitats. This species has experienced a noticeable decline in the northeastern United States and the Great Lakes region (Patuxent Wildlife Research Center 2005). The

species has been observed in the freshwater estuary. No quantitative information exists regarding its abundance in the system.

Indicator – Numbers of Lake Sturgeon

Current Condition – Poor

Lake sturgeon are threatened in all states where they occur due to over exploitation, and to loss or degradation of habitat and spawning beds due to dam construction, channelization and pollution. In New York, sturgeon have been collected in the St. Lawrence, Niagara, Oswegatchie and Grasse Rivers, and in Lake Ontario, Erie, Champlain, and Cayuga (NYSDEC 2008), but are thought to be extirpated from the Salmon River Freshwater Estuary. The NYSDEC is currently assessing restoration potential for this species in several waterways where it is known to occur (Zollweg et al. 2003, NYSDEC 2008) and some fisheries managers believe the Salmon River Freshwater Estuary is a potential site for reintroduction (D. Carlson, NYSDEC, personal communication).

KEA - Hydrology

Indicator – Surface Water Level Variation

Current Condition – Fair to Poor

Water levels within the freshwater estuary are influenced primarily by levels in Lake Ontario. Variability in water level probably served as an historic periodic disturbance that influenced plant community composition and local biodiversity. Water fluctuations would flood or dry out patches of emergent plants. These changes would reduce the extent and density of dominant, competitive plants and open exposed substrate for colonization by less dominant species, thus maintaining wetland community types within the freshwater estuary in a constant state of flux.

Lake Ontario water levels were stabilized beginning in the late 1950s to provide for unhindered shipping traffic through the St. Lawrence River. This stabilization in water levels using the current regulatory plan (1958-D with Deviations) has reduced variation in plant community types in coastal marsh communities along the lake, which in turn reduces potential breeding and feeding grounds for marsh-dwelling birds and fish. Greater variation in water levels leads to a greater variety of marsh communities, which in turn provides more productive and robust habitat for animals. Since regulation of water levels began in the late 1950s, there has been an estimated 50% reduction in meadow marsh and emergent-floating vegetation, and a concomitant 29% increase in cattail-dominated emergent marsh areas within the Lake Ontario and St. Lawrence wetlands (ILOSRL Study Board 2006). Guidance from ISOSLR (2006) suggests that ecological integrity of this and other similar embayments along Lake Ontario would benefit from greater fluctuations in lake water levels.

Indicator – Salmon River Baseflow

Current Condition - Good

Although water levels within the freshwater estuary are influenced primarily by the levels of Lake Ontario, water chemistry and temperature is determined largely by

surface water discharge by the Salmon River, local tributary streams (e.g., Mud Creek), and possibly groundwater discharge. The barrier dunes at the mouth of the Salmon River reduce circulation and mixing of water by wave action from the lake. During summer periods of low flow, it is possible that environmental conditions within the freshwater estuary (e.g., temperature, dissolved oxygen) may become suboptimal for many organisms. Although measuring temperature and dissolved oxygen is more direct in assessing condition within the freshwater estuary, river baseflow is the hydrologic process that may be most important for controlling these factors.

Baseflow conditions of the Salmon River at its mouth are regulated in large part by discharge from the hydropower reservoirs, with some contribution by the major tributaries entering the river below the dam. The licensing agreement (NERC 1996) for the hydropower plants requires an artificially sustained minimum baseflow of 185 cubic feet per second during the critical dry summer months. This minimum baseflow is greater than historic flows that were not influenced by upstream dams.

Indicator – Groundwater Discharge

Current Condition - Unranked

Groundwater discharge into the freshwater estuary would influence freshwater estuary temperature and water quality and potentially help to maintain summer baseflow conditions. There is currently no information available regarding groundwater discharge into the freshwater estuary and its consequences for freshwater estuary viability.

KEA - Water Quality

Indicator – Percent natural vegetation in 100-ft shoreline buffer

Current Condition - Fair

Vegetated buffers along waterways are important for maintaining several aspects of water quality and habitat viability. Vegetation within 100-ft buffers is effective at sequestering nutrients, stabilizing soils, delivering organic material to be used as aquatic energy sources, and providing shade to moderate water temperatures (Klapproth and Johnson 2000, Baird and Wetmore 2006).

Developed, agricultural and barren land uses comprise 8%, 9% and 4%, respectively, of the freshwater estuary's 100-ft buffer area (total 21%, Figure 21). The balance (79%) is in some form of natural cover type (forest, scrub/shrub, grassland, wetland). The freshwater estuary is well buffered along its south shore adjacent to Selkirk Shores State Park. Development and agriculture occur along the north and southeast shores of the freshwater estuary. The land-cover on the barrier dunes was mapped as scrub-shrub, but substantial development of seasonal homes exists there.

Indicator – Phosphorus (P) concentrations

Current Condition - Good

Phosphorus is a naturally occurring mineral nutrient that frequently limits biological productivity in freshwater systems. It typically occurs in freshwaters in low

concentrations owing to its low solubility. High P concentrations in water bodies are normally due to human activities (septic waste disposal, agricultural waste and fertilizer runoff), and typically result in high rates of productivity by algae and plants (eutrophication). The benthic (bottom) zones of eutrophic water bodies often become depleted in oxygen when large amounts of organic matter accumulate and undergo bacterial decomposition. Oxygen depletion, in turn, results in mortality of fish and other aquatic invertebrates.

US EPA guidelines suggest total phosphates in streams entering lakes or reservoirs should not exceed 0.05 mg/L (Mueller and Helsel 1996). No data are available to specifically quantify phosphate concentrations in the water column of the freshwater estuary. However, Harman et al. (2000) subjectively describe the freshwater estuary as a mesotrophic system, suggesting low to only moderate concentrations of elemental nutrients.

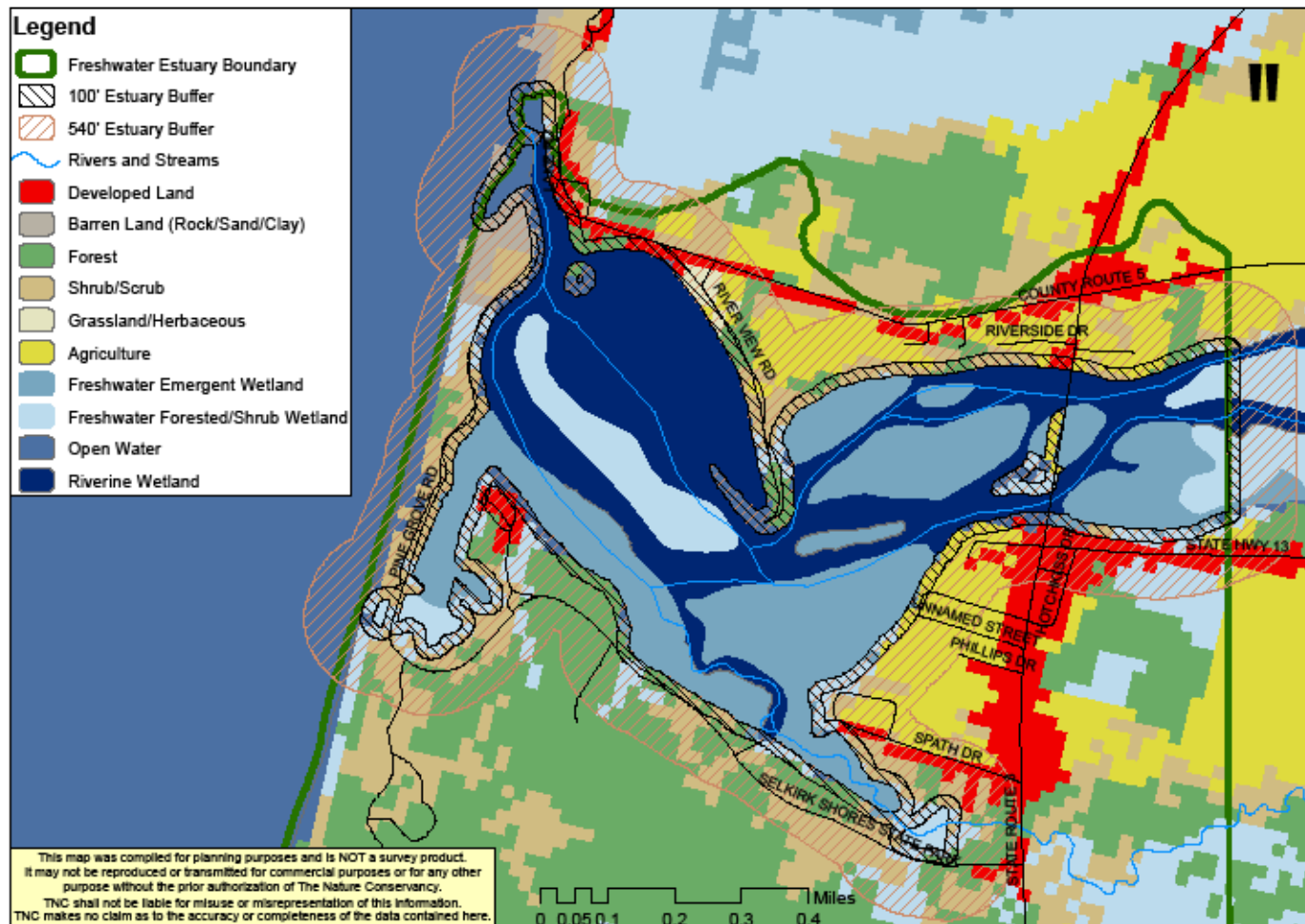


Figure 21. Analysis of land cover-types in 100- and 540-ft-wide buffers of the Salmon River freshwater estuary. Data are from the National Land Cover Database (2001).

*Indicator – Summertime water temperature**Current Condition - Good*

Temperature regulates the solubility of gases (particularly oxygen) in water – more oxygen can dissolve in cold water than in warm water. Also, biological processes such as bacterial decay of organic material are higher in warm water, thereby leading to more rapid oxygen depletion under warm conditions. The freshwater estuary naturally warms during the day and cools by night – especially during the summer months and in the shallower reaches with slow water velocity. Because the freshwater estuary is isolated from Lake Ontario, wave action is minimized and mixing of the water column is limited. The freshwater estuary is classified as a “warm water fishery” and therefore will naturally not support certain fish requiring colder water temperatures. Available data suggest that summertime high water temperatures fall within the range of tolerance for common warm water fish species. No summer fish kills associated with lethal temperatures have been reported for the freshwater estuary.

KEA - Pathogens

Several pathogens of concern to wildlife, fisheries and human health occur in or near the watershed and are being monitored by NYSDEC (A. Noyes, NYSDEC Aquatic Pathologist, personal communication).

*Indicator – Type E Botulism occurrence**Current Condition – Fair*

Type E Botulism is a disease caused by a neurotoxin that is produced by a bacterium. The disease leads to paralysis and is spread by consumption of infected meat and has been known to affect fish-eating shore birds in the Great Lakes since 1999 (NYSDEC 2006b). In autumn, 2006, an outbreak of Type E Botulism occurred in gulls, grebes and loons along the southern and eastern shores of Lake Ontario. This was the first occurrence in Lake Ontario (NYSDEC 2006b). No birds within the freshwater estuary were known to have been infected.

*Indicator – Bacterial Kidney Disease (BKD) occurrence**Current Condition - Fair*

Bacterial Kidney Disease (BKD) is caused by a bacterium that survives in and causes extensive tissue damage to kidneys (Grayson et al. 2002). The disease is widespread in the Upper Great Lakes, with symptoms occurring in ~30-40% of Coho, Chinook, and Steelhead salmon there. The disease is spread by spawning fish migrating back into the river from Lake Ontario. The bacterium has occurred sporadically in the Salmon River fishery but has not been detected since 2003.

*Indicator – Furnunculosis occurrence**Current Condition - Good*

Furnunculosis is a bacterial disease that causes severe blood poisoning and acute mortality. Fish affected with pathogen may swim erratically, become sluggish and stop

feeding. The disease is common throughout North America and the Great Lakes. The pathogen was recently detected in approximately 5-10% of fish in the Salmon River, but no disease symptoms have been observed.

Indicator – Infectious Pancreatic Necrosis (IPN) occurrence

Current Condition - Good

Infectious Pancreatic Necrosis is a viral disease that infects all ages and varieties of salmonines and is transmitted vertically (adults to eggs) or horizontally (consumption of infected dead fish or by fish excretions in the water). Infected fish may have swollen stomachs, swim in spiral manners, be inactive and produce white fecal casts. This disease was present in the Salmon River fishery in the 1950's and 1960's but has not been detected recently. It continues to be monitored.

Indicator – Enteric redmouth disease (ERM) occurrence

Current Condition - Fair

Enteric redmouth (ERM) is caused by a bacterium. Infected fish develop red mouths and are often found at the top of the water and isolated from other fish, and may stop eating. The bacterium is common in Appalachian and mid-Atlantic fisheries as well as in the western Great Lakes. ERM most often infects rainbow trout, but it also affects several other salmonines. The disease is present but not common in the Salmon River.

Viral Hemorrhagic Septicemia (VHS) occurrence

Current Condition - Good

Viral Hemorrhagic Septicemia (VHS, IV-B strain) was detected in Nova Scotia in the 1990s. Current evidence suggests this is probably an Atlantic strain of the virus that is just now being spread into the Great Lakes. This particular strain does not target salmonines as the other strains do (I, II and IV on salmonines in Europe and Asia; and IV-A in the Pacific Northwest), but rather walleye, perch, minnows and gobies. Infected fish exhibit dark color, pale gills, sluggishness and erratic swimming. The virus has not yet been detected in the Salmon River.

KEA - Toxins

Several known toxins are of concern within the freshwater estuary, some of which reach levels to warrant health advisories.

Indicator – Mercury tissue concentration in game fish

Current Condition – Fair

Mercury (Hg) is a naturally occurring element that has increased in abundance due to a number of human activities. Important sources of mercury into the air and water include utilities, municipal wastewater plants, and incinerators. Toxic effects include reduced reproductive success, hormonal changes and motor skill impairment (Driscoll et al. 2007). Mercury bioaccumulates through food chains and can reach levels in carnivorous fish that are hazardous to human health. It is believed that the source of mercury in the lower Salmon River is primarily from migrating salmonines returning

from Lake Ontario. However, mercury also enters the watershed through precipitation of rain, snow, dust and aerosols.

Elevated mercury levels are known to occur in fish in the lower Salmon River, but currently there are no fish consumption advisories for mercury in game fish taken from the lower Salmon River (NYSDOH 2006). No information is available on mercury concentrations on forage fish in the watershed.

Indicator – PCB tissue concentration in game fish and snapping turtle eggs

PCBs (polychlorinated biphenyls) are a class of organic chemicals that are persistent and bioaccumulate in aquatic food chains. PCB's are known to cause cancer, reproductive and developmental disorders, and nerve damage in humans.

Current Condition – game fish tissue concentrations - Poor

There is currently an NYSDOH fish consumption advisory for PCBs in smallmouth bass taken from the Salmon River from the mouth to the Redfield Reservoir (NYSDOH 2006).

Current Condition – snapping turtle eggs - Fair

There are no data available for snapping turtle PCB concentrations in the watershed, but scientists have begun measuring PCB levels in snapping turtle eggs in order to monitor local contamination levels. Pagano et al. (1999) reported snapping turtle egg concentrations to be 1.5 mg/kg at the nearby Rice Creek Biological Station in Oswego County. Since turtles are not migratory their contamination levels directly reflect those of their immediate environment.

Current Condition – mink jaw lesions – Poor: There are no data available on the occurrence of cancerous lesions in mink for the Salmon River watershed. However, based upon the work of Haynes et al. (2007), mink feeding within the Lake Ontario system near Rochester appear to be exposed to sufficiently high PCB concentrations to induce growth of lesions in jaw tissue (40 ppb), and this exposure is apparently from food sources exposed to contaminated water in Lake Ontario.

Indicator – Mirex concentration in game fish tissue and snapping turtle eggs

Mirex is an organochloride that was used as an insecticide and flame retardant before it was banned in the US in the 1970s. It is persistent and bioaccumulates in aquatic food webs. Mirex causes cancer, reproductive and developmental disorders, and nerve damage in humans (NYSDOH 2006, PAN Database 2007).

Current Condition – Game fish tissue concentrations – Poor

There is currently an NYSDOH fish consumption advisory for Mirex in smallmouth bass taken from the Salmon River from the mouth to the Redfield Reservoir (NYSDOH 2006).

Current Condition – Snapping turtle eggs - Fair

There are no data available for snapping turtle Mirex concentrations in the watershed. However, Pagano et al. (1999) reported Mirex concentrations in snapping turtle eggs to be 0.04 kg/mg at the nearby Rice Creek Biological Station in Oswego County.

KEA – Landscape Context

The condition of the freshwater estuary is influenced by factors outside the actual limit of the wetlands, such as fragmenting landscape features and land uses that may affect water quality within the freshwater estuary or influence its use or accessibility by wildlife. The local landscape surrounding the freshwater estuary is defined by projecting its eastern boundary (last riffle of the Salmon River) northward and southward to the intersection of the Salmon River watershed boundary (Figure 21). Natural vegetation surrounding the freshwater estuary provides habitat and migration corridors for wildlife species that utilize the freshwater estuary for certain aspects of their life histories, and provides certain ecosystem functions such as nutrient sequestration and sediment control.

*Indicator – Percent of local sub-watershed land in natural vegetation**Current Condition – Poor to Fair*

Seventy-five percent of the land cover in the local sub-watershed is “natural cover types” (i.e., wetland, forest, scrub/shrub, grassland, Figure 21). This overestimates natural land cover-types since available data classify the barrier dunes forming the western limit of the freshwater estuary as scrub/shrub. These dunes are wooded, but developed lots. The majority of natural cover within the freshwater estuary’s sub-watershed is provided by Selkirk Shores State Park.

*Indicator – Percent of 540-ft shoreline buffer in natural cover types**Current Condition - Poor*

Naturally-vegetated buffers provide opportunities for wildlife species to simultaneously utilize upland and wetland habitats within their home ranges, to migrate along water features, and to disperse from wetlands into adjacent upland communities. Amphibians are known to travel 1000-1800 ft, and up to 4500 ft between breeding grounds and hibernation areas (Hels and Buchwald 2001; Gibbs and Shriver 2005). Semlitsch (1998) suggested that a natural buffer of ~540 ft from wetlands would capture 95% of the local amphibian populations. Agriculture, development and barren lands comprise 33% of the 540-ft buffer surrounding the freshwater estuary (Figure 21). The balance (67%) is in some form of natural cover-type (forest, scrub/shrub, grassland, wetland).

*Indicator – Percent of 540-ft shoreline buffer isolated by roads**Current Condition - Poor*

Roads are known to be a significant source of mortality to amphibians and reptiles (Hels and Buchwald 2001; Gibbs and Shriver 2005), especially those that breed in aquatic habitats and must cross roads to travel between hibernation and breeding sites. The freshwater estuary is completely surrounded and isolated by paved roads (Figure 21). Seventy-nine percent of the area falling within a 540-ft buffer around the freshwater estuary has a road passing through it.

Indicator – Percent natural vegetation in 100-ft buffers of tributary streams

Current Condition - Poor

Apart from the main branch of the Salmon River, one mapped first-order stream feeds the freshwater estuary (Mud Creek). This stream may have localized influences on water quality and habitat within the freshwater estuary; vegetated buffers of 100 feet can provide effective nutrient and sediment controls. The Mud Creek watershed has high agricultural use, and the buffer along the length of the creek contains less than 75% natural cover.

DUNE COMMUNITIES

KEA - Size

Indicator – Dune area (acres)

Current Condition - Good

Approximately 33 acres of barrier dunes are present at the mouth of the Salmon River. These dunes are contiguous with the larger dune system extending northward from the mouth of the Salmon River. The area of existing dunes at the Salmon River mouth does not appear to be reduced by interruptions of natural dune building processes. A recent study (Woodrow et al. 2002) determined that the Salmon River does not contribute sediments to the beach/dunes and that the jetty system at the river's mouth does not inhibit long-shore transport along this section of the Ontario lakeshore. Material for the dunes was deposited when the lake levels were higher during deglaciation. The area of dunes that was lost through construction of cottages is not known.

KEA - Dune Plant Community

The barrier dunes at the mouth of the Salmon River represent the southern extent of a 17-mile long Great Lakes dune system. These rare communities occur in New York only along the eastern shore of Lake Ontario (Edinger et al. 2002). Community composition varies depending on stability of a particular dune and distance from the lake. Unstable dunes occur in closer proximity to the lake. With time and stability, shrub and vine communities establish. With further stabilization and time, open oak-maple forest communities establish (Bonanno 1992). The dunes within the Salmon River watershed are all on private lands that have been largely developed.

Indicator – Total vegetation cover

Current Condition - Unranked

No information exists on the plant communities of these privately-owned dunes.

Indicator – Rare species population densities/cover

Current Condition – Fair to Poor

Three rare plant species occur on the dunes at the Salmon River freshwater estuary: Champlain beachgrass (*Ammophila champlainensis*), low sand-cherry (*Prunus pumila* var. *pumila*) and sand dune willow (*Salix cordata*). The NY Natural Heritage Program

(Howard 2006) estimated the sand-cherry population at ~500 stems in five groups that were widely distributed within an active residential development. The population of dune willow is located at the edge of the marsh amongst *Phragmites* and purple loosestrife (*Lythrum salicaria*) along the base of a degraded dune. No information is available for Champlain beachgrass at this location.

Indicator – Invasive species occurrence/dominance

Current Condition - Unranked

No information is available on the distribution and abundance of invasive species in this dune complex. Potential for invasives is high given the degree of development and public use of the area.

Salmon River Freshwater Estuary and Dunes Viability Summary

Notes on Guidance for Current Condition:

- “NG” No guidance was obtained to rank this indicator
 “SGR” Subjective guidance and/or ranking based on professional opinion
 “ND” No data are available with which to rank this indicator

Estuary	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Size						
<i>Ind. - Estuary area (acre)</i>					~270-Good	SG; ranking based on current area
KEA-Condition -Estuary Plant Community						
<i>Ind. - Total cover aquatic vegetation</i>					Good	SGR; Harman et al. (2000)
<i>Ind. - Invasive plant frequency (% of plots)</i>	0	<5	5-25	>25	Fair	Drake et al. (2003)
<i>Ind. - Invasive plant cover (avg % cover)</i>	0	<5	5-25	>25	Good	Drake et al. (2003)
KEA - Condition - Fish Community						
<i>Ind.- Fish species richness (# species in samples)</i>					40+ Good	SGR, local fisheries managers
<i>Ind. – Index of Biotic Integrity</i>		>38	33-38	<33	Good	Carlson et al. 2006
<i>Ind.- Invasive fish species relative densities (sea lamprey)</i>	0	<5	5-25	>25	0.1% Good	Drake et al. (2003)
KEA-Condition-Rare & Endangered Species						
<i>Ind. – No. black tern breeding pairs</i>					Fair	SGR, Howard (2006)
<i>Ind. - No. pied-billed grebe breeding pairs</i>					Good-Fair	SGR, Howard (2006)
<i>Ind. - No. least bittern breeding pairs</i>					Good-Fair	SGR, Howard (2006)
<i>Ind. – No .sedge wren breeding pairs</i>					Unranked	ND
<i>Ind. – No. lake sturgeon</i>					Poor	SGR

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Condition-Hydrology						
<i>Ind. - Lake Ontario surface water level variation (m)</i>		74.0-75.5		74.5-75.0	Fair-Poor	ISOSLR (2006)
<i>Ind. - Freq. Salmon River summertime baseflow <25 cfs</i>		<40%		>40%	Good	FERC license agreement (1996)
<i>Ind. – groundwater discharge</i>					Unranked	NG, ND
KEA-Condition-Water Quality						
<i>Ind. - % of 100-ft buffer in natural cover types</i>		>90	75-90	<75	Fair	SGR, Klapproth & Johnson (2000), Baird & Wetmore (2006)
<i>Ind. - total dissolved phosphorus concentration (mg/L)</i>		<0.05		>0.05	Good	Mueller and Helsel (1996); SGR, Harman et al (2000)
<i>Ind. - Carlson Trophic Status (unitless)</i>		<50		>50	Unranked	US EPA (2007); ND
<i>Ind. - summertime water temperature (°F)</i>		68-80		>82	Good	Michigan DNR (2007)
<i>Ind. – sediment load / turbidity</i>					Unranked	NG, ND
KEA-Condition-Pathogens						
<i>Ind.– Type E Botulism occurrence (% of population w/ symptoms)</i>		0	1-5	>5	Fair	SGR, local fisheries managers
<i>Ind. – Bacterial Kidney Disease occurrence</i>		0	1-5	>5	Fair	SGR, local fisheries managers
<i>Ind. – Furnunculosis occurrence</i>		0	1-5	>5	Good	SGR, local fisheries managers
<i>Ind. – Infectious Pancreatic Necrosis occurrence</i>		0	1-5	>5	Good	SGR, local fisheries managers
<i>Ind. – Yersinia ruckeri occurrence</i>		0	1-5	>5	Fair	SGR, local fisheries managers
<i>Ind. – Viral Haemorrhagic Septicaemia occurrence</i>		0	1-5	>5	Good	SGR, local fisheries managers

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Condition-Toxins						
<i>Ind.– game fish mercury concentration (ppm)</i>		0	0-1	>1	Fair	NY State Dept. Health (2006)
<i>Ind.– game fish PCB concentration (ppm)</i>					Poor	NY State Dept. Health (2006)
<i>Ind.– snapping turtle egg PCB concentration (ppm)</i>		0	0-2	>2	Fair	SGR; Pagano et al. (1999)
<i>Ind. - PCB-induced mink jaw lesions (ppb)</i>		0	<40	>40	Poor	Haynes et al. (2007)
<i>Ind.- game fish Mirex concentrations (ppm)</i>					Poor	NY State Dept. Health (2006)
<i>Ind.- snapping turtle egg Mirex concentrations (ppm)</i>		0	0-0.2	>0.2	Fair	SGR; Pagano et al. (1999)
KEA-Landscape Context						
<i>Ind. - natural land cover of local watershed (%)</i>		>90	90-75	<75	Fair-Poor	SGR
<i>Ind. – natural land cover in 540-ft buffer (%)</i>		>90	90-75	<75	Poor	SGR
<i>Ind. – amount of 540-ft freshwater estuary buffer isolated by roads (%)</i>		<10	10-25	>25	Poor	SGR
<i>Ind. – natural vegetation in 100-ft buffers along local first order streams (%)</i>		>90	90-75	<75	Poor	SGR
Dunes						
KEA-Size						
<i>Ind. - Dune area (acre)</i>					~33-Good	SGR; based on current estimated area
KEA-Condition -Dune Plant Community						
<i>Ind. - total vegetation cover (%)</i>		40-80		<30	Unranked	Bonanno (1992); ND
<i>Ind. - rare species cover (%)</i>						
<i>Champlain beach grass</i>					Unranked	NG; ND
<i>Low sand-cherry</i>					Fair-Poor	SGR, Howard (2006)
<i>sand dune willow</i>					Fair-Poor	SGR, (Howard (2006)
<i>Ind. - Invasive plant frequency (% of plots)</i>	0	<5	5-25	>25	Unranked	Drake et al. (2003); ND
<i>Ind. - Invasive plant cover (avg % cover)</i>	0	<5	5-25	>25	Unranked	Drake et al. 2003; ND

2. MAIN BRANCH SALMON RIVER & MAJOR TRIBUTARIES

KEA – Area

Indicator: Volume Flow (cubic feet per second – cfs)

Current Condition = Good

The total area of in-stream habitat is a function of stream flow, and maintaining adequate baseflow during dry summer conditions provides greater within-channel habitat for aquatic organisms. As flow decreases, elevated areas of the channel will dry up, forcing fish and other aquatic organisms to move to remaining available submerged habitat.

Water flow in the lower reaches of the Salmon River is regulated by the Federal Energy Regulatory Commission (FERC) in accordance with the Salmon River Hydroelectric Project licensing agreement (FERC 1996), which requires that continuous minimum baseflow of 185 cfs be maintained. The required baseflow volumes were intended to maintain sufficient cover during dry summer months, provide necessary flow to sustain salmon spawning runs in the autumn and to cover and protect eggs during the winter. No information is available to assess baseflow levels in the major tributaries of the lower watershed. It is believed that flow within streams of the upper subwatersheds do not vary from natural regimes.

The Tug Hill Aquifer (Figure 7) is one of the largest and most productive groundwater reserves in New York and potentially very important for maintaining summertime flows in the Trout Brook and Orwell-Pekin sub-watersheds since the baseflows of these two largest tributaries in the lower watershed are not regulated by the Lighthouse Hill Reservoir.

KEA – Water Quality

Indicator - Percent Natural Cover-Types in 100-ft Stream Buffers

Current Condition: Upper sub-watersheds, Good; Lower sub-watersheds, Fair

Vegetated buffers along waterways are important for maintaining several aspects of water quality and habitat viability. Vegetation sequesters nutrients; stabilizes soils, thereby reducing erosion; delivers organic material to be used as aquatic energy sources; and provides shade to moderate water temperatures. Available guidance suggests that 100-ft-wide vegetated buffers are typically effective at maintaining water quality and shading stream environments (Klapproth and Johnson 2000, Baird and Wetmore 2006).

The vast majority of stream reaches within the watershed are well-buffered by natural vegetation (i.e., forest, scrub/shrub, grassland, wetland; Figure 22). No stream reaches in the watershed were ranked as “poor” (<75% natural cover) with regard to natural vegetation in the 100-ft buffer. All streams within the upper sub-watersheds achieved “good” rankings (>90% natural cover). Four stream reaches, all occurring in the lower sub-watersheds (Beaver Dam Brook-Meadow Creek-Reservoir, Lower Salmon River-Main Stem, Trout Brook, Orwell-Pekin) were ranked as “fair” (75-90% natural cover).

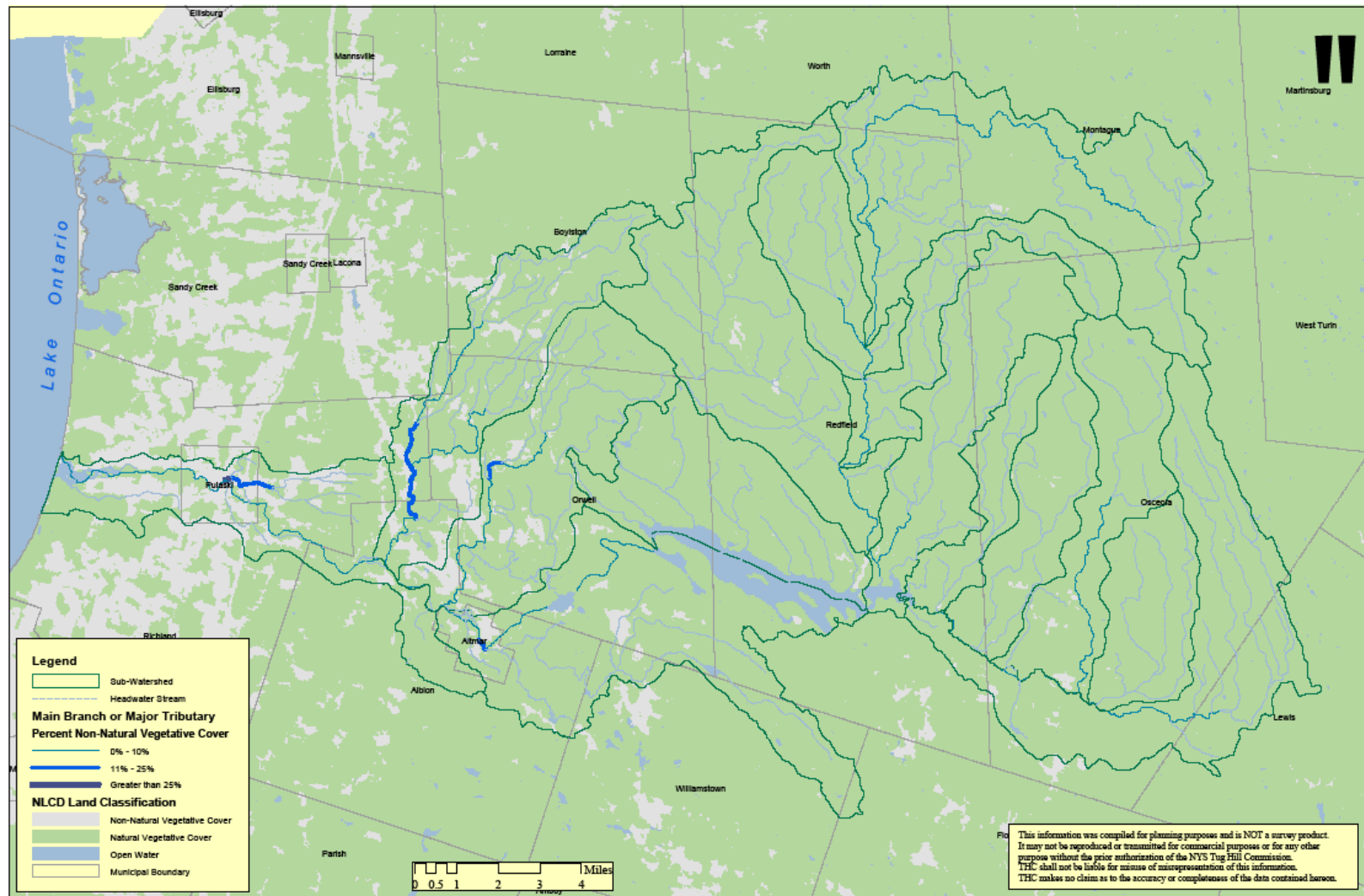


Figure 22. Analysis of land-cover types in 100-ft buffers of the Main Branch of Salmon River and its major tributaries. Data are from the National Land Cover Database (2001).

*Indicator – embeddedness**Current Condition – Unranked*

Embeddedness describes the degree to which fine sediments surround coarse substrates in a streambed. This measurement has been used to assess fish spawning and macroinvertebrate habitat. Increased embeddedness is caused by excessive levels of siltation, and therefore it is often used as a measure of water quality.

*Indicator - Summertime high temperature**Current Condition – Lower sub-watersheds, Good/Fair; Upper sub-watersheds, Good*

Temperature is an important regulator of gas solubility (particularly oxygen) in water. Higher concentrations of water can dissolve in cold water than in warm water. Furthermore, all aquatic organisms possess maximum temperature thresholds at which they begin to experience adverse physiological effects, and at which they are more susceptible to various pathogens (A. Noyes, NYSDEC Pathologist, personal communication). Many salmonines are intolerant of temperatures greater than 70°F (21°C).

Due to lack of complete canopy cover, mid-reach streams such as the Salmon River and its major tributaries naturally experience diurnal fluctuations in temperature – warming by day and cooling by night – especially during the summer months.

Several studies (Bode et al. 1996, Hallock 2003, Everitt 2006) have reported that summertime temperatures are generally cooler in the upper reaches of the Salmon River compared to the lower Salmon River. In all years for which data were obtained, summertime temperatures in the lower Salmon River surpassed tolerance thresholds for salmonines (70 °F) for at least one day. No information is available to describe the duration of time for which temperatures surpass tolerance thresholds.

GAP analysis (J. McKenna, unpublished data) reveals that most of the higher-order stream reaches in the watershed are predicted to reach 70-73 °F in mid-summer, even in upper sub-watersheds. Lower order streams are predicted to be generally cooler in upper sub-watersheds, compared to lower sub-watersheds (particularly the Trout Brook and Orwell-Pekin sub-watersheds).

*Indicator: pH**Current Condition - Good*

Acidity is a measure of hydrogen ion (H^+) concentration of a solution, and is frequently reported on the pH scale. The higher the concentration of H^+ , the more “acidic” a solution is said to be (corresponding to low pH values). Acidified waters typically impact aquatic organisms by increasing the solubility of aluminum (Al^{n+}) to toxic levels. Surface waters with pH <6.0 place aquatic biota at risk (Driscoll et al. 2001).

Faigenbaum (1940) reported pH of the Salmon River at Pulaski in June 1939 was 8.6. Springtime pH values in high order streams ranged 6-7 in 2000, while under summer

baseflow conditions, pH values ranged from 7-8 (Hallock 2003). NYSDEC Division of Water indicates no water bodies in the Salmon River drainage are impaired by acidification (NYSDEC Draft 2006 Section 303d list).

Indicator – total alkalinity

Current Condition - Good

Alkalinity refers to the ability of water to neutralize acids or resist changes in pH.

Water with total alkalinity <2.5 mg/L CaCO₃ is considered sensitive to acidification, and water with total alkalinity >100 mg/L CaCO₃ is considered well-buffered (Driscoll et al. 2001).

In early March, 2000, alkalinity measures were <60 mg/L for all river segments sampled by Hallock (2003). Alkalinity increased during summer baseflow periods that year, with Orwell and Trout Brooks attaining alkalinity values >100 mg/L.

Summertime alkalinity in the Mad River and N. Branch Salmon River were 67 and 61 mg/L (averaged over 1-3 years of sampling; source - R. Klindt, unpublished).

Indicator: dissolved oxygen (mg/L)

Current Condition – Good

Cold water fish such as trout and salmon generally require dissolved oxygen concentrations > 6 mg/L (Kozuchowski et al 1994). Hallock (2003) reported that dissolved oxygen (DO) concentrations in the Salmon River and its major tributaries never dropped below 8 mg/L during spring peak or summer baseflow periods in 2000. Bode et al. (1997) reported DO concentrations ranging from 7.7-9.2 mg/L in August 1996.

Indicator: phosphorus (P) concentration

Current Condition – Upper sub-watersheds, Good; Lower sub-watersheds, Fair

Phosphorus is a naturally occurring mineral nutrient that is frequently the single-most important limiting resource for biological productivity in freshwater systems. It naturally occurs in freshwaters in low concentrations (< 0.01 mg/L) owing to its low solubility. High P concentrations in water bodies are normally due to human activities (septic waste disposal, agricultural waste and fertilizer runoff), and typically result in high rates of productivity by algae and plants (eutrophication). The benthic (bottom) zones of eutrophic water bodies often become depleted in oxygen when large amounts of organic matter accumulate and undergo bacterial decomposition. Oxygen depletion, in turn, results in mortality of fish and other aquatic invertebrates. The USEPA has issued guidelines suggesting that to reduce eutrophication, total phosphates in streams not discharging directly to lakes or reservoirs should be less than 0.10 mg/L (Mueller and Helsel 1996).

Segments of the upper watershed and the Main Branch of the lower watershed consistently have low P concentrations (<0.01 mg/L). Summertime P concentrations in Orwell and Trout Brooks are elevated, but not above the USEPA guideline of 0.1 mg/L (Hallock 2003).

*Indicator – Nitrogen concentration**Current Condition – Fair*

Nitrogen (N) is an essential nutrient, but it is naturally available in low supplies. Human activities such as the use of nitrogen fertilizers and burning of fossil fuels have increased the availability of N in terrestrial and aquatic systems. Nitrogen loads in excess of natural levels have been shown to alter aquatic and terrestrial plant communities and reduce biodiversity. In unpolluted forested landscapes, total dissolved N (TDN) in streams is usually less than 0.35 mg/L, while TDN may frequently reach 0.7-2.1 mg/L in streams draining agricultural landscapes. In extremely high concentrations (>10 mg/L), nitrogen (in the form of nitrate, NO_3^-) can have adverse human health effects (Driscoll et al. 2003).

In 2000 (Hallock 2003), stream water N concentrations in upper sub-watersheds and in the lower Main Branch of the Salmon River exhibited a seasonal effect for TDN (higher concentrations in spring, 0.6-0.7 mg/L versus summer, 0.3-0.5 mg/L) that probably reflects pollution inputs with the melting snowpack. Concentrations of TDN remained higher than the anticipated levels for unpolluted forest landscapes. The lower sub-watersheds (Beaverdam, Orwell-Pekin and Trout Brooks) exhibited higher TDN concentrations during summer baseflow (0.8-1.1 mg/L) than during spring snowmelt. Agricultural runoff may be the source of high summertime N in the lower sub-watersheds. Even still, N concentrations remain well below USEPA drinking water standards throughout the watershed.

KEA – Macroinvertebrate Communities

Macroinvertebrates are important components of stream ecosystems, and many serve as the lower links of aquatic food chains that eventually support predatory fish, birds and mammals. Macroinvertebrate communities can be used as monitors of water quality and overall ecosystem health. Some invertebrates are intolerant of water conditions having low oxygen concentration and high organic content – these indicators of good water quality include mayflies, stoneflies, caddisflies, and many water beetles. Other invertebrates are able to tolerate low oxygen concentrations, and/or feed on bacteria that grow on suspended organic matter (such as that associated with sewage and agricultural wastes). These indicators of poor water quality include various midges (fly larvae), bloodworms, aquatic earthworms, leeches, sowbugs, and some black fly larvae.

*Indicators – Indices of Biotic Integrity**Current Condition – Good*

Bode et al. (1997) developed several indices of water quality in the Salmon River using information on the abundance of different macroinvertebrate species and their respective tolerances for degraded water quality. They reported that macroinvertebrate communities at all sites along a 25-mile reach of the Salmon River from below Pulaski to above the Redfield Reservoir were diverse and well-balanced. Two sites, directly below the Lighthouse Hill Reservoir, showed evidence of nutrient enrichment and it was believed this was an effect of the reservoir. However, invertebrate communities still indicated excellent water quality. Hallock (2003) suggested that the reservoir dams

are inhibiting the movement of organic debris, and that high and sustained summer discharges may be removing some types of invertebrates from the substrate and flushing them through the system.

KEA - Fish Communities

Indicator – Species Richness

Current Condition – Unranked

Local fisheries managers believe that species richness within the watershed is very good. Forty-two species have been sampled from the lower reaches of the Salmon River (various NYSDEC surveys, J. McKenna unpublished data). Available data account for only 8 and 12 species in Orwell and Trout Brooks, respectively. In the upper portions of the watershed, 20, 17 and 13 species have been sampled from the Mad River system, North Branch of the Salmon River, and upper Salmon River, respectively. Modeled estimates of species richness (McKenna, unpublished, Figure 23) predict the greatest species richness (>78 species in some reaches) in the lowest reaches of the Main Branch, with generally decreasing trends in richness toward the headwaters of the various sub-watersheds.

Indicator – Select Fish Species Distributions

Current Condition – common carp, exotic species - Unranked

Common carp (*Cyprinus carpio*) are native to Asia and their escape in North America has led to degradation of several water bodies. Carp have been observed in the lower watershed, and a recent GAP analysis (McKenna, unpublished) reveals that suitable habitat exists throughout the watershed, although this model predicts densities would remain low if they are introduced or eventually migrate throughout the watershed.

Indicator – Select Fish Species Distributions

Current Condition – brown and brook trout, game species – Unranked

Brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) are two common game species that are both stocked and naturally reproducing within the watershed. Brown trout are an introduced species that have been widely stocked in North America, and which have similar habitat requirements as the native brook trout. However, brown trout can tolerate warmer temperatures and are therefore capable of inhabiting larger streams. In the presence of brown trout, brook trout tend to retreat to colder, headwater streams. The GAP analysis (McKenna, unpublished) indicates they are both common throughout the watershed, and that brown trout are generally predicted to occur in greater numbers.

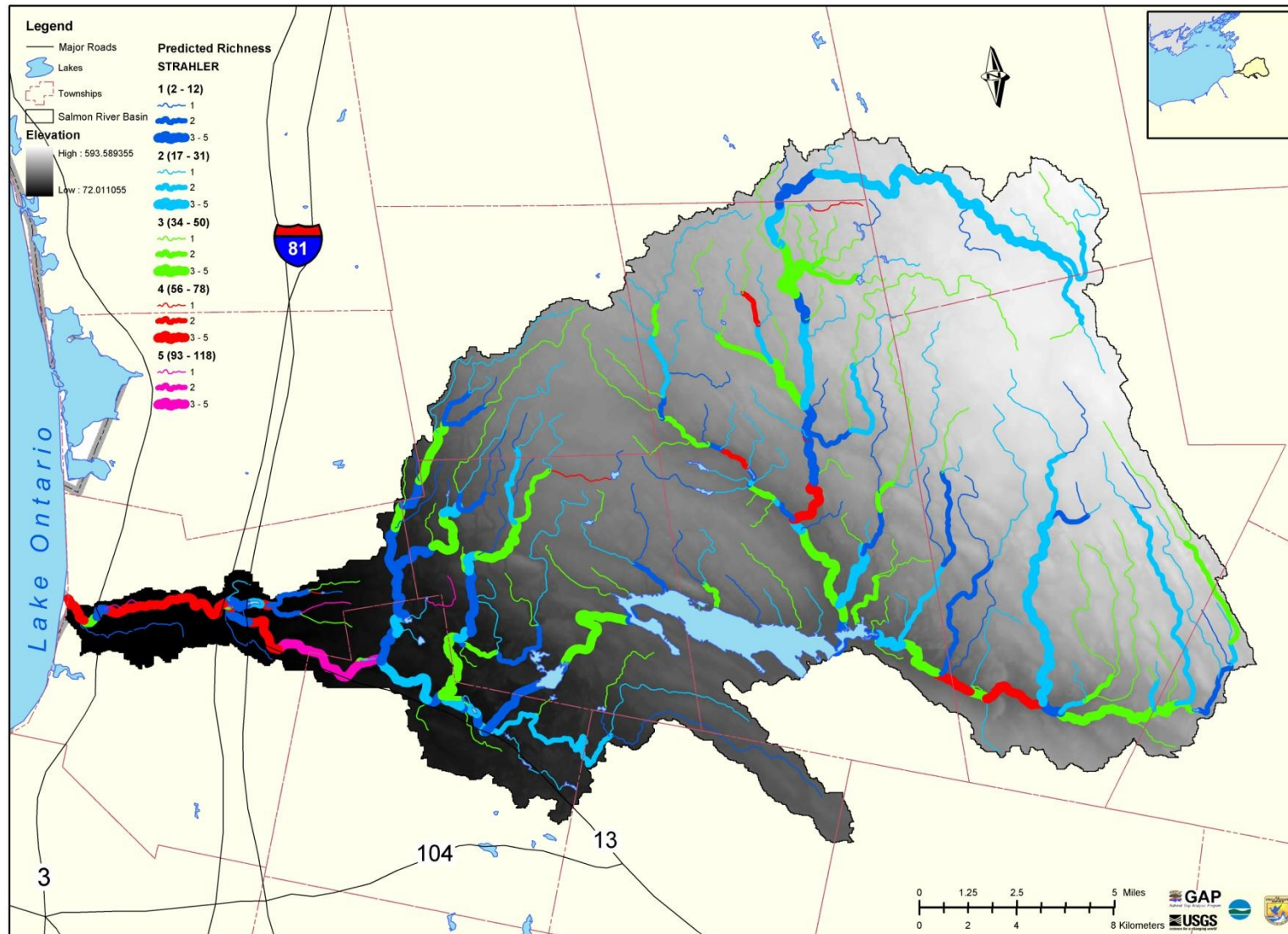


Figure 23. Predicted species richness in stream reaches of the Salmon River Watershed. Stream reaches are color coded to number of predicted species. Line thickness of each depicted stream reach reflects the respective Strahler stream order (from 1st- to 5th-order). (Source: McKenna, unpublished data.)

Indicators of natural salmonine reproduction

The level of natural salmonine production within the watershed (below the Lighthouse Hill Reservoir) integrates the number of returning adults from Lake Ontario that are available to reproduce, spawning habitat availability, and juvenile habitat and food availability. Information available for ranking these indicators in the watershed exists only for certain life history stages of Chinook salmon and rainbow trout.

*Indicator – Salmonine spawning habitat (proportion of available area)**Current Condition – Good*

Chinook salmon have specific requirements for substrate size in which to create redds (nests), as well as for water depth and velocity during spawning. Everitt (2006) estimated approximately 1,900 and 2,900 redds within the lower Salmon River in 2004 and 2005. Of the total river area available (199 hectares), 15% had suitable combinations of spawning substrate, water depth and water velocity.

*Indicator – Adult escapement and egg production estimate (#/yr)**Current Condition – Good*

The number of adults contributing to the naturally reproducing salmon population is that which is able to survive spawning runs, and escape anglers and hatchery harvest operations. Everitt (2006) estimated that ~6000-11,000 (12-18%) of returning adult salmon survived the spawning runs, anglers and hatchery harvest in 2004 and 2005 to produce 14.6 – 41.4 million eggs in those years; and concluded that with expected levels of mortality, the number of smolt that return to the lake from natural reproduction (146,000 – 414,000) is comparable to that produced by the hatchery (300,000).

*Indicator – Salmonine juvenile recruitment**Current Condition – Good*

Estimations of juvenile recruitment have been made only for rainbow trout that utilize mid-reach stream sections of the Orwell and Trout Brook systems for spawning. A recent study of natural reproduction in these streams, along with Sandy Creek classified Orwell Brook, Trout Brook and Little Sandy Creek as the only excellent salmonine producing streams in the Lake Ontario basin (31 total). Another study reported wide annual variation in relative abundance of naturally reproducing Chinook and coho salmon within Orwell and Trout Brooks, and Little Sandy Creek (Kennen et al. 1994).

KEA - Toxins

A number of environmental pollutants and toxins are capable of impairing ecological integrity of freshwaters. Toxins of current concern within the Salmon River watershed are mercury, PCBs and Mirex.

Indicator – Mercury tissue concentration in game fish

Current Condition – Lower sub-watersheds, Fair; Upper sub-watersheds, Unranked

See page 56 for background on mercury contamination. Elevated mercury levels are known to occur in fish in the lower Salmon River, but currently there are no fish consumption advisories for mercury in fish taken from the lower Salmon River (NYSDOH 2006). In 2006 the NYSDEC listed the Salmon River Reservoir as a Section 303(d) Impaired Water due to mercury contamination in some fish (NYSDOH 2006). It is likely that the mercury source for the reservoir is internal loading from sediments due to water fluctuations. Therefore conditions within the reservoir should not be extrapolated beyond the reservoir. No other information exists on mercury contamination in fish for the upper sub-watersheds.

Indicator – PCB tissue concentration in game fish

Current Condition – Lower sub-watersheds Poor; Upper sub-watersheds, Unranked

See page 57 for background on PCB contamination. There is currently an NYSDOH fish consumption advisory for PCBs in smallmouth bass taken from the Salmon River from the mouth to the Reservoir (NYSDOH 2006). There are currently no fish consumption advisories for sport fish above the Redfield Reservoir or for any of the upper sub-watersheds.

Indicator – PCB-induced mink jaw lesions

Current Condition – Lower sub-watersheds, Poor; Upper sub-watersheds, Unranked:

There are no data available on the occurrence of cancerous lesions in mink for the Salmon River watershed. However, based upon the work of Beckett and Haynes (2007) mink feeding within the Lake Ontario system near Rochester appear to be exposed to sufficiently high PCB concentrations to induce growth of lesions in jaw tissue (40 ppb), and this exposure is apparently from food sources exposed to contaminated water in Lake Ontario. No data are available that suggest exposure of mink to PCB concentrations sufficiently high to cause cancerous lesions in waterways where prey species are isolated from Lake Ontario.

Indicator – Mirex tissue concentration in game fish

Current Condition – Lower sub-watersheds, Poor; Upper sub-watersheds, Good

See page 57 for background on Mirex contamination. There is currently an NYSDOH fish consumption advisory for Mirex in smallmouth bass taken from the Salmon River from the mouth to the Reservoir (NYSDOH 2006). Mirex concentrations were below detection limits in forage fish above the Redfield Reservoir in 1988 (L. Skinner, NYSDEC, unpublished data).

Indicator – Permitted Point Source Discharges: There are currently four facilities with National Pollution Discharge Elimination System (NPDES) water discharge or USEPA Toxic Release Inventory (TRI) discharge permits in the watershed (Figure 24).

Current Condition – Felix Schoeller Technical Papers, Pulaski – Good

The facility has not been out of compliance with discharge schedules since 1991.

Current Condition – Pulaski Sewage Treatment Plant, Pulaski – Fair

The last violation of NPDES permit requirements for this facility was December 2002.

Current Condition - Pulaski Ford and Mercury, Pulaski – Unranked

No permit documents were found through the USEPA web database for this facility.

Current Condition - New York State Fish Hatchery, Altmar – Fair

The last violation of NPDES permit requirements for this facility was May 2004.

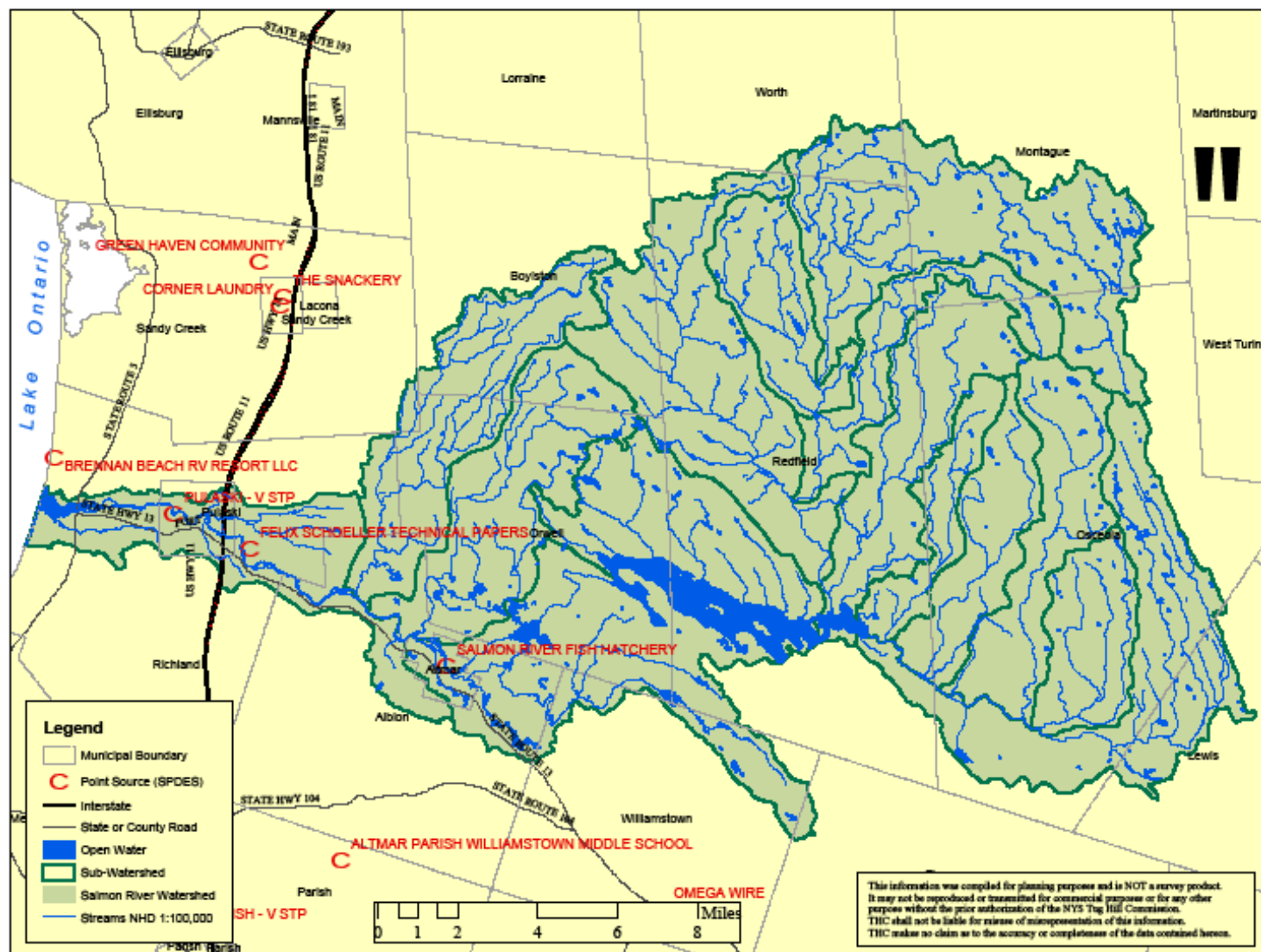


Figure 24. Location of facilities with National Pollution Discharge Elimination System (NPDES) or USEPA Toxic Release Inventory (TRI) discharge permits in the Salmon River Watershed.

KEA - Pathogens

Several pathogens of concern to fisheries and human health exist in or near the watershed that are monitored for health and fisheries management. There are six viral and bacterial pathogens that are being monitored by NYSDEC for the salmonine fishery management (A. Noyes, NYSDEC Aquatic Pathologist, personal communication). See section on Salmon River Freshwater Estuary for background on these pathogens.

Indicator – Bacterial Kidney Disease occurrence

Current Condition – Fair

The bacterium that is the agent for this disease has occurred sporadically in the Salmon River fishery but has not been detected since 2003.

Indicator – Furnunculosis occurrence

Current Condition – Good

The pathogen has recently been detected in approximately 5-10% of fish in the Salmon River, but no disease symptoms have been observed.

Indicator – Infectious Pancreatic Necrosis (IPN) occurrence

Current Condition – Good

This disease was present in the Salmon River fishery in the 1950's and 1960's, but has not been detected recently. It continues to be monitored.

Indicator – Yersinia ruckeri (enteric redmouth disease) occurrence

Current Condition – Fair

The disease is present but not common in the Salmon River.

Indicator – Viral Hemorrhagic Septicemia (VHS)

Current Condition – Fair

The virus has been detected in the Great Lakes and nearby Skaneateles Lake, but not yet in the Salmon River.

KEA –Barriers to Migration

Structures such as dams and culverts can inhibit the migration of fish and other aquatic organisms through the watershed. Therefore, some segments of the river system, although suitable for habitat, may not be accessible to organisms that would utilize them.

Indicator – Dam density (#dams/stream mile)

Current Condition – Unranked – greater impairment in lower sub-watersheds

Twenty-four dams are currently known to be present within the watershed; 19 within the lower sub-watersheds, and five within the upper sub-watersheds. Seven sub-watersheds (all above the reservoir) have no impoundments (Figure 25). Migration capacities of aquatic organisms are more impaired by dams at the lower sub-watersheds (average dam density = 0.07/mile) than at the upper sub-watersheds (average = 0.03/mile).

Indicator – Road crossing density (# road crossings/stream mile)

Current Condition – Unranked – greater impairment in lower sub-watersheds

There are 314 road-stream crossings within the entire watershed (Figure 25). Crossings within sub-watersheds range from 6 (Cold Brook) to 46 (Beaverdam Brook-Meadow Creek-Reservoir), and crossing densities range from 0.14/mile (Upper Salmon River) to 0.96/mile (Lower Salmon River – Main Stem). These data suggest that migration capacities of aquatic organisms are more impaired at the lower sub-watersheds (average road crossing density of lower sub-watersheds = 0.72/mile) than at the upper sub-watersheds (average = 0.35/mile).

Indicator – Proportion of 540-ft buffer in natural cover

Current Condition: Upper sub-watersheds, Good; Lower sub-watersheds, Fair-Poor

Naturally-vegetated (i.e., by forest, scrub/shrub, grassland, wetland) buffers provide opportunities for wildlife species to simultaneously utilize upland and wetland habitats within their home ranges, to migrate along water features, and to disperse from wetlands into adjacent upland communities. A buffer analysis (Figure 26) reveals that the vast majority of stream reaches within the upper sub-watersheds are well-buffered by natural vegetation (>90% cover of natural vegetation types) and only one stream reach ranked fair for this indicator (75-90% natural vegetation cover). The majority of stream reaches in the lower sub-watersheds ranked fair or poor (<75% natural cover) with regard to natural vegetation cover in the 540-ft buffers.

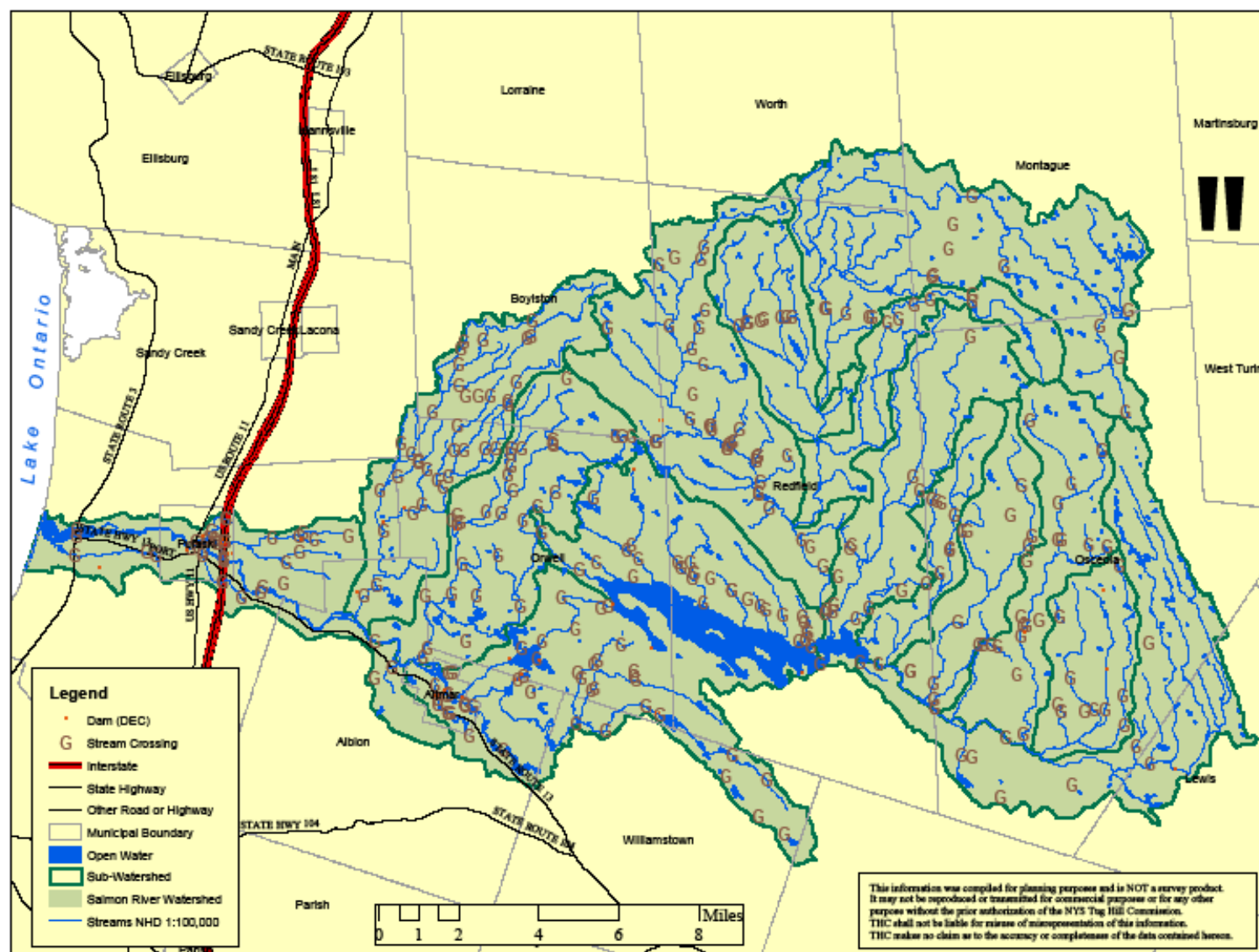


Figure 25. Locations of dams and stream crossings within the Salmon River Watershed.

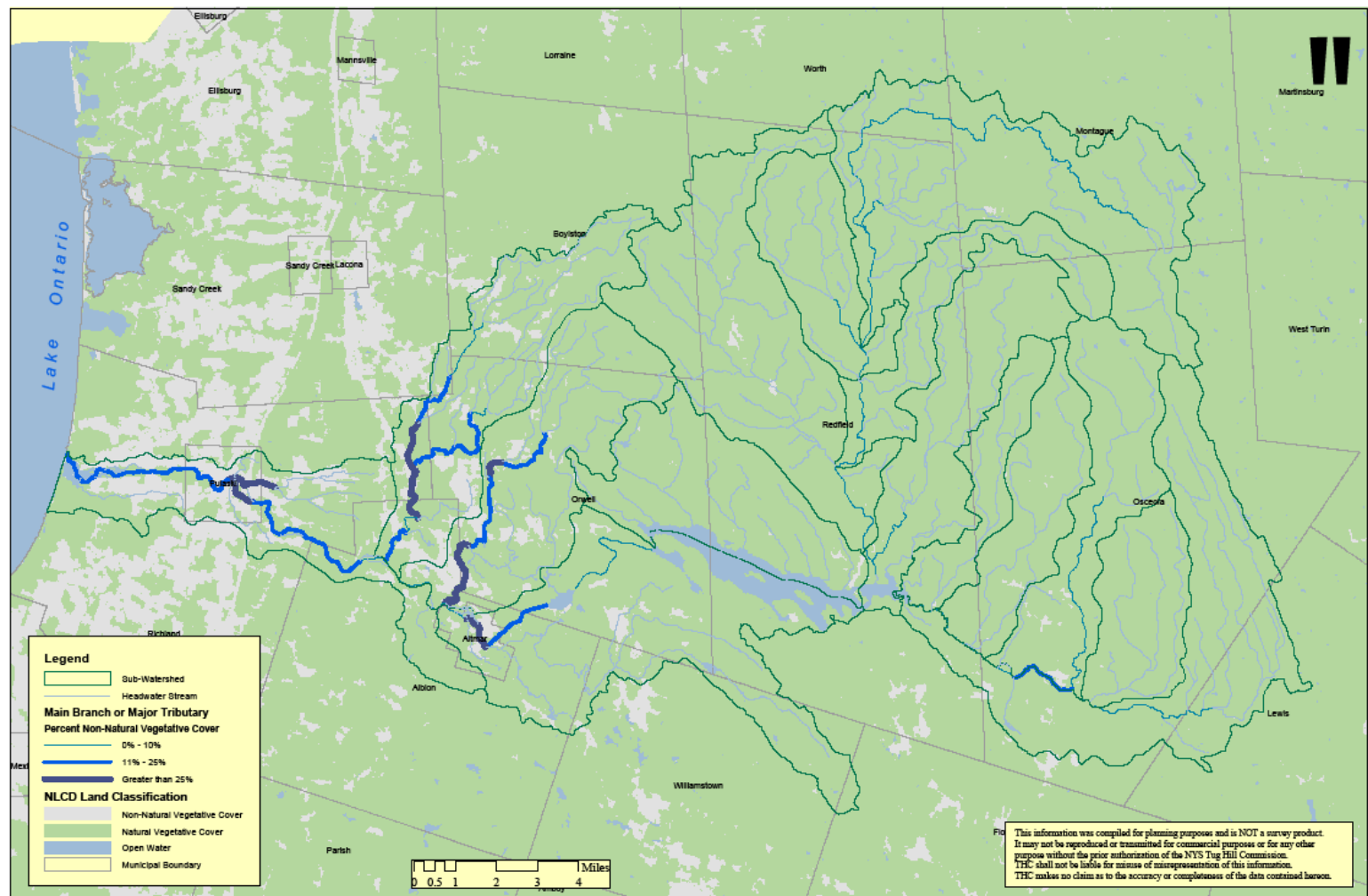


Figure 26. Analysis of land-cover types in 540-ft buffers of the Main Branch of Salmon River and its major tributaries.

Main Branch Salmon River & Major Tributaries Viability Summary

Notes on Guidance for Current Condition:

“NG”	No guidance was obtained to rank this indicator
“SGR”	Subjective guidance and/or ranking based on professional opinion
“ND”	No data are available with which to rank this indicator

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Size						
<i>Ind. - Freq. Salmon River summertime flow <200 cfs</i>		0%	1-50%		Good	SGR, FERC (1996)
KEA-Condition-Water Quality						
<i>Ind. - % natural cover-types within 100-ft buffer</i>		>90	75-90	<25		
<i>upper sub-watersheds</i>					Good	SGR, Klapproth & Johnson (2000), Baird & Wetmore (2006)
<i>lower sub-watersheds</i>					Fair	
<i>Ind. – embeddedness</i>					Unranked	NG, ND
<i>Ind. - summertime high temperatures (°F)</i>		<70		>73		
<i>upper sub-watersheds</i>					Good	Eastern Brook Trout Joint Venture (2005)
<i>lower sub-watersheds</i>					Good-Fair	
<i>Ind. – pH</i>		>6.5	5.0-6.5	<5	Good	Driscoll et al. (2001), Stoddard et al. (2003), Shreiber (2007)
<i>Ind. - alkalinity (mg/L CaCO₃)</i>	>100	2.5-100	0-2.5	<0	Good	Driscoll et al. (2001)
<i>Ind. - dissolved oxygen (mg/L)</i>		>6		<6	Good	Kozuchowski et al. (1994)
<i>Ind. - total phosphorus concentration (mg/L)</i>		<0.01	.01-0.1	>0.1		
<i>upper sub-watersheds</i>					Good	Mueller and Helsel (1996)
<i>lower sub-watersheds</i>					Fair	
<i>Ind. - total nitrogen concentration (mg/L)</i>		<0.35	.35-10	>10	Fair Current	Driscoll et al. (2003)

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Condition-Macroinvertebrate Communities						
<i>Ind. - Richness</i>	>26	19-26	11-18	<11	Excellent	Bode et al. (1997)
<i>Ind. - EPT</i>	>10	6-10	2-5	<2	Excellent	Bode et al. (1997)
<i>Ind. - Hilsenhoff Biotic Index</i>	0-4.50	4.51-6.50	6.51-8.50	8.51-10.0	Excellent	Bode et al. (1997)
<i>Ind. - Percent Model Affinity</i>	>65	50-64	35-49	<35	Excellent	Bode et al. (1997)
KEA-Condition-Fish Communities						
<i>Ind. - observed richness</i>					Unranked	NG
<i>Ind. - predicted richness</i>					Unranked	NG
<i>Ind. – fish species distributions (modeled)</i>						
<i>common species, white sucker & blacknose dace</i>					Unranked	NG
<i>uncommon species, fantail darter & mottled sculpin</i>					Unranked	NG
<i>exotic species, common carp</i>					Unranked	NG
<i>game species, brown trout & brook trout</i>					Unranked	NG
KEA-Condition-Natural Salmonine Reproduction						
<i>Ind. – salmonine spawning habitat</i>						
<i>no. Chinook redds</i>		1900-2900			Good	SGR-Everett (2006)
<i>% substrate acceptable for Chinook redds</i>		15%			Good	SGR-Everett (2006)
<i>Ind. -natural Chinook egg production</i>		15-41 x 10 ⁶			Good	SGR-Everett (2006)
<i>Ind. -rainbow trout recruitment (no. “yr1+” per km)</i>		450-900			Good	SGR-Wildridge (1990)
KEA-Condition-Toxins						
<i>Ind.– game fish mercury concentration (ppm)</i>		0	0-1	>1		
<i>upper sub-watersheds</i>					Poor	NYS Dept. Health (2006)
<i>lower sub-watersheds</i>					Fair	
<i>Ind.– game fish PCB concentration (ppm)</i>						
<i>upper sub-watersheds</i>					Unranked	NYS Dept. Health (2006)
<i>lower sub-watersheds</i>					Poor	
<i>Ind. – PCB-induced mink jaw lesions (ppb)</i>		0	<40	>40		Haynes et al. (2007)
<i>Upper sub-watersheds</i>					Unranked	
<i>Lower sub-watersheds</i>					Poor	

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
<i>Ind.- game fish Mirex concentrations (ppm)</i>						
<i>upper sub-watersheds</i>					Good	NYS Dept. Health (2006)
<i>lower sub-watersheds</i>					Poor	
KEA-Condition-Point Sources of Pollution						
<i>Ind. - NPDES&Toxic Discharge violations last 5 yrs</i>		0	1	>1		SGR
<i>Schoeller</i>					Good	
<i>Pulaski Sewage</i>					Fair	
<i>Pulaski Ford/Mercury</i>					Unranked	
<i>NY Fish Hatchery</i>					Fair	
KEA-Condition-Pathogens						
<i>Ind. - % of population displaying disease symptoms</i>		0	1-5	>5		SGR
<i>Bacterial Kidney Disease occurrence</i>					Fair	
<i>Furnunculosis occurrence</i>					Good	
<i>Infectious Pancreatic Necrosis occurrence</i>					Good	
<i>Yersinia ruckeri occurrence</i>					Fair	
<i>Viral Haemorrhagic Septicaemia occurrence</i>					Fair	
KEA-Landscape Context						
<i>Ind. - no. dam per stream mile</i>					Unranked	NG
<i>Ind. - no. road crossings per stream mile</i>					Unranked	NG
<i>Ind. - % natural cover in 540-ft buffer</i>		>90	75-90	<75		SGR, Semlitsch (1998)
<i>upper sub-watershed</i>					Good	
<i>lower sub-watershed</i>					Faur-Poor	

3. HEADWATERS

KEA - Area

Indicator – Total stream length (mi) and stream density (mi. stream/mi.² area)

Current Condition – Unranked

Total available aquatic habitat within an area can be quantified as total length of stream. This measure is often standardized to a per-unit-area basis (mi. stream/mi.² area). Stream lengths vary with size of watershed considered, and stream density is relatively constant for a given ecoregion, given long-term climatic and hydrologic conditions. Stream densities in the sub-watersheds average 2.1-3.2 mi/mi².

KEA - Water Quality

Indicator - Percent Natural Cover in 100-ft Buffer

Current Condition – Upper sub-watersheds, Good; Lower sub-watersheds, Fair-Poor

Only two headwater stream reaches in the upper sub-watersheds exhibited 75-90% vegetative cover (i.e., forest, scrub/shrub, grassland, wetland), while all others contained >90% cover of natural vegetation (Figure 27). However in the lower sub-watersheds numerous headwater streams had poor (<75% natural cover) to fair (75-90%) levels of natural cover in the 100-ft buffers.

Indicator – Summer time high temperatures

Current Condition – Upper sub-watersheds, Good; Lower sub-watersheds, Fair

No data reporting actual stream temperature measurements are available for the headwaters of the Salmon River watershed or for the greater Tug Hill region. Summertime temperatures are predicted (J. McKenna, unpublished data) to remain below 64 °F for the majority of headwater streams in the upper sub-watersheds. Headwaters of all the lower sub-watersheds (Beaverdam Brook-Meadow Creek-Reservoir, Lower Salmon River-Main Stem, Orwell-Pekin, and Trout Brook) have predicted summertime temperatures ranging from 70-73 °F, which is beyond the optimal range of some cold-water fish species (e.g., brook trout), and approaches their limits of tolerance.

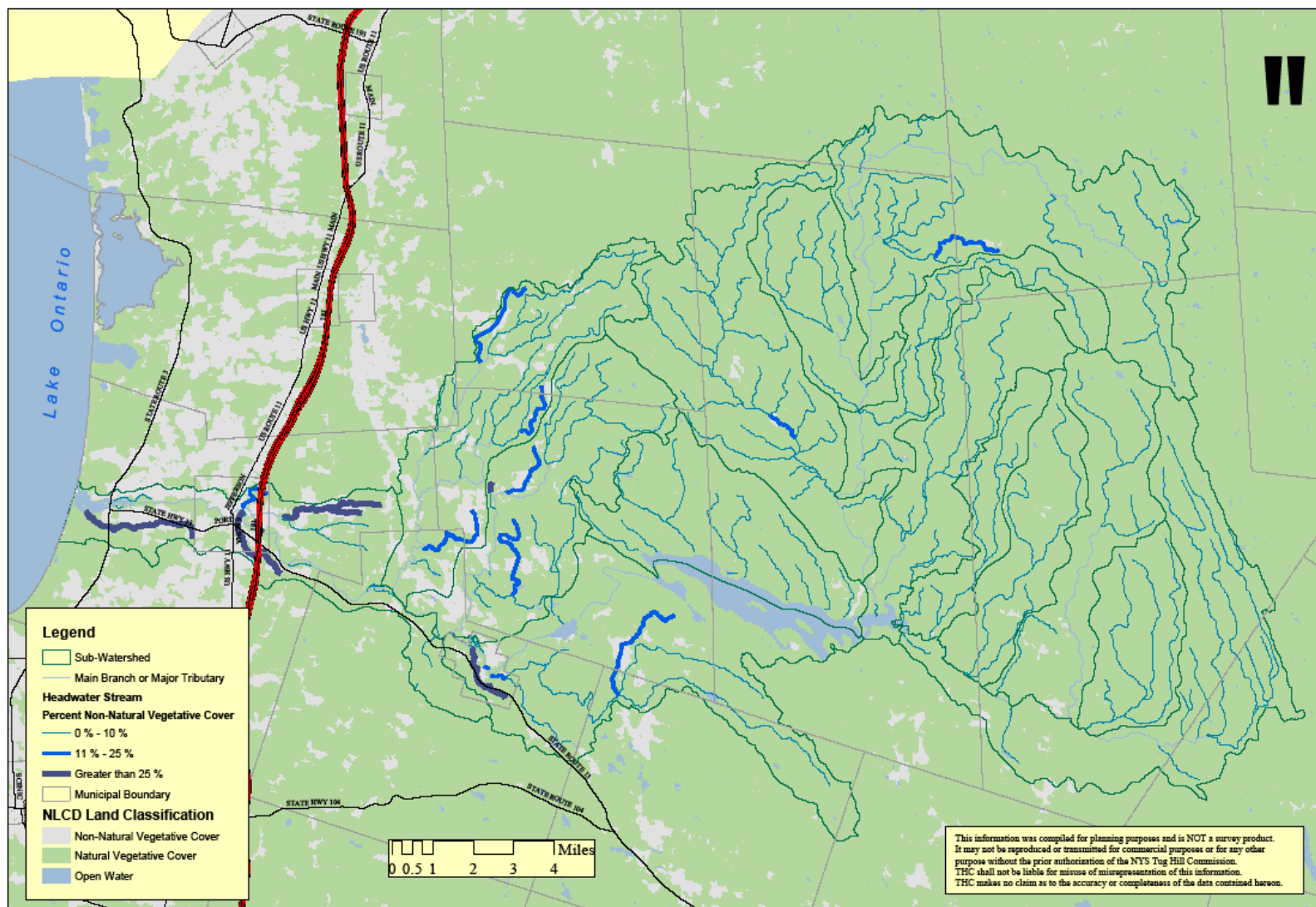


Figure 27. Analysis of land-cover types in 100-ft-wide buffers along headwaters of the Salmon River Watershed.

*Indicator – pH**Current Condition – Upper sub-watersheds, Good; Lower sub-watersheds, Unranked*

No water quality data are available for headwater reaches in the lower sub-watersheds, but based upon the rankings for the main branch target, pH values are probably good for the lower sub-watersheds.

*Indicator – total alkalinity**Current Condition – Upper sub-watersheds, Good; Lower sub-watersheds, Good:*

No water quality data are available for headwater reaches in the lower sub-watersheds, but based upon the rankings for the main branch target, alkalinity values are probably good for the lower sub-watersheds. The headwater streams of the upper sub-watersheds are not currently sensitive to acidification.

*Indicator: dissolved oxygen (mg/L)**Current Condition – Unranked*

No data are available on headwater stream oxygen concentrations within the watershed. Based upon the rankings of the main stem target, it is likely that oxygen concentrations are good within the rocky headwater streams throughout the watershed, but this extrapolation cannot be applied to marsh headwater streams.

*Indicator: phosphate concentration**Current Condition – Upper sub-watersheds, Good; Lower sub-watersheds, Fair*

There are currently no data available with which to rank this indicator for the headwaters of the watershed. However, given the condition of the main branch and major tributaries target, it is likely that phosphorus concentrations in the upper sub-watersheds are good, while those of the lower sub-watersheds are fair.

*Indicator – Nitrogen (N) concentrations**Current Condition – Fair*

No data are available for headwaters of the lower sub-watersheds, but headwater conditions are probably consistent with those of the main branch and major tributaries, which exhibited elevated total N concentrations during summer baseflow periods. Nitrogen concentrations remain well below USEPA drinking water standards.

KEA – Trout Habitat*Indicator – trout habitat**Current Condition – Unranked*

Native trout populations are good indicators of stream quality. Apart from requiring cold to cool water temperatures and high dissolved oxygen concentrations, good trout habitats have (a) abundant cobble and gravel substrate for spawning; (b) fast flow; (c) abundant riffles; (d) abundant coarse woody debris (Hunt et al. 2005); and (e) upwellings of groundwater into gravel substrate for suitable spawning habitat. Hunt et al. (2005) reported that the cobble/gravel substrate, fast flow and riffle habitats occur within rocky headwater stream communities and that these features occurred in all of

the exemplary headwater streams they described, and in approximately 5-10% of the reaches in exemplary marsh headwater streams. No information is available on the range of habitat conditions within the watershed or greater Tug Hill region.

Indicator – trout densities

Current Condition – Unranked

No data were obtained that describe observed densities of brook (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) in the headwaters of the watershed. A GAP analysis (J. McKenna, unpublished) predicts that both trout species occur in headwaters throughout the watershed. When the predicted densities of these species differ within a given headwater reach, brook trout tend to occur in higher densities in the upper sub-watersheds, while brown trout tend to occur in higher densities in the lower sub-watersheds.

KEA – Macroinvertebrate Communities

Indicator – Indices of Biotic Integrity

Current Condition – Unranked

The indices of biotic integrity described in the Main Branch section may be applied to rocky headwater streams only with extreme caution since they were developed for aquatic invertebrate communities inhabiting riffles of streams with gravel/cobble streambeds and moderate velocity (M. Novak, NYSDEC, personal communication). The indices should not be applied to marsh headwater streams.

Indicator – Macroinvertebrate abundance (#/m²)

Current Condition – Unranked

This indicator provides general information regarding the potential ecosystem productivity of stream communities (amount of energy being transferred up the food chain). Headwater streams will typically exhibit lower macroinvertebrate abundance than mid-reach (3rd-4th order) streams. Hunt et al. (2005) reported macroinvertebrate abundances only for headwater streams that they considered exemplary in the Tug Hill region, including sites in the Salmon River watershed. No similar data were obtained for streams of lower sub-watersheds, or for streams representing the range of conditions within the watershed.

Indicator – Macroinvertebrate species richness

Current Condition – Unranked

Species richness is influenced by stream water quality as well as the availability of diverse substrates and energy sources to support a wide range of species. Hunt et al. (2005) reported macroinvertebrate richness only for headwater streams that they considered exemplary in the Tug Hill region, including sites in the Salmon River watershed. No similar data were obtained for streams in the lower sub-watersheds, or for streams representing the range of conditions within the watershed.

KEA – Fur-Bearing Animals*Indicator – beaver and otter population densities**Current Condition - Unranked*

Animals such as beaver and river otters utilize headwater stream habitats. Their respective abundance provides an indicator of habitat quality and food availability within headwaters. The only data available for these species are NYSDEC fur-bearer trapping records, which are assembled on a town-by-town basis. These data cannot be used to estimate populations, and therefore are of limited value for ranking this indicator. These data indicate increasing levels of trapped beaver between 1960 and the mid-1980s. A recent leveling of the beaver trend may reflect real population dynamics or the influence of market forces on trapping effort. These data also indicate a slight increase in the number of trapped otter throughout the period of the record.

KEA – Barriers to Migration

Structures such as dams and culverts can inhibit the migration of fish and other aquatic organisms through the watershed. Therefore, some segments of the river system, although suitable for habitat, may not be accessible to organisms that would utilize them.

*Indicator – Dam density (#dams/stream mile)**Current Condition – Unranked – greater impairment in lower sub-watersheds*

Twenty-four dams are currently known to be present within the watershed; 19 within the lower sub-watersheds, and five within the upper sub-watersheds. Seven sub-watersheds (all above the reservoir) have no impoundments (Figure 25). Migration capacities of aquatic organisms are more impaired by dams at the lower sub-watersheds (average dam density = 0.07/mile) than at the upper sub-watersheds (average = 0.03/mile).

*Indicator – Road crossing density (# road crossings/stream mile)**Current Condition – Unranked – greater impairment in lower sub-watersheds*

There are 314 road-stream crossings within the entire watershed (Figure 25). Crossings within sub-watersheds range from 6 (Cold Brook) to 46 (Beaverdam Brook-Meadow Creek-Reservoir), and crossing densities range from 0.14/mile (Upper Salmon River) to 0.96/mile (Lower Salmon River – Main Stem). These data suggest that migration capacities of aquatic organisms are more impaired at the lower sub-watersheds (average road crossing density of lower sub-watersheds = 0.72/mile) than at the upper sub-watersheds (average = 0.35/mile).

*Indicator – Proportion of 540-ft buffer in natural cover**Current Condition – Upper sub-watersheds, Good; Lower sub-watersheds, Fair-Poor*

The vast majority of headwater stream reaches within the upper sub-watersheds are well-buffered by natural vegetation (>90% cover of forest, scrub/shrub, grassland, wetland). Three stream reaches ranked fair for this indicator (75-90% natural vegetation cover) and one was ranked as poor (<75% natural cover). In the lower sub-watersheds, 29 headwater stream segments received a ranking of fair (18) or poor (11) with regard to the natural vegetation cover in the 540-ft buffers (Figure 28).

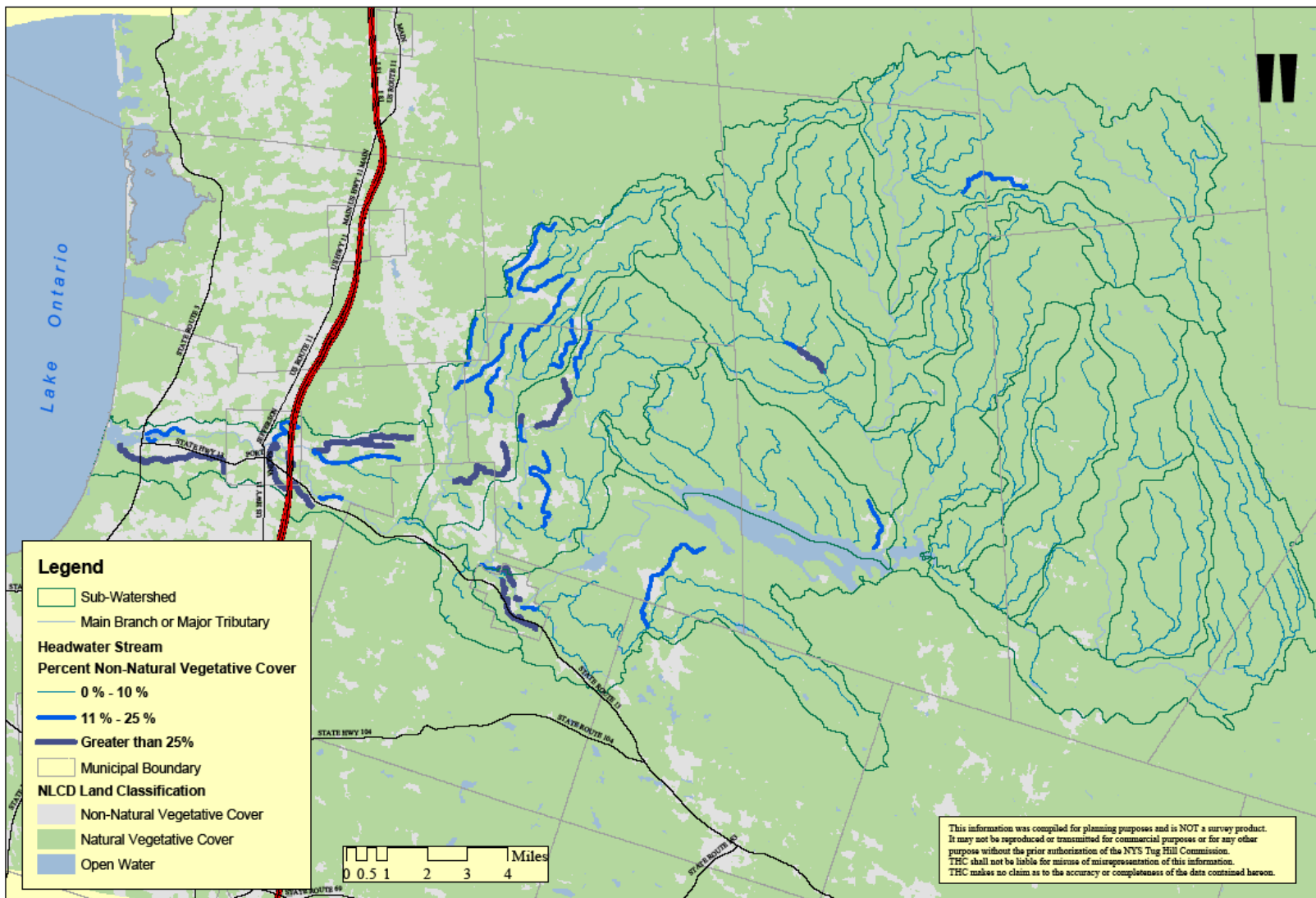


Figure 28. Analysis of land-cover types in 540-ft-wide buffers of headwater streams (1st- and 2nd-order) of the Salmon River Watershed.

Headwaters Viability Summary

Notes on Guidance for Current Condition:

“NG”	No guidance was obtained to rank this indicator
“SGR”	Subjective guidance and/or ranking based on professional opinion
“ND”	No data are available with which to rank this indicator

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Size						
<i>Ind. - stream density (stream mi / mi²)</i>					Unranked	NG
KEA-Condition-Water Quality						
<i>Ind. - % natural cover types within 100-ft buffer</i>		>90	75-90	<75		
<i>upper su-bwatersheds</i>					Good	SGR, Klapproth & Johnson (2000), Baird & Wetmore (2006)
<i>lower sub-watersheds</i>					Fair-Poor	
<i>Indi. - summertime high water temperature (°F)</i>		<65	72	>72		
<i>upper sub-watersheds (predicted)</i>					Good	Eastern Brook Trout Joint Venture (2005)
<i>lower sub-watersheds (predicted)</i>					Fair	
<i>Ind. – pH</i>		>6.5	5.0-6.5	<5		
<i>upper sub-watersheds</i>					Good	Driscoll et al. (2001), Stoddard et al. (2003), Shreiber (2007)
<i>lower sub-watersheds</i>					Unranked	
<i>Ind. - alkalinity (mg/L CaCO₃)</i>	>100	2.5-100	0-2.5	<0		
<i>upper sub-watersheds</i>					Good	Driscoll et al. (2001); lower sub-watersheds, ND - extrapolated from main branch target
<i>lower sub-watersheds</i>					Good	

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
<i>Ind. - dissolved oxygen (mg/L)</i>		>6		<6	Unranked	ND, Kozuchowski et al. (1994)
<i>Ind. - total phosphorus concentration (mg/L)</i>		<0.01	.01-.1	>0.1	Good	Mueller & Helsel (1996) ND, ranking extrapolated from main branch target
<i>upper sub-watersheds</i>					Fair	ND, ranking extrapolated from main branch target
<i>lower sub-watersheds</i>						
<i>Ind. - total nitrogen concentration (mg/L)</i>		<0.35	.35-10	>10	Fair	Vitousek et al. (1997), Driscoll et al. (2003)
<i>upper sub-watersheds</i>					Fair	ND, ranking extrapolated from main branch target
<i>lower sub-watersheds</i>						
KEA-Condition-Trout Habitat						
<i>Ind. - gravel substrate</i>					Unranked	NG, ND, Hunt et al. (2005)
<i>Ind. - stream flow</i>					Unranked	NG, ND, Hunt et al. (2005)
<i>Ind. - riffle habitat</i>					Unranked	NG, ND, Hunt et al. (2005)
<i>Ind. - coarse woody debris</i>					Unranked	NG, ND, Hunt et al. (2005)
<i>Ind. - groundwater discharge (ml/m²/min)</i>		1200	100		Unranked	ND, Brabrand et al. (2002)
<i>Ind. - trout densities (observed or predicted)</i>					Unranked	NG, ND

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Condition-Macroinvertebrate Communities						
<i>Ind. - Richness</i>	>26	19-26	11-18	<11	Unranked	ND, Bode et al. (1997) <i>Note: indices developed for mid-reach streams and should not be applied to marsh headwaters</i>
<i>Ind. - EPT</i>	>10	6-10	2-5	<2	Unranked	
<i>Ind. - Hilsenhoff Biotic Index</i>	0-4.50	4.51-6.50	6.51-8.50	8.51-10.0	Unranked	
<i>Ind. - Percent Model Affinity</i>	>65	50-64	35-49	<35	Unranked	
<i>Ind. - macroinvertebrate abundance (#/m2)</i>	1600-1800				Unranked	ND, Hunt et al. (2005)
<i>Ind. – macroinvertebrate species richness</i>					Unranked	ND, Hunt et al. (2005)
KEA - Condition - Furbearer Populations						
<i>Ind. - NYSDEC trapping reports (#/town/yr)</i>						NG
<i>beaver</i>					Unranked	
<i>otter</i>					Unranked	

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Landscape Context						
<i>Ind. - no. dams/stream mile</i>					Unranked	NG
<i>Ind. - no. road crossings/stream mile</i>					Unranked	NG
<i>Ind. - % natural cover in 540-ft buffer</i>		>90	75-90	<75		SGR, Semlitsch (1998)
<i>upper sub-watersheds</i>					Good	
<i>lower sub-watersheds</i>					Fair-Poor	

4. OPEN WATERS

KEA-Area

Indicator – Open Water Area (acres)

Current Condition – Good

The components of total open water area in the watershed that are most subject to change are the numerous, small beaver dams that exist there. Surface areas of the larger open waters, the Lighthouse Hill and Redfield Reservoirs, will remain constant due to regulation of these reservoirs. No historic estimation of open water exists for the watershed, and this was probably a dynamic level that fluctuated with local cycles in beaver populations. Beaver have recovered across northern New York from historic lows in the 19th century (Brocke and Zarnetske 1974). Therefore, open water area is now probably near expected natural levels, at least in some sub-watersheds.

There are currently ~450 open water bodies in the watershed that occupy ~4,300 acres. Note that open water areas are underestimated for the Beaverdam Brook-Meadow Creek, Keese-Smith-Finnegan, Fall Brook-Twomile-Threemile and Upper Salmon River sub-watersheds due to incomplete NWI data. Sixty-five percent of the total open waters in the watershed are accounted for by the 2,660-acre Redfield Reservoir and 150-acre Lighthouse Hill Reservoir. Of these non-reservoir water bodies, 92% are smaller than 10 acres (accounting for 45% of the total open water area). Three water bodies (accounting for <1% of the total number and 18% of the total area) are greater than 100 acres in size.

KEA – Beaver Dams

Indicator – Proportion of total open waters as beaver-influenced:

Current Condition - Unranked

Beaver (*Castor canadensis*) are recognized as important ecosystem “engineers” whose presence and activities contribute to maintaining diverse and variable natural communities. Figure 29 illustrates the beaver-influenced open waters of the watershed. No guidance is available for estimating expected, natural beaver populations in the watershed or areas of wetlands within the watershed expected to be influenced by beaver activities. Approximately 11% of the watershed’s water body area is influenced by beaver, with beaver influence ranging from 0 (Lower Salmon River sub-watershed) to 28% (Beaver-Gilmore-Willow-McDougal sub-watershed).

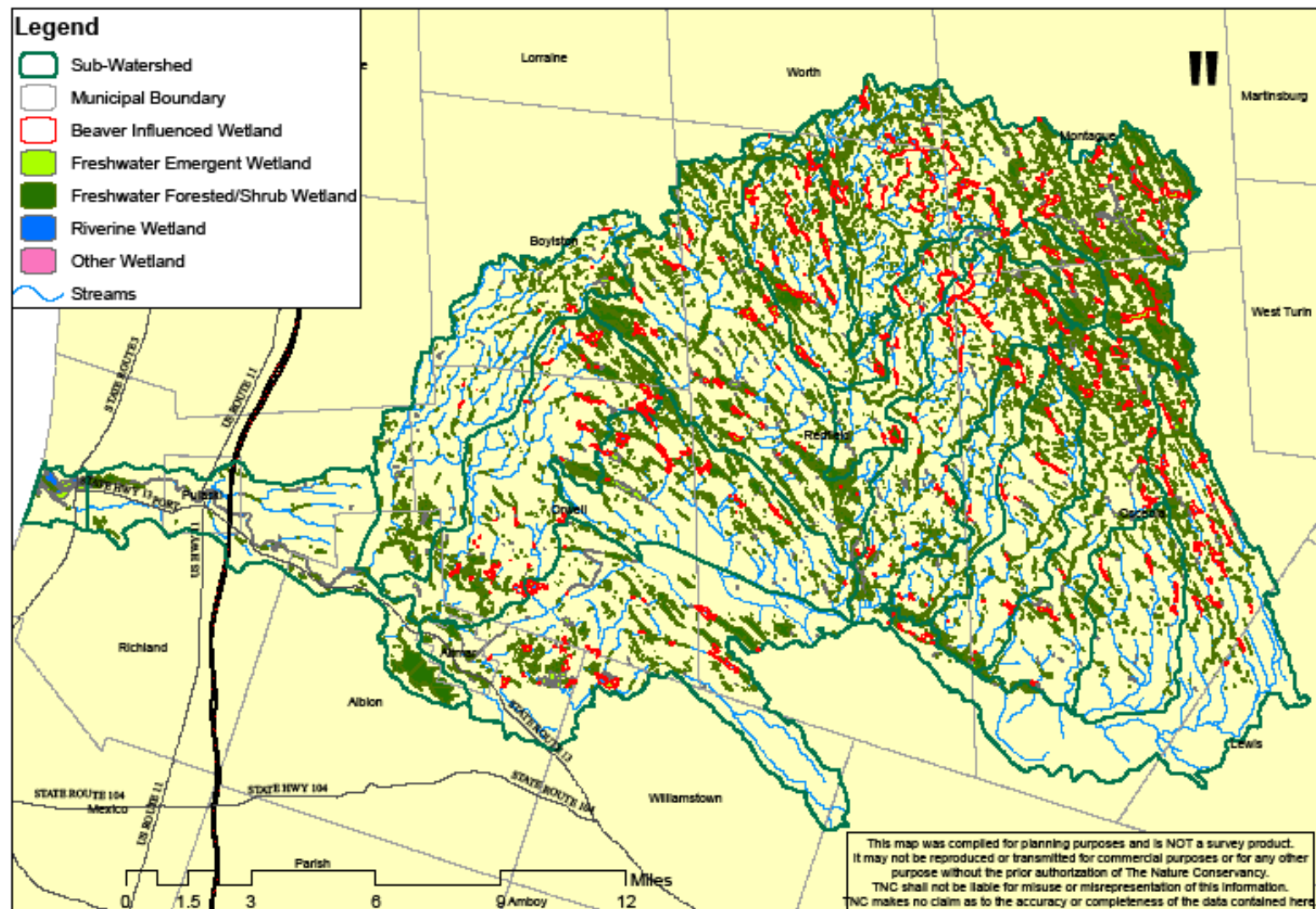


Figure 29. Beaver-influenced wetlands of the Salmon River Watershed.

KEA – Water Quality

Indicator - Percent Natural Vegetation in 100-ft-wide Buffer

Current Condition – Lighthouse Hill Reservoir, Good; Redfield Reservoir, Good

This indicator is ranked here only for the two reservoirs. Buffer analysis for the other open waters is incorporated in the non-estuarine wetland section. Natural vegetation (i.e., forest, scrub/shrub, grassland, wetland) represents 91% and 98% of the land-cover types within the 100-ft buffers of the Lighthouse Hill and Redfield reservoirs, respectively (Figure 30).

Indicator – pH

Current Condition – Good

The NYSDEC (Bureau of Fisheries, unpublished data) reports the pH of the Redfield Reservoir in June 2003 to be 7.0 (neutral). No information is available for pH of the watershed's other open waters, but their pH probably does not vary greatly from the other surface waters in the watershed.

Indicator – total alkalinity

Current Condition – Good

The NYSDEC (Bureau of Fisheries, unpublished data) reports total alkalinity of the Redfield Reservoir in June 2003 to be 68.4 mg/L CaCO₃. No information is available for alkalinity of the watershed's other open waters, but their alkalinities probably do not vary greatly from the other surface waters in the watershed.

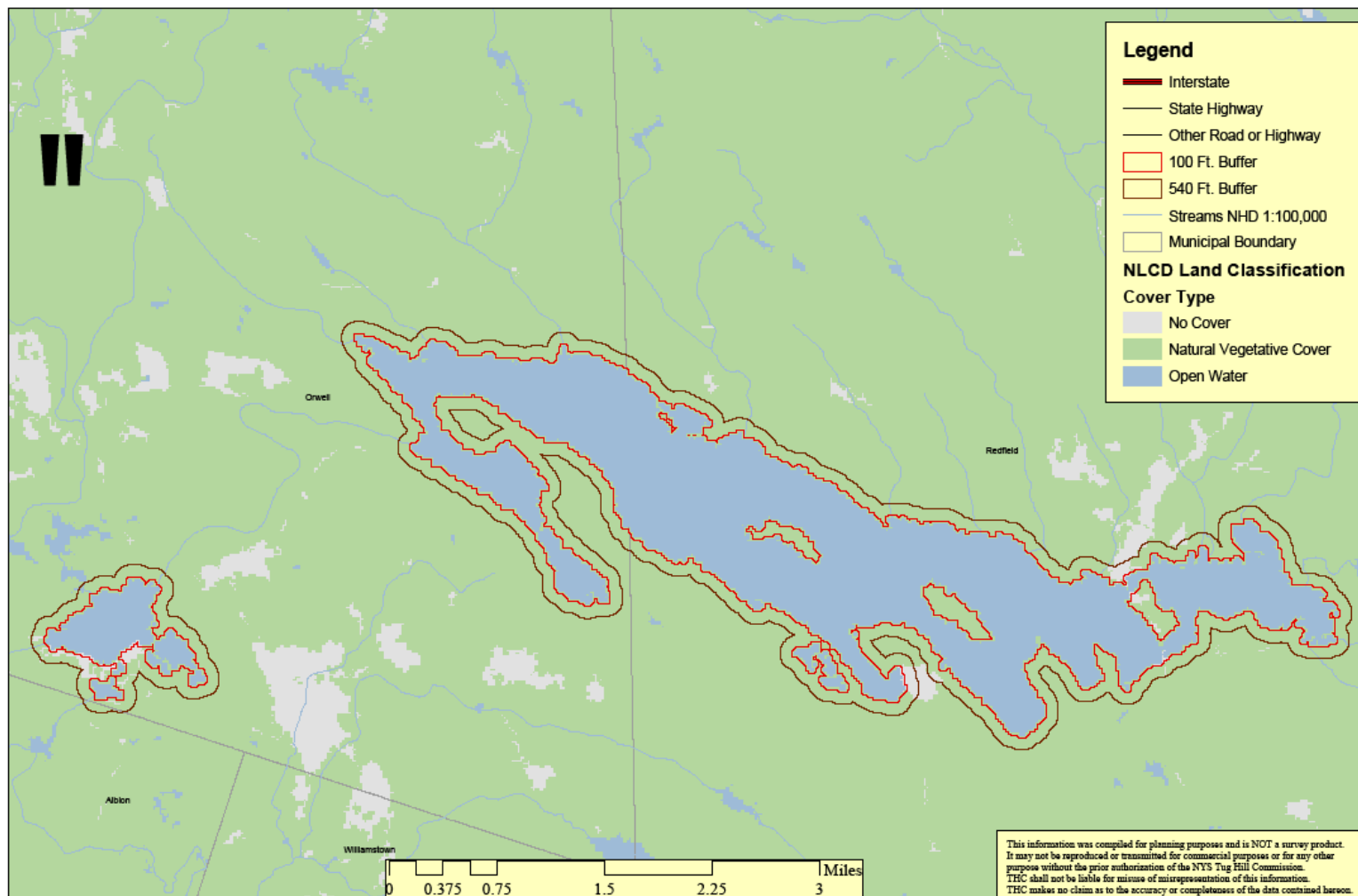


Figure 30. Analysis of land cover-types in 100- and 540-ft-wide buffers of the Lighthouse Hill and Redfield Reservoirs.

KEA – Toxins*Indicator – Game Fish Tissue Mercury Concentration**Current Condition – Redfield Reservoir, Poor*

See page 56 for background on mercury. In 2006 the NYSDEC listed the Redfield Reservoir as a Section 303(d) Impaired Water due to mercury contamination in some game fish (NYSDOH 2006). It is likely that that mercury is being liberated from the reservoir sediments due to effects of fluctuating water levels on sediment chemistry (Evers et al. 2007).

Current Condition – Upper Sub-watersheds – Unranked

The mercury in the Reservoir is not expected to affect other water bodies upstream. However, it is possible that mercury may be liberated from the extensive wetland systems, including small open waters, in the upper sub-watersheds due to similar interactions of fluctuating water chemistry on mercury liberation from sediments (Evers et al. 2007). No information is available on mercury contamination for other open water bodies of the upper watershed.

Current Condition – Lower Sub-watersheds – Fair

Mercury is present in game fish below the dam, but no fish consumption advisories are currently in effect for mercury below the reservoir. It is not known whether mercury advisories are appropriately applied to other open water bodies in the lower watershed.

*Indicator – Game Fish Tissue and Snapping Turtle Egg PCB Concentrations**Current Condition – Upper Sub-watersheds, Unranked*

See page 57 for background on PCB. No information is available on PCB concentration in game fish above the Redfield Reservoir. There is currently no PCB fish consumption advisory for the Reservoir (NYSDOH 2006). No information is available on snapping turtle eggs in sections of watersheds that are isolated from Lake Ontario.

Current Condition – Lower Sub-watersheds, Poor to Fair

There is currently a fish consumption advisory for PCBs in smallmouth bass taken from the Salmon River from the mouth to the Reservoir (NYSDOH 2006). It is not known whether PCB advisories are appropriately applied to other open water bodies in the lower watershed. Snapping turtle egg criteria, (Pagano et al. (1999) indicate the presence of PCBs in aquatic systems linked to Lake Ontario.

*Indicator – Game Fish Tissue and Snapping Turtle Egg Mirex Concentrations:**Current Condition – Upper Sub-watersheds, Good*

See pag 57 for background on Myrex. Data made available by NYSDEC (J. Skinner, unpublished data) indicate that Mirex concentrations in fish taken above the Salmon River reservoir were below detection limits in 1988. Given that Mirex has shown a declining trend in the environment over the last few decades (J. Skinner, personal communication), and that Mirex appears to originate from sources in the Great Lakes, it is not believed that Mirex poses a threat to water bodies above the Lighthouse Hill Reservoir.

Current Condition – Lower Sub-watersheds, Poor

There is currently a fish consumption advisory for Mirex in smallmouth bass taken from the Salmon River from the mouth to the Reservoir (NYSDOH 2006). It is not

known whether fish consumption advisories for Mirex are appropriately applied to other open water bodies in the lower watershed.

KEA – Aquatic Plant Communities

Plant and algal communities will vary among the lakes and ponds of the watershed based upon water depth and trophic status of the water bodies. Guidance regarding the expected communities in small ponds of the region has not been obtained. The following considerations apply to the Redfield Reservoir.

Indicator – Total Macrophyte Cover

Current Condition – Good

No information on the anticipated natural range of variation in aquatic vegetation of the Redfield Reservoir could be located to serve as a quantitative baseline for estimating viability. Harman et al. (2000) reported that most of the shoreline is emergent or shrub wetland, and that the lake supports little true aquatic vegetation. The submerged plants are diverse, but are few within the reservoir. An earlier survey by (Petreszyn 1990) indicated the presence of no aquatic plants in the reservoir in 1990.

Indicator – Invasive Species Cover

Current Condition – Good to Fair

Two potentially invasive macrophyte species (purple loosestrife and Eurasian milfoil), were observed in the Reservoir in 1999 (Harman et al. 2000), in low relative abundance. Milfoil was not thought to be a threat since it tends to occur in disturbed, eutrophic environments.

KEA – Fish Communities

Indicator – Fish Species Richness and Community Composition

Current Condition - Good

No information is available on fish communities inhabiting the smaller ponds of the watershed; the following information is specific to the Redfield and Lighthouse Hill Reservoirs. The Redfield Reservoir is a warm/cool water fishery that is managed by NYSDEC for game fish species. The reservoir currently contains at least 16 species, including six game fish species. Stocking for walleye began in the reservoir in 2005. Tributaries to the reservoir are stocked with rainbow and brook trout. Bass were introduced in 1960s and these have flourished without additional stocking (F. Verdoliva, personal communication). NYSDEC fisheries managers believe the Redfield Reservoir fishery to be in good condition. The Lighthouse Hill Reservoir is managed as a cool water fishery, and is stocked with rainbow trout (~4000/yr). It was previously stocked with brown trout until 1991 (F. Verdoliva personal communication).

KEA – Barriers to Migration

Indicator – Proportion of Natural Vegetation Cover in 540-ft Buffer

Current Condition – Lighthouse Hill Reservoir, Fair; Redfield Reservoir, Good

Figure 30 illustrates land-cover types surrounding the Lighthouse Hill and Redfield Reservoirs. Natural vegetation represents 87% and 98% of the land-cover types within the 540-ft buffers of the Lighthouse Hill and Redfield reservoirs, respectively.

Open Waters Viability Summary

Notes on Guidance for Current Condition:

- “NG” No guidance was obtained to rank this indicator
 “SGR” Subjective guidance and/or ranking based on professional opinion
 “ND” No data are available with which to rank this indicator

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Size <i>Ind. -% of total current open waters (excluding reservoirs)</i>		>90	75-90	<75	Good	SGR
KEA - Condition - Beaver Dams <i>Ind. - % open waters beaver-influenced</i>					Unranked	NG
KEA-Condition-Water Quality <i>Ind. - % of 100-ft buffer in natural cover types</i> <i>Redfield Reservoir</i> <i>Lighthouse Hill Reservoir</i>		>90	75-90	<75	Good Good	SGR, Klapproth & Johnson (2000), Baird & Wetmore (2006)
<i>Ind. – pH</i> <i>Redfield Reservoir</i> <i>other open waters</i>		>6.5	5.0-6.5	<5	Good Good	Driscoll et al. (2001), Stoddard et al. (2003), Shreiber (2007) extrapolated from headwaters

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
<i>Ind. - alkalinity (mg/L CaCO₃)</i>	>100	2.5-100	0-2.5	<0		Driscoll et al. (2001)
<i>reservoirs</i>					Good	
<i>other open waters</i>					Good	extrapolated from headwaters
KEA-Condition-Toxins						
<i>Ind.- game fish mercury concentration (ppm)</i>			0-1	>1		NYSDOH (2006) fish consumption advisories
<i>Redfield Reservoir</i>					Poor	
<i>upper sub-watersheds</i>					Unranked	
<i>lower sub-watersheds</i>					Fair	
<i>Ind.- game fish PCB concentration</i>						NYSDOH (2006) fish consumption advisories
<i>upper sub-watersheds</i>					Unranked	
<i>lower sub-watersheds</i>					Poor	
<i>Ind.- snapping turtle egg PCB concentrations</i>		0	0-2	>2		Pagano et al. (1999)
<i>upper sub-watersheds</i>					Unranked	
<i>lower sub-watersheds</i>					Poor-Fair	
<i>Ind.- game fish Mirex concentrations (ppm)</i>						NYSDOH (2006) fish consumption advisories
<i>upper sub-watersheds</i>					Good	
<i>lower sub-watersheds</i>					Poor	
<i>Ind.- snapping turtle egg Mirex concentrations</i>		0	0-0.2	>0.2		Pagano et al. (1999)
<i>upper sub-watersheds</i>					Good	
<i>lower sub-watersheds</i>					Fair	

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Condition-Aquatic Plant Communities						
<i>Ind. - macrophyte percent cover (for Redfield Reservoir)</i>					Good	SGR, Harman et al. (2000)
<i>Ind. - Invasive plant cover (avg % cover – Redfield Reservoir)</i>	0	<5	5-25	>25	Good-Fair	Drake et al. (2003)
KEA-Condition-Fish Communities						
<i>Ind. - Observed Richness (Redfield Reservoir)</i>					>16 Good	SGR
KEA-Landscape Context-Barriers to Migration						
<i>Ind. - % of 540-ft buffer in natural cover types</i>		>90	75-90	<75	Good	SGR
<i>Redfield Reservoir</i>					Fair	SGR
<i>Lighthouse Hill Reservoir</i>						

5. NON-ESTUARINE WETLANDS

KEA - Wetland Area

Indicator – Total Wetland Surface Area (ac)

Current Condition – Unranked

The ability of wetland systems to provide ecosystem services is related to both area of wetlands (i.e. habitat) and the proportion of land area occupied by wetlands (i.e. nutrient retention and water regulation). Total palustrine (excluding lakes and ponds) wetland area within the watershed is approximately 29,000 acres (Table 2). Note that this estimate includes only NYSDEC Regulated Wetlands, which are ≥ 12.4 acres, and the US Fish and Wildlife Service National Wetlands Inventory (NWI), which is derived from air photo analysis. Both data sources likely under-represent total wetland area because the smallest wetlands are not included or detected. It should also be noted that no digital NWI data were available for portions of the Beaverdam Brook-Meadow Creek-Reservoir, Fall Brook-Twomile-Threemile, Keese-Smith-Finnegan, and Upper Salmon River sub-watersheds. Therefore, reported areas are underestimated for these sub-watersheds.

The total 29,000 acres of wetland within the watershed represents approximately 16% of the watershed's land base. Forested and scrub/shrub wetlands consistently are the most abundant wetland category in all sub-watersheds. For those sub-watersheds with complete data, wetland coverage ranged from 23% (Mad River drainage) to 8% (Trout Brook drainage). It is possible that some wetlands were drained for agriculture in the lower sub-watersheds and that those losses persist (e.g., in the Trout Brook sub-watershed, which has 8% wetland area, and is among the most heavily farmed, see Figure 8). If wetlands were originally drained for agriculture in the upper sub-watersheds it is likely that sufficient time has passed to permit wetland hydrology and vegetation in impacted areas to return to natural conditions since the wide-scale abandonment of agriculture around the turn of the 20th century. Given the lack of development pressures in the upper sub-watersheds, it is not believed that wetland losses to development have been great there.

KEA –Wetland Community Types

A number of wetland community types are known to occur within the Salmon River watershed. Type descriptions are provided by Edinger et al. (2002), and detailed descriptions of exemplary occurrences within the watershed are provided by Howard (2006). Species composition has also been documented in some wetlands of the Salmon River Corridor (A. Nelson, in Dru Associates 2001).

Recognized wetland community types within the watershed, along with their NY Heritage rankings are:

- Black spruce – tamarack bog (G4G5 S3)
- Floodplain forest (G3G4 S2S3)

- Hemlock-hardwood swamp (G4G5 S4):
- Red maple – hardwood swamp (G5 S4S5)
- Spruce-fir swamp (G3G4 S3):
- Vernal Pool (G4 S3S4):
- Dwarf Shrub Bog (G4 S3):
- Inland poor fen (G4 S3):
- Shrub swamp (G5 S5):
- Sedge meadow (G5 S4):
- Shallow emergent marsh (G5 S5):

Indicator – Area (ac) of Wetland Community Type

Current Condition – Unranked

There is currently no accurate quantitative estimation for the amount of different wetland community types, or for the historic abundance of these community types in the watershed.

KEA – Invasive Species

Indicator – Frequency of Invasive Plant Occurrence in Wetlands

Current Condition – Good

There are currently no monitoring efforts for invasive plant species in the watershed, so no quantitative data are available with which to rank this indicator. However, several local wetland scientists agree that there is a remarkable lack of invasive plant species in the wetlands they have visited in the watershed. Species such as purple loosestrife and *Phragmites* tend to occur at lower elevations, and glossy buckthorn (*Rhamnus frangula*) has been observed in some peatlands.

KEA – Rare Species Populations

Several species of concern are known to inhabit wetland communities within the watershed. Species reported by Howard (2006) along with their NY Natural Heritage rankings are:

- Jacob's-ladder (*Polemonium vanbruntiae*) – G3G4 S3
- Lesser bladderwort (*Utricularia minor*) – G5 S3
- Pied-billed grebe (*Podilymbus podiceps*) – G5 S3B,S1N
- Pitcher plant borer moth (*Papaipema appassionata*) – G4 SU (unknown)

The following viability ratings are based upon NY Natural Heritage reports of known occurrences within the watershed. Element distribution models for predicting additional occurrences of these species have been developed but require verification.

Indicator – Jacob's-ladder Population Density

Current Condition – Excellent

The New York Natural Heritage program rated the occurrence of this plant in the town of Montague as excellent (Howard 2006). This report indicated thousands of plants in an 8-acre site.

*Indicator – Lesser Bladderwort Population Density**Current Condition - Fair*

The New York Natural Heritage program rated the occurrence of this plant in the town of Albion as fair (Howard 2006). This report indicated a small colony in a 1-acre, undisturbed area.

*Indicator – Pied-billed Grebe Occurrence**Current Condition – Fair to Poor*

The New York Natural Heritage (Howard 2006) program reported the sighting in 2005 of one territorial male in a marsh in Orwell.

*Indicator – Pitcher Plant Borer Moth Occurrence**Current Condition - Excellent*

The New York Natural Heritage program reported the occurrence of 40 acres of required habitat at a bog in Albion (Howard 2006).

KEA – Pests and Pathogens

There are few pests and pathogens of concern currently influencing wetland community composition in the watershed.

*Indicator – Viburnum Leaf Beetle Occurrence**Current Condition – Poor*

The viburnum leaf beetle (*Pyrrhalta viburni*) is native to most areas of Europe and was first observed in Ontario in 1947 and in New York in 1996. No quantitative data exist for viburnum beetle infestations in the watershed, however local botanists have reported recent widespread defoliation and mortality of arrow-wood (a host species) throughout the Tug Hill region.

KEA- Sentinel Groups (Migratory Birds, Amphibians)

Certain groups, or guilds, of wildlife require wetlands for some aspects of their life histories, and therefore the populations of these groups may serve as “sentinels” of wetland viability in the watershed.

*Indicator – Amphibian and Reptile Densities and/or Frequencies**Current Condition – Good*

There are no sources of data specific to the watershed indicating expected abundance of amphibians and reptiles in different wetland types. The New York Amphibian and Reptile Atlas database (NYSDEC 2007a) lists presence/absence of species throughout the state, and can coarsely infer frequency of species occurrence. Twenty-six amphibian and reptile species that utilize wetlands, and that are distributed equitably throughout New York (i.e., no regional patterns of distribution), occur in the Salmon River watershed. Of these, 24 species (92%) occur with equal or greater frequency in the watershed than the whole of New York.

*Indicator – Numbers of Breeding or Migratory Waterfowl**Current Condition – Unranked*

No quantitative data exist for migratory waterfowl use of wetlands within the watershed or in the NYSDEC wildlife management units of the greater Tug Hill region.

KEA – Hydrology

Different wetland types develop through variations in quantity and quality of surface and groundwater flow. Within a given wetland complex, diversity of community types reflects, in part, the combinations and location of water sources feeding the system (Drexler and Bedford 2002). Hydrologic alterations that would negatively influence wetland community occurrence include declines in surface water flow; ditching or tiling of wetland areas; breaching of impoundments; filling of wetlands above prevailing surface water or groundwater levels; and lowering of groundwater levels.

*Indicator – Regional Annual Water Surplus (inches)**Current Condition – Good*

The abundance of wetlands in the greater Tug Hill region is due, in large part, to the high levels of precipitation that sustain wetland hydrology. Deviations in annual water surplus from natural levels of variation would indicate potential for region-wide disruptions of wetland hydrology.

Current average water surplus values sustain widespread and diverse wetlands within the watershed. No data were obtained with which to analyze the historic range of variation in these levels for the region.

*Indicator – Source Alteration (% from Groundwater and Surface Water)**Current Condition – Unranked*

The source and quality of water supply to individual wetland systems dictates wetland community type and condition. A group of local wetland scientists suggested that no reliable information currently exists to accurately characterize the distribution of respective wetland types within the watershed, and therefore, to infer localized hydrologic regimes that support those wetlands.

KEA – Toxins*Indicator – Game Fish Tissue Mercury Concentrations**Current Condition – Upper Sub-watersheds, Unranked; Lower Sub-watersheds, Fair*

See page 56 for background on mercury contamination. In 2006 the NYSDEC listed the Redfield Reservoir as a Section 303(d) Impaired Water due to mercury contamination in some fish (NYSDOH 2006). It is likely that the mercury source for the reservoir is internal loading from sediments due to water fluctuations. Mercury is liberated from soils and sediments in the toxic methyl form under conditions that are common in wetlands (Evers et al. 2007). Given the extensive wetland systems within

the watershed, it is possible that mercury contamination may be problematic here. No other information exists with which to rank this indicator for upper sub-watersheds.

Elevated mercury levels are known to occur in fish in the lower Salmon River, but currently there are no fish consumption advisories for mercury in fish taken from the lower Salmon River (NYSDOH 2006). It is possible that the sources of mercury contamination in fish of the lower watershed also impact other wetland fauna due to migrations of salmonines.

Indicator - PCB tissue concentration in snapping turtle eggs

Current Condition – Upper Sub-watersheds, Unranked; Lower Sub-watersheds, Fair

See page 57 for background on PCBs. There are no data available for snapping turtle PCB concentrations in the watershed. The regional source for PCB contamination of turtle eggs is believed to be Lake Ontario, with migratory salmonines serving to disperse PCBs when they move inland from the lake. Therefore, sub-watersheds above the Lighthouse Hill Reservoir are isolated from this source. PCB concentrations in sport fish are known to be lower in the Redfield Reservoir compared to the lower reaches of the Salmon River. Therefore, it is probable that PCB concentrations in wetland fauna will be lower in the upper sub-watersheds than in the lower sub-watersheds.

Indicator – PCB-induced mink jaw lesions

Current Condition – Lower sub-watersheds, Poor; Upper sub-watersheds, Unranked:

There are no data available on the occurrence of cancerous lesions in mink for the Salmon River watershed. However, based upon the work of Beckett and Haynes (2007) mink feeding within the Lake Ontario system near Rochester appear to be exposed to sufficiently high PCB concentrations to induce growth of lesions in jaw tissue (40 ppb), and this exposure is apparently from food sources exposed to contaminated water in Lake Ontario. No data are available that suggest exposure of mink to PCB concentrations sufficiently high to cause cancerous lesions in waterways where prey species are isolated from Lake Ontario.

Indicator – Mirex tissue concentration in snapping turtle eggs

Current Condition – Upper Sub-watersheds, Good; Lower Sub-watersheds, Fair

See page 57 for background on Mirex. There are no data available for snapping turtle Mirex concentrations in the watershed. As with PCBs, the regional source for Mirex contamination of turtle eggs is believed to be Lake Ontario, with sub-watersheds above the Lighthouse Hill Reservoir being isolated from this source. Mirex concentrations in sport fish are known to be lower in the Redfield Reservoir compared to the lower reaches of the Salmon River. Therefore, it is probable that Mirex contamination of wetland fauna will be lower in the upper sub-watersheds than in the lower sub-watersheds.

KEA – Eutrophying Nutrients (Nitrogen and Phosphorus)

Wetlands play key roles in cycling of nitrogen (N) and phosphorus (P). In general, wetlands tend to remove these nutrients from ground and surface waters.

Although wetlands are capable of long-term capture and removal of N and P, high inputs of these nutrients are known to reduce wetland biodiversity. Inputs traced to elevated N deposition include linkages to N-saturated upland forests, and these may be significant to the Salmon River watershed because of the high level of atmospheric N deposition to the Tug Hill region (Figure 31).

Plant species able to increase growth rates in response to elevated N and P availability are able to competitively displace other slow-growing species. These competitive interactions can reduce biodiversity and lead to local problems of weedy or invasive species such as *Phragmites* (Rickey and Anderson 2004) and possibly *Typha* (Drexler and Bedford 2002).

*Indicator – Soil Nutrient Concentrations and Plant Richness**Current Condition – Unranked*

No data were obtained on soil or surface water nutrient concentrations for wetlands in the watershed, or on vascular plant and bryophyte species richness at a scale broad enough to apply ranking criteria.

*Indicator – Percent Natural Land Cover-types in 100-ft wetland buffers**Current Condition – Good*

Natural vegetation cover-types (i.e., forest, scrub/shrub, grassland) occupied greater than 90% of the 100-ft wetland buffers in all sub-watersheds. In general, the lower sub-watersheds had greater levels of non-natural cover-types (i.e., developed, agriculture, barren) in the buffers. The Lower Salmon River-Main Stem, Trout Brook and Orwell-Pekin sub-watersheds contained 7%, 7% and 3% non-natural cover, respectively. Note the analysis was conducted only on NYSDEC-regulated wetlands (>12.94 acres).

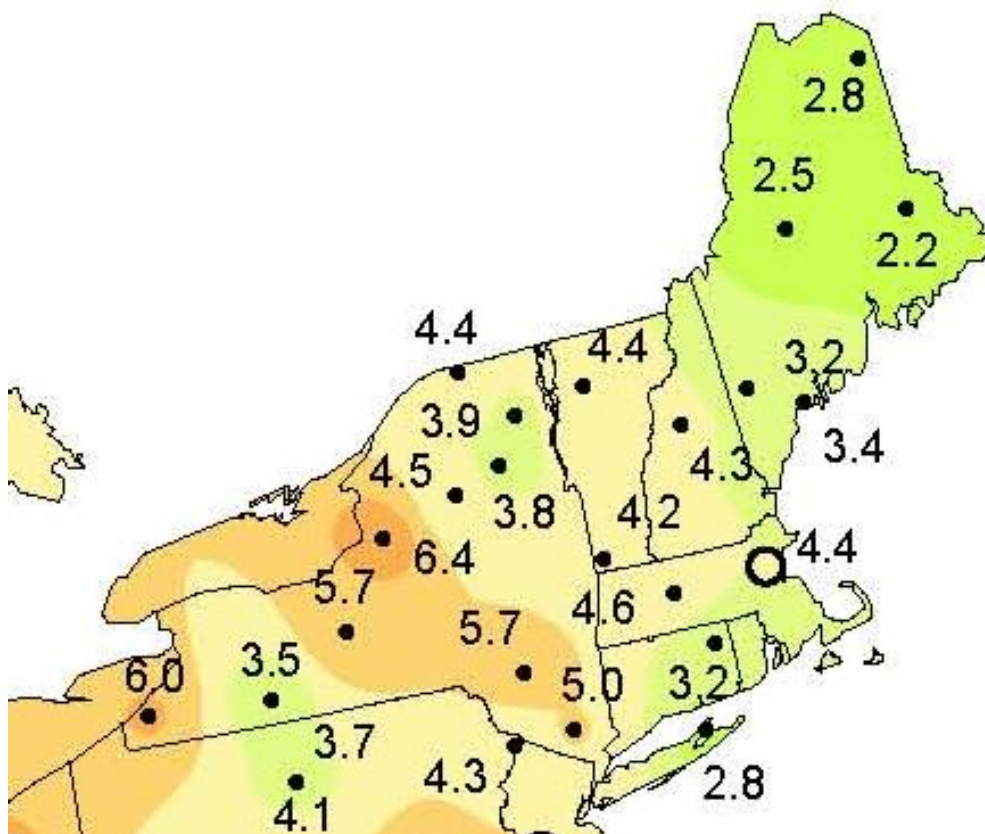


Figure 31. Annual (2005) total wet nitrogen (kg/ha as NO_3^- and NH_4^+) deposition in the northeastern US. (Source: National Atmospheric Deposition Program. <http://nadp.sws.uiuc.edu/>).

KEA – Barriers to Migration

Indicator – Proportion of Natural Land Cover-types in 540-ft Wetland Buffers

Current Condition – Upper Sub-watersheds, Good; Lower Sub-watersheds, Fair

All of the upper sub-watersheds contain > 95% natural cover-types (i.e., forest, scrub/shrub, grassland) in 540-ft wetland buffers. The lower sub-watersheds generally contained more non-natural cover-types in the buffers. The Lower Salmon River-Main Stem, Trout Brook and Orwell-Pekin sub-watersheds contained 14%, 13% and 9% non-natural cover, respectively. Note that this analysis was conducted only on NYSDEC-regulated wetlands (> 9.4 acres).

Indicator – Length of Road Bisecting 540-ft Wide Wetland Buffers

Current Condition – Unranked

Road crossings have been shown to be a significant source of mortality to amphibians and reptiles (Hels and Buchwald 2001; Gibbs and Shriver 2005), especially those that breed in aquatic habitats and must cross roads to travel between hibernation and breeding sites. Semlitsch (1998) estimated 95% of salamander populations occur within 540 ft of wetlands.

An estimated total of ~107 miles of road segments (~33%) occur in the watershed within 540 ft of NYSDEC-regulated wetlands (Figure 32). On a sub-watershed basis, road segments in wetland buffers ranged from 0.6 to 19.7 miles. Sub-watersheds with the greatest length of road within 540-ft buffers are North Branch (19.7 miles, 67% of total road length), Beaverdam Brook-Meadow Creek-Reservoir (17.4 miles, 40%), Orwell-Pekin (15.6 miles, 52%) and Lower Salmon River-Main Stem (14.7 miles, 24%).

Note that this analysis was conducted using only the mapped NYSDEC wetlands (>12.94 acres). Due to the fact that dirt and gated roads were not discerned from paved roads in this analysis, the results may overstate the potential for amphibian and reptile mortality by vehicles since traffic volume and speed are expected to be substantially lower on many road segments. However, it should also be noted that many of the dirt roads and gated paths are open to ATV traffic and therefore may still pose threats to migrating reptiles and amphibians.

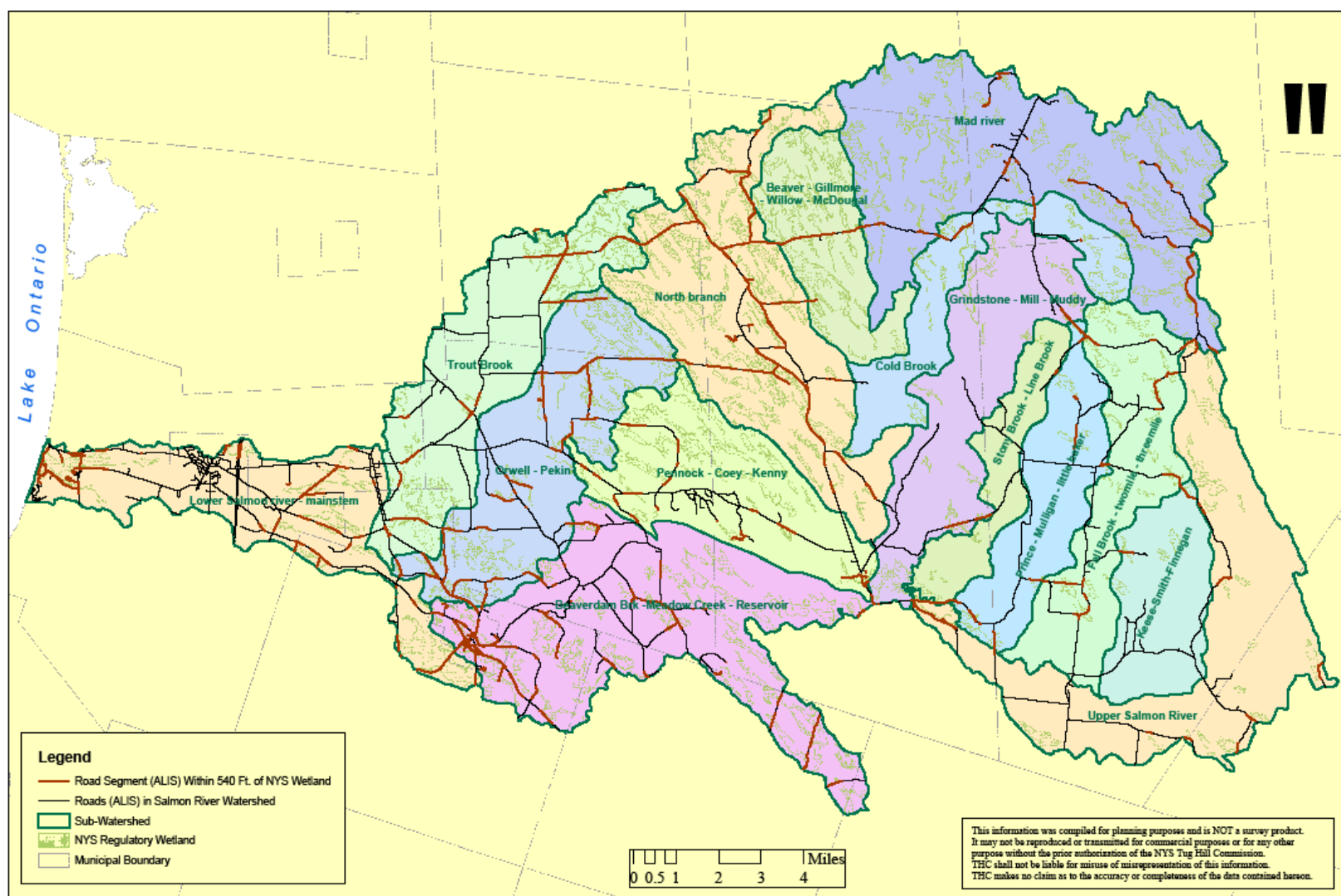


Figure 32. Road segments occurring within 540 ft of NYSDEC-regulated wetlands in the Salmon River Watershed.

Non-Estuarine Wetlands Viability Summary

Notes on Guidance for Current Condition:

- “NG” No guidance was obtained to rank this indicator
 “SGR” Subjective guidance and/or ranking based on professional opinion
 “ND” No data are available with which to rank this indicator

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Size						
<i>Ind. – total surface area (acres) as wetland</i>					Unranked	NG
<i>Ind. - % of total area</i>					Good	SGR
KEA-Condition -Wetland Community Types						
<i>Ind. - Abundance of wetland community types (acres)</i>					Unranked	ND, NG
KEA-Condition-Invasive Species						
<i>Ind. - Frequency of Invasive Plant Occurrences</i>	0	<5	5-25	>25	Good	Drake et al. (2003)
KEA-Condition-Rare Species Populations						
<i>Ind. – Jacob’s ladder population occurrence and density</i>					Good	SGR, Howard (2006)
<i>Ind. – lesser bladderwort</i>					Fair	SGR, Howard (2006)
<i>Ind. – pied-billed grebe</i>					Fair-Poor	SGR, Howard (2006)
<i>Ind. – pitcher plant borer moth</i>					Excellent	SGR, Howard (2006)
KEA-Condition-Pests & Pathogens						
<i>Ind. - Viburnum beetle (frequency of infestation)</i>	0	<5	5-25	>25	Poor	SGR
KEA-Condition-Sentinel Wildlife Groups						
<i>Ind. - Amphibian species frequency in watershed relative to whole of NY state (Herp Atlas Quads)</i>		>90	80-90	<80	Good	SGR
<i>Ind. - Breeding and migratory bird densities (#/acre)</i>					Unranked	NG, ND

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Condition-Hydrology						
<i>Ind. - Regional water surplus (inches)</i>						
<i>Upper sub-watersheds</i>		40			Good	SGR, Eschner et al. (1974)
<i>lower sub-watersheds</i>		16			Good	SGR, Eschner et al. (1974)
<i>Ind. - source alteration (% ground vs. surface water)</i>					Unranked	NG, ND
KEA-Condition-Toxins						
<i>Ind.- game fish mercury concentration (ppm)</i>			0-1	>1		
<i>Upper sub-watersheds</i>					Unranked	NYSDOH (2006) fish consumption advisories
<i>lower sub-watersheds</i>					Fair	
<i>Ind.- snapping turtle egg PCB concentrations</i>		0	0-2	>2		Pagano et al. (1999)
<i>Upper sub-watersheds</i>					Unranked	
<i>lower sub-watersheds</i>					Poor-Fair	
<i>Ind. – PCB-induced mink jaw lesions (ppm)</i>		0	<40	>40		Haynes et al (2007)
<i>Upper sub-watersheds</i>					Unranked	
<i>lower sub-watersheds</i>					Poor	
<i>Ind.- snapping turtle egg Mirex concentrations</i>		0	0-0.2	>0.2		Pagano et al. (1999)
<i>Upper sub-watersheds</i>					Good	
<i>lower sub-watersheds</i>					Fair	
KEA-Condition-Nutrient Loading						
<i>Ind. - Soil P (mg/cm³)</i>		0.01		>0.3	Unranked	ND (Drexler & Bedford 2002)
<i>Ind. - Soil extractable NO₃- (ug/cm³)</i>		<dl		>0.02	Unranked	ND (Drexler & Bedford 2002)
<i>Ind. - Vascular plant richness (#sp./m²)</i>		>20		<10	Unranked	ND (Drexler & Bedford 2002)
<i>Ind. - Bryophyte richness (#sp./m²)</i>		>8		<5	Unranked	ND (Drexler & Bedford 2002)
<i>Ind. - % of 100-ft buffer in natural cover types</i>		>90	75-90	<75	Good	SGR
KEA-Landscape Context – Migration Barriers						
<i>Ind. - % of 540-ft buffer in natural land cover-types</i>		>90	75-90	<75	Good	SGR
<i>Ind. – Road length (mi.) bisecting 540-ft' wetland buffers</i>					Unranked	NG

6. MATRIX FORESTS

KEA – Forest Area and Cover

Indicator – Total Contiguous Forest Cover (ac)

Current Condition – Upper Sub-watersheds, Good; Lower Sub-watersheds, Fair

Forest area provides an estimator of total gross forest ecosystem and social functions (e.g., carbon sequestration capacity; supply of raw materials for renewable forest products industry; and recreational opportunities such as hunting, fishing, hiking, skiing and snowmobiling), some of which cannot be realized until forests reach a minimum size threshold (e.g., habitat for numerous forest-dwelling organisms including many animals that require large home ranges or interior forest conditions). Current guidance on forest reserve size suggests that at least 25,000 acres of contiguous forest are required to permit natural ecosystem processes to occur unabated, and to support viable populations of all forest-dwelling organisms native to northeastern forest types (Anderson et al. 2004).

Forests of the upper sub-watersheds are contiguous with those of the greater Tug Hill region, and together they occupy the western extreme of the Tug Hill “Core Forest” (Figure 33). The Core Forest is a large area (~120,000 acres) of intact forest and wetlands, and is the third largest area of forested landscape in New York (after the Adirondacks and Catskills). Forests of the extreme western portions of the lower sub-watersheds, and all of the Lower Salmon River Main Stem sub-watershed, are highly fragmented and do not form any forested blocks >25,000 acres.

Indicator – Percent Forest Cover

Current Condition – Upper Sub-watersheds, Good; Lower Sub-watersheds, Poor

Percent of a landscape in forest cover reflects the capacity for forests to provide localized ecosystem services regardless of total forest cover. These localized functions include nutrient sequestration, hydrologic and sedimentation control, and riparian buffers that help to sustain healthy aquatic communities throughout the watershed. The Salmon River watershed is heavily forested, with the matrix forests (excluding forested wetlands) occupying approximately 86% (~131,800 acres) of the watershed’s total upland land base. As a percentage of upland (non-wetland) cover-types, forests comprise 94% of the land area in the upper, eastern sub-watersheds. All of the upper sub-watersheds possess $\geq 90\%$ forest cover in uplands. Matrix forest cover in the lower, western sub-watersheds averaged 69% of upland cover-types and ranged from 48% (Lower Salmon River-Main Stem) to 79% (Beaver Brook-Meadow Creek-Reservoir).

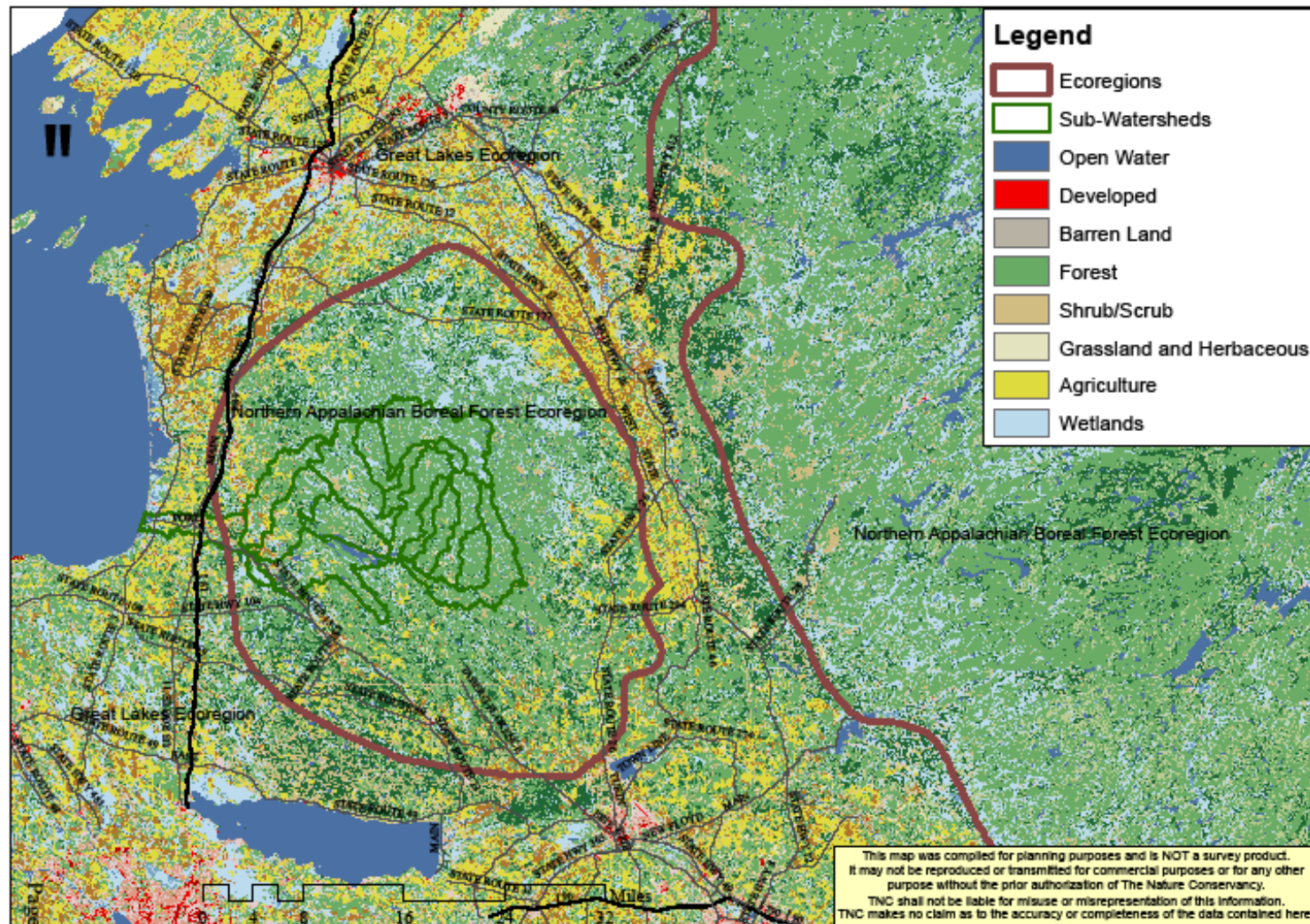


Figure 33. Regional land-cover types surrounding the Tug Hill Plateau.

*Indicator – Area by Forest Cover-Type**Current Condition – Unranked*

Broad forest cover-types provide habitat for a variety of different wildlife, plant and microbial species. Within the Salmon River watershed, known broad forest cover-types include deciduous hardwood, conifer (natural hemlock, spruce, pine, and conifer plantations), and forests having natural mixtures of hardwoods and conifer (spruce, hemlock and pine). Historic natural abundances of forest types are not known for the watershed. However, at lower elevations, conifer-dominated stands (hemlock and pine) occurred along waterways, wetlands and wetland edges and shaded ravines. At upper elevations, conifer stands (spruce, fir, hemlock and pine) occurred along wetland edges and waterways, and upland forests contained a substantial conifer (spruce) component (Hotchkiss 1932, Stout 1958).

The matrix forests of the watershed are dominated by deciduous types (81% of lower sub-watersheds; 85% of upper sub-watersheds). The Pennock-Coey-Kenny sub-watershed contains 60% conifer forest type, reflecting the several NY State reforestation areas that occur there. The amount of mixed forest types is low given the historic accounts of spruce, hemlock and white pine admixtures in the original forests of the watershed. This likely reflects the historic level of selective cutting for conifers during the 19th century. However, red spruce regeneration was encountered on 41% of sampled hardwood dominated forests across the Tug Hill, including sites within the Salmon River watershed (see regeneration indicator). Therefore potential exists for re-establishing widespread mixed conifer-hardwood stands in the upper sub-watersheds.

KEA - Forest Fragmentation

Forest fragmentation is the division of large, contiguous forest tracts into smaller woodlots by alternative land uses such as agriculture, development and roads.

Fragmentation increases the ratio of forest edge habitat relative to forest interior. While forest edge habitat is important for many wildlife species (primarily game species, e.g., white-tailed deer, hare, pheasant) because it maximizes the ability for such animals to simultaneously achieve cover and foraging habitat, fragmentation can lead to impairment of forest communities in other ways. Forest edges (those areas within 60-150 ft of openings) are influenced by environmental conditions and processes occurring in adjacent open areas. Light, temperature and humidity changes abruptly over several meters thereby permitting competitive, shade-intolerant and weedy species to become established. Reduced reproductive success of many nesting bird species (Rosenberg et al. 1999) can occur in forest edges. Road corridors and utility rights-of-way also provide avenues for dispersal of invasive plants.

*Indicator – Edge:Area Ratio**Current Condition – Upper Sub-watersheds, Good; Lower Sub-watersheds, Fair*

The degree of forest fragmentation is described as the ratio of forest perimeter to area. The forests of the upper sub-watersheds are largely contiguous and unfragmented by

non-natural vegetation types. A major fragmenting feature in the upper sub-watersheds are roads and trails. The fragmentation ratio for the lower sub-watersheds were 10- to 25-fold greater than the upper watersheds due to the prevalence of agriculture and development there. The Lower Salmon River-Main Stem sub-watershed has the highest ratio (2.6).

Indicator – Frequencies of Forest Interior Birds

Current Condition – Unranked

Different bird species are influenced, negatively or positively, by forest fragmentation and availability of edge. Several “forest interior” bird species will breed only in large tracts of forests that are far from an edge. Other species thrive in woodlands that are interspersed with open habitats.

New York State Breeding Bird Atlas data (2000-2005) indicate less frequent distributions of forest interior species in the western, more fragmented section of the watershed. However, when substantial (>10%) difference in bird frequencies occurred between the western and eastern portions of the watershed, the eastern forests tended to have greater occurrences of the interior indicator species than the western forests.

Indicator – Presence of Wide-ranging Forest Mammals

Current Condition – Unranked

Several wildlife species that are native to the Tug Hill region (black bear, bobcat, fisher, possibly moose) require large home ranges of unfragmented forest (Saunders 1988, Fox 1990, Serfass and Mitcheltree 2004). Officials at NYSDEC indicate that black bears, although still uncommon and possibly transient, are known to the Tug Hill, and a few moose sightings have been reported. Fox (1990) identified the western Adirondacks and eastern Tug Hill Plateau as one of three core population centers for bobcats in New York (the other two being in the Catskills and Taconics). The NYSDEC Bowhunter Log data also indicate that sightings of fisher, bobcat and bear, are frequent, although data from this source are insufficient to suggest long-term population trends for these species. It is not known whether the recent lack of river otter sightings represents a meaningful trend.

Indicator – Connectivity to Regional Forest Types

Current Condition – Upper Sub-watersheds, Good-Fair; Lower Sub-watersheds, Poor

Fragmentation influences forest community health at both small and large (ecoregional) scales. Many wide-ranging animals require large blocks of unbroken habitat to meet all their needs and to sustain regional movement. In the presence of global climate change species migrations across broad ranges will be facilitated by connectivity among regional habitat types. The forests of the upper, eastern portion of the Salmon River watershed are components of the western-most limits of the Northern Appalachian-Boreal Forest Ecoregion. Biodiversity of these forests will be sustained, in part, through continued connectivity to the forest of the greater Tug Hill region and the

Adirondack and northern Appalachian forests. Forests of the lower, western portion of the watershed represent the eastern extreme of the Great Lakes Ecoregion (Figure 33), and require connectivity to other communities within that ecoregion.

The upper sub-watersheds are embedded within the Tug Hill forest matrix, which represents a ~150,000-acre roadless region of forests and wetlands. However, the Tug Hill, itself, is bounded by agriculture in the Black River Valley to the north and east, and in the Mohawk Valley to the south; by development to the north (Watertown) and south (Syracuse metropolitan area); and by Oneida Lake to the south. With the exception of a narrow forested corridor, extending toward the southwestern Adirondacks, and located south of Booneville and through the Webster Hill, Jackson Hill, Buck Hill, Clark Hill and Benn Mountain State Forests, there is no connectivity between the Tug Hill and other components of the Northern Appalachian-Boreal Forest Ecoregion in the Adirondacks and New York's Southern Tier (Figure 33). Forests of the lower sub-watersheds are highly fragmented and embedded within a matrix of agricultural land use. The Great Lakes forests as a whole are highly fragmented.

KEA- Distribution of Forest Successional Stages

It is likely that the current landscape of the Tug Hill and Salmon River watershed has a greater diversity of forest age classes today than before European settlement when disturbance regimes were controlled primarily by natural events (wind, ice, frontal winds). Clearing for agriculture and intensive logging during the mid- to late-19th century increased the abundance of early successional community types, thereby providing opportunities for grasslands and shrub lands to establish along with the variety of birds, mammals and insects that flourish in these communities (e.g., Chambers 1983, Keller et al 2003, PADCNr 2007). Importantly, grasslands that are maintained open, but not regularly mowed, provide critical habitat for some species that are not common to the region due to the natural lack of grassland communities in the region, reversion of open fields to woodlands due to agricultural abandonment, and the fragmentation or development of those grasslands that remain.

Indicator – Forest Stand-Size Class Distribution

Current Condition –Unranked

Forest stands are traditionally categorized into stand-size classes that can be used to provide limited guidance on developmental stage of the stand (Alerich and Drake 1995). From smallest to largest, these stand-size classes are: Sapling, Poletimber, Sawtimber.

Forests of the Tug Hill region have exhibited a shift in estimated stand-size class distributions between 1968 and 2004. Although the overall amount of commercial forest land did not change appreciably during this time, there is regional trend toward forest maturation during this period; a trend that was initiated with widespread

agricultural abandonment in the early 20th century. Substantial areas of sapling- and poletimber-size classes have advanced to sawtimber-size stands.

Indicator – Early Successional Community Cover (ac) and Percent Cover

Current Condition – Good

Shrub lands and inactive grasslands occupy approximately 11% (~5800 ac) and 4% (~5000) of the lower and upper sub-watersheds, respectively. The current total area of early successional habitat is undoubtedly lower than the historic maximum in the late 19th and early 20th centuries when farmland was widely abandoned on marginal sites, but probably higher than conditions under natural disturbance regimes. The NYSDEC, in conjunction with the USDA Grassland Reserve program, has not identified the Salmon river watershed as a Grassland Reserve Zones (Figure 16), indicating that the watershed has low potential for management of natural grassland habitat.

Indicator – Grassland Bird Species Occurrence

Current Condition – Unranked

The New York State Landowner Incentive Grassland Protection Program (NYSDEC 2007b) identifies nine grassland bird species that are known to be in decline in New York since 1966, eight of which occur historically in the Salmon River watershed. Total occurrences of these species were greater in the western portion of the watershed relative to the eastern, reflecting the greater abundance of early successional communities there.

KEA – Forest Structural Diversity

Terrestrial and aquatic ecologists have long recognized that multiple habitats are important for maintaining biodiversity. A variety of forest successional stages (e.g., grasslands; shrub lands; and sapling, pole, and sawtimber forest size classes) provide different habitats that support greater diversity of plants and animals than an equal area of a single type (Chambers 1983, Keller et al 2003). Similarly, within a forest stand structural habitat features such as large-diameter trees, decaying logs of different species and decay stages, and standing dead trees provide unique habitat for numerous forest-dwelling organisms (e.g., Chambers 1983, Harmon et al. 1986, Hansen et al. 1991, DeGraaf et al. 1992, McGee and Kimmerer 2002, Root et al. 2007ab).

Indicator – Large Tree Densities

Current Condition – Fair

Large, old trees, whether they occur in natural or managed forests, provide unique and necessary habitat for a number of organisms such as lichens (Root et al. 2007a), oribatid mites (Root et al. 2007b), bryophytes (McGee and Kimmerer 2002), myxomycetes (Stephenson 1989), and large cavity-nesting or roosting birds and mammals (Chamber 1983, DeGraaf et al. 1992). Northern hardwood stands across the Tug Hill region, including sites in some upper sub-watersheds, contain an average ~3

trees/acre greater than 20" diameter. No data were located that describe canopy structure in the Lake Plain forests in the lower sub-watersheds.

Indicator – Decaying Log Volume

Current Condition – Fair

Decaying logs provide critical habitat for a variety of birds, mammals, amphibians, fish, fungi, and plants (Harmon et al. 1986, Hayes and Cross 1987, Aubry et al. 1988, Bader et al. 1995, Flebbe and Dolloff 1995, Hanula 1996, Loeb 1996). No data were available to assess volumes of decaying logs in forests of the watershed or Tug Hill region. Given the similarities between disturbance and management histories of the watershed forests with industrial forests of the Adirondacks (McGee et al. 1999), it is expected that forests of the Salmon River watershed would contain approximately 60 m³/hectare of decaying logs.

KEA – Nutrient Cycling Processes: Nitrogen Deposition

Nitrogen (N) is an essential, elemental nutrient that naturally occurs in such low concentrations that it frequently limits plant growth in terrestrial and agricultural systems. However, the formation of nitrous oxides (NO_x) from primarily human activities has led to increased deposition of N throughout much of northeastern North America. The Tug Hill region consistently receives among the highest rates of atmospheric N deposition in North America (Figure 31). When nitrogen accumulates in forests to the point where it exceeds the forests biological demand, that forest is said to be “nitrogen saturated.” Nitrogen saturation can lead to forest decline because much of the excess N is converted from ammonium (NH₄⁺) to nitrate (NO₃⁻) by a microbiological process called nitrification. Nitrification is an acidifying process that liberates hydrogen ions (H⁺). Therefore, as with impacts of acidic deposition, nitrogen saturation leads to depletion of other soil nutrients, altered nutrients in plant tissues, and the release of aluminum in potentially toxic levels.

Indicator-Foliar N Concentration

Current Condition – Fair to Poor

Tree foliage sampled from 36 forest sites across the Tug Hill region (including 13 in the Salmon River watershed) during summer 2005 (McGee et al., unpublished) exhibited N concentrations at or above levels produced in experiments in ME and MA, which receive far less N deposition than the Tug Hill region (Magill et al. 1997). These high foliar N concentrations suggest potential onset of nitrogen-saturated conditions in regional forests.

Indicator-Forest Floor C:N ratio

Current Condition – Poor

As nitrogen accumulates in soils relative to carbon, C:N ratios decline. Available data indicate that Tug Hill forest soils may have accumulated N to levels that indicate the onset of N-saturated conditions.

*Indicator-Seasonal Surface Water NO₃⁻ Concentrations**Current Condition – Good to Fair*

Surface water nitrate (NO₃⁻) concentrations are one of the most sensitive indicators of the effects of atmospheric N deposition to forest ecosystems (Aber et al. 2003).

Observed NO₃⁻ concentrations in Tug Hill headwater streams indicate the region may be entering early stages of N-saturation.

KEA – Nutrient Cycling Processes: Acidification

Acidic deposition leads to the leaching of several base nutrients from soils: calcium, magnesium, and potassium. Soil nutrient depletion, in turn, leads to foliar deficiencies and increased dysfunction to plant root systems. These conditions predispose forests to decline from multiple stresses including drought, insect defoliation and freezing damage (Horsley et al. 1999; Shortle et al. 1997). Acid-induced losses of calcium from forest soils have also been implicated in the decline of forest-dwelling species with high reliance on calcium for egg shells or carapaces (e.g., terrestrial snails).

*Indicator – Soil pH**Current Condition – Upper Sub-watersheds, Fair; Lower Sub-watersheds, Good*

Soil pH can be used to suggest the resilience of soils to acidifying processes. Upland forest and agricultural soils in the higher, eastern sub-watersheds are generally strongly to extremely acid, owing in large part to naturally low buffering capacity of the material from which the soils formed. Soils dominating the cultivated and forested uplands of the western sub-watersheds are generally better buffered. Therefore the soils of the lower sub-watersheds generally have better buffering capacity against detrimental impacts of acidic deposition.

*Indicator-Foliar Ca:Al ratio**Current Condition – Upper Sub-watersheds, Poor; Lower Sub-watersheds, Unranked*

Samples of American beech, red maple and sugar maple foliage collected across the Tug Hill region during the summers of 2005 and 2006 exhibited Ca:Al ratios, of substantial annual variation, but all levels are at or considerably below those levels of experimentally acidified forest soils suggesting the potential that forest soils of the region may be undergoing acidification.

KEA – Toxins

An environmental toxin of growing national interest is mercury (Hg). In its biologically active form (methyl-mercury, MeHg) this element bioaccumulates in the food chain, thereby causing greater exposure to higher-level carnivores. Mercury is a neurotoxin that leads to reduced reproductive success and impaired motor skills in wildlife and humans (Driscoll et al. 2007). Mercury enters forest ecosystems by uptake of gaseous Hg through pores in leaves, where it then passes into the food chain through decomposition of leaf

litter by detritivores such as slugs, snails, woodlice and millipedes. These invertebrates are then consumed by predaceous invertebrates such as centipedes and spiders, which are in turn consumed by foraging birds, and importantly, by ground foraging birds such as the wood thrush (Evers and Duron 2006).

Indicator-Insectivorous Bird Blood Mercury Concentration

Current Condition – Good

In a survey across New York and Pennsylvania, including a site in the Tug Hill region, blood mercury concentration of wood thrushes was found to be above expected levels for uncontaminated sites, but still below levels that would cause negative reproductive impacts (Evers and Duron 2006).

KEA – Forest Understory Community Composition and Diversity

A number of factors influence the composition and diversity of native forest understory vascular plants. First, site conditions (moisture and nutrient availability) importantly influence the suite of species that occupy a particular location based upon their respective tolerance for limited moisture and nutrients. Past disturbance history also influences understory plant composition. Past agricultural activities, such as cultivation and pasturing, are known to reduce the number and types of species that occur in second-growth forests that reestablish on abandoned agricultural lands. Natural and human canopy disturbances also influence the abundance and composition of understory plants by altering resource (i.e., light, soil moisture and nutrients) availability in the understory. Intense canopy disturbances or repeated low intensity disturbances favor the establishment of more competitive, shade-intolerant, and invasive species.

Indicator – Invasive Plant Species Frequencies of Occurrence

Current Condition – Upper Sub-watersheds, Good; Lower Sub-watersheds, Unranked

New York State Invasive Species Task Force and the Adirondack Park Invasive Plant Program offer guidance for some species to monitor on a local or regional basis. There are currently no efforts to systematically monitor invasive plants within the Salmon River watershed or greater Tug Hill region, and few data sources are available with which to gauge distribution of invasives within the watershed. No invasive plant species were tallied on sample plots during the 2001 Salmon River Greenway Corridor survey (Dru Assoc., 2001), but some were included in the flora checklist for the corridor's study area. McGee (unpublished data) reported no invasive plant species on 49 upland forest sites on NY State and private lands across the Tug Hill (including several in the Salmon River watershed east of the Redfield Reservoir). These surveys suggest that, although terrestrial invasive plant species are present within the watershed, they are not dominant components of the forest flora. Information regarding invasive plant occurrences in forests of the lower sub-watersheds is especially lacking.

*Indicator – Native Forest Herb Densities/Frequencies**Current Condition – Upper Sub-watersheds, Good; Lower Sub-watersheds, Unranked*

No quantitative information exists that provides baseline conditions for native forest herb species cover or frequencies in forests of the watershed or greater Tug Hill region. Hotchkiss (1932) provided a subjective rank-ordered species list for herbs commonly found in climax forests of the Tug Hill. McGee (unpublished data, 2005) found that the most frequently encountered species in 49 northern hardwood study sites across the Tug Hill, including sites in the watershed westward to approximately Redfield, were among the common species listed by Hotchkiss. However, McGee also found that a number of competitive and weedy species (briars, hay-scented fern and New York fern) are currently more frequent than is suggested by Hotchkiss data. No information is available on herb communities in forests of the lower watershed.

KEA – Forest Tree Regeneration

The maintenance of productive, well-stocked and diverse forests requires abundant and well-distributed tree regeneration to replace trees that die naturally or are removed by logging activities. Several variables influence the regeneration of ecologically and commercially desirable tree species including site conditions, herbivory, competition by herbaceous and other woody species, and, in working forests, the application of silvicultural prescriptions that ensure adequate seed production and optimal growing conditions for species that are best suited for a given site and management objective (Nyland 1996).

*Indicator – Regeneration Frequency**Current Condition – Good*

The proportion of sites on which seedlings of component forest species occur provides a measurement of potential for regeneration of respective species across the watershed. Two recent studies recorded seedling/sapling frequencies on sites along the Salmon River Corridor (Dru Associates 2001) and on Tug Hill northern hardwood sites, including some in the eastern portion of the Salmon River watershed (McGee unpublished data, 2005). No invasive tree species were recorded in the regeneration layer of the watershed's forests. Red maple was the most abundant seedling/sapling in the higher elevation forests (89% of sites), followed by black cherry, striped maple, American beech and yellow birch. Sugar maple and red spruce occurred on approximately 40% of sites. In lower elevation forests west of Redfield, American beech was the most abundant seedling/sapling (60% of sites), followed by maple (undetermined), striped maple, hemlock and red oak.

*Indicator – Regeneration Density**Current Condition – Unranked*

Seedling and sapling densities, by height class, of component forest tree species provide the best indication of potential regeneration success. No data were obtained reporting seedling/sapling densities in the forests of the watershed.

KEA – Forest Overstory Composition

Current forest overstory reflects the cumulative effects of past disturbances on the capacity for component species to regenerate. Current overstory composition and diversity may deviate from expected due to a number of factors such as disease, changes in the extent and intensity of natural or human disturbances, or deliberate management decisions to favor certain species.

*Indicator – Invasive Species Frequencies/Dominance**Current Condition – Upper Sub-watersheds, Good; Lower Sub-watersheds, Unranked*

No invasive species were recorded in any of the overstory layers in 147 samples of Tug Hill forests, including sites extending to lower elevations to approximately Orwell (Wink, 2002; McGee unpublished, 2005; NYSDEC 480A forest management plans). No quantifications of forest canopy composition are known for the Ontario Lake Plain forests.

*Indicator – Rank Abundance of Native Component Species**Current Condition – Upper Sub-watersheds, Fair; Lower Sub-watersheds, Unranked*

In the absence of wide-scale human disturbances, a forest landscape will be dominated by species that are most adapted to prevailing site conditions and historic disturbance regimes. Historic considerations of the natural vegetation of the Tug Hill region indicate that regional forests were dominated by various combinations of American beech, yellow birch and sugar maple with an abundant mixture of conifers. In the transitional Tug Hill fringe, northern hardwoods dominated, with hemlock, white pine, and some spruce restricted to stream sides and ravines (Hotchkiss 1932, Stout 1958). A large change in the dominance distribution of forest overstory trees on a landscape scale indicates the occurrence of some historic shift in regeneration processes.

Available data, primarily from sites in the the upper elevations and transitional sections of the watershed (Wink, 2002; McGee unpublished, 2005; NYSDEC 480A forest management plans) indicate that red maple and black cherry, which are early- to mid-successional species, together account for 40% of the relative basal area of the region. Their dominance in regional forests may reflect their widespread establishment on abandoned post-agricultural lands throughout portions of the watershed, and/or management decisions that favor the regeneration and growth of these species. Red spruce accounts for only 1% of the regional forest canopy tree basal area, although it occurs on 31% of sampled sites. Its relatively high frequency but low basal area reflects its selective removal in the 19th century, and its potential for becoming a dominant forest canopy component in the future. American beech occurs frequently, but comprises only 7% of the average basal area, reflecting widespread effects of beech bark disease on regional forest structure.

No information is available on forest canopy composition of the Ontario Lake Plain forests.

KEA – Forest Pests and Pathogens

A number of forest pathogens (fungi, bacteria, viruses) and insect pests are endemic to, have been introduced to, or are of potential concern to northern forest ecosystems in general, and to the matrix forests of the Salmon River watershed in particular.

Indicator – Sirex woodwasp distribution

Current Condition – Fair

Sirex woodwasp (*Sirex noctilio*) is a wood-boring pest of conifers, primarily 2 & 3-needled pines. It is a recently introduced invasive species that was first discovered in New York near the town of Fulton in 2004. Since then the presence of Sirex woodwasp has been confirmed in over half of the counties in the state, including those counties which contain the Salmon River Watershed. It has also been detected in Pennsylvania, Vermont, and Ontario. Scots pine, red pine, Austrian pine, and eastern white pine are all susceptible hosts occurring within the watershed. The cumulative result of woodwasp impacts is death of the tree within 2-3 years.

A few specimens of *Sirex* have been trapped in Oswego County; its presence poses a serious threat to the regional forests. At this time it is unclear what the long-term ecological impact of Sirex woodwasp will be in the watershed. The majority of trees attacked in New York have been weak, overtopped or otherwise pre-disposed hosts.

Indicator – Forest tent caterpillar distributions

Current Condition – Fair

Eastern (*Malacosoma americanum*) and forest (*Malacosoma disstria*) tent caterpillars are two important tree pests in New York. These defoliators can cause widespread damage to a variety of native hardwood species. The forest tent caterpillar is the most common defoliator pest in northern hardwood forest types and, in the Northeast, sugar maple is the principle host. Hardwood stands in this part of New York can typically be expected to experience some “background” level of defoliation every year, and native tree species are well adapted to it.

However, these species are known to cause periodic, extensive defoliation. Outbreaks in the Lake States typically last for 3-4 years, occur at 7-12 year intervals, and can cover areas as large as 40,000 km² (Wink 2002; Wink and Allen 2007). NYSDEC aerial survey data (Figures 34) illustrate the extent of damage within the watershed caused by the most recent outbreak of tent caterpillars during the period 2002-2007 and by a drought in 2007. Depending on the intensity and extent of defoliation, forest trees may experience diminished productivity, direct mortality, or may be predisposed to forest decline through other contributing agents such as past disturbance or drought. When extensive defoliation occurs, understory plants may respond rapidly to the increased availability of light beneath the canopy, so the species make-up of this understory layer becomes an important determining factor in what the future composition of the forest will be.

Forest management influences the ability of woodlands to recover from defoliation. A recent study found that Tug Hill forests subjected to selective removal of trees over a set diameter exhibited greater mortality associated with forest tent caterpillar defoliation than forests that had received timber stand improvement cuts (Wink 2002; Wink and Allen 2007).

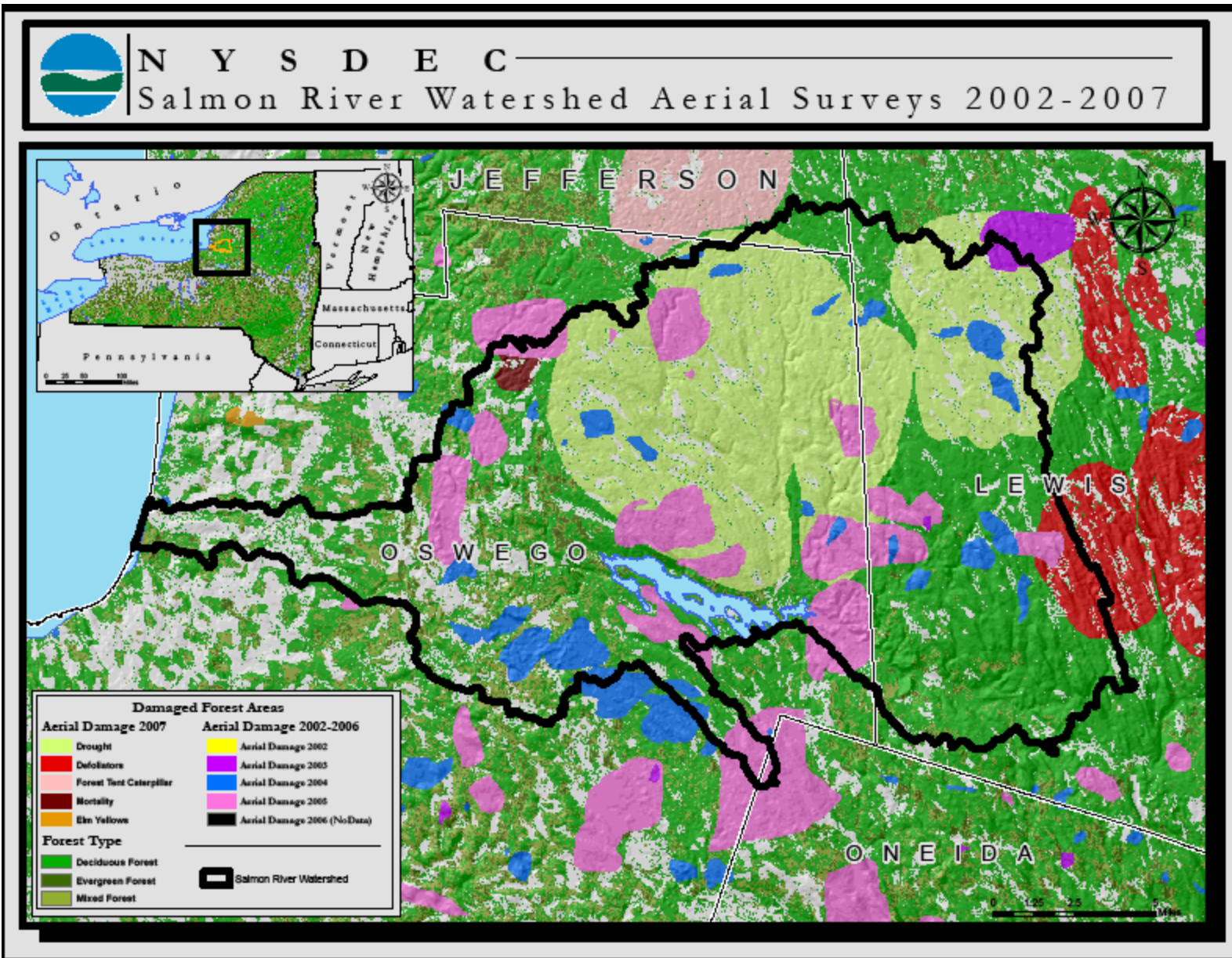


Figure 34. NYSDEC aerial survey data of forest damage in the Salmon River Watershed during the period 2002-2007.

*Indicator – Beech bark disease distribution**Current condition – Poor*

Beech bark disease is caused by fungi, preceded by beech scale on American beech. The scale was introduced in North America around 1890 (Houston 1994) and, along with the associated fungi, has extended through Canada's maritime provinces, New England and into the mid-Atlantic states. The fungus causes extensive above-ground mortality to larger trees, which leads to establishment of extensive root-sprout thickets (Shigo 1972) that may impose heavy competition on other understory woody and herbaceous species.

Beech bark disease has spread throughout the Tug Hill and affects stand structure and composition there. In a survey of four unmanaged New York State Forest Preserve stands within the Tug Hill region, data from McGee (unpublished) indicate the impact of beech bark disease; in stands that have not been harvested for over 100 years, densities of large, old beech would be comparable to those of other long-lived species such as sugar maple, yellow birch hemlock and red spruce if beech bark disease was not a factor.

There are several other potential pests that are not currently known to occur in the Salmon River watershed, but which several forest managers indicate should be carefully monitored.

Emerald Ash Borer (*Agrilus planipennis*) is an exotic pest of ash trees that has been detected in MI, OH, IN, VA, WV, MD, PA and Ontario. It has not yet been detected in New York. EAB is a wood-boring beetle that attacks all species and varieties of ash. There is currently no effective chemical or biological control for EAB. Unless one is developed in the next few years, the long-term outlook for ash in the region seems uncertain at best.

The Asian Long Horned Beetle (*Anoplophora glabripennis*) is a wood boring beetle native to China that attacks a variety of hardwoods including maples, elms, poplars and willows. Infestations have been found in New York City, northern New Jersey, Illinois and Ontario. The maple-dominated forests of northern New York, including the Salmon River watershed are highly susceptible to infestation by the beetle (TNC 2007b).

Hemlock Woolly Adelgid (*Adelges tsugae*) is a scale insect native to east Asia that has infested and caused extensive mortality to hemlock trees in New England, and mid-Atlantic states. It is currently restricted to the lower Hudson and Delaware Valleys in New York, but could potentially cause extensive ecological damage to New York's forests.

Matrix Forests Viability Summary

Notes on Guidance for Current Condition:

- “NG” No guidance was obtained to rank this indicator
 “SGR” Subjective guidance and/or ranking based on professional opinion
 “ND” No data are available with which to rank this indicator

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA - Area - Forest Cover						
<i>Ind. – Total contiguous forest area (ac)</i>		> 25,000	< 25,000			Anderson et al. (2004)
<i>upper sub-watersheds</i>					Good	
<i>lower sub-watersheds</i>					Fair	
<i>Ind. - Upland percent forest cover</i>		> 90	90-75	< 75		SGR
<i>upper sub-watersheds</i>					Good	
<i>lower sub-watersheds</i>					Poor	
<i>Ind. – Percent cover by forest type</i>					Unranked	NG
KEA - Landscape Context – Fragmentation						
<i>Ind. - Forest Edge:Area Ratio</i>		< 0.3	> 0.3			SGR based on current upper sub-watershed conditions
<i>upper sub-watersheds</i>					Good	
<i>lower sub-watersheds</i>					Fair	
<i>Ind. - Frequencies forest interior birds (NY Bird Atlas)</i>						NG
<i>upper sub-watersheds (avg. freq. interior species)</i>					Unranked	
<i>lower sub-watersheds (avg. freq. interior species)</i>					Unranked	
<i>Ind. - Frequency brown-headed cowbird (NY Bird Atlas)</i>						NG
<i>upper sub-watersheds</i>					Unranked	
<i>lower sub-watersheds</i>					Unranked	

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
<i>Ind. – Presence of wide-ranging forest mammals</i>					Unranked	NG
<i>Ind. – Connectivity to regional forest types</i>						
<i>upper sub-watersheds</i>					Good-Fair	SGR
<i>lower sub-watersheds</i>					Poor	SGR
KEA-Condition - Distribution Successional Stages						
<i>Ind. – Forest stand size-class distribution ratio</i>						
<i>Old : Mature/Uneven : Immature/Uneven : Sapling/Pole</i>		5:70:20:5			Unranked	ND, Frelich & Lorimer (1991a,b)
<i>Ind. - Early successional community cover (percent)</i>						
<i>upper sub-watersheds</i>					Good	SGR
<i>lower sub-watersheds</i>					Good	
<i>Ind. - Frequency grassland bird species (NY Bird Atlas)</i>						
<i>upper sub-watersheds (avg. freq. grassland species)</i>					Unranked	NG
<i>lower sub-watersheds (avg. freq. grassland species)</i>					Unranked	
KEA-Condition - Forest Structural Diversity						
<i>Ind. - large (20+ inch) tree densities (#trees/acre)</i>	>10	7-10	3-6	0-2	Fair	McGee et al. (1999)
<i>Ind. - decaying log volume (m³/ha)</i>		100-60	60-20	< 20	Fair	McGee et al. (1999)

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Condition - Nutrient Cycling Processes						
<i>Ind. - Foliar nitrogen concentration (%)</i>		1.6-2.2		2.0-2.4	Fair-Poor	Magill et al. (1996, 1997)
<i>Ind. - Forest floor carbon:nitrogen ratio</i>		> 25	25-22	< 22	Poor	Fenn et al. (1998) Aber et al. (2003)
<i>Ind. - Summer surface water NO₃⁻ (µeq/L)</i>		< 10	10-50	> 50	Good-Fair	Stoddard (1994)
<i>Ind. - soil pH</i>						
<i>upper sub-watersheds</i>					Fair	SGR
<i>lower sub-watersheds</i>					Good	
<i>Ind. - Foliar Ca:Al ratio</i>		300-550		200-450		Aber et al. (1995)
<i>upper sub-watersheds</i>					Poor	Magill et al. (1997)
<i>lower sub-watersheds</i>					Unranked	ND
KEA-Condition - Toxins						
<i>Ind. – Insectivorous bird blood mercury concentration</i>		<1	1-1.4	>1.4	Good	Evers and Duron (2006)
KEA-Condition - Understory Communities						
<i>Ind. -Frequency invasive plant species</i>	0	<5	5-25	>25		Drake et al. (2003)
<i>upper sub-watersheds</i>					Good	
<i>lower sub-watersheds</i>					Unranked	ND
<i>Ind. -Freq. native forest herb species</i>						
<i>upper sub-watersheds</i>					Good	SGR
<i>lower sub-watersheds</i>					Unranked	ND
<i>Ind. – Forest tree regeneration frequency (% sites)</i>					Good	SGR
<i>Ind. – Forest tree regeneration density</i>					Unranked	ND

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes on Guidance for Current Condition</u>
KEA-Condition - Forest Overstory Community						
<i>Ind. – Frequency Invasive Species</i>	0	<5	5-25	>25		Drake et al. (2003)
<i>upper sub-watersheds</i>					Good	
<i>lower sub-watersheds</i>					Unranked	ND
<i>Ind. - Rank Abundance Component Species: in upper sub-watersheds, beech, s. maple, y. birch, r. spruce and hemlock expected to have highest, average basal areas and frequencies</i>		5 in top 7	4 in top 7	< 4 in top 7	Fair	SGR
<i>lower sub-watersheds</i>					Unranked	ND
KEA - Condition - Forest Pests and Pathogens						
<i>Ind. - Sirex wood wasp frequency on potential hosts</i>	0	<5%	5-25%	>25%	Fair	SGR
<i>Ind. - Tent caterpillars</i>	0	<5%	5-25%	>25%	Fair	SGR
<i>Ind. - Beech bark disease</i>	0	<5%	5-25%	>25%	Poor	SGR
<i>Ind. - Emerald ash borer</i>	0	<5%	5-25%	>25%	Excellent	SGR
<i>Ind. - Asian longhorn beetle</i>	0	<5%	5-25%	>25%	Excellent	SGR
<i>Ind. - Hemlock wooly adelgid</i>	0	<5%	5-25%	>25%	Excellent	SGR

7. SALMON RIVER GORGE AND STEEP SLOPE COMMUNITIES

SALMON RIVER GORGE

One of the pronounced geologic features of the Tug Hill region is the numerous, steep, and often deep gorges. The only such feature in the watershed is the Salmon River Gorge, which begins at 110-ft high falls and continues downstream for approximately 3000 ft.. The Gorge includes high sheer cliffs and talus slopes that support unique plant assemblages and several rare plant species.

KEA – Hydrology

Indicator – Frequency of Low Flow Volume (cfs)

Current Condition – Unranked

Water flow over the falls and through the gorge (the “Bypass Reach”) has the potential to be quite low due to natural reduction in flow during dry summer periods, but current low flows are due primarily to diversions for hydropower production. Minimum flow rate over the falls are important for a number of cliff-dwelling organisms (mosses, lichens, ferns) that require moist, humid substrate. It is not known whether the minimum flows set for aesthetic purposes are sufficient to maintain viable populations of cliff- or pool-dwelling organisms. Furthermore, it is not known whether the historic, regulated minimum flows have caused contraction or extirpation of such organisms.

KEA – Fish Communities

Indicator – Fish Species Richness

Current Condition - Good

The Salmon River Falls represents the natural upper limit of salmonine migration in the watershed. Currently the upper limit to migration is the dam at the Lighthouse Hill Reservoir, located two miles downstream. Therefore all immigrating individuals to the fish community within the Bypass Reach are from the stocked or natural populations within the Lighthouse Hill Reservoir and its tributaries. No stocking occurs within this section of river and it is not managed as a fishery.

KEA – Plant Communities

Sawchuck (2006) described four, and Howard (2006) an additional two plant community types within the Salmon River Gorge (Figure 35):

- ❖ northern hardwood forest
- ❖ hemlock forest
- ❖ shale talus slope woodlands (S3)
- ❖ shale cliff and talus community (S3)
- ❖ calcareous cliff community (S3S4)
- ❖ calcareous shoreline outcrop (S2)

Of these community types, the talus slope and the shale cliff/talus communities have been classified as unique communities by the New York Natural Heritage Program (Edinger et al. 2002) with a state ranking of S3 (typically 21-100 occurrences of limited acreage). The calcareous shoreline outcrop is ranked S2 (< 20 occurrences or demonstrably vulnerable).

*Indicator – Unique Native Plant Community Composition**Current Condition – Calcareous Cliff Community, Good*

These communities are small, but they occur in a contained and protected landscape (Howard 2006).

Current Condition – Calcareous Shoreline Outcrop, Good

These communities have high species richness and occur in a protected landscape. Some consideration should be given to range of variation in water flow over the falls and the extent to which this influences community composition (Howard 2006).

Current Condition – Shale Cliff and Talus Communities, Good

The community has high species richness, is in a protected landscape and is inaccessible (Howard 2006).

Current Condition – Shale Talus Slope Woodland, Good

Howard (2006) rated the occurrence of this community type at this location.

*Indicator – Threatened Species Population Densities**Current Condition - Good*

Two state-protected plant species occur within the shale cliff and talus communities of the Salmon River gorge: yellow mountain saxifrage (*Saxifraga aizoides*) and birds-eye primrose (*Primula mistassinica*). No long-term data are available on these species, but monitoring is planned as part of the Unique Area Unit Management Plan. These species are known to have persisted here for several decades and given the state management of the cliff communities, there appears to be good possibilities for long-term success. Impacts of ice climbing are of potential concern for these species since ice formations occur along the shaded cliffs that these species occupy.

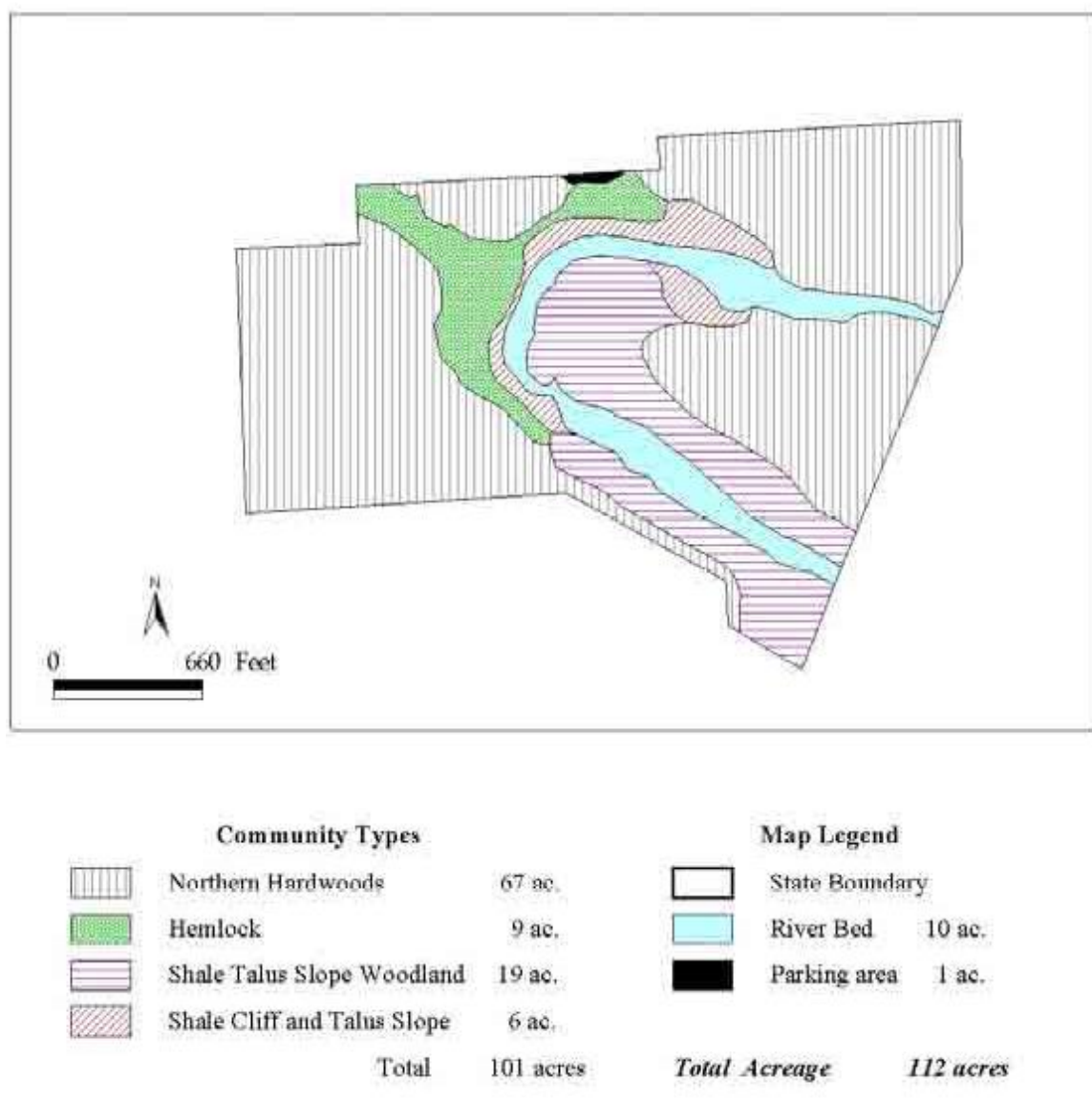


Figure 35. Salmon River Gorge plant communities (from Sawchuck 2006).

*Indicator – Invasive Species Cover or Frequencies**Current Condition – Good*

No invasive plant species were reported in the Unit Management Plan to occur in the Unique Area (Sawchuck 2006) but it is unclear whether a systematic search for invasives had been conducted. The area abuts a paved road and trails are being developed in certain areas of the unit. Therefore, potential exists for the establishment and spread of invasive plants.

OTHER STEEP SLOPE COMMUNITIES**KEAs and Indicators of Steep Slope Communities and Species**

In addition to the Gorge, numerous other less prominent areas are known or are likely to exist in the watershed that provide for unique combinations of habitats such as exposed bedrock (shale, sandstone or limestone), moist and shaded microenvironments, and talus slopes. Locations that have unusual or locally uncommon combinations of environmental conditions provide habitat for rare species.

Several GIS analyses were conducted in an effort to make a first approximation of the potential locations for steep slope communities or rare biological element occurrences within the watershed (Howard 2006). At this time, limited data are available with which to build these element distribution models, and most have not been extensively ground-truthed. Therefore it is likely that the accuracy of these models is limited. Even still, these analyses provide a starting point for identifying potentially locations of rare outcrop and steep slope communities, and rare species such as yellow mountain-saxifrage, birds-eye primrose, smooth cliff brake, alpine cliff fern. There is currently no information, with the exception of the element distribution models, on the actual distribution, community composition and viability ranking of the other steep slope communities in the watershed.

Salmon River Gorge & Steep Slopes Viability Summary

Notes on Guidance for Current Condition:	“NG”	No guidance was obtained to rank this indicator
	“SGR”	Subjective guidance based on professional opinion
	“ND”	No data available to rank this indicator, although guidance is available

	<u>Excellent</u>	<u>Good</u>	<u>Fair</u>	<u>Poor</u>	<u>Current Condition</u>	<u>Notes</u>
Gorge						
KEA – Condition - Water Flow						
<i>Ind. - frequency of low flow volume</i>					unranked	NG
KEA – Condition - Fish Community						
<i>Ind. - Fish species richness (% of lower Main Branch)</i>		>90	90-75	<75	100% Good	SGR
KEA – Condition - Plant Community Composition						
<i>Ind. - Native Plant Community Composition</i>						
<i>Calcareous cliff community</i>					Good	SGR, Howard (2006)
<i>Calcareous shoreline outcrop</i>					Good	SGR, Howard (2006)
<i>Shale cliff and talus community</i>					Good	SGR, Howard (2006)
<i>Shale talus slope woodland</i>					Good	SGR, Howard (2006)
<i>Ind. - Threatened Species Populations</i>						
<i>yellow mountain saxifrage</i>					Good	SGR, Howard (2006)
<i>birds-eye primrose</i>					Good	SGR, Howard (2006)
<i>Ind. - Invasive Plant Species Frequency & Dominance</i>	0	<5	5-25	>25	Good	Drake et al. (2003)

Other Steep Slopes

No quantitative information exists on the distribution, composition and viability of other steep slope communities within the watershed

E. Trends and Projected Cumulative Impacts

Population Growth and Land Use

The Salmon River watershed is located within the 4.3 million-acre Southeast Lake Ontario Basin, which spans the area from Stony Creek, southward and westward to Rochester and includes the Great Lakes Plain, the Finger Lakes, the Tug Hill, and the Syracuse metropolitan area. There are about 1.3 million people living in the basin, about 45% of which live in and around Syracuse. The region's population growth rate has been near zero over the past 40 years and has been negative over the past decade. Population decline is expected to continue into the near future (NYSDEC 2006a). Similarly, the population growth of the Northeastern Lake Ontario & St. Lawrence watershed, which begins just north of the study area and possesses a rural character much like the Salmon River watershed has been very low for more than a century (Figure 36).

For the four counties in which the Salmon River watershed is located, Lewis and Oneida have experienced recent population declines of 1% and 0.6% between 2000 and 2006, while populations have grown 2.3% and 0.6% in Jefferson and Oswego Counties (Table 4). The Jefferson County growth rate is greater than the overall growth rate for New York (1.7%). Population densities of the four counties range from 21/sq. mile (Lewis) to 194/sq. mile (Oneida). Population density for the whole of New York is 402/sq. mile. The median household incomes in each of the four counties is below the state-wide median income, but poverty levels for these counties are also below the state-wide level (US Census Bureau, 2007a).

The total percentage of developed land in the Southeast Lake Ontario Basin other than agriculture is 5% (NYSDEC 2006a). In comparison, developed lands comprise approximately 1.5% of the Salmon River watershed area. In the lower, western sub-watersheds, 2.8% of the land base is developed. The watershed maintains among the most rural conditions of the southeast Lake Ontario region.

However, it is not expected that population declines will lead to slowing of habitat loss by human development. For example, even though there was a loss of 6,500 residents in central New York between 1982 and 1997, 100,000 acres became urbanized in the region during that same timeframe (Pendall 2003). Rural development and land conversion closely track subdivision (greater numbers of smaller properties brought about by subdivision) trends. In the Salmon River Watershed, subdivision pressures are greatest within the western sub-watersheds (Figure 37). Recent interest in large-scale development plans for retail, tourism and research in the northern Syracuse metropolitan area may lead to increased housing and development pressures northward along the Interstate 81 corridor toward Pulaski.

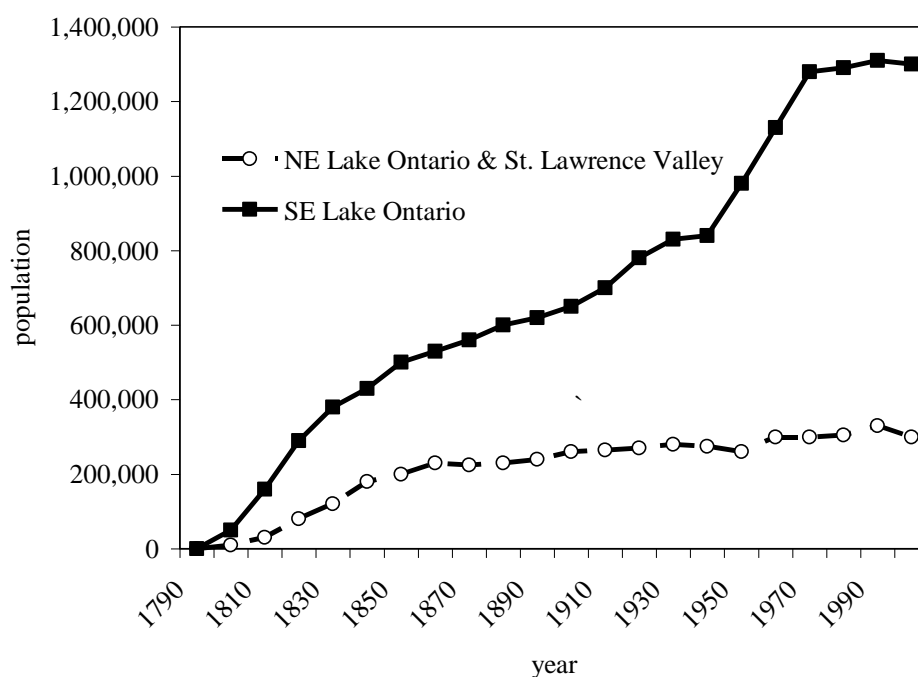


Figure 36. Long-term population trends in northwestern New York (Source: US Census Bureau)

Table 4. Population statistics for counties of the Salmon River Watershed (US Census Bureau 2007a).

	population 2006	population change (%) 2000-2006	population density (#/sq mi) 2000	median household income 2004	population (%) below poverty level 2004
New York State	19,306,200	1.7	402	\$45,300	14.5
County					
Jefferson	114,300	2.3	88	\$35,500	13.9
Lewis	26,700	-1.0	21	\$36,000	12.8
Oneida	234,000	-0.6	194	\$37,300	13.6
Oswego	123,100	0.6	128	\$39,200	13.6

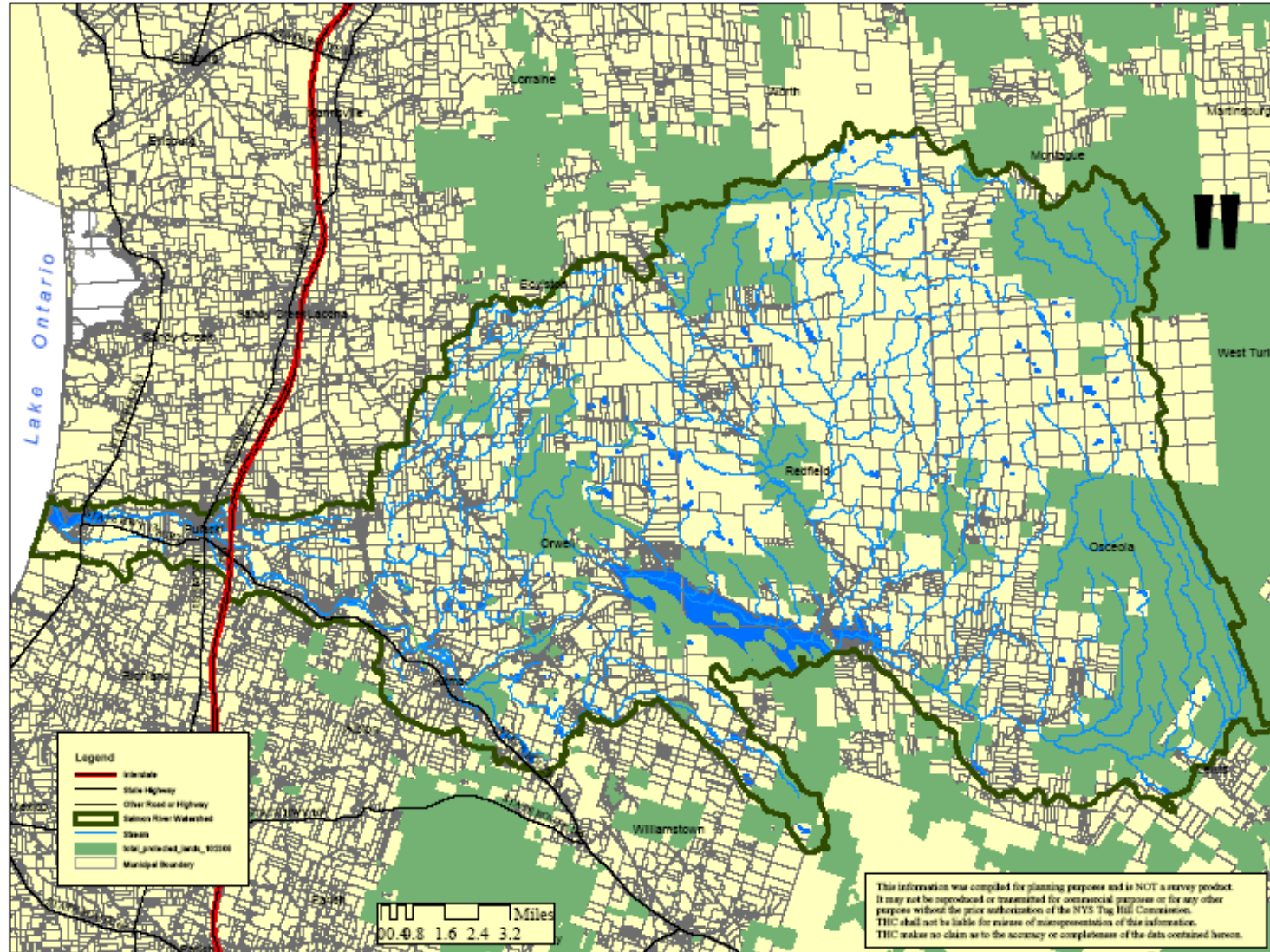


Figure 37. Property parcel map of the Salmon River Watershed (2001).

National trends in the decline of the family farm and agricultural land use are partially reflected in the four counties of the Salmon River watershed (Table 5). The number of farms in the four counties declined between 1997 and 2002, while the average size of farms and total agricultural production increased during this time period. Total farmland area declined in Oswego and Oneida Counties, but increased in Jefferson and Lewis (US Census Bureau 2007b).

Table 5. Agriculture statistics for counties of the Salmon River Watershed (US Census Bureau 2007b).

	number of farms		farmland area (ac)		average farm size (ac)		total value of farm products (\$)	
	1997	2002	1997	2002	1997	2002	1997	2002
Jefferson	1,042	1,028	298,322	330,561	286	322	76,343,000	99,952,000
Lewis	731	721	194,860	196,774	267	273	62,357,000	72,178,000
Oneida	1,113	1,087	229,888	220,486	207	203	75,263,000	78,370,000
Oswego	737	682	109,232	103,156	148	151	34,013,000	31,526,000
TOTAL	3,623	3,518	832,302	850,977	227	237	247,976,000	282,026,000

Fisheries

The Salmon River was purportedly among the most productive native salmon-producing tributaries to Lake Ontario prior to the late 19th century, but abuses occurring in both the lake and within the watershed greatly altered the fishery resource of the river prior to the 1900s. Lake Ontario originally supported two top predatory fish species; the Atlantic salmon (*Salmo salar*) and the lake trout (*Salvelinus namaycush*). A number of factors led to the collapse of these species' populations, including over-fishing, loss or alteration of spawning habitat within the tributaries (for migratory Atlantic salmon), and inhibition of spawning migrations by dam construction. For instance, on the Salmon River, the fishery showed a record of decline between 1810 and 1900, and especially following the 1837 construction of a dam just west of Pulaski (New York Conservation Department 1939). Another factor causing the decline of Atlantic salmon was the introduction of alewife (*Alosa pseudoharengus*) to Lake Ontario. Alewives are rich in the enzyme thiaminase, which breaks down thiamine; when Atlantic salmon feed on this species they experience thiamine deficiencies, which result in reproductive failure of developing embryos. The eventual loss of predatory fish in the Great Lakes led to an overpopulation of alewives and rainbow smelt (*Osmerus mordax*), and in order to reestablish predatory control in Lake Ontario, Pacific salmon (Chinook salmon, *Oncorhynchus tshawytscha*; coho salmon, *Oncorhynchus kisutch*) were stocked in the late 1960s and early 1970s (see Coughlin 2004 and Everitt 2006 for reviews).

The Pacific salmonines have shown excellent growth and reproductive capacity in some tributaries of the Great Lakes, including the Salmon River. By the early 1980s, natural reproduction of Pacific salmonines was documented in the Salmon River system (Johnson 1978; Johnson and Ringler 1981), and within a decade this system was

estimated to be the leading Lake Ontario tributary for naturally spawned salmon (Wildridge 1990).

Excellent juvenile habitat and barrier-free spawning routes within the Salmon River watershed would permit reintroduction of Atlantic salmon. Based on a recent analysis using introduced rainbow trout (*Oncorhynchus mykiss*), which has similar habitat requirements as Atlantic salmon, as a surrogate, abundant spawning and juvenile habitat exist for Atlantic Salmon within the watershed (McKenna and Johnson 2005). Furthermore, some experimental evidence indicates that Atlantic salmon are more competitive than rainbow trout under slightly warmer water temperatures ($>20^{\circ}\text{C}$), while rainbow trout are more competitive in slightly colder waters. Therefore, potential may exist for co-occurrence of these species within the watershed (Coughlin 2004). However, the continued presence of alewife within the Great Lakes system would likely continue to limit the ability of Atlantic salmon to establish a self-sustaining population. Fisheries management within the watershed continues to focus on maintenance of Pacific salmonines and other game fish in the lower sub-watershed; cold-water trout (brook and brown) in upper sub-watersheds; and warm-water fisheries in the freshwater estuary and reservoirs.

Recreation

Outdoor recreation is a vital component of the economy in the watershed, as well as the greater Tug Hill region. Recreational opportunities include hunting, trapping, fishing, hiking, camping and nature study. Many individuals canoe on the region's small open waters and calm streams, boat from Port Ontario, and rafting on the Salmon River when recreational releases of water from the reservoirs permit. The region's lake-effect snows are enjoyed by many who snowmobile, snowshoe and cross-country ski. Off road use of all-terrain-vehicles and mountain bikes is promoted by many towns and businesses in the area, and visitation of riders has steadily increased over the past decade.

Wetlands

The finest resolution regarding trends in wetland area in New York is provided at the broad, eco-regional scale (Huffman and Associates, 2000). The Salmon River watershed spans two of these eco-regions, the Lake Plain and Appalachian Highlands. Total wetland area has remained relatively stable in these two eco-regions between the mid-1980s and mid-1990s. However, emergent and shrub-dominated wetland area has declined, while forested wetlands and open waters have increased in area (Table 6).

Table 6. Change in wetland area in Lake Plain and Appalachian Highland ecoregions of New York (Huffman and Associates, 2000).

Wetland type	time period	Lake Plain		Appalachian Highlands	
		area (ac)	% change	area (ac)	% change
forested	1980s	592,000	7	244,000	7
	1990s	631,000		261,000	
shrub	1980s	219,000	-8	103,000	-5
	1990s	201,000		98,000	
emergent	1980s	93,000	-16	67,000	-24
	1990s	78,000		51,000	
open water	1980s	21,000	52	29,000	24
	1990s	32,000		36,000	
Total	1980s	925,000	2	443,000	1
	1990s	942,000		446,000	

Forest Resources

The forest resources of the greater Tug Hill region are vital to the economic viability and cultural heritage of the region. They contribute more than \$200 million and 7,000 jobs to the region through timber harvesting, wood and paper products manufacturing, recreation (hunting, snowmobiling) and sugar maple production (New York State Tug Hill Commission 2002).

The current structure and composition of forests in the Salmon River watershed, like most forest landscapes across the Northeast, have resulted from agricultural land use, logging and settlement of the past century. Stout (1958) and Hotchkiss (1932) report that forest composition at the time of European settlement was characterized by northern hardwoods (American beech, sugar maple, yellow birch) with an abundant mix of red spruce, eastern white pine, eastern hemlock, balsam fir and tamarack (primarily on lower slopes and swamp edges). In the transitional Tug Hill fringe, northern hardwoods dominated with hemlock, white pine, and some spruce restricted to stream sides and ravines. Logging for softwoods began late in the 19th century and, as transportation capacity improved (e.g., Glenfield & Western Railroad), hardwoods began to be extracted. Widespread selective cutting resulted in increased dominance of red maple on many sites by the mid-1950s (Stout 1958). As is the case in all forest types in the Northeast, continued selective cutting on some forestlands in the region has reduced the abundance of large-diameter trees below those levels expected under natural conditions

and under prescription for sustainable production of large sawtimber (McGee unpublished data, Arbogast 1957, Bohn and Nyland 2006).

By the late 19th forest clearing to support subsistence agriculture peaked in central and northern New York. In the Southeast Lake Ontario basin, 90% of the land was in agricultural use (NYSDEC 2006a). Agricultural history in the lower, more fertile western portion of the Salmon River watershed likely reflects that of the broader region. However, agriculture was never attempted in much of the higher elevations in the eastern watershed. At the turn of the 20th century, widespread abandonment of marginal agricultural sites around the Tug Hill fringe resulted in the establishment of successional hardwood stands (primarily red maple and cherry), and the planting of numerous conifer plantations on NY State Reforestation Areas (Stout 1958).

F. Threats

THREAT IDENTIFICATION

On May 4, 2007, a day-long public workshop was held in Pulaski to develop an understanding of the existing and potential factors that may negatively impact the quality of the natural resources in the Salmon River Watershed (Forester 2007b; Appendix 2).

The participants of this workshop were charged with the following tasks:

- identify activities and conditions that negatively affect the long- and short-term viability of each of the conservation targets in the watershed;
- develop an understanding of the causal factors influencing the level of each threat; and
- rank the significance of each threat with respect to each target based upon its
 - scope (how widespread the threat currently is or is likely to be in 10 years);
 - intensity (the magnitude of the impact where the threat is present); and
 - irreversibility (the difficulty in abating the threat and restoring the natural resource).

The results of these ranking process were combined to give each threat a single, qualitative rank, “very high,” “high,” “medium” or “low,” for its impact on a specific natural resource target. Rankings were then combined across all targets to identify the most critical threats to the natural resources of the Salmon River watershed.

Through this process, the following seven general threat categories (listed in order of their significance), having negative impacts on multiple targets and/or having substantial impacts on the targets they do affect, were identified. These general threats each had several more specific threats included within them (see Table 7).

- Invasive Species
- Regional/Global Issues
- Altered Hydrology
- Land Cover/Land Use Change
- Physical Habitat Disturbance
- Pollution and Sedimentation
- Pests/Pathogens/Diseases

Table 7. Summary of threat rankings for the Salmon River Watershed. Specific threats identified by workshop participants for each of the seven watershed conservation targets are listed under seven general threat categories. Qualitative threat rankings (Very High, High, Medium, Low, or if blank, no perceived threat) were determined by workshop participants for each of the specific threats under each target. The Summed Rank is a unit-less value that sums the overall perception of all workshop groups of importance of each general threat category – the value should be used only for general comparison purposes.

General Threat Category	Specific Threats	Summed Rank	Main Stem & Major Tributaries	Head-waters	Steep Slopes & Gorge	Open Waters	Non-estuarine Wetlands	Fresh-water Estuary	Matrix Forest
<u>Invasive Species</u>		63	VH	M	H	H	H	VH	M
	Invasive Species			M		H	H	VH	M
	Terrestrial Invasive Species		VH		H				
	Aquatic Invasive Species		M		M				
<u>Regional / Global Issues</u>		53	H	VH		VH	VH	H	H
	Atmospheric Deposition		H			VH	VH		
	Temperature Change		H	VH		M	L		
	Climate Change							H	H
<u>Altered Hydrology</u>		48	H	VH	H	M	H	H	
	River Flow Alteration							M	
	Change in Base Flow		M						
	Bypass Baseflow				M				
	Lack of Groundwater Discharge			M					
	Temperature Change		H	VH		M	L		
	Altered Hydrology		H	L	H	M	H	H	

Table 7, continued. Summary of threat rankings for the Salmon River Watershed.

General Category	Specific Threats	Summed Rank	Main Stem & Major Tributaries	Head-waters	Steep Slopes & Gorge	Open Waters	Non-Estuarine Wetlands	Fresh-water Estuary	Matrix Forests
<u>Land Cover / Land Use Change</u>		43	H	VH	M		H	VH	H
	Land Use Change								H
	Land Cover Change		H						
	Vegetation Cover				M				
	Physical Habitat Disturbance						H		
	Habitat Fragmentation							VH	M
	Temperature Change		H	VH		M	L		
	Removal of Riparian Vegetation		H						
<u>Physical Habitat Disturbance</u>		42	H	VH	H	M	M		
	Loss of Soil/Habitat				H				
	Beavers		H			M	M		
	Habitat Changes			H					
	Temperature Change		H	VH		M	L		
	Physical Stream Impacts			M					
<u>Pollution and Sedimentation</u>		39	H	M		H	H	M	
	Non-Point Source Pollution					H	H		
	Pollution							M	
	Increased Nutrient Loading		M						
	Sedimentation		H	M					
	Towns		H					M	
<u>Pests / Pathogens / Diseases</u>		28	H					VH	M
	Pests / Pathogens / Diseases							VH	M
	Fish Disease		H						

SUMMARY OF GENERAL THREAT CATEGORIES

The following text describes the current understanding of how the seven critical threats are known or suspected of impacting the respective conservation targets of the Salmon River watershed.

Invasive Species

Invasive species are those non-native, terrestrial or aquatic, plant or animal species that, after establishing within a natural community, becomes so dominant that it reduces the diversity of native species. Terrestrial and aquatic invasive species were recognized as threats to all seven natural resource targets in the watershed. Invasive species were considered a very high threat to the main stem of the Salmon River, and the freshwater estuary.

Potentially invasive plant species that are currently present in the freshwater estuary and along the main branch and major tributaries include purple loosestrife (*Lythrum salicaria*), Eurasian milfoil (*Myriophyllum spicatum*), curly pondweed (*Potamogeton crispus*), European frog-bit (*Hydrocharis morsus-ranae*) and knotweed (*Polygonum cuspidatum*). Potentially invasive fish species in the watershed include sea lamprey (*Petromyzon marinus*) and common carp (*Cyprinus carpio*).

Invasive species were perceived as high threats to steep slopes, open waters and wetlands. The plant species listed above for the Main Stem and freshwater estuary may pose threats to all wetland systems, headwaters and open waters. Eurasian milfoil and purple loosestrife are known to occur in the Redfield Reservoir. Sea lamprey and carp are currently known to occur only in the lower sub-watersheds, and their migration to upper sub-watersheds is inhibited by the dam at Lighthouse Hill Reservoir and the Salmon River Falls.

Participants recognized invasive species as a medium threat to headwater streams and matrix forest. Brown-headed cowbirds (*Molothrus ater*) are known to occur in the majority of survey blocks in both the upper and lower sub-watersheds, but occur more frequently in the lower, western sub-watersheds. A number of terrestrial invasive vascular plant species are known to occur in the watershed, but none have been dominant components of any reported floristic surveys in the watershed – these species include: garlic mustard (*Alliaria petiolata*), purple loosestrife (*Lythrum salicaria*), common reed grass (*Phragmites australis*), Japanese knotweed, common and smooth buckthorn (*Rhamnus cathartica*, *R. frangula*), black locust (*Robinia pseudoacacia*) and black swallowwort (*Vincetoxicum nigrum*). Other terrestrial invasive plants that likely occur in the watershed that have not been reported include Russian and autumn olive (*Elaeagnus angustifolia*, *E. umbellata*), fly and Tatarian honeysuckle (*Lonicera morrowii*, *L. tatarica*), and white sweet-clover (*Melilotus alba*). Other native species for which concern has been expressed due to their competitiveness and increasing abundance

include hay-scented fern (*Dennstaedtia punctilobula*), New York fern (*Thelypteris noveboracensis*) and red maple (*Acer rubrum*).

Regional/Global Issues

The regional global/issues represent threats that originate outside of the Salmon River watershed, but that impact the natural resources of the watershed. Regional/global issues were not identified as threats to the steep slopes conservation targets, but were rated very high threats to headwater streams, open water and wetlands, and as high threats to the main stem, freshwater estuary, and matrix forests.

These threats include the following.

- Atmospheric deposition of acid, nitrogen and mercury: The Tug Hill region receives some of the highest rates of nitrogen and acid deposition in North America (Figure 31). Natural buffering capacity of the region's soils appears to provide a degree of resilience to the detrimental effects of acidic deposition on the watershed's aquatic communities. The region's headwater streams, and forest soils and vegetation are showing signs of excessive nitrogen deposition and accumulation, indicating the potential for future declines in forest health and productivity. Given the high rate of acid and nitrogen deposition to the region, mercury deposition is also speculated to be high here. Furthermore, since mercury becomes biologically available and toxic under conditions common to wetlands (saturated, low oxygen, high organics), and given the abundance of wetlands in the watershed, mercury may pose a substantial, but yet unknown, threat to the watershed's biota.
- Mercury and PCB contamination of migratory fish in Lake Ontario: Contamination of the watershed's fish and other aquatic and semi-aquatic wildlife by mercury and PCBs may also be due to sources in and around Lake Ontario. This contamination can enter the watershed by migratory fish returning to the watershed from Lake Ontario. Fish consumption advisories for PCBs continue to be issued by the State of New York for some game fish in the lower Salmon River, including the freshwater estuary.
- Global climate change: Global climate change will have unknown consequences for the terrestrial and aquatic communities of the watershed. Possible effects include altered regional precipitation patterns that will, in turn, influence the hydrologic regime of the streams, wetlands and open waters of the watershed; and overall warming of surface water and soil that may cause large-scale changes in plant, animal and microbial communities. The capacity of the watershed's terrestrial and aquatic communities to respond to global change may be hindered by features that isolate the watershed's resources from other relatively intact regional communities. The matrix forest of the upper sub-watersheds is contiguous with the greater Tug Hill forest, but this is largely isolated from other regional forests by agricultural lands in the Black River Valley and by agriculture

and urbanization in the Mohawk Valley. Matrix forest of the lower sub-watershed is embedded within the highly fragmented agricultural landscape of the Ontario Lake Plain. Functional wildlife migration corridors (i.e., 300-ft-wide) along naturally vegetated riparian zones are disrupted in several locations in the lower sub-watersheds. While the aquatic communities of the lower sub-watersheds have connections with the Great Lakes systems, the upper sub-watersheds are isolated by the Lighthouse Hill Reservoir Dam and by the Salmon River Falls.

- Water level regulation of Lake Ontario (for the freshwater estuary): The stabilization of Lake Ontario water levels in the 1950s to facilitate shipping traffic through the St. Lawrence River has reduced variation in plant community types in coastal marsh communities along the lake including the Salmon River freshwater estuary. This has caused a 50% reduction in meadow marsh and emergent-floating vegetation within the Lake Ontario wetland systems, as well as a reduction in the variety of marsh communities. These changes, in turn, reduce the habitat availability for marsh-dwelling birds, reptiles and amphibians, and fish.

Altered Hydrology

Altered hydrology is a broad threat related to changes in the volume, variability and seasonality of surface water flow and groundwater that influence the availability and quality (substrate type, water temperature) of in-stream habitat. Altered hydrology was not considered a threat to the matrix forest, but was ranked a very high threat to headwater streams; a high threat to the main stem of the Salmon River, steep slopes (especially for the Salmon River Gorge), wetlands and the freshwater estuary; and a medium threat to open waters.

Specific threats associated with altered hydrology include the following.

- Reduced baseflow in headwaters and high order streams: Baseflow represents water present in stream channels that is provided by groundwater (especially during low-flow periods); is impounded and slowly released on a more or less continuous basis from wetland systems; or is the regulated discharge released from the reservoirs under the FERC license agreement (this influences only the Bypass Reach and lower reaches of the Salmon River). Baseflow in the lower reaches of the Salmon River is well regulated by discharge from the reservoirs, but the other major tributaries to the Salmon River are subject to baseflow fluctuations caused by natural variation groundwater recharge (which may be subject to future change by global climate change) as well as by municipal and industrial water withdrawals. The high quality fisheries and aquatic communities of most major tributaries and headwaters require adequate baseflow to maintain water coverage across their channels for habitat, especially during dry summer months. Native and stocked trout species require cold groundwater recharge into streams for successful spawning beds. Cold groundwater discharge into streambeds helps to maintain adequate temperatures for sustaining cold water fish

and associated invertebrates through summer months. This cold water remains important as it discharges into the freshwater estuary and regulates water temperature there. These important stream habitat qualities are sensitive to degradation if future industrial, municipal and residential groundwater withdrawal becomes excessive. The abundant wetlands within the watershed (many of which are created and maintained by beaver activity) serve to maintain baseflow discharges in the headwaters during dry summer months. However, tree mortality caused by flooding of riparian forest vegetation by beavers reduces streamside shading, thereby causing localized increases in water temperature that may be detrimental to cold water fish species.

- Variability in surface water discharge: Variability in surface water discharge produces variation in substrate conditions (e.g., amount of gravel and boulders on stream beds) and maintains natural stream meanders while not causing excessive stream bank erosion.
- Increase in surface water temperatures brought about by lack of riparian buffers: Stream water temperature is also greatly influenced by the amount of shade provided by overhanging riparian vegetation. The lack of riparian vegetation along some high-order stream reaches in the agricultural and urbanized western sub-watersheds can cause stream bed substrate will heat up on sunny summer days, sometimes to levels that threaten many aquatic organisms. Removal of riparian cover by logging remains a constant but uncommon threat to aquatic communities in the watershed. It is especially important during low baseflow periods to maintain shaded conditions above pools that provide refuge for aquatic organisms. Excessive beaver activity may also lead to an imbalance in the availability of cold, fast-flowing headwater streams.
- Maintenance of wetland area and saturation levels: Loss of wetland area due to drainage and filling threatens the hydrologic functions and biodiversity provided by these systems. The greatest development and agricultural pressures on wetland habitat are in the western, lower sub-watersheds, while wetland area has likely increased in recent decades following agricultural abandonment in the more forested upper sub-watersheds.

Land Cover/Land Use Changes

Land cover/land use change is a broad threat category that includes loss of habitat and fragmentation of remaining habitat through removal of natural vegetation. This was ranked as a very high threat to headwater streams and the freshwater estuary; a high threat to the main stem of the Salmon River, wetlands and the matrix forest; and a medium threat to steep slopes. It was not identified as a threat to open waters.

The most important cause of habitat loss is sprawling patterns of land conversion to residential and commercial uses. Even though the overall population of the Southeast Lake Ontario Basin has not increased over the last 50 years, and current estimations are

for a continuation of that trend, sprawling development continues to cause irreversible conversion of the land base, increases in impervious cover (which in turn increases runoff and non-point source pollution) and fragmentation by roads and utility rights-of-way. Areas for which greatest concern has been expressed over uncontrolled future development include Pulaski, Orwell, the Salmon River Corridor from Redfield to Port Ontario, and shorelines of the Redfield and Lighthouse Hill Reservoirs.

Habitat fragmentation poses a significant threat to terrestrial and aquatic communities by providing corridors for dispersal and establishment of invasive species, and by hindering the movement of dispersal-limited plants and wildlife among suitable habitat patches. Many birds, mammals and amphibians utilize natural vegetation within riparian corridors (up to 540 ft wide) movement and migration. Past agricultural and residential land conversion, especially in the western sub-watersheds, has eliminated functional riparian corridors along many reaches of headwater (Figure 28) and high-order streams (Figure 26). Furthermore, roads that traverse riparian buffers (Figure 32) are known to cause substantial mortality to migrating amphibians and reptiles, and isolate breeding populations of these animals. The north and east shores of the freshwater estuary are nearly completely isolated by residential development, agriculture and roads (Figure 21). At a broader, regional scale, the whole of the Tug Hill is completely isolated from other large habitat blocks by agricultural land use and urbanization (Figure 33).

Dams and culverts and road crossings serve as fragmenting features for many aquatic and semi-aquatic organisms in the watershed. Stream crossings average 0.72 per stream mile in lower sub-watersheds and 0.35 per stream mile in upper sub-watersheds (Figure 25). Migration capacities of aquatic organisms are potentially more impaired by dams (Figure 25) at the lower sub-watersheds (average dam density = 0.07/mile) than at the upper sub-watersheds (average = 0.03/mile).

Physical habitat disturbance

Physical habitat disturbance occurs when the soil or vegetation is disturbed or the basic structure of the habitat is altered (but not lost) due to human or natural disturbances. Physical habitat disturbances were ranked as very high threats to headwater streams, high threats to the main stem Salmon River and steep slope communities, and medium threats to open waters and wetlands.

Disruption of riparian vegetation and soils along headwater and higher-order streams leads to increased water temperature and degradation of aquatic habitat due to erosion and sedimentation. Sources of streamside soil disturbance include ATVs, livestock, over-use by anglers. Flooding from beaver activities also disturbs natural vegetation.

Pollution and sedimentation

Pollution and sedimentation includes all point and non-point sources of nutrients, toxins, and other forms of pollutions as well as erosion, run-off and other types of sedimentation. Pollution and sedimentation was identified as a high threat to the main stem of the

Salmon River, open waters, and wetlands, and a medium threat to the freshwater estuary and headwater streams.

Four facilities within the Salmon River watershed are permitted point sources of pollutant discharges through the National Pollution Discharge Elimination System (NPDES) water discharge or USEPA Toxic Release Inventory (TRI) programs. All facilities discharge into the lower Salmon River (Figure 24).

- Felix Schoeller Technical Papers: permitted for temperature, turbidity, biological oxygen demand (BOD), pH, total suspended and settleable solids, phosphorus, and aluminum. Toxic releases from this facility have declined from 976,580 lb in 1987 to 380 lb in 2005. The facility has not been out of compliance with discharge schedules since 1991.
- Pulaski Sewage Treatment Plant: permitted for temperature, BOD, pH, total suspended solids, settleable solids, phosphorus, chlorine, and fecal coliform. The last violation of NPDES permit requirements for this facility was December 2002.
- New York State Fish Hatchery: permitted for hydrogen peroxide, terramycin, formalin, diquat product, chloramine, chloride, pH, BOD, temperature, suspended and settleable solids, ammonia, phosphorus, potassium permanganate. The last violation of NPDES permit requirements for this facility was May 2004.
- Pulaski Ford and Mercury: NPDES permit is on record, but no other permit documents were found for this facility.

Agriculture, especially in the lower, western sub-watersheds, represents one important non-point source of nutrients such as phosphorus and nitrogen. The lack of adequate (100-ft-wide) vegetated buffers along headwater (Figure 27) and higher-order streams (Figure 22) in some locations of the western sub-watersheds contributes to runoff, sedimentation and nutrient loading of streams there. Other important non-point sources of pollution and sedimentation include poorly functioning septic systems, runoff from urbanized areas, and forestry operations that do not meet recognized best management practices for maintaining water quality.

Pests, Pathogens and Diseases

There may be some overlap between pest/pathogens/diseases (PPDs) and invasive species, but typically invasive species efforts have not focused extensively on PPDs. In addition, PPDs can include native as well as exotic species. Threats posed by PPDs were ranked very high in the freshwater estuary, high for the main stem of the Salmon River and medium for the matrix forest target.

The following pests, pathogens and diseases currently pose important threats to fisheries of the freshwater estuary and high-order streams of the western sub-watersheds, and to regional wetlands.

- Perhaps the most serious pathogen currently threatening the watershed's fisheries is viral hemorrhagic septacemia (VHS). This disease, which has spread into the Great Lakes, but is not yet known to occur in the Salmon River, targets fish such as walleye, perch, minnows and gobes.
- Type E Botulism has affected affect fish-eating shore birds in the Great Lakes since 1999 (NYSDEC 2006), and an outbreak recently affected gulls, grebes and loons along the southern and eastern shores of Lake Ontario. No birds within the Salmon River's freshwater estuary have yet been observed with the disease.
- Other diseases being monitored by regional fisheries managers include Bacterial Kidney Disease (BKD), Furnunculosis, Infectious Pancreatic Necrosis (IPN), and Enteric Redmouth Disease (ERM).
- The viburnum leaf beetle (*Pyrrhalta viburni*) is a non-native insect defoliator that stands to devastate arrow-wood, which is a dominant shrub in regional wetlands.

The following pests, pathogens and diseases currently pose important threats to the region's forests.

- The beech bark disease complex has substantially altered regional forest structure and composition. Beech bark disease is caused by the fungi *Nectria* spp., preceded by the beech scale *Cryptococcus fagisuga* on American beech. The complex causes above-ground mortality to pole and sawtimber size beech trees, and promotes root sprouting from the surviving root systems. Understory dominance by beech saplings is exacerbated by past and ongoing selective harvests that increase beech dominance in impacted stands. The disease seriously complicates management options for sustaining yields of high quality wood products and for retaining wildlife value in affected forests.
- The sirex woodwasp (*Sirex noctilio*) has been confirmed in Oswego County and poses a serious threat to regional forests, especially state reforestation areas that contain white, red and Scots pine.
- The eastern (*Malacosoma americanum*) and forest (*Malacosoma disstria*) tent caterpillars are two important tree defoliators deciduous hardwood stands in New York. Hardwood stands in this part of New York normally experience some "background" level of defoliation every year, and native tree species are well adapted to it. However, severe outbreaks can cause periodic, extensive defoliation that can cause direct mortality to affected trees or predispose those trees to mortality by other agents such as drought. Poor forest management practices that leave the smallest and weakest trees in a stand can predispose the forest to increased mortality from subsequent defoliation.

- Other exotic forest pests that occur within the northeast that pose substantial threats to the watershed's forests include the emerald ash borer (*Agrilus planipennis*), Asian long horned beetle (*Anoplophora glabripennis*), and hemlock wooly adelgid (*Adelges tsugae*).

G. Priority Issues

Fishing Industry

The Salmon River watershed supports a world-class fishery for salmon, trout, warm water fish, and lake fish. Significant economic activity results from anglers visiting the watershed from outside the region, the state and the US. The regional fishing industry includes guide services, river and lake charters, fish cleaning, bait shops, restaurants and hotels. The fishing industry is active year-round to cater to salmon fishing in the lower reaches of the Main Stem and the major tributaries, trout fishing in the cold headwaters of the upper watershed, warm water bass fishing as well as ice fishing on the freshwater estuary and the reservoirs, and lake fishing from Port Ontario. Anglers are known to have different recreational fishing interests, with many visiting the watershed only to fish for salmon, or to fly-fish for trout, or to access Lake Ontario, etc. Many anglers seek the experience of fishing for native brook trout, and therefore interest exists in sustaining populations of naturally-reproducing, native trout. Much interest also exists to restore native Atlantic salmon populations to this and nearby watersheds. Substantial risks to the fishing industry are posed by fish pathogens, invasive fish (such as carp, gobies, lamprey). Other concerns that challenge long-term management of this productive and diverse fishery include potential over-fishing, stream bank destabilization and erosion due to excessive use, loss of public access on private lands, pollution and contamination by toxins, and surface water and groundwater withdrawals.

Forests and Forestry

The watershed possesses a working forest landscape that is vital to the local forest products industry. Forest lands include a mix of private (industrial; small, non-industrial; and NGO) and public (NY State forests, wildlife management units, and a few small satellite forest preserves) holdings. The extensive forest cover throughout the watershed is fundamental to sustaining the water quality and habitat that is necessary to maintain the region's fisheries and it contributes to the large, un-fragmented core forest landscape of the Tug Hill. Substantial concern has been expressed about the capacity for private woodland owners to continue holding forest lands in the face of rising property taxes, property tax policy that keeps landowners from managing forest land sustainably, and increasing land values brought about by subdivision, sprawling development and seasonal, second home development. Other concerns have been expressed for the long-term impacts of past, and to some extent ongoing, exploitive cutting on forest health and productivity, and on the ability of the region's woodlands to continue producing high quality and diverse wood products. Several forest pests and pathogens, and atmospheric deposition of nitrogen and acid represent potential stresses to the watershed's forests.

Tourism

Tourism is another important economic driver in the Salmon River Watershed. Apart from the fishing industry, which draws approximately 1/3 of all anglers from out-of-state, there are other important "traditional" recreational uses of the region's resources including hunting and trapping. Many hunting clubs include members who travel to the region from elsewhere. Other low-impact recreational uses of the watershed's resources include bird watching, hiking, cross-country skiing and snowshoeing. Periodic

recreational releases of water from the Lighthouse Hill Reservoir provide opportunities for whitewater rafting on the Salmon River. Travel and tourism jobs numbered over 5,900 in 2000, with 95% of those jobs being year-round, despite 63% of businesses being seasonal. According to the results of a feasibility study in the summer of 1999, snowmobile activity generated \$20 million of direct and indirect economic benefits to Oswego County each year. Emerging dynamics in the use of ATVs are creating new management challenges for water quality, wildlife and invasive species on private and state lands.

Wetlands

The substantial wetland areas in the Salmon River watershed provide important ecosystem and hydrogeological functions/benefits. They maintain rich biological diversity and provide habitat for many of the watershed's rare plant and animal species. They retain and slowly discharge surface and ground water into streams to maintain baseflow in the watershed stream network during dry summer months, and serve to filter surface waters to maintain high water quality. Their protection is critical in order to maintain the high quality fisheries and wildlife habitat of the region. However, wetlands also offer challenges to landowners who may be limited in the use of their properties that contain wetlands. Fragmentation of wetland systems and wetland buffers by roads and development offers further challenges to wildlife management. Recent increases in beaver populations following state-wide extirpation in the 19th century are causing changes in wetland community types and offer challenges to landowners and resource managers. Several invasive species also pose impending threats to the composition and diversity of many wetland systems, especially in areas of the watershed where dispersal vectors such as roads, ATVs, and boats, increase the rate of invasive species dispersal into wetlands.

Water Quality/Quantity

The Salmon River watershed possesses an abundant, but finite supply of freshwater due to high levels of lake effect precipitation, in combination with gentle topography that supports development of extensive wetland systems. This water recharges the Tug Hill Aquifer, which is a substantial groundwater source that, in turn, maintains baseflow in many headwater streams of the lower sub-watersheds; discharges cold spring water into streams, which is necessary for salmon and trout spawning; and serves as a residential, municipal, and industrial water source. Protection of the quantity and quality of the surface and groundwater resources in the watershed is paramount for ensuring long-term viability of the region's fisheries, communities and industry. Potential factors that would degrade the quality or reduce the quantity of water include unplanned and excessive consumption and diversions for residential, agricultural, commercial and industrial uses; degradation by pollution and sedimentation; and atmospheric deposition of acid, mercury and PCBs.

Open Space/Development/Rural Character

The Salmon River Watershed maintains a rural character with its handful of villages and hamlets set within agricultural and forested landscapes. Residents of the watershed share a desire to maintain the rural character of the region and the traditional uses of its natural

resources. This they desire while allowing for wise, directed economic growth because they realize that sustainable economic growth will depend on maintaining the character of region and the quality of the natural resources. Concern has been expressed regarding potential long-term impacts of recent subdivision trends and sprawling development in some communities in the watershed. Such changes pose threats to the character of the region through outright loss of open space, increased amounts of non-point source pollution, and increasing tax burdens associated with maintenance of new, widely scattered services. These increasing tax burdens, in turn, lead to management and ownership decisions by private and industrial land owners that diminish the capacity for long-term sustainability.

Regional Issues

A number of regional issues, for which residents of the watershed have no control, also pose existing or potential future threats to the quality and sustainability of the watersheds natural resources. The issues include global economy and trade, which exacerbates the dispersal of invasive species; global climate change, which is expected to alter the terrestrial and aquatic environments in unpredictable ways; and regional air pollution patterns that deposit acid, nitrogen and mercury, which may soon cause declines in forest productivity and wildlife populations.

Payment of Local Property Taxes on State-Owned Lands and Conservation Easement Properties

As this report was being finalized for printing, a new issue emerged via the court system. A challenge to the State's method of paying taxes to localities for state-owned lands and conservation easement holdings was upheld in western New York. A decision was issued in November 2007 from the State Supreme Court in Chautauqua County in a case of the State vs. Dillenburg that said that the State's method of paying taxes to localities for its properties is indeed haphazard, and ordered that all payments to localities by the State (including the Adirondacks) be halted and a comprehensive policy be developed. The decision was immediately stayed and appealed by the State. To date, no decision has emerged from the appeal.

Currently, only a legislative method is possible, where localities must work with their State legislative representatives to have their locality included in legislation allowing payments, such as in the State's Property Tax Law. This is how certain Tug Hill municipalities have attained tax revenue from the State for lands owned within their boundaries, owing to significant public land acreage. Should the State be ordered to stop all payments to municipalities currently receiving tax revenues on state-owned lands and conservation easement properties, several Tug Hill towns would be severely affected. For example, the public land in the Town of Montague, located in the northeast portion of the Salmon River watershed, comprises over 54% of the town's land area. Greater than 40% of the tax revenue received by the Town of Montague is received from the State of New York.

III. Strategies for Basin-Wide Implementation

On June 21, 2007, the third and final workshop in the Salmon River Watershed Restoration and Protection Strategy project was held in Altmar to develop plans for implementing conservation actions within the watershed (Forester 2007c; Appendix 3). Participants used data gathered in past workshops, including the situation diagrams developed in Workshop 2 (Forester 2007b; Appendix 2) illustrating the paths by which the various threats act on the targets, and their own expert knowledge for this work. Strategies were proposed to abate the seven critical threats identified in Workshop 2, and to maintain or enhance the current condition of the natural resource targets. The proposed strategies were further refined, clarified and synthesized by the project partners in several follow-up meetings.

The objectives and strategic actions to address the seven, respective critical threat are outlined below.

THREAT: ALTERED HYDROLOGY

Goal: Maintain local hydrology by sustaining long-term forest cover throughout the watershed at or above current levels.

Objective: Minimize subdivision (to no more than 10% of 2008 level) and encourage long-term land ownership over next five years in priority areas (e.g. Orwell; 1-mile-wide corridor along Salmon River from Redfield to Lake Ontario; reservoir shorelines; and the lower sub-watersheds (Orwell Brook, Beaverdam Brook-Meadow Creek, Trout Brook, Lower Salmon River)); and focus development and subdivision in villages and hamlets where infrastructure is present (Villages of Pulaski and Altmar, Hamlets of Orwell and Redfield).

Actions:

- Promote landowner use of existing conservation programs (e.g., Forest Land Enhancement Program, Conservation Reserve Program, Wetland Reserve Program, Forest Legacy, NY State Conservation Landowner Incentive Program, Conservation Easements, Conservation Reserve Enhancement Program, Purchase of Development Rights, Transfer of Development Rights, Inheritance Planning) to provide landowners with financial incentives to limit development and land conversion.
- Permanently codify state reimbursement to towns experiencing greater than a 1% shift in tax revenues due to 480A enrollment.
- Increase capacity of local conservation organizations (e.g., Tug Hill Tomorrow Land Trust) to protect open space.
- Investigate creation of forest/conservation tax districts to alleviate property tax burdens and curtail land conversion.

- Express to the NY state legislature a need for a change in the tax code so that property tax values are based on current use rather than potential use.
- Express to the NY state legislature a need for a change in the tax code so that timber is no longer assessed as “real property” (Empire State Forest Products Association, NY Forest Owners Association, Nature Conservancy, Tug Hill Commission).
- Express to NY state legislature the need to codify low-volume roads classification by towns.

Objective: Double compliance with New York Forestry Best Management Practices Field Guide by 2018.

Actions:

- Determine existing compliance levels.
- Require training/certification of loggers to cut wood off of public land.
- Provide local or state tax relief incentives to forest property owners who demonstrate continued utilization of loggers who are certified through FSC or NYS Logger Association.
- Encourage local mills to purchase wood only from certified/trained loggers.
- Ensure that BMP workshops are offered annually as part of the New York Trained Logger Certification Program (ESFPA)

Objective: Increase by 10% private landowner participation by 2015 in established sustainable forest management programs (e.g., Forest Stewardship Council, Sustainable Forestry Initiative, Tree Farm), particularly where DEC has identified the highest potential for Forest Stewardship Program benefits (Figure 9).

Actions:

- Determine existing participation in established forest management/certification programs.
- Codify state reimbursement to towns experiencing greater than a 1% shift in tax revenues due to 480A enrollment.
- Provide resources to increase DEC staff time devoted to landowner interaction, and to develop outreach materials and programs.
- Provide landowner incentives to participate in established forest certification programs.
- Enable FSC training for local consulting foresters to become FSC-certified in order to enroll forest owners.
- Within five years, develop funded program with partners (e.g., SUNY-ESF, Cornell Extension) to conduct outreach using existing materials to landowners of more than 50 acres to educate them about forestry management, invasive species, rare/endangered species and wetlands protection.

Objective: Maintain state-wide Forest Stewardship Council (FSC) and Sustainable Forestry Initiative (SFI) certification (achieved in 2008) on NYSDEC forest lands.

Actions:

- NYSDEC Bureau of Lands and Forests to correct all minor nonconformities spelled out in SFI (Ferrucci 2007) and FSC (Griffin 2007) certification audit reports.
- Express the need to state legislature to allow NYSDEC to use timber revenue to hire sufficient staff to maintain certification standards.

Objective: By 2018 establish and retain >90% vegetative cover in 100-ft stream buffers, where possible, throughout the watershed. Target efforts along reaches of Beaver Dam Brook, Trout Brook, Orwell Brook and the Lower Salmon River Main Branch that currently have <90% natural vegetation in buffer zones (Figure 22) , and several headwaters in the four lower sub-watersheds with buffers having <90% natural vegetation cover (Figure 27).

Actions:

- Utilize existing State and land trust programs for establishing voluntary conservation easements on private lands to maintain buffers in the above reaches as well as in other sub-watersheds with high development pressure (e.g., E. Branch Salmon River).
- Utilize existing agriculture programs such as Conservation Reserve Program.
- By 2010 convene discussion forums (e.g., Tug Hill Land Trust and Tug Hill Commission) with landowners to develop incentive ideas.
- Support the Salmon River Greenway Trail Project and its efforts to enhance stream bank vegetation restoration.

Goal: Maintain current hydrologic conditions (seasonal variation in flow, temperature, etc.), that are regulated through the FERC license, and which are adequate to maintain salmonine populations (steelhead and Chinook) in the Main Stem Salmon River (see also tributaries, below).

Objective: Maintain FERC (Federal Energy Regulatory Commission) licensing agreement, which mandates minimum seasonal baseflow requirements, through the length of the agreement (February 1, 2036).

- 285 cfs January-April
- 185 cfs May-August
- 335 cfs September-December

Actions:

- Continue annual meeting of FERC Flow Management Team to discuss state-of-knowledge on the adequacy of Main Stem Salmon River flows and reservoir levels.
 - Dave Clark, Chief of Environmental Compliance, National Park Service
 - Bruce Carpenter, New York Rivers United
 - James W. Atkinson, Supervisor, Town of Richland

- Connie Rogers, Tug Hill Chapter Trout Unlimited
- Karen Noyes, Oswego Co Planning Department
- Current member, Oswego County Legislator 2nd District
- Roy Lamberton, Alternate, Trout Unlimited
- David Stilwell, US Fish & Wildlife Service
- Bob Reinhardt, NYS OPRHP
- Ernest Wheeler, Mayor, Village of Pulaski
- Bob Adamski, Pulaski/Eastern Shore Chamber of Commerce
- Steve Murphy, Brookfield Power
- Tom Burke, Oswego Co. River Guides
- Jerry Hargrave, American Whitewater
- Frank Adams, Town of Redfield
- Representative, NYS Conservation Council
- Vaughn Roy, Brookfield Power
- Gerald P. Rasmussen, Natural Resource Supervisor, NYS DEC
- John Feltman, Division of Environmental Permits, NYS DEC
- Jim Pasco, Oswego Co. Federation of Sportsmens Clubs
- Peter Skinner, American Whitewater Affiliation
- John Elmer, Brookfield Power
- Fran Verdoliva, NYS DEC
- Dan Bishop, NYS DEC
- Bill Kuipers, Alternate, Adirondack Mountain Club
- Mark Woythal, NYS DEC

Objective: Prevent major diversions and consumptive uses of surface and groundwaters in the Salmon River Watershed by 2010.

Actions:

- Encourage NY Governor to sign NY State Great Lakes Diversion and Consumptive Uses Act (SB 4324B).
- Support Great Lakes Compact approval by US Congress.

Objective: Maintain sufficient flow to sustain critical water temperature (current best understanding is 70-72 °F), velocity (40 cms for Chinook), and dissolved oxygen (> 5 ppm) within tolerable thresholds for Chinook and steelhead, and associated macro-invertebrates.

Actions:

- NYSDEC and/or regional fisheries research stations (SUNY-ESF, Cornell University, USGS Tunison Laboratory) to assess effects of current FERC flow agreement for natural reproduction of steelhead and Chinook during critical life history stages, e.g., autumn high flows (as they influence spawning habitat and reduce mortality by angling), winter-spring (egg incubation stage), spring (emergence) and summer baseflow (juvenile and summer-returning adult habitat).

- Reestablish and maintain year-round, long-term monitoring of water temperature, velocity, discharge, and dissolved oxygen in upper (at Lighthouse Hill Reservoir by Brookfield Power), middle (USGS at Pineville Station) and lower (a new monitoring site below village of Pulaski) reaches of Main Stem.

Objective: By 2018 implement stream bank stabilization measures in key areas along the major tributaries along reaches of the Main Stem Salmon River.

Actions:

- NYSDEC to identify key areas for stream bank stabilization along the Main Stem, between Altmar and Pineville, by 2012, and implement stabilization plan by 2016 using Occidental Chemical settlement funds.

Objective: Maintain vegetative buffer along Salmon River Main Stem to within 10% per mile of existing cover by 2016.

Actions:

- NYSDEC, USFWS, USGS and/or regional research institutions to identify by 2013 areas that are critical for maintaining natural buffers.
- Restore streamside buffers in reaches having <90% cover by 2028 (Figure 22)
- In addition to the recent Niagara-Mohawk land acquisition, encourage DEC to acquire stream-side conservation easements on a voluntary basis, particularly on sites where a vegetated buffer would enhance stream quality. Priority segments include:
 - downstream of Sportsman Pool to County Rt. 2A;
 - downstream of County Rt. 2A through Village of Pulaski;
 - between Pulaski and the Salmon River Freshwater Estuary
- Where applicable, increase the width of vegetated buffer on newly acquired Niagara-Mohawk/National Grid properties beyond the existing vegetated stream banks.
- Utilize existing programs for establishing conservation easements on private lands.
- Utilize existing agricultural programs, such as the Conservation Reserve Program, where appropriate.
- Identify conifer-dominated stands that moderate early spring stream flow and work with private and public landowners to establish and maintain conifer components in those stands.

Goal: Maintain the hydrologic conditions (volume and seasonal variation in flow, temperature, cover) within tolerable thresholds of salmonine populations (steelhead, brook trout and Chinook salmon) in the major tributaries of the Salmon River.

Objective: Maintain sufficient flow to sustain critical water temperature (current best understanding is 70-72 °F), velocity (40 cms for Chinook), and dissolved oxygen (> 5

ppm) within tolerable thresholds for Chinook and steelhead, and associated macro-invertebrates.

Actions:

- NYSDEC and/or regional fisheries research stations (SUNY-ESF, Cornell University, USGS Tunison Laboratory) to assess current range of flow in major tributaries for ability to sustain natural reproduction of steelhead, brook trout and Chinook during critical life history stages, e.g., autumn flows (as they influence spawning habitat and egg deposition), winter-spring (egg incubation stage), spring (emergence) and summer baseflow (juvenile habitat).

Objective: Establish a monitoring system by 2012 to determine baseline data for ecological health (flow, temperature, water clarity, salinity) in Trout, Orwell, Beaver Dam, and Lindsay Brooks; East and North Branches of the Salmon River; and the Mad River.

Actions:

- In 2007-08, NYSDEC and regional fisheries research stations to determine most cost effective method for citing and operating gauges to adequately capture variation in hydrologic conditions in the tributaries; or to establish predictive models that link gauges to more specific locations.
- Work with private and public landowners to place gauges on major tributaries to monitor flow.
- Acquire funding for maintaining new gauges.
- Identify an objective institution to administer gauges.

Objective: By 2018 implement stream bank stabilization measures in key areas along the major tributaries.

Actions:

- NYSDEC to identify key areas for stream bank stabilization in major tributaries (Orwell-Pekin Brook, Trout Brook, Beaverdam Brook, Spring Brook) by 2016.
- NYSDEC to acquire funding and implement stabilization plans by 2018.

Objective: Maintain vegetative buffer along major tributaries at or above existing levels.

Actions:

- NYSDEC, USFWS, USGS and/or regional research institutions to identify by 2013 areas that are critical for maintaining natural buffers.
- Restore streamside buffers in reaches having <90% cover by 2028 (Figure 22)
- In addition to the ongoing Niagara-Mohawk/National Grid land acquisition (including land on the north shore of the Redfield Reservoir), encourage DEC to

acquire stream-side conservation easements particularly on sites where a vegetated buffer would enhance stream quality. Priority segments include:

- Trout, Orwell, Beaver Dam, and Lindsay Brooks; East and North Branches of the Salmon River; Mad River; and tributaries to these streams.
- Utilize existing programs for establishing conservation easements on private lands.
- Utilize existing agricultural programs, such as the Conservation Reserve Program, where appropriate.
- Identify conifer-dominated stands that moderate early spring stream flow and encourage private and public landowners to establish and maintain conifer components in those stands.
- Encourage landowners to establish natural conifer components in other hardwood-dominated forests along riparian zones.

Objective: Assess impacts of current and projected future groundwater withdrawal from Tug Hill aquifer on the tributaries (Spring Brook, Orwell Brook-Pekin Brook, Trout Brook, Beaverdam Brook) and Main Stem of the Salmon River system by 2015.

Actions:

- Conduct USGS study to determine effects of current and projected water usage on surface water conditions.
- Identify institutional, governmental and academic partners to seek funding or appropriations for study.

THREAT: INVASIVE SPECIES

Goal: Prevent the introduction of new invasive species and the spread of existing populations within the watershed.

Objective: By 2010 institutionalize St. Lawrence-Eastern Lake Ontario (SLELO) Partnership for Regional Invasive Species Management (PRISM).

Actions:

- Obtain program funding from NYS and grants.
- Hire coordinator, support and seasonal staff.
- Identify office location for SLELO coordinator.
- Ensure that all future invasive species activities, including plant, animals, and diseases, in the watershed are coordinated through or with SLELO.

Objective: By 2018, double general public awareness about invasive species in the Salmon River Watershed.

Actions:

- By 2010, SLELO-PRISM coordinator to conduct survey that quantifies current level of awareness regarding invasive among general public.

- In 2013 and 2018, conduct repeat surveys to assess increases in public awareness.
- By 2010, SLELO-PRISM coordinator to establish network of local research scientists, resource managers and community leaders to facilitate communication among interested parties regarding status and control of invasive species.
- SLELO-PRISM coordinator to develop educational programs for schools in cooperation with agencies such as US Forest Service, US Fish and Wildlife Service, National Wildlife Federation, Cooperative Extension Youth Programs, SUNY-ESF “ESF in the Classroom” program, SUNY-Oswego Rice Creek Field Station, Lewis & Oswego County Conservation Field Days.
- Spread general, on-going messages regarding invasive species through public service announcements, editorials, press releases, newsletters.

Objective: By 2018, double awareness about invasive species among target audiences (people who live and/or recreate in areas where invasive species are likely to occur and/or engage in activities that are known to spread invasive species) in the Salmon River Watershed. Target areas include the Salmon River freshwater estuary, Redfield and Lighthouse Hill reservoirs, heavily fished reaches and more developed areas of the lower sub-watersheds. Target user groups include forest land owners, boaters, anglers, ATV clubs.

Actions:

- Utilize existing or develop new signs/flyers on invasive species issues. Distribute/display where they are likely to occur or people who go into those areas are likely to see them (e.g., boat landings, fishing access areas, Salmon River hatchery, sporting goods outlets, bait shops, campsites, chambers of commerce, home and garden stores, plant nurseries, landowner associations, community centers).
- Distribute information materials with sporting licenses, camping permits, boat and ATV registrations on what invasive species are and how they are spread by human activities.
- Conduct public workshops in locations where invasive species exist and are likely to spread.
- Develop training workshops on invasive species for foresters and loggers, and work with existing groups (e.g. Empire State Forest Products Association, Northeastern Loggers Association) to incorporate them into their certification programs.
- Develop targeted workshops for groups that engage in the transport and trade of live organisms (e.g. proprietors and customers of food and pet retail outlets, nurseries, wood products, shipping industry).
- Engage local, county and state Departments of Transportation in invasive species identification, monitoring, and management.

Objective: By 2015, identify and monitor susceptible areas throughout the watershed that are conducive to terrestrial or aquatic invasive species establishment.

Actions:

- Establish protocols for baseline assessment and long-term monitoring programs.
- Through a combination of remote sensing and on the ground surveys (with permission), map existing populations of invasive species, likely places for new invasions (such as along transportation and stream corridors, in the freshwater estuary, in the reservoir) and Invasive Species Prevention Zones.
- Identify and incorporate existing invasive species monitoring programs (e.g. hydroplants, Salmon River hatchery) to establish a baseline occurrence database that will be administered and maintained by SLELO.
- Based on current scientific knowledge and existing modeling tools, determine criteria for susceptibility to invasive species establishment throughout the watershed.
- Establish a monitoring network of professionals and volunteers who follow protocols based on scientific research and quality assurance-quality control.
- Acquire funding sufficient to establish a scientifically rigorous program.

Objective: By 2018 implement local, regional, national and international policy initiative to eliminate or minimize new invasive species introductions, and to contain the spread of established invasive species.

Actions:

- Express support to state and federal leadership for prohibiting ocean-going vessels (which comprise 8% of Great Lakes shipping but have contributed the majority of invasive species) from the Great Lakes.
- Support state regulatory/legislative restrictions on the sale of invasive species.
- Expand the Environmental Protection Fund to include funding for early detection/rapid response and species other than plants.
- Increase funding for both monitoring and eradication of invasive terrestrial and aquatic species.
- Establish boat cleaning facilities at public launches and require them at private marinas.
- Pass local ordinances requiring boat cleaning prior to launch within the watershed.

Objective: Improve ability to manage spread of invasive species by 2013.

Actions:

- Develop criteria to determine whether a strategy of eradication, containment or managed co-existence is the most appropriate course of action in each situation.
- Develop strategies to manage environments permanently altered by invasive species.
- Have a system of coordinated responses established to deal with future invasions.

- Facilitate cooperative response to invasive species spread.
- Develop management strategies in anticipation of new invasive species and probable ecosystem changes.

Objective: Improve resistance and resilience of natural communities to impacts of invasive species by 2013.

Actions:

- Selectively utilize and maintain barriers to prevent the spread of aquatic invasives.
- Encourage management practices that improve landscape resistance and resilience to invasive species (e.g., maintenance of biodiversity and genetic diversity).

THREAT: LAND USE/LAND COVER CHANGE

Goal: Maintain current land use/cover types that have a variety of naturally occurring conifer and hardwood forest types.

Objective: By 2013 increase information to all municipal officials within the watershed to encourage resource protection through local comprehensive planning, especially where development and/or subdivision pressures are greatest.

Actions:

- Tug Hill Commission to provide more extensive and more spatially specific natural resources information to help municipalities focus development in appropriate areas.
- Tug Hill Commission and partners to develop, publish and distribute a comprehensive guide on how to design site development to minimize impacts.

Objective: Minimize (cap increase to <10% of current level) subdivision and encourage long-term land ownership within the next five years. Prioritize Pulaski area, Orwell, the Salmon River corridor within 1 mile of river from Redfield to Lake Ontario, shorelines of Redfield and Lighthouse Hill Reservoirs, and within the western sub-watersheds where development pressures are highest.

Actions:

- Implement a monitoring program to track subdivision trends within entire watershed.
- Promote landowner use of existing conservation programs (e.g., Forest Land Enhancement Program, Conservation Reserve Program, Wetland Reserve Program, Wildlife Habitat Incentive Program, Forest Legacy, NY State Conservation Landowner Incentive Program, Conservation Easements, Conservation Reserve Enhancement Program, Purchase of Development Rights, Transfer of Development Rights, Inheritance Planning) to provide landowners with financial incentives, limit development and land conversion.

- Permanently codify state reimbursement to towns experiencing greater than a 1% shift in tax revenues due to 480A enrollment.
- Increase capacity of local conservation organizations (e.g., Tug Hill Tomorrow Land Trust) to protect open space.
- Investigate creation of forest/conservation tax districts to alleviate property tax burdens and curtail land conversion.
- Express to the NY state legislature a need for a change in the tax code so that property tax values are based on current use rather than potential use.
- Express to the NY state legislature a need for a change in the tax code so that timber is no longer assessed as “real property” (Empire State Forest Products Association, NY Forest Owners Association, Nature Conservancy, Tug Hill Commission).

Objective: Maintain vegetative buffer along Salmon River Main Stem to within 10% per mile of existing cover, taking into account the goal of no additional loss of cover in sub-watersheds having <83% natural cover (Lower Salmon River-Main Stem, Orwell-Pekin Brook, Trout Brook, Beaverdam Brook) by 2016.

Actions:

- NYSDEC, in conjunction with partners, to inventory and map riparian areas to prioritize restoration and protection.
- Encourage NYSDEC to acquire stream-side easements, particularly on sites with wooded cover.
- Encourage public and private land owners to establish vegetated buffers.
- Develop BMP (best management practices) guidelines for riparian areas.
- Stabilize stream banks and restore vegetation in key riparian buffer areas (namely from Altmar to Pineville).
- Utilize existing programs for establishing conservation easements on private lands
- Utilize existing agricultural programs, such as the Conservation Reserve Program and the Wildlife Habitat Incentive Program, where appropriate

Objective: Restore and retain >90% vegetative cover within 540-ft wildlife corridors along all segments of the Main Branch and major tributaries in the lower sub-watersheds (i.e. Lower Salmon River-Main Stem, Orwell-Pekin Brook, Trout Brook, Beaverdam Brook, and Pennock-Coey-Kenny; Figure 26) by 2028.

Actions:

- Conduct survey to field-verify and document location of stream reaches having >90% natural cover in 540-ft buffers.
- Utilize existing programs for establishing conservation easements on private lands to maintain buffers in the above reaches as well as other sub-watersheds with high development pressure (e.g., E. Branch Salmon River).
- Utilize existing agriculture programs such as Conservation Reserve Program and the Wildlife Habitat Incentive Program.

- By 2012 convene Tug Hill Commission discussion forums with landowners to develop incentive ideas.

Objective: No net decrease of 300-ft vegetative buffers along steep slopes and 540-ft wildlife buffers along wetlands and open waters in eastern sub-watersheds by 2013.

Actions:

- Conduct survey to field-verify and document location of stream reaches having >90% natural cover in 540-ft buffers, after obtaining land owner permission for access.
- Establish and maintain properly designed trail systems and fishing access points within the 22 mile-long NYSDEC acquisition from Niagara-Mohawk.

Objective: Maintain 2008 wetland area and function in lower sub-watersheds, especially in areas currently susceptible to highest development pressures, including Pulaski area, Orwell, the Salmon River corridor within 1 mile of river from Redfield to Lake Ontario, shorelines of Redfield and Lighthouse Hill Reservoirs. Monitor on 10-year cycles.

Actions:

- Establish baseline wetland area in watershed.
- Support DEC efforts to update the map of regulated wetlands.
- Increase DEC enforcement abilities for DEC-regulated wetlands.
- Educate general public about importance of wetlands for flood control, water quality and biodiversity.
- Create incentives for landowners to maintain/restore wetland habitat, and educate landowners about existing incentive programs (Wetlands Reserve Program, Conservation Reserve Program, Conservation Reserve Enhancement Program, Ducks Unlimited, wetland banks, non-profit land trust conservation programs).
- Support state protection for unregulated wetlands (those under 12.4 acres and/or not covered under the Clean Water Act).

THREAT: PESTS, PATHOGENS AND DISEASES

Goal: Conduct research, monitoring, and public education efforts to prevent or minimize the impact of Pests, Pathogens and Diseases (PPDs).

Objective: Improve the understanding of a PPD's life history and habitat requirements to support effective management before 5% of watershed is affected by it.

Actions:

- Develop a research strategy for emerging and established PPDs (e.g. life history, population dynamics, habitat requirements, expansion mechanisms, control methods).
- Create a system for effective information exchange with and feedback from the monitoring programs.
- Create appropriate channels for information and technology transfer from researchers to educators and managers.
- Establish funding sources to develop all of the above.

Objective: Increase general public awareness of PPDs for 80% of the population by 2026.

Actions:

- Develop cooperative educational programs for schools (e.g., with US Forest Service, US Fish and Wildlife Service, National Wildlife Federation, Cooperative Extension Youth Programs, SUNY-ESF "ESF in the Classroom" program, SUNY-Oswego Rice Creek Field Station, Lewis & Oswego County Conservation Field Days, SLELO).
- Spread general, on-going messages regarding PPDs through public service announcements, editorials, press releases, newsletters.

Objective: By 2026, double awareness about PPDs among target audiences (people who live and/or recreate in areas where PPDs are likely to occur and/or engage in activities that are known to spread PPDs) in the Salmon River Watershed.

Actions:

- Develop signs/flyers on PPD issues and distribute/display where they are likely to occur (e.g., boat landings, fishing access areas, Salmon River hatchery, sporting goods outlets, bait shops, campsites, chambers of commerce).
- Distribute information materials with sporting licenses, camping permits, boat and ATV registrations.
- Develop and conduct workshops on PPDs for bait dealers and farmers, game farmers, and private aquaculturists.

Objective: By 2015, establish monitoring/assessment process to improve detection precision of changes in existing PPD populations or those that pose imminent threats by 50%.

Actions:

- Identify and consolidate existing PPD monitoring programs (e.g., NYSDEC, USFS Forest Inventory & Analysis Plots) to establish a PPD baseline occurrence database.
- Based on current scientific knowledge and existing modeling tools, determine criteria for susceptibility to PPD establishment throughout the watershed, and identify areas where new introductions are likely.
- Develop a system for information exchange.
- Identify gaps in existing monitoring programs and develop a strategy to fill them.

Goal: Develop and implement plans for introduction prevention, eradication, containment or managed co-existence of PPD within the watershed.

Objective: Improve ability to manage outbreaks of PPDs by 2013.

Actions:

- Develop criteria to determine whether a strategy of eradication, containment or managed co-existence is the most appropriate course of action.
- Develop strategies to manage environments permanently altered by PPDs.
- Have a system of coordinated responses established to deal with future PPD outbreaks.
- Facilitate cooperative response to PPD outbreaks.
- Develop a checklist for evaluating management decisions based on PPDs (State Environmental Quality Review, internal agency policies and procedures).
- Develop management strategies in anticipation of impending PPD outbreaks and probable ecosystem changes.

Objective: Improve resistance and resilience of natural communities to impacts of PPDs by 2013.

Actions:

- Utilize and maintain barriers to prevent the spread of aquatic PPDs (one specific example is placing a new barrier on Pekin Brook to halt spread of lamprey and eliminate the need for lampricide).
- Encourage management practices that improve landscape's resistance and resilience to PPD outbreaks (e.g., maintenance of biodiversity and genetic diversity).

THREAT: PHYSICAL HABITAT DISTURBANCE

Goal: Prevent physical habitat disturbance (including human and natural) from degrading or eliminating natural communities.

Objective: Establish buffers by 2012 for Natural Heritage elements using important areas modeling developed by the NY Natural Heritage Program.

Action:

- Ground truth the presence of elements that were identified by element distribution models (Howard 2006) where land owners grant permission for access.
- Identify appropriate buffer distances for each element type.
- Conduct outreach and education on prioritized areas to all town and county planners by 2012
- Prioritize on the ground actions for conservation of buffered target areas and lands by 2018.

Objective: Maintain current 2008 wetland area and function in lower sub-watersheds, especially in areas currently susceptible to highest development pressures, including Pulaski area, Orwell proper, the Salmon River corridor within 1 mile of river from Redfield to Lake Ontario, shorelines of Redfield and Lighthouse Hill Reservoirs

Actions:

- Support DEC efforts to update the map of regulated wetlands.
- Increase DEC enforcement abilities for DEC-regulated wetlands.
- Educate general public about importance of wetlands for flood control, water quality and biodiversity.
- Create incentives for landowners to maintain/restore wetland habitat, and educate landowners about existing incentive programs (Wetlands Reserve Program, Conservation Reserve Program, Conservation Reserve Enhancement Program, Ducks Unlimited, wetland banks, non-profit land trust conservation programs).
- Support state protection for unregulated wetlands (those under 12.4 acres and/or not covered under the Clean Water Act).

Objective: Ensure that the net impact of beaver activity across the watershed does not reduce viability of headwater stream and wetland communities below a “good” condition (as defined in the viability analysis) over the next 10 years.

Actions:

- Identify streams (e.g., Trout Brook and Orwell-Pekin Brooks) where beaver activity may need to be limited in order to meet other management objectives, such as sea lamprey control, natural reproduction of salmonines and other cold water fish.

- Make it possible to obtain a permit (via the “other” category) for beaver removal based on ecological management considerations (such as those described above), in addition to current nuisance permit program.
- Work with DEC wildlife staff to determine beaver population goals sufficient to maintain the natural process of wetland creation and conversion to ensure a diversity of wetland communities are present within the watershed.
- Work with DEC wildlife staff to remove beaver during an established trapping season. Nuisance permits can be used for those locations where other management techniques are ineffective.

Goal: Improve and maintain the quality and diversity and function of terrestrial and aquatic systems

Objective: Develop and implement BMPs for rare/endangered species and communities that are particularly vulnerable to physical habitat disturbance by 2012.

Actions:

- Develop a list of priorities for species and communities using vulnerability guides developed by NY Natural Heritage (www.guides.nynhp.org).
- Update NY Heritage data and guides for 50% of priority species and communities by 2018,
- Educate/advise landowners on those management practices for rare/endangered species.
- Send landowner packets over the next 5 years to landowners of more than 50 acres in the watershed to educate them about forestry management, invasive species, rare/endangered species, wetlands, etc. Identify grant to cover costs (similar to dune packets done by Sea Grant with a grant).

Objective: Minimize subdivision (to an additional 10% of 2008 level) and encourage long-term land ownership over next 5 years in priority areas (e.g. Orwell; 1-mile-wide corridor along Salmon River from Redfield to Lake Ontario; reservoir shorelines; and the lower sub-watersheds (Orwell Brook, Beaverdam Brook-Meadow Creek, Trout Brook, Lower Salmon River)); and focus development and subdivision in villages and hamlets where infrastructure is present (Villages of Pulaski and Altmar, Hamlets of Orwell and Redfield).

Actions:

- Promote landowner use of existing conservation programs (e.g., Forest Land Enhancement Program, Conservation Reserve Program, Wetland Reserve Program, Forest Legacy, NY State Conservation Landowner Incentive Program, Conservation Easements, Conservation Reserve Enhancement Program, Purchase of Development Rights, Transfer of Development Rights, Inheritance Planning) to provide landowners with financial incentives, limit development and land conversion.

- Permanently codify state reimbursement to towns experiencing greater than a 1% shift in tax revenues due to 480A enrollment.
- Increase capacity of local conservation organizations (e.g., Tug Hill Tomorrow Land Trust) to protect open space.
- Investigate creation of forest/conservation tax districts to alleviate property tax burdens and curtail land conversion.
- Express to the NY state legislature a need for a change in the tax code so that property tax values are based on current use rather than potential use
- Express to the NY state legislature a need for a change in the tax code so that timber is no longer assessed as “real property” (Empire State Forest Products Association, NY Forest Owners Association, Nature Conservancy, Tug Hill Commission).

Objective: Increase by 10% the acreage of private forest land enrolled in sustainable forest management programs (e.g., Forest Stewardship Council, Sustainable Forestry Initiative, Tree Farm) by 2018, particularly where DEC has identified the highest potential for Forest Stewardship Program benefits (Figure 9).

Actions:

- Determine current amount of forest land enrolled in sustainable management programs.
- Permanently codify state reimbursement to towns experiencing greater than a 1% shift in tax revenues due to 480A enrollment.
- Develop outreach materials and programs, perhaps including DEC staff time devoted to landowner interaction.
- Enable FSC training for local consulting foresters to become FSC-certified in order to enroll forest owners.
- Send landowner packets over the next 5 years to landowners of more than 50 acres in the watershed to educate them about forestry management, invasive species, rare/endangered species, wetlands, etc. Identify grant to cover costs (similar to dune packets done by Sea Grant with a grant).

Objective: Maintain state-wide Forest Stewardship Council (FSC) and Sustainable Forestry Initiative (SFI) certification (achieved in 2008) on NYSDEC forest lands.

Actions:

- NYSDEC Bureau of Lands and Forests to correct all minor nonconformities spelled out in SFI (Ferrucci 2007) and FSC (Griffin 2007) certification audit reports.
- Express the need to state legislature to allow NYSDEC to use timber revenue to hire sufficient staff to maintain certification standards.

Goal: Reduce current and minimize future adverse effects of non-motorized recreational disturbances to all targets within the watershed while maintaining appropriate recreational access opportunities.

Objective: Develop a formalized trail system associated with the state easements along Salmon River from Redfield to Pulaski (~22 miles), where feasible. Complete entire trail system by 2026, and 5 miles of trail by 2017.

Actions:

- Provide adequate funds (at least \$100,000/mile)
- Develop and construct 5 educational kiosks along Salmon River trail system and/or at key access points by 2017.

Objective: Educate 100% of landowners owning property restricted by conservation easements about permissible activities and the need to abide by restrictions, and inform adjacent landowners about permissible activities on neighboring lands and benefits of voluntary private land protection, by 2013.

Actions:

- Develop an ongoing strategy to work with landowners
- Identify priority conservation easement areas for outreach and education.

Objective: Work with all guides association and other legally registered guides (licensed by DEC) by 2010 to decrease by 50% habitat alteration along the river and educate about the importance of habitat.

Action:

- Hold educational meetings.
- Send technical habitat information.
- Identify priority sites to prevent habitat alterations.

Goal: Reduce current and minimize future adverse effects of motorized recreational disturbances to all targets within the watershed while maintaining appropriate recreational access opportunities.

Objective: Eliminate illegal use of ATVs on non-designated trails such as snowmobile and cross-country ski trails by 2018.

Actions:

- NYSDEC, in conjunction with local research partners and local ATV clubs (e.g., Oswego County ATV Club), to survey the extent and intensity of ATV use within watershed, by 2013.

- NYSDEC, in conjunction with local research partners and local ATV clubs (e.g., Oswego County ATV Club), to survey locations where ATV trails intersect sensitive ecological areas by 2013.
- Apply collected ATV registration fees to enforce ATV laws by hiring two DEC law enforcement officers by 2013.
- Establish and maintain an ATV trail system designed to avoid sensitive ecological areas and that follows best management practices for trail construction.
- Enact legislation to allow stiffer penalties for illegal operation of motorized recreational vehicles (ATVs, snowmobiles, dirt bikes), such as seizure of equipment, and enable admission of alternative evidence for conviction, such as photographs.

THREAT: SEDIMENTATION AND POLLUTION

Goal: Maintain or improve current state classification of Salmon River (Currently class C(t), which means designation for fishing, recreation and fish propagation).

Objective: Increase awareness of the causes and consequences of sedimentation and pollution (both point and non-point) to Salmon River and its tributaries for 75% of the individuals in target audiences (see table below) by 2015.

Actions:

- By 2008, inventory existing educational materials and programs and compare them with the table of identified needs (below).
- Update existing program information and tailor the programs for all audiences by mid 2009.
- Deliver relevant educational programs.

ABOUT

Septic system operation and maintenance

Recreational impacts

Recycling and waste disposal

BMP requirements, methods, benefits, uses, info sources

Permits

Water quality

TO/WHERE (Audience)

Homeowners, realtors, home associations, town officials, enforcement officers, kids/schools

ATV safety trainers, sportsman groups, trail head kiosks, web sites, enforcement officers, stewards, sporting goods stores, local businesses, bait shops

Schools/kids, stores, landfills/trash collectors

Landowners, town officials, farmers, foresters, loggers, contractors that use heavy equipment, schools/kids

Same as above for BMPs

Schools/kids, watershed groups, and all of the above audiences and groups

Objective: Achieve and maintain 100% compliance with point source permitting (NYSDEC Non-Point Source Discharge Elimination System) by 2009. The following facilities currently maintain NPDES permits: Felix Schoeller Technical Papers; Pulaski Sewage Treatment Plant, Pulaski; Pulaski Ford and Mercury, Pulaski; New York State Fish Hatchery, Altmar.

Actions:

- Re-evaluate/update NY State stream quality ratings for the main branch and major tributaries.
- Increase regulatory staffing at DEC.
- Achieve 100% enforcement and stiffen penalties for non-compliance.

Objective: Reduce levels of municipal stormwater discharge by 50% by 2028.

Actions:

- Commission targeted, synoptic survey of surface water quality to identify locations of potential pollution loading from municipal non-point sources by 2012.
- Encourage the NY State Building Code Council to review code for stormwater BMPs to focus on impacts of water discharges relative to sedimentation and pollution.
- Expand MS4 Performance Measures on a statewide basis.
- Inform local and state leaders of the benefits of the low volume road designation.
- Provide incentives to reduce usage and properly store road sand and salt, particularly along critical waterways.
- Provide incentives to towns to follow stormwater BMPs and establish stormwater collection systems where appropriate.

Objective: Increase proper disposal of municipal solid and hazardous waste by 50% by 2013.

Actions:

- Provide annual local funding and opportunities for collection and disposal of municipal household hazardous waste (e.g., County Household Hazardous Waste Days), used motor oil and tires.
- Enable/support free and accessible recycling and waste disposal facilities.
- Create fish waste collection and beneficial reuse program.

Objective: Reduce pollution from septic system operations in sensitive areas by 50% by 2018.

Actions:

- Assess adequacy of state and county resources for administration and enforcement of septic system regulations.
- Determine areas sensitive to pollution from septic systems.

- Commission a targeted survey of sensitive areas of septic systems near susceptible surface waters (e.g., freshwater estuary).
- Provide homeowner incentives (e.g., grant programs, free voluntary inspections, low-interest loans) for proper maintenance and improvement of existing septic systems.

Objective: Reduce pollution and sedimentation from new development by 50% through low-impact development and smart planning by 2018.

Actions:

- By 2014, change tax codes to reduce conversion of agricultural and forest lands for development (i.e., assess based on current land use; eliminate valuation of standing timber as real property).
- Provide technical assistance and incentives for communities to develop comprehensive plans that incorporate smart growth principles.
- Provide more extensive and spatially specific natural resources information to help municipalities focus development in appropriate areas.
- Develop, publish and distribute a comprehensive guide on how to site/manage development to minimize impacts.

Objective: Reduce sedimentation and pollution from non-point sources, such as logging, construction, agricultural activities and road maintenance by 25% by 2013.

Actions:

- Commission study to determine current level of and most important contributors to bank destabilization and sedimentation in the watershed.
- Prioritize locations for bank stabilization activities.
- Expand the use of timber harvesting best management practices by educating foresters, loggers, and forest landowners about the New York Forestry Best Management Practices Field Guide.
- Ensure that BMP workshops are offered annually as part of the New York Trained Logger Certification Program (ESFPA)
- Promote 3 forest BMP workshops in the next 3 years among landowners.
- Create incentives for loggers to gain FSC or New York Trained Logger certification, and for marketing certified forest products.
- Work with highway departments to implement best maintenance practices (e.g., Adirondack Highway Department Green Book) to reduce road salt and sand application and run-off.
- Include chloride monitoring in watershed water quality monitoring program.

THREAT: REGIONAL/GLOBAL ISSUES

Goal: Facilitate local action within the watershed to contribute to international initiatives aimed at abating global climate change.

Objective: Encourage immediate local energy conservation initiatives in homes, businesses and public facilities and adoption of renewable energy technology to reduce local carbon emissions by 2018.

Actions:

- Implement region-wide, residential and commercial energy conservation initiatives through partnerships with New York Energy Smart and the Syracuse Center of Excellence in Environmental and Energy Systems (Syracuse CoE).
- Within constraints of ecologically sustainable supplies (i.e., as determined through FSC certification) develop regional low grade forest product markets (biomass-to-energy, wood heating, ethanol).
- Develop incentives for co-generation of electricity.
- Encourage development and use of local biodiesel fuels.
- Create and support incentives that encourage forest landowners to keep intact forest lands.

Objective: Increase participation by individuals and businesses in energy conservation initiatives and renewable energy technology by 2013.

Actions:

- Support and participate in research that further elucidates net negative and positive impacts of wind energy developments on wildlife.
- Commission research to estimate and project region-wide sustainable yield of wood products from agricultural and woodland sources that could supply regional wood heat, biomass-to-energy, and cellulosic ethanol production without diminishing forest ecosystems or quality of water and soil resources.
- Encourage participation of local farmers and business leaders in Syracuse CoE/SUNY-ESF willow biomass project to evaluate its commercial viability, ecological impacts, and capacity to reduce net regional carbon emissions.
- Encourage participation of local farmers and business leaders in dairy waste-to-energy, manure and food waste co-digestion research into methane reduction, conducted through Syracuse CoE, Clarkson University and Cornell University.
- Encourage local farmers and business leaders to participate in Northeast Region Sun Grant Initiative (Cornell University) to develop diverse agricultural practices to support emerging biobased industries.

Objective: Support adoption of the Regional Greenhouse Gas Initiative (REGGI) by 2010.

Actions:

- Express to NYS legislators the benefits of regional measures to reduce carbon emissions.
- Establish Regional Greenhouse Gas Initiative (REGGI) carbon trading system that leads to long-term sequestration of carbon through forest management and production of durable goods, based on the best available science.

Goal: Improve understanding of mercury, nitrogen and acid deposition impacts to regional aquatic and terrestrial ecosystems and communicate information to state and federal regulators and policy makers.

Objective: Begin investigation levels of mercury contamination in soils, sediments, flora and fauna of the watershed by 2010.

Actions:

- Utilize guidance from the NY State Wildlife Grant Program research project entitled “Biogeography of mercury contamination in New York – risk to species of greatest conservation need” to establish continued research programs on private and state land in the watershed with local research laboratories (e.g., Syracuse University, Clarkson University) that:
 - assesses current levels of mercury contamination in soils, sediments, invertebrates, insectivorous song birds and bats, turtles, amphibians and predatory fish and mammals;
 - determines the sources and fate of mercury in the respective upper and lower sub-watersheds and the Redfield and Lighthouse Hill reservoirs.

Objective: Monitor effects of nitrogen and acid deposition on terrestrial and aquatic communities of the watershed.

Actions:

- Encourage local research laboratories (e.g., Syracuse University, Clarkson University, SUNY-ESF, SUNY-Oswego) to establish long-term monitoring stations for forest and headwater streams in the upper and lower sub-watersheds to monitor trends in :
 - in stream water N, acid and alkalinity;
 - soil and vegetation nitrogen accumulation and acidification.

Goal: Create, maintain, and manage terrestrial and aquatic ecological communities in the watershed that can adapt to and recover from the effects of global change.

Objective: Improve adaptability and recovery ability of Salmon River watershed forest and stream habitats by establishing and protecting connective corridors with adjacent largely undeveloped areas, such as the Adirondacks, and by decreasing isolation of woodlands in the Lake Plain forests by 2028.

Actions:

- The Nature Conservancy to complete connectivity modeling for wide ranging mammal species between the Tug Hill and Adirondacks by 2013.
- Work with private and public cooperators to improve natural habitat corridor through area including Webster Hill, Jackson Hill, Buck Hill, Clark Hill, Benn Hill State Forest, and across the Black River Valley to provide migration routes for wide ranging mammal species between the Adirondacks and Tug Hill.
- Establish integrated, private and/or public woodland preserve system in lower sub-watersheds that creates large, connected forest parcels that typify the lower elevation Lake Plain forest type by 2028.
- Identify appropriate areas to eliminate effects of man-made barriers (culverts, bridge abutments, dams) on the habitat and movement of aquatic organisms and amphibians by 2013.
- Implement findings or apply locally the methodology of NY State Wildlife Grant Program research on “Incorporating aquatic SGCN requirements and conservation objectives into state transportation planning” that will:
 - prioritize streams across New York using models for SGCN and their habitats as criteria;
 - identify the most important culverts, dams, and bridges for improving and restoring SGCN habitat and ecosystem functions;
 - prioritize the previous results based on the existing DOT five-year transportation plan and maintenance program.

Objective: Maintain or increase the current (2008) diversity of community types and occurrences of rare species within terrestrial and aquatic habitats.

Actions:

- Increase resources available to NY Natural Heritage Program to monitor occurrences of aquatic species and community types, and to maintain up-to-date records of occurrences for the following heritage elements that occur within the watershed:

plants

Jacob's ladder, *Polemonium vanbruntiae*
 wild Sweet-William, *Phlox maculata* ssp. *maculata*
 broad-lipped twayblade, *Listera convallarioides*
 lesser bladderwort, *Utricularia minor*
 bird's-eye primrose, *Primula mistassinica*
 yellow mountain-saxifrage, *Saxifraga aizoides*
 sand dune willow, *Salix cordata*
 low sand-cherry, *Prunus pumila* var. *pumila*
 ram's-head lady slipper, *Cypripedium arietinum*
 slender bulrush, *Schoenoplectus heterochaetus*
 giant pine-drops, *Pterospora andromedea*)
 pod grass (*Scheuchzeria palustris*)

animals

northern harrier, *Circus cyaneus*
 bald eagle, *Haliaetus leucocephalus*
 least bittern, *Ixobrychus exilis*
 pied-bill grebe, *Podilymbus podiceps*
 black tern, *Chlidonias niger*
 three-toed woodpecker, *Picoides dorsalis*
 pitcher plant borer moth, *Papaipema appassionato*
 lake sturgeon, *Acipenser fulvescens*

- Promote a focus on regenerating diverse forest tree species.
- Educate landowners about the economic and ecological benefits of selection system and timber stand improvement cuts, as well as the responsible application of even-age stand management.
- Promote establishment of diversity of forest habitat structures (coarse woody debris, trees representing natural range of diameter classes, a mix of hardwood and conifer components) to sustain a broad diversity of forest-dwelling organisms.
- Increase private and state landowner participation in FSC certification programs.
- In anticipation of future climate change, establish long-term monitoring program to establish current baseline physical, chemical and flow conditions in river reaches throughout the watershed and detect future changes.
- In anticipation of future climate change, maintain minimum baseflows in river reaches throughout the watershed that are sufficient to keep physical and chemical parameters within natural range of variation.

IV Feedback on Implementation of Proposed Strategies

Follow-up groups consisting of regional resource managers, scientists, government officials, citizens, business representatives will be established to facilitate periodic (10-yr cycle) review of assessment and progress in implementation of strategies. Baseline information from the Viability Analysis will be used to inform future assessments of resource condition, and to adapt future strategies for sound resource management.

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APPENDIX 1

**SALMON RIVER WATERSHED
NATURAL RESOURCES ASSESSMENT**

**PROCEEDINGS OF WORKSHOP ONE: NATURAL RESOURCE
TARGETS**

Salmon River Watershed Natural Resources Assessment

Workshop One: Natural Resource Targets

A Report of Workshop Process and Products

September 25, 2006

Prepared for:

NYSDEC, Division of Fish, Wildlife and Marine Resources
Tug Hill Tomorrow Land Trust
Oswego County Environmental Management Council
New York Natural Heritage Program
The Nature Conservancy
SUNY College of Environmental Science and Forestry
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Appendix One – Participants

Appendix Two – Target Identification

Appendix Three – Viability Analyses

Appendix Four – Workshop Evaluation Results

Introduction

On September 25, 2006, a workshop was held in the Snow Building in Pulaski, NY to begin a conservation planning process for the Salmon River Watershed as part of the Salmon River Watershed Natural Resource Assessment Project. The overall project objective is to develop a hands-on land use planning tool for the Salmon River watershed that highlights the significant natural resource assets in the area that can be used by both individual land owners and agencies when making decisions about land use and local planning.

The planning process relies on local knowledge and ecological expertise to identify important conservation targets, outline threats to those targets, and develop strategies to abate those threats. The key planning work is done in open forums (workshops) where participants of varied backgrounds can share information and perspectives. Between workshops, information is compiled by partner agencies and organizations, and shared with other participants to facilitate informed decision-making.

The objectives of this particular workshop were to:

1. Identify and prioritize conservation targets for the Salmon River watershed, and
2. Become familiar with the Conservation Action Planning process, including viability assessments.

Participants

Thirty-eight people attended the workshop (a complete list of participants is included as Appendix One). Participants represented government agencies, non-profit organizations, universities, municipalities, sportsmen, and private industry. Workshop organizers strived for a cross section of stakeholders to represent the different interest groups and knowledge within the watershed.

Conservation Target Identification

The first step in the planning process is to identify conservation targets. The targets should represent the full range of biodiversity within the watershed. They may include individual species, natural communities, or entire ecosystems.

In order to do this, workshop participants worked in small groups to select potential targets. Using index cards and a sticky board, potential targets were shared with all participants. Through discussion, participants grouped related targets. A final list of eight conservation targets was drawn up that includes:

1. Freshwater Estuary
2. Non-estuarine Wetlands

3. High Order Riverine System
4. Open Water
5. Open Terrestrial Communities
6. Forest
7. Falls/Gorge
8. Headwater Streams

A complete listing of potential targets and how they were grouped is included in Appendix Two.

Viability Analyses

A next important step in the planning process is to conduct viability analyses for each of the conservation targets. Much of this work will be done between workshops. In order to capitalize on participants' knowledge about targets and help participants become familiar with the viability assessment process, information to be included in viability analyses was collected for four of the targets. The four targets selected were large riverine systems, non-estuarine wetlands, forests, and headwater streams.

The viability analyses will focus on three key concepts: key ecological attributes (KEAs), indicators, and acceptable range of variation of those indicators. The definitions used in this process are:

Key Ecological Attributes (KEAs): Aspects of a target's biology or ecology that, if missing or altered, would lead to the loss of that target over time. As such, attributes define the target's viability or integrity (e.g. water chemistry, population size).

Indicators: Measurable entities related to a specific attribute. Indicators should be measurable, precise, and sensitive (e.g. pH, spawning adults observed per hour). There may be several indicators associated with each attribute.

Acceptable range of variation: Defines the limits of variation that allow the target to persist over time. An acceptable range of variation establishes the minimum criteria for identifying a conservation target as conserved or not (e.g. pH between 6.0 and 7.5).

For each of the four selected targets, participants brainstormed key ecological attributes. They then listed indicators and acceptable ranges of variation for selected attributes. The results are included in Appendix Three.

Workshop Evaluation Results

At the conclusion of the day, participants were asked to fill out an evaluation of the workshop process and logistics. Twenty-two participants completed evaluations. The results will help organizers in planning and facilitating future workshops. The full results of the evaluation are included in Appendix Four.

Over 80% of participants generally or strongly agreed that they understood the purpose of the Salmon River Watershed Natural Resources Assessment, and that their time at the workshop was well spent. Most participants acknowledged that they understood the planning process and the concepts used during the workshop (specifically conservation target and viability analysis). While the majority of respondents felt that the target selection process was productive, two did not. Several people did not completely understand how the workshop products would be used.

The workshop logistics (advance materials, facilitation, format, room, and food and drink) were rated as “good” or better by most participants. About one quarter of the participants rated the advance materials and methods for achieving the workshop objectives as “fair.”

Next Steps

Over the next few months Greg McGee, a professor and researcher at the State University of New York College of Environmental Science and Forestry will facilitate the completion of viability analyses for each of the identified targets. He will work with professionals with specific knowledge of each of the targets and use best available data to compile the analyses.

Concurrently, members of the Tug Hill Commission will continue to raise awareness among town councils and local residents as to the methods and purpose of the Salmon River Watershed Natural Resource Assessment.

A second workshop to identify threats to the identified targets is tentatively scheduled for April 2007. It is anticipated that many of the participants of this first workshop will attend. They will be joined by additional people with knowledge of the Salmon River Watershed and its resources. The information amassed in the viability analyses, as well as feedback from the outreach efforts, will help to inform the second major step of the process.

Appendix One – Workshop Participants

Dudley Bailey
Fall Brook Club

Dave MacNeil
NY Sea Grant

John Bartow
NYS Tug Hill Commission

Amy Mahar
NYS DEC Region 8

Paul Baxter
Salmon Rivers Council of Governments

Katie Malinowski
NYS Tug Hill Commission

Dan Bishop
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Jim McKenna
Tunison Laboratory of Aquatic Science

Patrick Crast
Harden Furniture

Bob McNamara
Self-employed

Ed Delaney
Village of Pulaski

John Muller
Gutchess Lumber

Debbie Forester (facilitator)
Engaging People

Fred Munk
NYS DEC Region 6

Linda Garrett
Tug Hill Tomorrow Land Trust

Richard Pancoe
NYS DEC

Linda Gibbs
NYS Tug Hill Commission

Michelle Peach
The Nature Conservancy

Christine Gray
Oswego County Dept. of Planning and
Tourism

Mary Penney
NY Sea Grant

Charlie Hall
SUNY ESF

Jerry Rasmussen
NYS DEC

Tim Howard
NYNHP

Peter Rosenbaum
SUNY Oswego, Dept. of Biological
Sciences

Jim Johnson
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Dan Sawchuck
NYS DEC

Marie Kautz
NYS DEC

Rich Smardon
SUNY ESF

Gerry Smith
Self-employed

Tracey Tomajer
NYS DEC

Jessica Trump
Oswego County Dept. of Planning and
Tourist

Fran Verdoliva
NYS DEC

Dave White
NY Sea Grant

Fran Yerdon
Town of Osceola

Appendix Two – Target Identification

The final identified targets are numbered. Bulleted targets were agreed to be part of the identified target. Some potential targets identified by participants were not explicitly included as they were deemed integrated into the final targets (identified as “other” below).

1. Freshwater estuary

2. Non-estuarine Wetlands

- Headwater wetlands – bogs/fens/meadows/tamarack/spruce/alder
- Fens communities along lower Salmon River (rare/endemics)

3. High Order Riverine System

- Fish biodiversity of lower reach of Salmon River
- Fish (migratory/predatory and supporting system of biotic and abiotic communities)
- Large Riverine systems

4. Open Water

- Fish communities in reservoirs
- Lakes/ponds
- N.B. include man-made impoundments

5. Open Terrestrial Communities

- Non-forested communities
 - Agriculture
 - Grasslands
- Grassland birds
- Village of Pulaski (community infrastructure)

6. Forest

- Conifer component
- Northern hardwood forest (maple, beech, birch)
- Hardwood forest on high elevation
- Unbroken forest

7. Falls /Gorge

8. Headwater Streams

- Native brook trout

Other

- Bald eagle

- Important (unique) habitat
- Unique species (salmon, mussel, eagle, lynx, moose)
- Wetlands (needs to be narrowed)
- Uncommon elements of biodiversity – fauna
- Upland habitats and associated biotic communities
- Hydrology – groundwater and sub-surface water
- Intact aquatic communities
- Riparian zones
- Riparian vegetative communities (temperature maintenance and water quality)
- Aquatic habitats
- Water quality

Appendix Three – Viability Assessments

Viability analysis information collected at the workshop for large riverine systems, non-estuarine wetlands, forests, and headwater streams is outlined below.

Target: Large Riverine Systems

Potential Key Ecological Attributes

- Water quality (turbidity)
- Water quantity (flow)
- Water temperature
- Tributary integrity
- Reservoir impacts
- Migration corridor intact
- Riparian cover
- Bank stability
- Invasive species
- Migratory fish species
- Resident fish species
- Groundwater influence
- Coldwater refuges
- Invertebrate species
- Tributary habitat – critical spawning habitat – Steelhead
 - Beaver effects
 - Angler effects
- Mainstream habitat – critical spawning habitat – Chinook
- Lake Ontario contaminants
- Cobble embededness (sedimentation)
- Public education and outreach
- Predatory bird species
 - eagles
 - ospreys
 - raptors
 - great blue heron
 - Mergansers

Key ecological attribute – Water Temperature

Indicators

- Mainstream and tributaries
 - Mean temperature
 - Minimum temperatures
 - Maximum temperatures

Range of variation for salmonids, for maximum temperature (°F)

	poor	fair	good	very good
Mainstem of Salmon River	76	74	72	70
Tributaries	75	72	70	68

Key ecological attribute – Migratory Species (salmonids)

Indicators

	poor	fair	good	very good
#fish count	30k	50k	90k	150k
# fish harvested				
Angler hours				
# returns to hatchery				
# spawning beds				
≥year of young density in mainstream – Chinook	100	200	300	400
Density year of young and older steelhead tribs	0.3	0.7	1.0	1.2

Target: Non-estuarine wetlands

Swamps

Marshes/Emergent wetlands

Peatlands

bogs
fens

Beaver Impoundments

Vernal Pools

Potential Key Ecological Attributes

- Intact hydrology
- Species composition
- Upland buffer
- Exotic/invasive species
- Geochemistry
- Connectivity -> to a mix of wetland types and to the broader landscape
- Amount of wetlands edge
 - Change over time
- Rare species – herps, plants, insects
- Indicator species – herps, plants
- Migratory birds
- Wetland usage patterns (heritage uses)
- Nutrient load (point and non-point)
- Toxins

- Maintain diversity of types

Key ecological attribute – Nutrient load

Indicators

- Nitrogen – trates – trites
- Phosphorus
- pH
- dissolved oxygen (water or soil characteristics)
- conductivity

** range of variability will depend on specific wetland type

Key ecological attribute – Buffer/Wetland edge

Indicators

- proportion of natural vs. non-natural cover -> change over time (ASCS air photos every two years or NYS air photos)
- wetland size (loss or expansion)
- disturbance -- % of area, type
- roads in buffer

Range of variability – Wetland buffer Indicators

	poor	fair	good	very good
% natural cover w/i 500 (?)m buffer	≤ 80%		80-95%	95-100%

Key ecological attribute – Intact hydrology

Indicators

- water source (surface, subsurface, comb.)
 - source alteration (% from different sources)
- flow reduction (look for blockages, i.e. road, stuffed culvert) – surface flow
- wetland water level -> minimum and variability
- pool longevity for vernal pools -> 2-3 weeks

** The group thought that priority should be given to isolated wetlands, which might be more susceptible to changes in hydrology

Target: Forest

Potential key ecological attributes

1. Condition

- composition
 - woody plants
 - conifer hardwood
 - understory
 - bird communities

- structure
 - canopy diameter distribution
 - cwd
 - successional stage
- “forest health”
 - pH, N loading

2. Size

3. Landscape context

- connectivity/fragmentation

Threats

Adelgid

Sirex (wood wasp)

Key ecological attribute – Structure

Indicators

- density #trees/acre
- diameter distribution #trees/dia class
- tree quality
 - % AGS
 - % UGS
- snags #snags/acre
- downed coarse woody debris ft³/acre
- canopy closure
- indicator species
- regeneration
- shrub/herb layer #/m² composition

Key ecological attribute – Composition

Indicators

- bird indicator species
 - abundance
 - #birds/hr
 - #birds/mile
- amphibian
- % invasives
- herb layer composition

Target: Freshwater Estuary

Notes for future use:

Freshwater estuary target can roughly be mapped as the area west of Route 3

Private ownership (development opportunity) is one of the largest threats

The freshwater estuary target is the target most heavily impacted by recreation

- boat launch motorized
- heavily used

Potential key ecological attributes

- water quality
- accessibility of passage: aquatic system
- habitat and freshwater estuarine processes
- water level – quantity (flow)
- coastal wetland integrity
- black tern populations integrity
- flooding regime
- riparian zone
- hydrology
- seasonal abundance of game fish
- resident assemblage of fish and other organisms
- index of species diversity

Key ecological attribute – Water quality

Indicators

- pH * village of Pulaski collecting data
 * hatchery – Brookfield Power collecting data
- dissolved oxygen
- total suspended solids
- metals
- PCBs
- Temperature

** as far as we know, water quality is ok

Key ecological attribute – Black tern population integrity (specific nesting habitat) ** ask Gerry Smith

Indicators

- # of birds
- # of nests
- # of fledglings
- amount of appropriate habitat (grass in wetlands)

Key ecological attribute – Hydrology regime
Indicators

- water level
- flow volume*
- flow timing*
- miles of natural channel
- ground water/water table

*ask Dan Bishop/Dan Sawchuk/Fran Verdoliva
 specific information available/needed:

How does the lake impact the freshwater estuary target? – IJC

How much of the freshwater estuary was included in FERQ relicensing?

Target: Headwater streams

Potential key ecological attributes

- cold water
- forest cover/alder swamp mix
- macroinvertebrate community
- spawning habitat
- springs/seeps/interaction with groundwater
- beavers
- low road density
- presence of large woody debris in stream
- low level of vehicle disturbance
- one or more species of trout present
- beginning of stream system
- presence of fur-bearing animals
- clear water
- low nutrient levels
- presence of mussels

Key ecological attribute – Water conditions
Indicators

- 65-70°F maximum
- pH 05-08
- conductivity 45-200
- turbidity
- dissolved oxygen (5-9)
- phosphorus < 10ppl

Key ecological attribute – Vegetative cover
Indicators

- % cover – 75% minimum in riparian zone

Key ecological attribute – Indicator species

Indicators

- macroinvertebrates
- presence of (see Bob Bode) –
- salamanders/amphibians
 - mussels – need to know baseline (ask Fran Y.)
 - fur-bearing mammals – otter, beaver, mink, muskrat

Key ecological attribute – Spawning habitat

Indicators

- gravel in stream bed – 65% minimum
- stream sediment
- turbidity (need low)

Key ecological attribute – Interaction with groundwater

Indicators

- Darcy Flow modeling
- Presence of trout spawn indicates presence of seep/spring

Key ecological attribute – Level of disturbance

Indicators

- Road density
 - Take cue from elk/lynx measurements
 - Karen Murray – USGS – road crossing/water/stream quality
- Distance to nearest parking area
- Evidence of vehicles in stream (low to no needed)
- Salt and sand chloride levels

Key ecological attribute – Fishery

Indicators

- Presence/absence of trout
- Density of spawning adults ->go to literature
- Presence of woody debris
- Presence of winter habitat

Key ecological attribute – Stream system/structure

Indicators

- Geographic location
- Stream order – 1st or 2nd only
- # of 1st order streams – range?
- # of dam/dam-like barriers

Appendix Four – Workshop Evaluation Results

Salmon River Watershed Natural Resources Assessment Workshop 1—Targets September 25, 2006

Evaluation of Workshop Content

•Twenty two workshop participants completed evaluations.•

Please mark your level of agreement with the following statements.

	Strongly Agree	Generally Agree	Partially Agree	Mostly Disagree	Strongly Disagree
My personal goals for participating in this workshop were met	18%	59%	23%		
I understand what the purpose of the SRWNRA* is	36%	45%	18%		
I understand the SRWNRA* process	24%	62%	14%		
I understand what a target is	18%	59%	23%		
The process of selecting the targets was productive	23%	36%	32%	9%	
I understand what viability analysis is	14%	86%			
I understand how the products of the workshop will be used	18%	41%	36%	5%	
Participating in this workshop increased my knowledge of conservation in the Salmon River Watershed	27%	36%	32%	5%	
My participation in this workshop was valuable to the process	9%	64%	27%		
My time today was well spent	32%	50%	18%		

*Salmon River Watershed Natural Resources Assessment

How might you and/or your organization use the information shared during this workshop?

- Raising awareness; best vehicle may be a draft summary and updates through a newsletter
- Future agency planning
- Talking to town government and sportsman organizations
- Contributing data and identifying targets
- As an example of a collaborative planning process, and for use in an open space course taught at SUNY ESF
- Management plans
- Information, data, and recommendations can be used in the DEC's UMP process
- Identify needed research
- Natural resource management
- Later in the process the information can be used in outreach

What do you see as the most significant challenge to the success of conservation in the Salmon River Watershed?

- Getting all significant parties involved in the planning process and helping them to gain buy-in to the plan
- Acceptance by residents (5)
- Acceptance from management agencies
- Acceptance by local government
- Local participation
- Reconciling major economic aspects of recreational fishing and habitat preservation goals
- Working with snowmobilers and ATVers
- Development, recreation, and economic pressure
- Money
- Resolving conflicting resource use
- Need more integration of terrestrial and aquatic management
- Citizen and government interest

Can you recommend others who might benefit from, or be able to contribute towards, this natural resource assessment process? Please provide names, organization, and any other contact information you might have. Or ask us to send you an email next week reminding you to send us this information!

- Brookfield Power
- Oswego County Planning researcher did a plan south of Salmon River Corridor
- Jeff Devine, Executive Director, Save the County Land Trust
- Representative from Trust for Public Lands
- NYC is interested in this whole region
- Stakeholder groups: conservation fishing, landowners

Evaluation of Workshop Logistics

Please fill in the blank in each sentence by checking the appropriate box.

	Excellent	Very Good	Good	Fair	Poor	
Advance Materials						Comments
In general, the materials sent prior to the workshop were _____.		35%	45%	20%		_____
The advance materials gave me a(n) _____ understanding of the scope of the workshop, including the goals.	5%	20%	50%	25%		_____
The advance materials did a(n) _____ job of explaining new concepts.		25%	40%	30%	5%	_____
Workshop						
The facilitators did a(n) _____ job of keeping to the agenda.	15%	50%	25%	10%		_____
The workshop was _____ for achieving the objective of identifying conservation targets.	5%	40%	30%	25%		_____
The workshop was _____ for becoming familiar with the process of viability assessments	10%	35%	30%	25%		_____
Logistics						
The meeting room was _____ for this workshop.	20%	40%	30%	10%		_____
The food and drink was _____.	25%	45%	30%			_____

APPENDIX 2

SALMON RIVER WATERSHED NATURAL RESOURCE ASSESSMENT

PROCEEDINGS OF WORKSHOP TWO: THREAT IDENTIFICATION AND SITUATION ANALYSIS

Salmon River Watershed Natural Resources Assessment

Workshop Two: Threat Identification and Situation Analysis

A Report of Workshop Process and Products

May 4, 2007

Prepared for:

NYSDEC, Division of Fish, Wildlife and Marine Resources
Tug Hill Tomorrow Land Trust
Oswego County Environmental Management Council
New York Natural Heritage Program
The Nature Conservancy
SUNY College of Environmental Science and Forestry
SUNY Oswego
New York Sea Grant
NYS Tug Hill Commission

Prepared by:

Deborah Forester
Engaging People

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Workshop Evaluation	4
Next Steps	4

Appendices

Appendix One – Participants

Appendix Two – Direct Threats

Appendix Three – Situation Analyses

Appendix Four – Workshop Evaluation Results

Introduction

On May 4, 2007, a workshop was held in the Snow Building in Pulaski, NY to further the conservation planning process for the Salmon River Watershed as part of the Salmon River Watershed Natural Resource Assessment Project. The overall project objectives are to develop a hands-on land use planning tool for the Salmon River watershed that highlights the significant natural resource assets in the area, and can be used to guide local planning efforts, Department of Environmental Conservation management, and individual land use decisions.

This evaluative process relies on local knowledge and ecological expertise to identify important conservation targets, outline threats to those targets, and develop strategies to abate those threats. The primary work is done in open forums (workshops) where participants of varied backgrounds can share information and perspectives. Between workshops, information is compiled by partner agencies and organizations, and shared with other participants to facilitate informed decision-making.

The objectives of this particular workshop were to:

1. Identify potential threats to the conservation targets (identified in an earlier workshop), and
2. Complete situation analyses to identify indirect threats and causal pathways.

Participants

Forty-eight people attended the workshop (a complete list of participants is included as Appendix One). Participants represented government agencies, non-profit organizations, universities, municipalities, sportsmen, and private industry. Workshop organizers strived for a cross section of stakeholders to represent the different interest groups and knowledge within the watershed.

Threats Identification

The first step in the planning process was to identify conservation targets. In a workshop held September 25, 2006, 38 participants identified seven important conservation targets within the watershed. Those targets were:

- Freshwater Estuary
- Gorge/Falls/Cliffs
- Headwater Streams
- Main Stem Salmon River and its Tributaries
- Matrix Forest
- Non-Estuarine Wetlands
- Open Waters

During this second workshop, working in small groups, participants began by identifying direct threats to each conservation target. A direct threat is an agent or factor that directly degrades a target. Considering a ten-year time period, participants then ranked each direct threat on a scale of 1 (low) to 4 (high) for each of three characteristics: scope, severity, and irreversibility.

Scope was defined spatially as the geographic scope of impact on the conservation target at the site that can reasonably be expected within 10 years under current circumstances (i.e., given the continuation of the existing situation). Severity was defined as the level of damage to the conservation target that can reasonably be expected within 10 years under current circumstances. Irreversibility was defined as the degree to which the effects of a direct threat can be restored. Irreversibility refers to the “effects of the direct threat on the target” not the direct threat itself; it is the “recoverability” of the target from the effects of the threat.

The scores for each characteristic were then added to provide a simple index ranking the seriousness of each threat. The index is a relative ranking of each threat in this watershed, for this target. The index number has no significant relevance outside of this exercise. Those threats with the highest rankings were deemed “critical” for the identified target.

For each of the conservation targets the following critical threats were identified (for a list of all direct threats associated with each target, and their scores and index number, please see Appendix Two).

- Freshwater Estuary
 - Invasive species
 - Pests/Disease/Pathogens
 - Altered hydrology
 - Climate change
- Gorge/Falls/Cliffs
 - Terrestrial invasives
 - Loss of soil/habitat
 - Altered Hydrology
 - Humidity
- Headwater Streams
 - Temperature stress
 - Habitat changes
 - Water Chemistry changes

- Main Stem Salmon River and its Tributaries
 - Invasive Species
 - Removal of riparian vegetation
 - Altered Hydrology
 - Sedimentation
 - Increased water temperature
 - Fish disease
 - Acid rain
- Matrix Forest
 - Land-use change
 - Climate change
 - Failure to regenerate
 - Severe climate
 - Loss of microhabitats
- Non-Estuarine Wetlands
 - Atmospheric Deposition
 - Invasive Species
 - Nonpoint Source Pollution
 - Altered Hydrology
 - Physical disturbance
- Open Waters
 - Atmospheric Deposition
 - Invasive Species
 - Nonpoint Source Pollution

Situation Analyses

The next step in the planning process was to develop situation analyses for each target. To achieve conservation critical threats must be abated and degraded targets restored. To do this effectively, requires an understanding of the system or situation that drives these problems and identifying promising conditions that may lead to solutions. This means understanding the biological, political, economic, and socio-cultural context within which targets exist – in particular, the indirect threats and opportunities behind each critical threat.

The purpose of this exercise was to start building a conceptual model for each target. A conceptual model is a diagram of a set of relationships between certain factors that are believed to impact targets. In other words, it illustrates the things (“factors”) that have an impact on the targets. The goal was to identify the indirect threats that affect or cause the direct threats. The situations analysis for each target is meant to present a picture of the situation at the site, illustrate the critical threats and indirect threats, and show the assumed relationships between

factors affecting the target. Situation analyses for each target are included in Appendix Three.

Workshop Evaluation Results

At the conclusion of the day, participants were asked to fill out an evaluation of the workshop process and logistics. Twenty-one participants completed evaluations. The results will help organizers in planning and facilitating future workshops. The full results of the evaluation are included in Appendix Four.

Seventy-two percent of participants generally or strongly agreed that they understood the purpose of the Salmon River Watershed Natural Resources Assessment, and 85% felt that their time at the workshop was well spent. Over 80% of participants generally or strongly felt that the process of selecting and ranking the threats was productive; and 86% of respondents felt similarly about the process for completing the situation analysis. Several people did not completely understand how the workshop products would be used.

The workshop logistics (advance materials, facilitation, format, room, and food and drink) were rated as “very good” or better by most participants. Participants rated workshop logistics higher than they had for the first workshop.

Next Steps

The Nature Conservancy will collate the threats information and situation analyses for each target. Using the data collected, the most critical threats for the entire watershed will be determined. The data and diagrams will be put into a form useful for sharing with workshop participants and other interested stakeholders.

Concurrently, members of the Tug Hill Commission will continue to raise awareness among town councils and local residents as to the methods and purpose of the Salmon River Watershed Natural Resource Assessment.

A third workshop to identify strategies to abate the critical threats is planned for June 21, 2007. It is anticipated that many of the participants of this workshop will attend. They will be joined by additional people with knowledge of the Salmon River Watershed and its resources. Feedback from workshop participants and other stakeholders will help to inform the development of appropriate conservation strategies.

Appendix One – Workshop Participants

Frances Adams
Town of Redfield

Paul Baxter
Salmon Rivers Council of
Governments

Tom Bell
NYSDEC, Region 7

Bruce Brach
Harden Furniture, Inc.

Russ Briggs
SUNY ESF

Janet Clerkin
Oswego County Dept. of Tourism &
Promotion

Patrick Crast
Harden Furniture, Inc.

Debbie Forester
Workshop Facilitator

Kristin France
The Nature Conservancy

Linda Garrett
Tug Hill Tomorrow Land Trust

Linda Gibbs
NYS Tug Hill Commission

Jennifer Harvill
NYS Tug Hill Commission

Michelle Henry
Tunison Laboratory of Aquatic
Science

Susan Heuph
Town of Redfield

Tim Howard
NY Natural Heritage Program

Jim Johnson
Tunison Laboratory of Aquatic
Science

Jane Jones
Cooperative Tug Hill Council

Marie Kautz
NYSDEC, Region 7

Dave King
LandVest

Kevin King
Empire State Forest Products
Association

David Klein
The Nature Conservancy

Wayne Kwasniewski
Kwasniewski Club

Jim Lacelle
Town of Orwell

Chris Lajewski
The Nature Conservancy

Amy Mahar
NYSDEC, Region 8

Katie Malinowski
NYS Tug Hill Commission

Dick McDonald
NYSDEC, Region 6

Greg McGee
SUNY ESF

Jim McKenna
Tunison Laboratory of Aquatic
Science

John Mueller
Gutchess Lumber

Fred Munk
NYSDEC, Region 6

Steve Murphy
Brookfield Power

Andrew Nelson
SUNY Oswego, Rice Creek Field
Station

Bob O'Brien
Cotton-Hanlon, Inc.

Chuck Parker
Oswego County Federation of
Sportsmen's Clubs

Michelle Peach
The Nature Conservancy

Mary Penney
NY Sea Grant

Jerry Rasmussen
NYSDEC, Region 7

Connie Rogers
Douglaston Manor

Peter Rosenbaum
SUNY Oswego, Dept. of Biological
Sciences

Steve Servies
Gutchess Lumber

Rich Smardon
SUNY ESF

Tracey Tomajer
NYSDEC

Jessica Trump
Oswego County Dept. of Tourism &
Promotion

Fran Verdoliva
NYSDEC, Salmon River Coordinator

Gretchen Wainwright
The Nature Conservancy

Ernie Wheeler
Village of Pulaski

Dave Zembiec
NYS Tug Hill Commission

Appendix Two – Direct Threats

Groups identified direct threats to each target, and then rated those threats on the criteria of scope, severity, and irreversibility. An additive process gives a simple index that ranks the seriousness of each threat. The importance is the relative ranking of each threat, not the index number per se.

Freshwater Estuary

Direct Threat	Scope	Severity	Irreversibility	Index
Invasive Species	4	4	3	11
Pests/Disease/Pathogens	3	4	4	11
Altered Hydrology	4	3	3	10
Climate Change	4	3	3	10
River Flow Alteration	4	2	1	7
Habitat Alteration	2	2	3	7
Pollution	2	2	2	6
Toxins	2	2	2	6

Gorge/Falls/Cliffs

Direct Threat	Scope	Severity	Irreversibility	Index
Terrestrial Invasives	3	4	3	10
Loss of soil/habitat	3	3	4	10
Altered Hydrology	2	4	3	9
Humidity	2	4	3	9
Light conditions	1	2	3	6
Aquatic invasives	1	2	3	6
Direct taking	1	3	2	6
Recreation	2	2	2	6
Vegetation cover	1	2	3	6
Bypass baseflow	1	3	1	5

Headwater Streams

Direct Threat	Scope	Severity	Irreversibility	Index
Temperature stress	4	3	4	11
Habitat changes	4	3	2	9
Water Chemistry changes	4	2	3	9
Non-native species (upper)	1	2	3	6
Invasive species	1	2	3	6
Lack of GW discharge	1	1	3	5
Physical stream impacts	2	2	1	5
Siltation/erosion (acceleration of)	2	1.5	1	4.5
Alterations to stream Structure/geomorphology	1	1	2	4

Headwater Streams

Direct Threat	Scope	Severity	Irreversibility	Index
Invasive species	4	3	4	11
Removal of riparian vegetation	3	3	4	10
Altered Hydrology	4	3	3	10
Sedimentation	3	4	3	10
Increased water temperature	3	3	4	10
Fish disease	3	3	4	10
Acid rain	3	3	4	10
Land cover change	2	3	4	9
Beaver	2	3	3	8
Increased evaporation	3	1	4	8
Toxins	3	2	3	8
Channelization	2	3	2	7
Change in base flow	2	3	2	7
Diversion of water	3	2	2	7
Increased nutrient loading	1	2	3	6
Aquatic invasives	2	2	2	6
Overfishing	1	1	2	4
Stocking	1	1	1	3
New barriers	1	1	1	3

Matrix Forest

Direct Threat	Scope	Severity	Irreversibility	Index
Climate change	4	1	4	9
Land Use Change	2	3	4	9
Severe Weather	1.5	3	4	8.5
Failure to regenerate	3.5	3	2	8.5
Loss of microhabitats	3	3	2	8
Fragmentation	2.5	1	3	6.5
Pests/Disease/Pathogens	3.5	3	2.5	6.5
Change in species diversity	1	2.5	3	6.5
Invasive Species	1	1	3	5

Non-Estuarine Wetlands

Direct Threat	Scope	Severity	Irreversibility	Index
Atmospheric Deposition	4	4	4	12
Invasive Species	4	3	3	10
Nonpoint Source Pollution	2	3	4	9
Altered Hydrology	3	3	2	8
Physical Disturbance	4	2	2	8
Beavers	3	3	1	7
Removal of Cover	3	1	1	5
Temperature Change	1	1	1	3

Open Waters

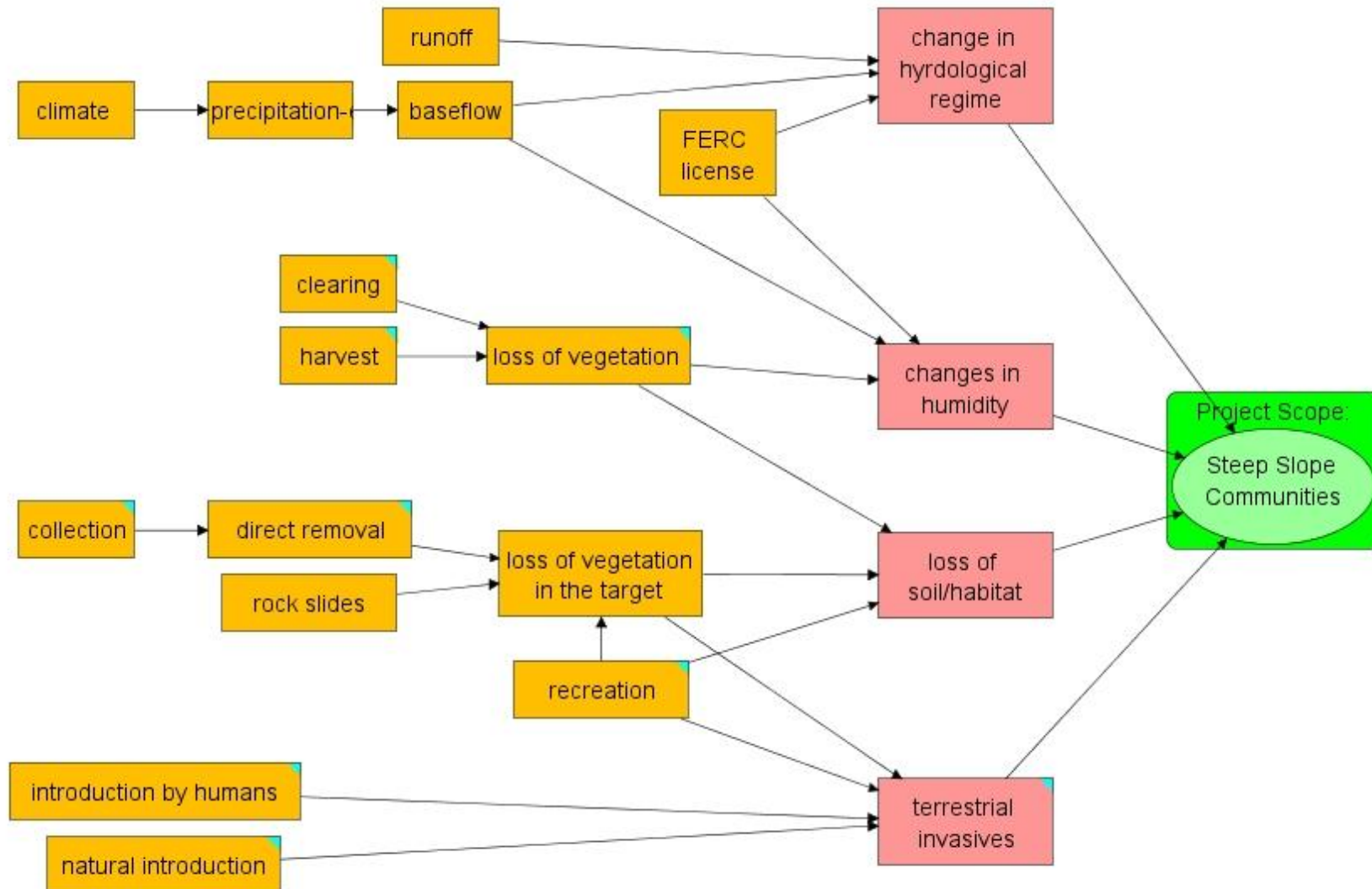
Direct Threat	Scope	Severity	Irreversibility	Index
Atmospheric Deposition	4	4	4	12
Invasive Species	4	3	3	10
Nonpoint Source Pollution	2	3	4	9
Beavers	3	3	1	7
Temperature Change	1	2	3	6
Altered Hydrology	1	3	2	6

Appendix Three – Situation Analyses

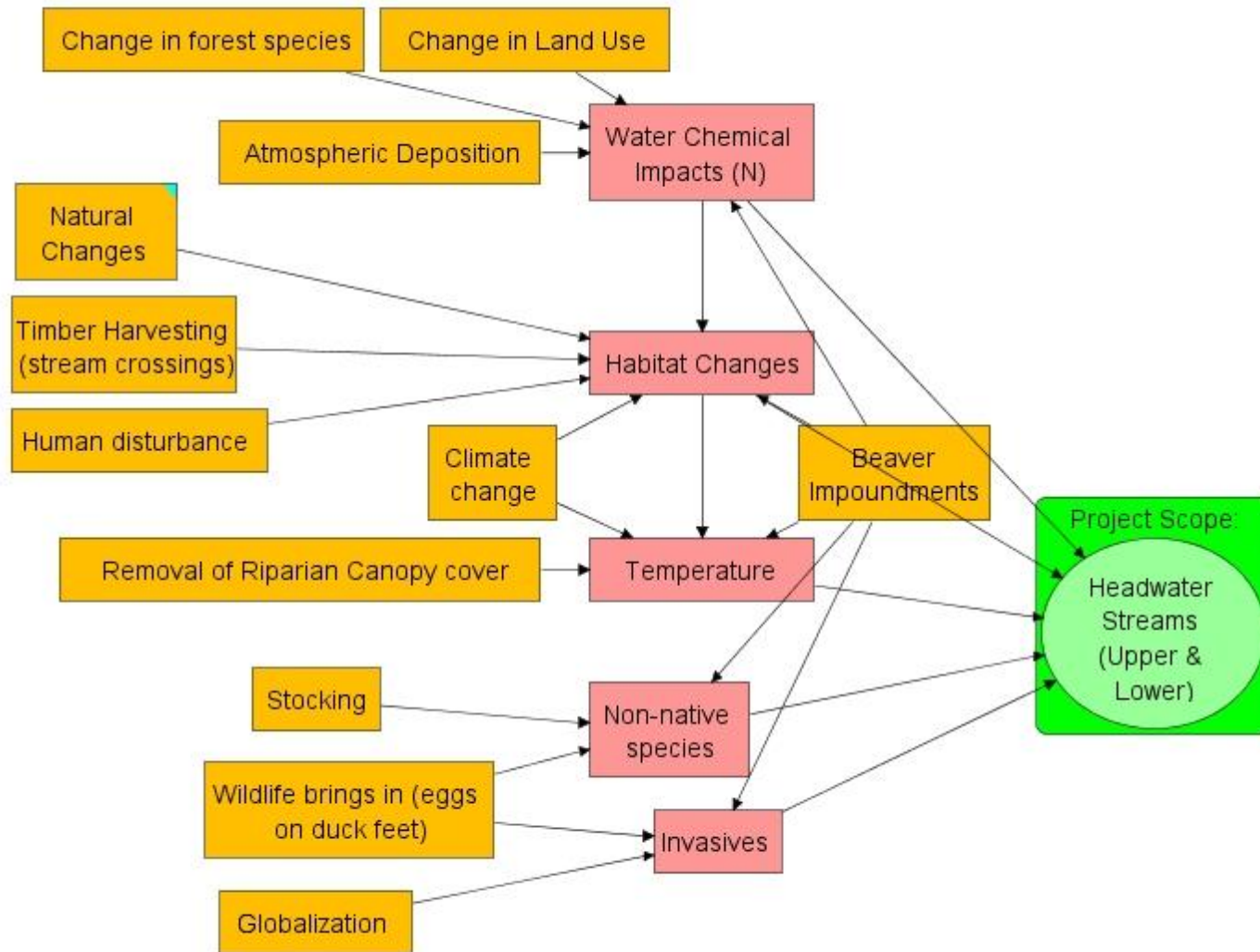
Freshwater Estuary



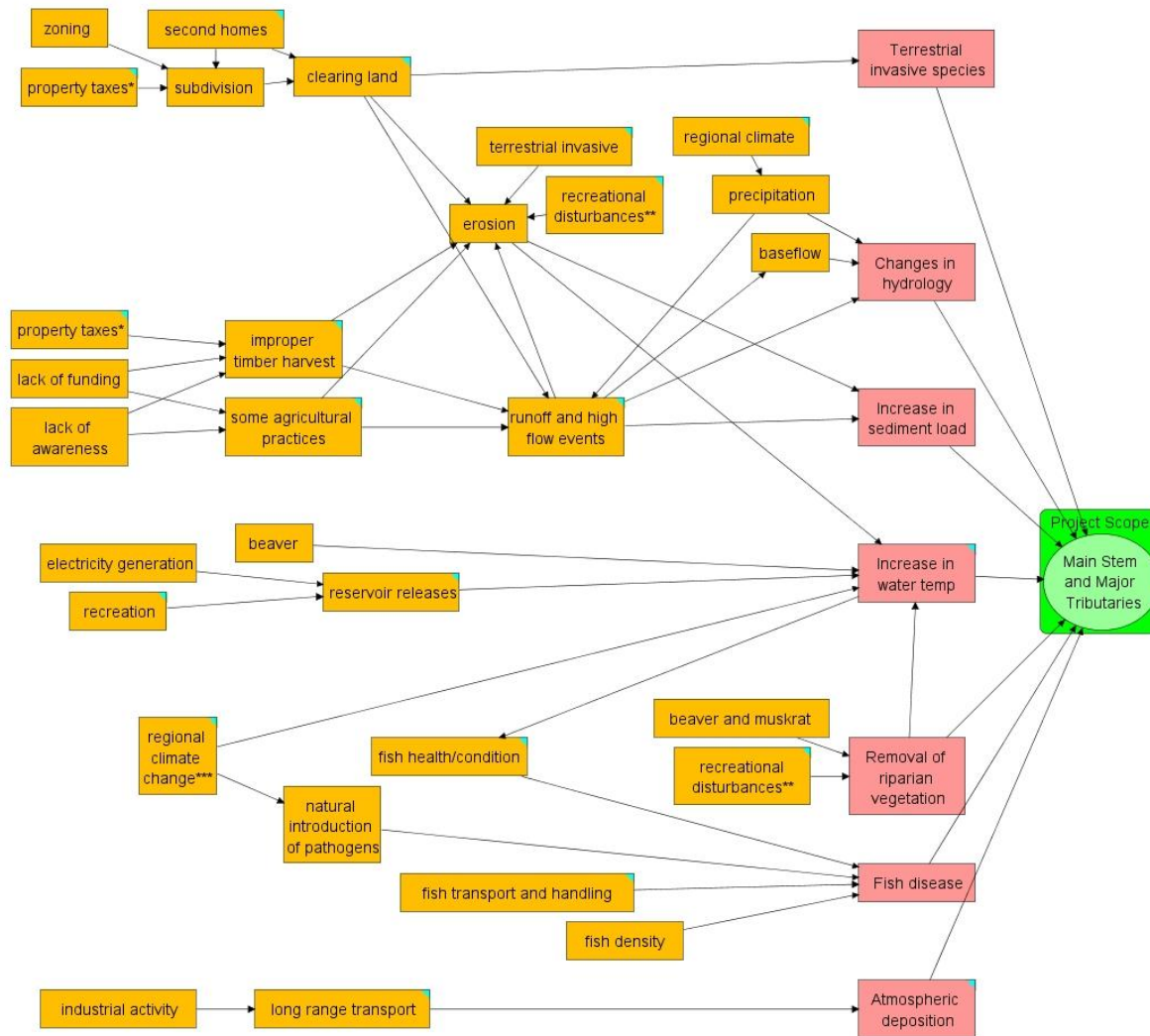
Gorge/Falls/Cliffs



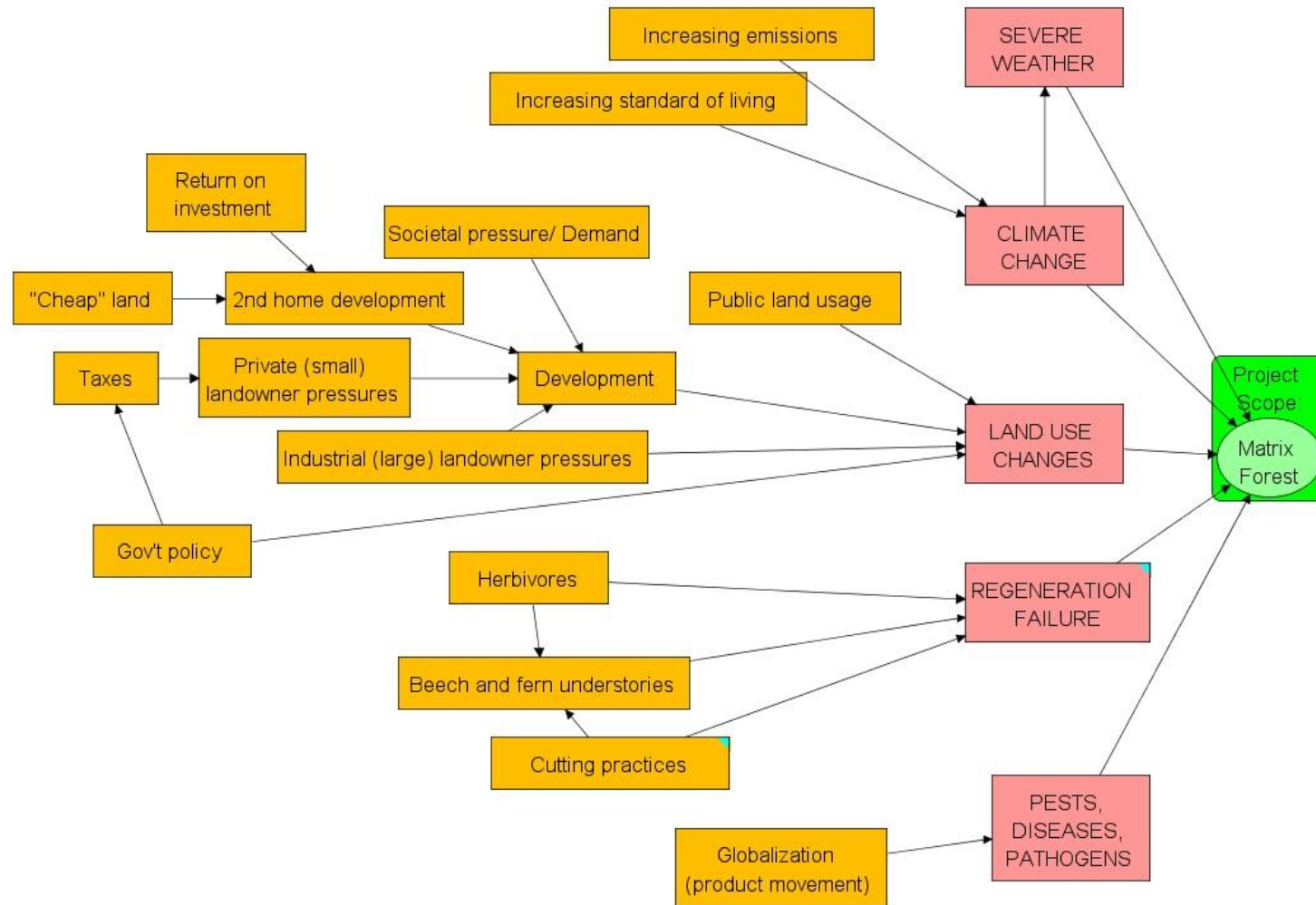
Headwater Streams



Main Stem Salmon River and its Tributaries



Matrix Forest



Non-Estuarine Wetlands and Open Waters



Appendix Four – Workshop Evaluation Results

Salmon River Watershed Natural Resources Assessment

Workshop 2—Threats

May 4, 2007

Evaluation of Workshop Content

Please mark your level of agreement with the following statements.

	Strongly Agree	Generally Agree	Partially Agree	Mostly Disagree	Strongly Disagree
My personal goals for participating in this workshop were met	14%	76%	10%	0	0
I understand what the purpose of the SRWNRA* is	29%	43%	29%	0	0
I understand the SRWNRA* process	40%	45%	15%	0	0
I understand what a threat is	45%	40%	15%	0	0
The process of selecting and ranking the threats was productive	33%	48%	19%	0	0
The process for competing the situation analysis was useful	29%	57%	15%	0	0
I understand how the products of the workshop will be used	29%	29%	33%	10	0
Participating in this workshop increased my knowledge of conservation in the Salmon River Watershed	33%	38%	19%	5	5
My participation in this workshop was valuable to the process	15%	65%	20%	0	0
My time today was well spent	25%	60%	15%	0	0

*Salmon River Watershed Natural Resources Assessment

How might you and/or your organization use the information shared during this workshop?

- to understand others concerns
- increased our understanding of diversity of resources and issues affecting them --especially recreational use
- my organization is more interested in the outcome
- help develop voluntary guidelines
- it will be a good tool for use in our work
- to share with non-participants for their reactions --starting point for discussions
- ultimately the information can be used to do a better job with management
- we might be able to incorporate some of this information into management objectives
- the knowledge of knowing what other organizations would like to do with the natural resources we share
- Tug Hill management for invasive species
- we manage 10K acres in the watershed

What do you see as the most significant challenge to the success of conservation in the Salmon River Watershed?

- taxes --land use from tax burden
- local government and local citizen recognition of need for appropriate education and action
- local participation and acceptance
- property taxes
- population --2nd home development
- cooperation
- getting the public involved
- trying to balance diverse components, prioritize, and gather more complete information on current status are all challenges
- getting the general public involved
- development
- education
- consensus on necessary actions
- communicating the complexity of contributing factors in a simple, understandable way to local officials and the general public
- the variability across the watershed and the number of different landowners and other entities that influence how any recommendations might be implemented.
- globalization of the mass movements of goods and services bringing invasives and changing ideas of land management; increase population and development.

- knowing what to leave alone and what to change
- buy in from private landowners

Evaluation of Workshop Logistics

Please fill in the blank in each sentence by checking the appropriate box.

	Excellent	Very Good	Good	Fair	Poor	
Advanced Materials						Comments
In general, the materials sent prior to the workshop were _____.	20%	53%	13%	13%	0	
The advance materials gave me a(n) _____ understanding of the scope of the workshop, including the goals.	20%	47%	13%	20%	0	
The advance materials did a(n) _____ job of explaining new concepts.	13%	53%	20%	13%	0	
Workshop						
The facilitators did a(n) _____ job of keeping to the agenda.	29%	59%	6%	6%	0	
The workshop was _____ for achieving the objective of identifying conservation targets.	12%	53%	35%	0	0	
The workshop was _____ for becoming familiar with the process of viability assessments.	19%	44%	38%	0	0	
Logistics						
The meeting room was _____ for this workshop.	29%	35%	29%	6%	0	
The food and drink was _____.	53%	47%	0	0	0	

APPENDIX 3

**SALMON RIVER WATERSHED
NATURAL RESOURCE ASSESSMENT**

PROCEEDINGS OF WORKSHOP THREE: STRATEGIES

Salmon River Watershed Natural Resources Assessment

Workshop Three: Strategies

A Report of Workshop Process and Products

June 21, 2007

Prepared for:

NYSDEC, Division of Fish, Wildlife and Marine Resources
Tug Hill Tomorrow Land Trust
Oswego County Environmental Management Council
New York Natural Heritage Program
The Nature Conservancy
SUNY College of Environmental Science and Forestry
SUNY Oswego
New York Sea Grant
NYS Tug Hill Commission

Prepared by:

Deborah Forester
Engaging People

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Appendices

Appendix One – Participants

Appendix Two – Workshop Evaluation Results

Introduction

On June 21, 2007, a workshop was held in the Snow Building in Pulaski, NY to further the conservation planning process for the Salmon River Watershed as part of the Salmon River Watershed Natural Resource Assessment Project. The overall project objectives are to develop a natural resources assessment of the Salmon River watershed that highlights the significant natural resource of the area, and can be used to guide local planning efforts, Department of Environmental Conservation management, and individual land use decisions.

This evaluative process relies on local knowledge and ecological expertise to identify important conservation targets, outline threats to those targets, and develop strategies to abate those threats. The primary work is done in open forums (workshops) where participants of varied backgrounds can share information and perspectives. Between workshops, information is compiled by partner agencies and organizations, and shared with other participants to facilitate informed decision-making.

The objectives of this particular workshop were to:

3. Identify two to four objectives for each critical threat and/or the targets they affect, and
4. Identify up to 10 strategic actions that will advance each objective..

Participants

Fifty people attended the workshop (a complete list of participants is included as Appendix One). Participants represented government agencies, non-profit organizations, universities, municipalities, sportsmen, and private industry. Workshop organizers strived for a cross section of stakeholders to represent the different interest groups and knowledge within the watershed.

Workshops One and Two

The first step in the planning process was to identify conservation targets. In a workshop held September 25, 2006, 38 participants identified seven important conservation targets within the watershed. Those targets were:

- Freshwater Estuary
- Gorge/Falls/Cliffs
- Headwater Streams
- Main Stem Salmon River and its Tributaries
- Matrix Forest
- Non-Estuarine Wetlands
- Open Waters

During a second workshop, in May 2007, participants identified direct and indirect threats to each target. Using ranking criteria based on the scope, severity, and irreversibility of each threat, the most critical threats for each target were identified. The data on all of the threats were then combined to develop a “master list” of critical threats in the Salmon River Watershed. The seven threats identified are outlined below, along with the specific terms and threats used to describe them for individual targets.

Altered Hydrology

- Altered hydrology
- Bypass baseflow
- Change in base flow
- Lack of ground water discharge
- River flow alteration
- Temperature change

Invasive Species

- Aquatic invasive species
- Invasive species
- Terrestrial invasive species

Land Cover/Land Use Change

- Fragmentation
- Land cover change
- Land use change
- Removal of riparian vegetation
- Temperature change
- Vegetation cover

Pests/Pathogens/Diseases

- Fish disease
- Pests/Disease/Pathogens

Physical Habitat Disturbance

- Beavers
- Habitat changes
- Loss of soil/habitat
- Physical disturbance
- Physical stream impacts
- Temperature change

Pollution and Sedimentation

- Increased nutrient loading
- Nonpoint source pollution
- Pollution

- Sedimentation
- Toxins

Regional/Global Issues

- Atmospheric deposition
- Climate change
- Temperature change

Developing Objectives and Strategies

The seven critical threats in the Salmon River Watershed were the focus of this workshop. Participants used data gathered in past workshops, including the situation diagrams developed in Workshop 2 illustrating the paths by which the various threats act on the targets, and their own expert knowledge for this work. They brainstormed actions that could be taken to abate the critical threats, then grouped like actions and developed measurable objectives for abating the threat.

The objectives and strategic actions to address each critical threat are outlined below.

Threat: Altered Hydrology

Objective: No net loss of forest cover in watershed (presently 73%) with emphasis on sustainably managed forest – measured as biomass produced per acre per year

Strategic Actions: management of state forests and wildlife management units – state forests achieve FSC certification by 2015

- specific actions – develop unit management plans (UMPs) that incorporate
- UMPs include inter-division consultation
- UMPs based on thorough surveys of lands other than forestry – other threats could include ATVs, which also alter hydrology
- use timber revenue to hire the necessary staff so that FSC on 100% of state forests in watershed is achieved by 2012. Lobby state legislators to achieve this legislative change.
- promote maintaining current conifer stands on state lands to moderate early spring stream flow

Strategic Actions: management of commercial lands --

- Tug Hill Commission initiate dialogue to re-assess property tax values based on current use rather than potential use – timber should not be assessed as real property
- Will need special legislation from state to declassify timber as real property in Tug Hill – may add on to current Tug Hill legislation, by 2012
- encourage best management practices for silvicultural system

- enforce current DEC regulations – build up the staffing of DEC to add the necessary staff by 2012
- Tug Hill Commission work with towns to find incentives to encourage commercial timber to gain FSC-NYS Logger Association certification
- develop a method for educating and encouraging BMP use

Strategic Actions: Management of lands in individual private ownership

- identify critical areas for conservation measures
- incentives for private landowners to manage sustainably – 480A
- focus on buffers – find incentives to encourage buffers – CRP-like program
- watershed protection measures – CRP-like program for buffers; tax or assessment incentive for maintaining a buffer
- aim for 100ft buffer
- Tug Hill agency, with regulatory powers?
- landowners have to have ownership of the process, help design the incentives
- reimbursement for towns for 480A taxes by NYS as part of existing Tug Hill tax program. achieve 2012

Objective: Maintain the current hydrologic functions of the main-stem and tributaries – focal species are steelhead, brook trout and Chinook

Strategic Actions:

- establish gages Trout, Orwell, Beaver Dam Creeks and east branch of main stem (Mad River) and North Branch – find funding for more gages
- In 2007-08 establish committee to determine most cost effective method for operating gages
- Identify an objective institution to administer gages
- put gages in place by 2010
- need to reassess current use of TH aquifer, and establish an optimal maximum withdrawal – detailed survey to repeat USGS study from 20 years ago. Find a partner and funding, or seek Congressional appropriation

Threat: Invasive Species

Objective: By 2010 institutionalize St. Lawrence-Eastern Lake Ontario PRISM (partnership for regional invasive species management).

Strategic Actions

- Hire coordinator, support and seasonal staff
- Program funding from NYS and grants
- Obtain NGO status

- Decide where to house SLELO

Objective: By 2010 increase public awareness of invasive species in the Salmon River Watershed by implementing a Center for Community Studies (CCS) survey.

Strategic Actions:

- Workshops
- Printed materials
- Media outreach
- Public areas outreach
- Establish collaborative network of researchers and information
- Establish funding source
- Conduct survey

Objective: By 2015 assess ecological health of the watershed on public and private land (with permission) to identify susceptible areas that are conducive to invasive species establishment.

Strategic Actions:

- Conduct assessment of ecological health of key ecological attributes.
- Establish monitoring protocols to conduct assessment and monitoring programs.
- Establish a monitoring network of volunteers based on scientific research and quality assurance-quality control.
- Funding (\$1 million over 5 years) for scientific rigor to establish program

Objective: By 2010 implement a public policy aimed at no new invasive species introductions and no net spread of invasive species.

Strategic Actions:

- Bi-national prohibition of ocean vessels on Great Lakes (only 8% of all ships on Great Lakes were on the ocean)
- State legislation on the sale/monitoring of invasive species
- Nuisance aquatic species (NAS) clean boater education and cleaning facilities at public sites.
- Expand the Environmental Protection Fund for early detection/rapid response and eradication of invasive terrestrial and aquatic plants.

Threat: Land Use/Land Cover Change

Objective: Over the next 20 years, maintain land use/cover to within 10% of current distribution

Strategic Actions:

- obtain better (more spatially specific? more extensive?) natural resources information to help municipalities focus development in appropriate areas
- develop, publish and distribute comprehensive guide to how to site/manage development to minimize impacts
- help residents stay here and not have to parcelize
 - fund Forest Land Enhancement Program (part of the Farm Bill)
 - get reimbursements from state to local governments for 480a taxes into a statute (currently has been done by decree from governor)
 - increase endowment/\$ for Tug Hill Tomorrow
 - increase awareness of easements and their benefits to landowners
 - we need something broader than 480a...?

Objective: Maintain vegetative buffers along main stem, major tributaries, and steep slope communities to within 10% per mile of existing cover

Strategic Actions:

- determine what “vegetative buffers” are appropriate. Natural cover within 25 ft?
- develop BMP (best management practices) guidelines for steep slopes and riparian areas
- establish and maintain properly designed trail systems/fishing access points
- establish and maintain an ATV trail system AND **enforce use** with seizure of equipment
- institute targeted blanket beaver removal permit system throughout watershed
 - -“blanket” removal only applies to small spatial area specified in permit
 - -permit approved by biologist
 - -what conditions/nuisances do applicants need to demonstrate to get a permit?

Objective: Maintain current wetlands (no net loss) in viable condition (water quality, diversity (of both type of wetland and species?-KEAs all Good or Very Good?).

Strategic Actions:

- current wetlands-what size does this apply to?

Threat: Pests, Pathogens and Disease

Objective: Increase public awareness of PPDs for 80% of the population by 2026

Strategic Actions

- Develop educational programs for schools, such as invasives/PPD station at Conservation Field Days
- Develop signs/flyers on PPD issues where they are likely to occur, such as boat landings, with sporting licenses, campsites, etc.
- Use media outlets to spread the message

Objective: Establish monitoring and assessment process by 2015 to improve ability for detection of significant chances to PPDs by 50%

Strategic Actions:

- Establish PPD baseline occurrence database
- Identify areas where new introductions are likely
- Develop a system for information exchange
- Evaluate improvement to the current monitoring efforts

Objective: Improve ability manage outbreaks and prepare for future PPDs by x% by y year.

Strategic Actions:

- Develop strategies to management environments permanently altered by PPD
- Have a system of coordinated responses established to deal with future PPD outbreaks
- Utilize and maintain barriers to prevent the spread of aquatic PPDs
- Manage to maintain landscapes resistant and resilient to PPD outbreaks
- Develop management strategies in anticipation of future PPD outbreaks.
- Develop a checklist for evaluation management decisions based on PPDs
- Facilitate cooperative response to PPD outbreaks

Objective: Improve the understanding of PPD life history and habitat requirements to support effective management before 5% of watershed is affected.

Strategic Actions:

- Develop a research strategy for emerging and established PPDs
- Research strategy to prevent spread of PPD
- Provide information exchange and feedback with monitoring program
- Create appropriate channels for information and technology transfer (for education and management)
- Establish funding sources
- Develop criteria to determine whether a strategy of eradication, containment or managed co-existence is the most appropriate course of action

Threat: Physical Habitat Disturbance

Objective: Reduce or minimize adverse effects of recreational disturbances to flowing waters in the watershed by 50% by 20 years, while maintaining appropriate recreational access opportunities.

Strategic Actions:

- Provide adequate funds for development of formalized trail system along state easement along Salmon River where needed. Goal is to build 5 miles of trail by 2017 with a minimum of \$500,000.
- Develop and implement 5 educational kiosks along trail system by 2017.
- Work with guides association and other legally registered guides (licensed by DEC) to control habitat alteration along the river and educate about the importance of habitat. Reach out to all guides by 2010.
- Work with all local ATV groups within the next two years (like Oswego County ATV Club) to minimize illegal use of snowmobile trails by ATVs.
- Add designated funding to enforce ATV laws and use funding to hire two DEC law enforcement officers by 2009.

Objective: Maintain or improve land management practices to improve water quality and maintain headwater systems through best management practices and education.

Strategic Actions:

- Follow timber harvesting best management practices and educate foresters, loggers, and forest landowners on those BMPs.
 - Offer 3 additional forest management workshops in the next 3 years targeted toward landowners.
- Identify specific key rare/endangered species sites that need their own management practices. Educate/advise landowners on those management practices when appropriate.
 - Send 100 landowner packets over the next 5 years to landowners of more than 50 acres in the watershed. Include information on forestry management, invasive species, rare/endangered species, wetlands, etc. Identify grant to cover costs (similar to dune packets done by Sea Grant with a grant).
 - Educate more about why it is important to have regulated wetlands; work with the smaller than 12.5 acre wetlands. Create incentives for landowners to maintain/restore wetland habitat, possible property tax reduction?

Threat: Pollution and Sedimentation

Threat: Regional/Global Change Issues

Objective – Community/Region lead effort to demonstrate renewables

Strategic Actions:

- Enhance/increase biomass energy
 - Community development
 - Climate changes
- Increase Low Grade Markets
 - Biomass
 - Wood – Ethanol (Catalyst Renewables)
 - Wood boilers for heat
- Promote energy renewable initiatives, schools in area that have biomass heating systems, introduce renewable energy into our region.
- Incentive to co-generate electricity.
- Regional Greenhouse Gas Initiative (REGI)
 - Carbon Exchange (used as an offset)
 - Changing REGI rules to recognize the role of forest management in decreasing carbon emissions
 - Opportunity of forest landowners to get an incentive for keeping their forest lands in tact
- Further consider benefits and impacts of wind energy

Objective - Forest able to respond

Objective – River System Able To Respond

Objective – Organism Migration

Workshop Evaluation Results

Twenty-four participants completed evaluation questionnaires at the end of the day. The complete results of this evaluation are included in Appendix Two.

More than three-quarters of participant generally or strongly agree that they understand the purpose and process of the Salmon River Watershed Natural Resources Assessment. The vast majority of participants felt that their participation in the process was valuable and their time was well spent.

Individuals and organizations will use the results of this planning process in many different ways. Some of the potential uses of the materials and information noted included development of management plans, outreach and education, planning and prioritizing projects, and as a tool in support of program proposals.

Next Steps

A final report incorporating all of the data and results of this planning process will be prepared by the partners. It will be shared with workshop participants and other stakeholders in draft form, and then finalized before distribution to a wider audience. Interest was expressed in establishing a watershed-wide coordinating group that would meet at regular intervals to exchange information and establish opportunities to collaborate and coordinate activities.

Appendix One – Workshop Participants

Francis Adams
Town of Redfield

John Bartow
NYS Tug Hill Commission

Paul Baxter
Salmon Rivers Council of
Governments

Tom Bell
NYSDEC

Dan Bishop
NYS DEC

Bruce Brach
Harden Furniture

Patrick Crast
Harden Furniture

Kristin France
The Nature Conservancy

Debbie Forester
Engaging People

Linda Garrett
Tug Hill Tomorrow Land Trust

Linda Gibbs
NYS Tug Hill Commission

Nate Gibbs
LandVest, Inc

Jennifer Harvill
NYS Tug Hill Commission

Leon Heagle
SRCG Executive Committee

Michelle Henry
Tunison Laboratory of Aquatic
Science

Ted Hoffman
Gutchess Lumber

David Hogestyn
Gutchess Lumber

Tim Howard
NYNHP

Jim Johnson
Tunison Laboratory of Aquatic
Science

Jane Jones
Cooperative Tug Hill Council

Dave King
LandVest, Inc

Kevin King
Empire State Forest Products
Association

David Klein
The Nature Conservancy

Kent Koptiuch
Nestle Waters North America, Inc.

Jim Lacelle
Town of Orwell

John Lacey
Nestle Waters North America, Inc.

Chris Lajewski
The Nature Conservancy

Laura Macklen
Town of Worth

Amy Mahar
NYS DEC Region 8

Katie Malinowski
NYS Tug Hill Commission

Greg McGee
SUNY ESF

Jim McKenna
Tunison Laboratory of Aquatic
Science

John Mueller
Gutchess Lumber

Fred Munk
NYS DEC Region 6

Steve Murphy
Brookfield Power

Ralph Nyland
SUNY ESF

Bob O'Brien
Cotton-Hanlon, Inc.

Richard Pancoe
NYS DEC

Stewart Pappa
Town of Williamstown

Chuck Parker
Oswego County Federation of
Sportsmen's Clubs

Michelle Peach
The Nature Conservancy

Mary Penney
NY Sea Grant

Connie Rogers
Douglaston Manor

Peter Rosenbaum
SUNY Oswego, Dept. of Biological
Sciences

Dan Sawchuck
NYS DEC Region 7

Gerry Smith
Self-employed

Tracey Tomajer
NYS DEC

Jessica Trump
Oswego County Div. of Promotion &
Tourism

Fran Verdoliva
NYS DEC

Gretchen Wainwright
The Nature Conservancy

Fran Yerdon
Town of Osceola

Appendix Two– Workshop Evaluation Results
Salmon River Watershed Natural Resources Assessment
Workshop 3—Strategies
 June 21, 2007

Evaluation of Workshop Content

Please mark your level of agreement with the following statements.

	Strongly Agree	Generally Agree	Partially Agree	Mostly Disagree	Strongly Disagree
My personal goals for participating in this workshop were met	16.7%	66.7%	16.7%	0	0
I understand what the purpose of the SRWNRA* is	50.0%	37.5%	8.3%	0	4.2%
I understand the SRWNRA* process	37.5%	45.8%	16.7%	0	0
The process for identifying objectives and strategic actions was useful	25.0%	50.0%	20.8%	4.2%	0
I understand how the products of the workshop will be used	20.8%	50.0%	20.8%	4.2%	4.2%
Participating in this workshop increased my knowledge of conservation in the Salmon River Watershed	34.8%	47.8%	8.7%	8.7%	5%
My participation in this workshop was valuable to the process	16.7%	62.5%	20.8%	0	0
My time today was well spent	25.0%	62.5%	12.5%	0	0

*Salmon River Watershed Natural Resources Assessment

How might you and/or your organization use the results of the Salmon River Watershed Natural Resources Assessment?

- development of management plans
- greater awareness of issues
- implementation of appropriate local actions and informed support for regional/state/federal-international level action
- incorporate into technical assistance provided to local municipalities during planning processes
- incorporate the results into the DEC Watershed Action Plan for the Southeast Lake Ontario Watershed for species of greatest conservation need
- interpretive manual
- model SW grants program watershed team to this format
- outreach and education
- planning and prioritizing projects
- reference in unit management plan process
- to keep current about changing conditions, opinions and changes in Tug Hill
- tool in support of program proposals

Evaluation of Workshop Logistics

Please fill in the blank in each sentence by checking the appropriate box.

	Excellent	Very Good	Good	Fair	Poor	
Advance Materials						Comments
In general, the materials sent prior to the workshop were _____.	21.1%	42.1%	31.6%	0	5.3%	_____
Workshop						
The facilitators did a(n) _____ job of keeping to the agenda.	25.0%	60.0%	15.0%	0	0	_____
The workshop was _____ for identifying objectives and strategies.	5.0%	60.0%	30.0%	5.0%	0	_____
Logistics						
The meeting room was _____ for this workshop.	10.0%	45.0%	30.0%	10.0%	5.0%	_____
The food and drink was _____.	55.0%	35.0%	10.0%	0	0	_____

APPENDIX 4

Expert Working Groups

The following individuals participated on the working groups and/or contributed substantially to data acquisition and analyses during the development of the Salmon River Watershed Viability Analysis.

Forests:

Tom Bell, NYSDEC
 Art Brooks, Brooks Forestry Associates
 Pat Crast, Harden Lumber
 Jim Farquhar, NYSDEC
 Ed Kautz, NYSDEC
 John Mueller, Gutchess Lumber
 Fred Munk, NYSDEC
 Michelle Peach, TNC
 Dave Riehlman, NYSDEC
 Dan Sawchuck, NYSDEC
 Charles Smith, Cornell University
 Jerry Smith
 Fran Verdoliva, NYSDEC

Wetlands:

Sandy Bonanno
 Linda Gibbs, THC
 Sandy Doran, US Fish & Wildlife Service
 Andrew Nelson, SUNY Oswego
 Michelle Peach, TNC
 Peter Rosenbaum, SUNY Oswego
 Rich Smardon, SUNY-ESF

Aquatics:

Dan Bishop, NYSDEC
 Mike Connerton, NYSDEC
 Frank Flack, NYSDEC
 Michelle Henry, USGS, Tunison Lab
 Jim Johnson, USGS, Tunison Lab
 Roger Klindt, NYSDEC
 Amy Mahar, NYSDEC
 Dick McDonald, NYSDEC
 Jim McKenna, USGS, Tunison Lab
 Andy Noyes, NYSDEC
 Neil Ringler, SUNY-ESF
 Larry Skinner, NYSDEC
 Howard Simonin, NYSDEC
 Fran Verdoliva, NYSDEC

APPENDIX 5

SOURCE DATA FOR MAP PRODUCTION AND GIS ANALYSES

The geographic mapping and analyses prepared specifically for this report include data from the following sources.

Notes on GIS maps and analyses in this report:

1. Unless otherwise indicated on the map or figure description, all maps were created by NYS Tug Hill Commission or The Nature Conservancy expressly for the Salmon River Watershed Natural Resources Assessment and associated Viability Analysis.
2. The following list of data sources applies to maps and analyses conducted by NYS Tug Hill Commission and/or The Nature Conservancy for this project, which includes figures 1-7, 10, 11, 13, 23-27, 30-34, 36-38, and 48. The source of all other maps and figures included in this report is indicated in the description of those maps and figures, and the original authors can be contacted for additional information about the data sources they used.
3. GIS software used: ArcGIS 9.1 and 9.2

I. Basemaps and Background Layers

Layer: Municipal Boundary

Data Type: polygon

Source: NYS Office of Cyber Security and Critical Infrastructure Coordination

Description: Union of Tug Hill communities by the Tug Hill Commission

Use in this report: Used as a location and background dataset in many maps

II. Boundaries

Layer: Salmon River Watershed and Subwatershed

Data Type: polygon

Source: A cooperative effort by US Department of Agriculture Natural Resources Conservation Service (USDA NRCS), NYS Department of Environmental Conservation (NYS DEC) - Division of Water, and US Geological Survey (USGS) - Water Division. Adapted by NY Natural Heritage Program (NYNHP).

Description: This is the definition datalayer of the study area and analysis units for the project. This dataset was developed by NYNHP in-house by beginning with 11 digit Hydrologic Unit Coverage (HUC) watersheds, and then custom-delineating smaller watershed using the 1:24,000 USGS topographic quadrangle basemaps and the stream hydrology layer to define water flow.

Use in this report: Used as a location and background dataset in many maps and to do analyses by subwatershed within the Salmon River watershed.

Layer: TNC Ecoregions or “Subsections”

Data Type: polygon

Source: The Nature Conservancy (TNC)

Description: Developed by TNC's ecoregional planning teams. Written justification for each modification is available through TNC's Ecoregional Planning Office. Scale is 1:7,500,000.

Use in this report: Used in Figures 5 and 6 to show the Salmon River Watershed in relation to ecoregions.

III. Datalayers used in target mapping and viability assessment

Layer: Stream Crossing

Data Type: point

Source: NYNHP

Description: Road features (ALIS) were intersected with stream features (Hydrography Source: NYS DEC, USGS, and adapted by NYNHP. Hydrography Description: These data were being developed by the DEC - Division of Water and the Habitat Inventory Unit of the Division of Fish and Wildlife, as digital versions of the water features in the USGS 1:24,000 quadrangle maps. They are still in development stages. Points were generated where these two features intersected.

Use in this report: Appears on Figure 24 showing the locations of dams and stream crossings within the Salmon River watershed.

Layer: Dam (DEC)

Data Type: point

Source: NYS DEC - Dam Safety Section, Division of Water

Description: Metadata for this data set are not available at this time (2006). Point locations of dams located by DEC though out the study area. Field descriptions are available from the NYS Department of Water.

Use in this report: Appears on Figure 24 showing the locations of dams and stream crossings within the Salmon River Watershed.

Layer: State Pollution Discharge Elimination System (SPDES) point sources

Data Type: point

Source: NYS DEC - Division of Water/GIS Unit Description

Description: Wastewater treatment facilities (also called "point sources") are issued State Pollutant Discharge Elimination System (SPDES) permits regulating their discharge. "Point sources" means discrete conveyances such as pipes or man made ditches. These facilities are municipal, industrial or larger private, commercial, institutional (ie. shopping malls, restaurants, hospitals, correctional facilities, trailer parks, etc) waste water treatment plants.

Use in this report: Appears on Figure 23, which shows the locations of facilities within the Salmon River watershed with National Pollution Discharge Elimination System (NPDES) or USEPA Toxic Release Inventory (TRI) discharge permits

Layer: Roads (ALIS), (Appear in Legends as Interstate, State Highway, State or County Road, and Other Road or Highway)

Data Type: line

Source: NYS DEC, Department of Motor Vehicles (DMV), and Department of Transportation (DOT)

<http://www.nysgis.state.ny.us/gisdata/inventories/details.cfm?DSID=932>

Description: The Accident Location Information System (ALIS) project is a multi-agency project that the NYS Office of Cyber Security & Critical Infrastructure Coordination (CSCIC) is jointly developing with the NYS DMV and the NYS DOT. A major component of the ALIS Project is the creation of an up-to-date statewide GIS street map file containing all public roads, along with their street names, alternate/alias street names, route numbers, and address ranges on each street segment.

Use in this report: This dataset was used primarily for visual reference in many of the maps and also as described in the “Stream Crossing” Layer below. It was also used to show segments of road within 540 ft, of a NYS regulated wetland (See “NYS Regulatory Wetland” Layer below).

Layer: Streams NHD 1:100,000 (Appear in legends as Main Branch or Major Tributary, Headwater Stream, etc.)

Data Type: line

Source: USGS Great Lakes Science Center, Tunison Laboratory of Aquatic Sciences, USGS Gap Analysis Program

Description: The National Hydrography Dataset (NHD) is a vector data layer of *The National Map* representing the surface waters of the United States. The NHD includes a set of surface water reaches delineated on the vector data. Each reach consists of a significant segment of surface water having similar hydrologic characteristics, such as a stretch of river between two confluences, a lake, or a pond (USGS, 2000).

Use in this report: Appears on many figures as background information. In addition this dataset was used to derive stream targets: Main Branch and Major Tributaries (greater than second order streams) and Headwaters (first and second order streams). This dataset, processed along with a specific buffer size and the NLCD 2001 data, was also used to derive and display each reach in relation to the amount of area (0%-10%, 11%-25% or greater than 25%) of non-natural cover through which it travels. An example: this reach, as a whole, runs through an area of land that is classified as being greater than 25% non-natural cover. Derivative data appear in figures: 11, 13, 25, 26, 27 and 30.

Layer: Bedrock Geology

Data Type: polygon

Source: Distributed by USGS and compiled by NYS Museum/NYS Geological Survey

Description: The scale of the data is 1:250,000. It shows broadly defined bedrock geology materials.

Use in this report: Used in Figure 3 to show the bedrock geology of the Salmon River Watershed.

Layer: NYS Regulatory Wetland layer

Data Type: polygon

Source: NYS DEC (Distributed by Cornell University Geospatial Information Repository (CUGIR), <http://cugir.mannlib.cornell.edu>)

Description: Based on official New York State Freshwater Wetlands Maps as described in Article 24-0301 of the Environmental Conservation Law. Data are not, however, a legal substitute for the official maps. The purpose of these data are to provide a faithful representation of official New York State regulatory freshwater wetlands maps for GIS resource analysis at scales equal to the 1 to 24,000 scale of original mapping or smaller scales (e.g., 1 to 100,000 scale).

Use in this report: Used to map the extent of the Non-Estuarine Wetland Target and to assess the potential of wetland wildlife coming into hazardous contact with motorized vehicles. Appears in Figures 34 and 36.

Layer: National Wetlands Inventory

Data Type: polygon

Source: U.S. Fish and Wildlife Service (USFWS) - Division of Habitat and Resource Conservation

Description: This data set represents the extent, approximate location and type of wetlands and deepwater habitats in the conterminous United States. The NWI wetland maps were produced as topical overlays using USGS topographic maps as the base. The hard copy product is a composite map showing topographic and planimetric features from the USGS map base and wetlands and deepwater habitats from the Service's topical overlay. Thus, the data are intended for use in publications, at a scale of 1:24,000 or smaller. Due to the scale, the primary intended use is for regional and watershed data display and analysis, rather than specific project data analysis. The map products were neither designed nor intended to represent legal or regulatory products.

Use in this report: Used to help delineate the Non-Estuarine Wetland Target and analyze wetland community types (Figure 34) as well as evaluate the extent of beaver impacts on Open Waters (Figure 32). NWI data was also used to delineate the extent of wetlands within the Freshwater Estuary Target (Figures 7 and 10)

Layer: Tug Hill Aquifer

Data Type: polygon

Source: NYS Tug Hill Commission (THC)

Description: Digitized by the NYS THC as part of the USGS Water Resources Investigation Report 88-4014 titled: Hydrogeology and water quality of the Tug Hill glacial aquifer in northern New York. <http://pubs.er.usgs.gov/usgspubs/wri/wri884014>

Use in this report: Appears on Figure 4, which shows the location of the Tug Hill Aquifer within the Salmon River Watershed.

Layer: 100 Ft. Buffer and 540 Ft. Buffer

Data Type: polygon

Source: Derived using ESRI's buffer analysis

Description: Derived using ESRI's buffer analysis on features from other data sources, such as wetlands and streams.

Use in this report: Buffers of the following targets: Non-Estuarine Wetlands, Open Waters, Main Branch and Major Tributaries, Freshwater Estuary, and Headwater Streams. Appears on Figures 10 and 33. Although not shown on Figures 13, 25, 27 or 30, these buffers were used in the analyses of these figures as described in "Streams NHD 1:100,000" above.

Layer: Percent Slope (0-40%, Greater than 40%)

Data Type: image

Source: New York State Digital Elevation Models (DEM)

USGS (distributed through CUGIR at <http://cugir.mannlib.cornell.edu>)

Description: The 7.5-minute DEM (10- by 10-m data spacing, elevations in decimeters) is cast on the Universal Transverse Mercator (UTM) projection (the quads UTM zone can be found in the header record (Record A)) in the North American Datum of 1927. Slopes derived using ESRI Spatial Analyst.

Use in this report: Appears on Figure 48, which maps the Gorge and Steep Slope Target (>40% slope) of the Salmon River watershed.

Layer: National Land Cover Database (NLCD) Land Classification (Appear in map legends in various ways)

Data Type: image, polygon

Source: NLCD 2001 U.S. Geological Survey <http://www.mrlc.gov>

Description: The NLCD 2001 for mapping zone 64 was produced through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium. The MRLC Consortium is a partnership of federal agencies (www.mrlc.gov), consisting of the USGS, the National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA), the U.S. Forest Service (USFS), the National Park Service (NPS), the U.S. Fish and Wildlife Service (FWS), the Bureau of Land Management (BLM) and the USDA NRCS. The MRLC data set consists of 30 by 30-meter cells that correspond to an area on the earth. <http://www.mrlc.gov/mrlc2k.asp>.

Use in this report: This dataset, or derivatives from it, appear on many figures as background information. When used as a background dataset to show landcover (e.g. Figures 5, 6, 7, and 10), NLCD 2001 Data was often reclassified as shown in the table below under “Reclassification 2.” In several figures NLCD 2001 Data was reclassified into one of three categories shown in the table below under “Reclassification 1” to derive the Open Waters, Natural Vegetative Cover, and Non-natural Vegetative Cover classifications (e.g. Figures 13, 25, 27, 30, and 33). These maps were then used to derive Percent Non-Natural Vegetative Cover parameters, the results of which are described in the text. NLCD 2001 Data was also used to map the geographical extent and community types of the Matrix Forest Target in Figure 37.

Data Classification	Reclassification 1	Reclassification 2
Open Water	Open Water	Open Water
Developed, Open Space	Non-natural Vegetative Cover	Developed
Developed, Low Intensity	Non-natural Vegetative Cover	Developed
Developed, Medium Intensity	Non-natural Vegetative Cover	Developed
Developed, High Intensity	Non-natural Vegetative Cover	Developed
Barren Land (Rock/Sand/Clay)	Non-natural Vegetative Cover	Barren Land
Deciduous Forest	Natural Vegetative Cover	Forest
Evergreen Forest	Natural Vegetative Cover	Forest
Mixed Forest	Natural Vegetative Cover	Forest
Shrub/Scrub	Natural Vegetative Cover	Shrub/Scrub
Grassland/Herbaceous	Non-natural Vegetative Cover	Grassland/Herbaceous
Pasture/Hay	Non-natural Vegetative Cover	Agriculture
Cultivated Crops	Non-natural Vegetative Cover	Agriculture
Woody Wetlands	Natural Vegetative Cover	Freshwater Forested/Shrub Wetland
Emergent Herbaceous Wetland	Natural Vegetative Cover	Freshwater Emergent Wetland