The Cheboygan River Watershed Habitat Partnership Conservation Area Plan

Organizations involved in planning process:

- ***Headwaters Land Conservancy***
- ***Huron Pines Resource Conservation & Development Council***
- ***Little Traverse Conservancy***
- ***Michigan Department of Natural Resources***
- ***The Nature Conservancy, MI Chapter***
- ***Northeast Michigan Council of Governments***
- ***Tip of the Mitt Watershed Council***

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Executive Summary

The Cheboygan River Watershed supports habitat for high-quality terrestrial and aquatic biodiversity and provides important commodities for the resource and tourist-based economy of the northern Lower Peninsula. The landscape is characterized by large, inland glacial lakes, wild rivers and large forested areas that provide habitat for a variety of species, both common and rare. While much of the Watershed is in state ownership, many sensitive areas along lakeshores and riparian corridors are in private ownership.

The Cheboygan River Watershed Habitat Partnership was created to bring together several agencies and organizations dedicated to the protection of the Watershed's natural resources including: Tip of the Mitt Watershed Council, Little Traverse Conservancy, The Michigan Chapter of the Nature Conservancy, Northeast Michigan Council of Governments, Headwaters Land Conservancy, The Michigan Department of Natural Resources, and Huron Pines Resource Conservation & Development Council. Over the course of several months these partners developed this conservation plan in an effort to devise strategies to preserve biological diversity throughout the Watershed in a comprehensive and complementary manner.

Following the model outlined in "The Five-S Framework for Site Conservation: A Practitioner's Handbook for Site Conservation Planning and Measuring Conservation Success" (The Nature Conservancy, 2001), the planning team identified a set of ecological targets and values that provide the basis for conservation activities in the Watershed. These targets are: bogs, fens and hardwood -conifer swamps, Michigan monkey-flower, Hungerford's crawling water beetle, lakes and associated wetlands, lakes and streams in karst terrain, ground water-driven streams and riparian corridors, and wildlife corridors and core habitat. In spite of historical and ongoing impacts from human activities, these targets and the ecological processes that support them remain relatively intact. The overall healthy condition of the conservation targets is reflected in the "Good" biodiversity health assessment rank.

The primary sources of stress impacting the conservation targets are residential development, roads and utilities, dams, increased imperviousness, and shoreline alteration and hardening. While these threats are projected to increase given continued expansion of residential, commercial, and recreational development in the region, numerous opportunities exist to minimize the impacts of human activities and to educate both residents and visitors to the Watershed on the importance of natural resource protection. The planning team identified 16 strategies to address threats to the conservation targets. Six of these were selected for immediate development and implementation: stabilizing and upgrading road/stream crossings, coordinated land protection, establishing and enforcing sound planning and zoning, implementing shoreline best management practices (BMPs), promoting economic benefits of resource protection, and retrofitting existing developed areas to reduce polluted stormwater runoff.

Background and Introduction

The Cheboygan River Watershed – long recognized by local residents and conservation groups for its natural resource values – was identified in 1996 as a key aquatic biodiversity site in the Great Lakes Ecoregion during an intensive ecoregional planning process conducted by an inter-organizational group of experts (The Nature Conservancy, 2000). This process of ecoregional planning was initiated by the Great Lakes Program of The Nature Conservancy (TNC) to identify high priority biodiversity conservation areas that represent the full range of biodiversity across the ecoregion, including common and rare species, communities, and other significant natural features. The Cheboygan River Watershed supports high-quality examples of aquatic and terrestrial biodiversity that, in conjunction with other identified sites in the Great Lakes Ecoregion, contribute to this objective of comprehensive biodiversity conservation.

In addition to large kettle lakes, large forested areas, and an expansive network of streams and wetlands, this 900,000-acre Watershed is home to a variety of aquatic species including several that are endangered, the Michigan monkey-flower (*Mimulus glabratus* var. *michiganensis*), Hungerford's crawling water beetle (*Brychius hungerfordi*), and the state threatened lake sturgeon (*Acipenser fulvescens*). Several large wetlands, such as the Indian River Spreads and the Pigeon River Spreads, also provide important nesting habitat for rare birds such as the bald eagle (*Haliaetus leucocephalus*), the common loon (*Gavia immer*) and the black tern (*Chlidonias niger*).

The purpose of this plan is to identify strategies to preserve representative conservation targets throughout the Cheboygan River Watershed. This process evolved around a partnership including Tip of the Mitt Watershed Council, Little Traverse Conservancy, The Nature Conservancy, Northeast Michigan Council of Governments, Headwaters Land Conservancy, Michigan Department of Natural Resources, and Huron Pines Resource Conservation & Development Council.

The planning team followed the guidelines from *"The Five-S Framework for Site Conservation: A Practitioner's Handbook for Site Conservation Planning and Measuring Conservation Success"* (The Nature Conservancy 2001). This process entails identifying conservation targets and assessing their viability; identifying stresses to those targets; developing the sources of those stresses; developing strategies to abate those sources of stress; and measures to determine the success of these strategies**.** The conservation plan contains a number of Microsoft Excel spreadsheets that the team developed as part of the Five-S Framework. Select spreadsheets appear as tables in this plan.

1. Site Description and Context

1.1 Geographic Location/ Ecoregional-Bioregional Location

The Cheboygan River (Map 1) drains parts of Emmet, Cheboygan, Presque Isle, Charlevoix, Otsego, and Montmorency Counties at the northern tip of Michigan's Lower Peninsula. The Cheboygan River itself is a short reach between Mullett Lake and the Straits of Mackinac, where the Cheboygan empties into Lake Huron. The drainage area of the Cheboygan River includes over 900,000 acres and numerous rivers and lakes. In addition to Mullett Lake, other large lakes include Douglas Lake, Burt Lake, Pickerel Lake, Crooked Lake, and Black Lake. The major rivers in the Cheboygan River drainage basin include the Crooked River, Maple River, Sturgeon River, Pigeon River, and Black River. Several of these systems are connected in what is called the Inland Waterway.

Numerous glacial retreats and advances define the irregular topography of this Watershed. The current landscape is a direct product of this ice scouring and redeposition, as well as postglacial erosion and soil formation processes. The resulting landscape is characterized by steep morainal ridges, rolling drumlins, kettle lakes, swamps, marshes, and depressions (Albert 1995).

1.2 Site Context

Ecological Context

Ecoregional planning identified aquatic systems in the Cheboygan River Watershed as exemplary of their types. Large kettle lakes in the project area are the least developed and highest quality in Michigan's Lower Peninsula, supporting healthy native fish communities. Ground water-fed headwater streams drain a relatively unfragmented forest matrix. As hydrology is a major ecosystem process in relationship to the conservation targets at this site, the conservation area boundaries are defined by the Watershed boundaries.

Human Context

The political landscape of the Cheboygan River Watershed consists of parts of six counties, 45 townships, numerous small towns, and the cities of Gaylord, Indian River, Atlanta, Onaway, Pellston, and Cheboygan. The Watershed contains extensive public lands including the Pigeon River Country State Forest, but also has numerous, large privately owned tracts. Approximately 37% of the Watershed is in public ownership (Map 2).

The Cheboygan River Watershed supports some of Michigan's highest quality lakes and trout streams. From boating on the 43-mile-long Inland Waterway to catching native brook trout in headwater streams, the Cheboygan River Watershed is the quintessential water wonderland. Because of lakes like Burt, Mullett, Black,

Douglas, Crooked, and Pickerel, and rivers such as the Black, Pigeon, Maple, and Sturgeon, aquatic habitats in the Cheboygan River Watershed are the focus of a thriving resource-based tourist and resort economy and are experiencing some of the fastest residential development in the state (Map 3; U.S. Census Bureau 2001).

The Cheboygan River Watershed is at a crossroads. One direction involves uncoordinated development that threatens the very resources that drive the local economy and upon which thousands of residents and visitors rely for their recreation. Another direction involves the coordination of land use decisions across the Watershed in a way that promotes a sustainable economy based on protecting the resources that make this area special.

Stakeholder Analysis

For the purposes of this project, stakeholders are considered to be those that affect or are affected by conservation efforts. The list below is not intended to be a comprehensive listing of stakeholders, but rather some examples of the specific stakeholders and the broad categories of businesses, organizations, and agencies that are important to the success of this project. It is important to note that given the nature of the conservation targets in this Watershed, all residents and visitors affect, and will be affected by, the strategies included in this plan.

Conservation and Environmental Organizations:
Audubon Society (two chapters in the Watershed)
Ducks Unlimited (four chapters in the Watershed)
Headwaters Land Conservancy
Little Traverse Conservancy
Mackinaw Forest Council
Sierra Club (local chapter)
SEE-North
Sturgeon for Tomorrow
The Nature Conservancy, Michigan Chapter
Trout Unlimited (two chapters in the Watershed)
Tip of the Mitt Watershed Council
Upper Black River Watershed Restoration Committee

Businesses and Business Organizations:
Banks
Cabins
Chambers of Commerce
Hotels/Motels
Lodges
Realtors/Builders Associations

Local Government/Quasi-Government:
Conservation Resource Alliance
County Building, Planning, and Erosion Agencies
County Conservation Districts
County Road Commissions
Huron Pines Resource Conservation and Development
Northeast Michigan Council of Governments
Regional Economic Development Councils
Townships

Recreational Groups and Homeowner Associations:
Camping Facilities
Canoe Liveries
Cross-Country Skiing Facilities/Trails
Fishing Guides
Hunt Clubs
Lake and River Associations
Marinas
Pigeon River Country Habitat Initiative
Snowmobile and ATV user groups

State and Federal Governments:
Michigan Department of Agriculture
Michigan Department of Environmental Quality
Michigan Department of Natural Resources
Michigan Department of Transportation
U.S. Army Corps of Engineers
U.S. Department of Agriculture
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service

Academic Institutions:
North Central Michigan College
Public and Private Schools
University of Michigan Biological Station

2. Conservation Targets

The intent of the target selection in the conservation planning process is to help define conservation goals in the landscape (The Nature Conservancy, 2000). Conservation targets are species, ecological communities or ecological systems (Map 4). These focal conservation targets guide the identification of conservation strategies at individual sites by determining which critical threats and persistent stresses must be abated in order to maintain or enhance the key components or processes of each conservation target. Nested targets have also been identified for each of the focal conservation targets. While these nested targets are of equal conservation concern, the area and ecological processes upon which they depend

are encompassed by that of the focal conservation targets: when the conservation target and its sustaining ecological processes are protected, the nested targets are also protected.

2.1 Conservation Target Definitions and Justification

Bogs, Fens, and Conifer-Hardwood Swamps

This target includes several large conifer swamps interspersed between morainal uplands, as well as scattered fens and bogs. These hydrologically dependent systems developed in a landscape of varying glacial terrain with abrupt ecotones. Although few endangered or threatened species are associated with these wetlands, they tend to harbor an incredible diversity of species. The Green Swamp, which feeds the headwaters of two major branches of the Black River, supports at least two-thirds of all orchid species known in Michigan and is home to a thriving population of state threatened red-shouldered hawks (*Buteo lineatus)*. The bogs, fens, and conifer-hardwood swamps serve a range of important functions that contribute to the health of aquatic and terrestrial ecosystems in the Watershed. The key ecological processes upon which this target depends are forest and hydrologic connectivity.

Nested Targets: Yellow pitcher plant
Orchids
Red-shouldered hawk
Northern white cedar

Michigan Monkey-Flower (*Mimulus glabratus var. michiganensis*)

Michigan monkey-flower, endemic to Michigan, was federally listed as endangered in 1990. The species is restricted to alkaline habitats with a consistent flow of cold ground water and abundant sunshine (Penskar and Higman, 2001). Michigan monkey-flower (*M. glabratus var. michiganensis)* is largely clonal, growing in localized, but dense colonies with low genetic diversity. Consequently, the species has a limited capacity for dispersal and its adaptive ability is also likely to be quite low. The population at Lake Kathleen has experienced some human disturbance, but remains vigorous, and was the only population found to set viable seed in a 1986 study, making it perhaps the most important occurrence for the long-range seed dispersal of the species. Michigan monkey-flower is highly vulnerable to isolated disturbances including residential and recreational development, lake level fluctuations, upstream water diversions, and increased shoreline and riparian activity by humans. Protection efforts should therefore focus on known habitat and the protection of water flow and quality via buffer areas. Transplantation may provide a viable mechanism for restoring population numbers given the vegetative reproductive ability of the species.

Nested Targets: Ground water seeps

Hungerford's Crawling Water Beetle (*Brychius hungerfordi*)

This post-glacial relict species is endemic to the Great Lakes, and three of the five known occurrences of the species are found in the Cheboygan River Watershed. While much remains unknown about the beetle's life cycle and habitat requirements, it is generally found in stream segments with moderate to fast stream flow, inorganic substrate, and good stream aeration. Cool water conditions and impoundments (beaver dams or similar man-made structures) appear to be integral aspects of the beetle's habitat. The impoundments regulate stream flow fluctuations and create the riffle environment preferred by the beetle. The larvae also require clean gravel substrate, but prefer stream segments with slower currents and dense growths of macroalgae. All habitat conditions must be protected in order to maintain viable beetle populations. *B. hungerfordi* dispersal mechanisms seem to be limited to movement within the stream system and they are not likely to fly between tributaries or stream segments (Hyde and Smar, 2000). Beetle populations are primarily threatened by changes in habitat due to human activities, such as logging, stream channel modification, and incompatible fisheries management.

Nested Targets: East Branch of the Maple River
Van Etten Creek
East Branch of the Black River

Lake Sturgeon (*Acipenser fulvescens*)

Historically, lake sturgeon inhabited numerous inland lakes and rivers in Michigan. Currently, known spawning populations persist in only a few of these systems, most notably in Black and Mullett Lakes. The sturgeon is a bottom dwelling species, most frequently associated with large lakes or the deep pools of rivers where benthic organisms are abundant, and generally avoid areas with aquatic vegetation. Preferred spawning habitat consists of gravelly tributary streams that flow into the larger rivers and lakes (Goforth, 2000). Migratory barriers, loss of spawning and nursery areas, fishing and poaching pressures, combined with the species late maturity and low reproductive rates, have led to the decline of sturgeon populations. Reestablishing habitat connectivity could benefit the sturgeon and other fish species that require access to a variety of aquatic habitats, such as the Great Lakes Muskellunge.

Nested Targets: Black Lake
Upper Black River
Burt Lake
Mullett Lake
Great Lakes Muskellunge
Northern Pike

Lakes and Associated Wetlands

Large, deep, oligotrophic, kettle lakes support an array of fish and wildlife and serve as the core attraction for a thriving resource-based tourist economy. Expansive estuarine systems that have formed where the large rivers filter into these lakes likewise provide crucial habitat for a variety of species. As much of the shoreline around these lakes has already been heavily developed (with the

exception of Douglas Lake), conservation efforts are needed to preserve (and restore) remaining wetland and shoreline habitats, and to protect water quality.

Nested Targets:
- Large, glacial lakes (Douglas, Burt, Mullet, Crooked, Pickerel, and Black Lakes)
- Bird habitat (common loon, black tern, osprey, bald eagle)
- Pugnose shiner (Black Lake)

Lakes and Streams in Karst Terrain

The eastern side of the Watershed is distinguished by a karst landscape composed of sinkholes, abrupt ridges, caverns, and disappearing and underground streams. This topography provides numerous pathways for surface contaminants to infiltrate very rapidly into an unpredictable subterranean network. In addition, high permeability and rock solubility preclude adequate filtering of point and nonpoint source pollutants. Many of these sinkholes continue to be used as dumps.

Nested Targets:
- Rainy River (upstream of Black Lake)
- Rainy Lake
- Pigeon River Country State Forest
- Lake Louise

Ground Water-Driven Streams and Riparian Corridors

The Sturgeon, Pigeon and Black Rivers are low-gradient streams with high base flow and low surface flow. These streams and their associated riparian corridors define the hydrology of the southwest portion of the Watershed. Both the Sturgeon and the Pigeon Rivers are used for spawning by migratory fish from Burt and Mullet Lakes. Kleber and Alverno dams inhibit such migratory spawning behavior on the Black River. These ground water-driven streams have all been subjected to erosion from past logging activities as well as on-going human uses.

Nested Targets:
- Sturgeon, Pigeon, and Black Rivers and their tributaries
- Instream spawning habitat
- Ground water seeps

Wildlife Core Habitat and Corridors

This target addresses the need to preserve and restore large, contiguous tracts of intact forest to provide critical habitat for a variety of wildlife species. These forests have been highly altered by historical and current logging practices, oil and gas development, roads, development pressure, and agricultural activities.

Nested Targets:
- Northern hardwood forest
- Elk, bear, bobcat, red-shouldered hawk, pine marten
- Potential habitat for wolf, lynx, and cougar

3. Biodiversity Health Assessment

An important part of the planning process is to assess the biodiversity health, or viability, of the conservation targets. The conservation planning team analyzed viability based on considerations of size, condition, and landscape context. The summary of this assessment is presented in Table 1. Although degradation has occurred in various ways in this Watershed, ecological systems and processes remain relatively intact. This condition is reflected by the "Good" overall biodiversity health ranking, indicating that the Watershed may be considered a functional landscape (Pioani and Richter, 2000).

Table 1: Viability Assessment for Cheboygan River Watershed Targets

Site Conservation Target	SIZE		CONDITION		LANDSCAPE CONTEXT		Overall Biod. Health Score
	Rank	Justification	Rank	Justification	Rank	Justification	
Bogs, Fens, and Conifer-Hardwood Swamps	**Very Good**	Many of the cedar swamps were logged and didn't regenerate as cedar due to deer browsing. Nevertheless, many swamps still remain. There are only a few bog systems in the Watershed, but the number/size of these have not notably decreased over time. Size has not greatly changed over time.	**Good**	Vegetation community in many of the swamps has been altered due to historic timbering and deer browsing causing a change in species composition. Decline in snowshoe hare population due to decline in cedar. Bogs in Very Good condition.	**Good**	Landscape fragmentation due to development, gas, and oil development and associated roads. Grazing impacts from surrounding areas.	**Good**
Michigan Monkey-Flower	**Fair**	Species has a very specific habitat niche, but seems to be thriving where it occurs. It has not been found in some areas where it seems that it could grow. There is only one known sexual reproducing population of this species. Continued survey and discovery of additional populations could lead to a change in the ranking.	**Poor**	Mostly vegetatively reproducing. Even sites that occur on protected land are not completely protected from external impacts (changes in ground water hydrology, foot traffic, adjacent development, changes in available sunlight). Need further information on species genetics and genetic viability of existing populations.	**Fair**	Populations are highly sensitive to anthropogenic impacts due to the vulnerability of its niche.	**Fair**
Hungerford's Crawling Water Beetle	**Fair**	Few known populations exist although there is additional potential habitat in the Watershed (especially Black River, Tomahawk Creek, and Canada Creek). Prefers warmer water below lakes and natural impoundments, fallen debris and blockages. A glacial relict, small population numbers have further declined due to historic logging and current fisheries management (removal of beaver dams and increased predation by introduced brown and rainbow trout).	**Fair**	Small populations may have a negative impact on the genetic viability of the species, but more information is needed to assess the condition of known populations. Known populations are spatially distributed across the Watershed, suggesting that the beetle populations may be greater than currently known. Reintroduction may be possible in streams where it is not currently known.	**Fair**	Current cold-water fisheries management can adversely impact known beetle habitat niches. Not all streams in the Watershed are appropriate for cold-water trout management.	**Fair**
Lake Sturgeon	**Fair**	Black Lake population currently meets the minimum criteria to be restorable (sturgeon are currently reproducing	**Fair**	Habitat fragmented due to dams - spawning habitat particularly limited. Historically, downstream of	**Fair**	Dams have affected hydrology of the system, aquatic corridors and,	**Fair**

Site Conservation Target	SIZE Rank	SIZE Justification	CONDITION Rank	CONDITION Justification	LANDSCAPE CONTEXT Rank	LANDSCAPE CONTEXT Justification	Overall Biod. Health Score
		naturally as well as spawning in the same streams they have spawned in the past). The best habitat (high gradient streams downstream from lakes) is currently inundated behind impoundments.		Black Lake was probably the best habitat, but it is now inundated. The Black Lake population is disconnected from the Great Lakes, Burt, and Mullett Lakes. DNR Fisheries is currently researching genetic viability of the population - appears to be currently viable.		consequently, species' life cycles. Development in the Watershed and along the shorelines has impacted water quality and flow.	
Lakes and Associated Wetlands	**Fair**	Big lakes are not changing in size over time so we are not considering them in the size ranking. Only wetlands are being considered for this rank score. Less than half of the original wetlands area around the big lakes is remaining. Roads (road fill and culverts) impact water flow, cutting off wetland systems. Canals through former wetlands have both destroyed wetland areas and altered species composition. Many shoreline wetlands have been filled for new home sites.	**Good**	Canals have altered the species composition of some wetland areas. Condition has been impacted by invasive species (zebra mussel, purple loosestrife, etc.). Water quality is good, although anthropogenic nutrient inputs are significant.	**Fair**	Landscape context varies across the Watershed. Target is subject to extensive shoreline development and continued development pressures.	**Fair**
Lakes and Streams in Karst Terrain	**N/A**		**Good**	Due to the natural flashiness of these systems they may be particularly impacted by imperviousness. The target is also particularly sensitive to climate change in addition to seasonal changes, whether natural or human-induced. Many of the small lakes are in state forest ownership. The Rainy River corridor is largely in private ownership (mostly farm land). The target has been impacted by nutrient loading from agriculture. Agricultural runoff has also caused some Ground water contamination because there is	**Good**	Many of the small lakes are in state ownership, but Rainy Lake and much of the Rainy River are in private ownership. The landscape is heavily fragmented by agriculture. The system is highly sensitive to climate change. Target needs further research to confirm ranking. This portion of the Watershed is not experiencing severe development pressure as are other areas.	**Good**

Site Conservation Target	SIZE Rank	SIZE Justification	CONDITION Rank	CONDITION Justification	LANDSCAPE CONTEXT Rank	LANDSCAPE CONTEXT Justification	Overall Biod. Health Score
				little filtering of Ground water inputs through glacial till. Landfills have also resulted in contamination, but these problems have since been remediated. Condition is ranked as Fair to Good, but needs further research			
Ground Water-Driven Streams and Riparian Corridors	**Very Good**	Size of streams has not changed over time. Riparian corridor remains Very Good with regards to size, although the lower reaches are more disturbed than the headwaters.	**Good**	Condition depends on location in the Watershed, but Good overall. Several restoration activities are already in place. Road placement has a large impact on condition. Headwaters to the Sturgeon are impacted by sediment.	**Good**	Geomorphology is excellent for supporting Ground water streams, but relatively steep slopes and erodable soils pose a high risk to the system.	**Good**
Wildlife Core Habitat and Corridors	**Good**	Good core habitat exists in Pigeon River Country and large blocks of intact habitat in state and private ownership, but lacks connectivity. Existing corridors represented by state lands and other protected lands do not provide optimal connectivity for far-ranging species. I-75 blocks wildlife corridors and fragments contiguous habitat. Exclusion/inclusion fences also constrict wildlife movement. Future development may also adversely affect viability.	**Good**	Healthy bear and elk populations. Bobcat population okay. Nested targets have different habitat requirements, but across the Watershed, core habitat is fairly diverse (forest dominated and more open areas). Condition of corridors varies across the Watershed from excellent to poor.	**Fair**	Gaylord is developing and growing rapidly, as well as other human population centers in and around the Watershed (Petoskey, Indian River, etc.) Also oil and gas development and associated roads on public and private land increase fragmentation across the landscape.	**Good**

4. Threats Assessment

Every natural system is subject to various disturbances. For our planning purposes, however, only the destruction, degradation or impairment of conservation targets resulting directly or indirectly from human causes was considered a stress. Understanding the stresses that impact each target (Table 2), and the relative severity and scope of that stress is critical to developing conservation strategies (see Appendix C for detailed descriptions of each stress). Table 3 summarizes the impacts of the primary sources of stress across all of the conservation targets.

Table 2: Summary of Stresses to Conservation Targets in the Cheboygan River Watershed

Conservation Target	Stress	Severity	Scope
Bogs, Fens, and Conifer-Hardwood Swamps	Habitat destruction and conversion	**Very High**	**Medium**
	Habitat fragmentation	**High**	**Medium**
	Altered hydrology	**High**	**High**
	Altered composition/structure	**High**	**Medium**
	Excessive herbivory	**High**	**High**
	Habitat disturbance	**Medium**	**High**
Michigan Monkey-Flower	Habitat destruction or conversion	**Very High**	**High**
	Altered hydrology	**High**	**High**
	Habitat disturbance	**High**	**High**
	Sedimentation	**High**	**High**
	Nutrient loading	**Medium**	**High**
	Thermal alteration	**High**	**High**
	Shading/light competition	**High**	**Medium**
Hungerford's Crawling Water Beetle	Modification of natural flow patterns	**High**	**Medium**
	Habitat disturbance	**Very High**	**High**
	Excessive predation	**Medium**	**High**
	Sedimentation	**High**	**Very High**
	Habitat destruction or conversion	**High**	**Medium**

Conservation Target	Stress	Severity	Scope
	Habitat fragmentation	High	Medium
Lake Sturgeon	Sedimentation	Medium	Medium
	Altered hydrology	High	High
	Habitat fragmentation	Very High	High
	Excessive predation	Medium	Medium
	Nutrient loading	Low	Low
	Habitat disturbance	Medium	Low
	Habitat destruction or conversion	High	High
Lakes and Associated Wetlands	Habitat destruction or conversion	Very High	Very High
	Nutrient loading	High	High
	Habitat disturbance	High	Very High
	Habitat fragmentation	Very High	Very High
	Altered composition and structure	Very High	Very High
	Toxins/contaminants	Medium	Very High
	Sedimentation	Medium	Very High
	Altered hydrology	Medium	High
Lakes and Streams in Karst Terrain	Toxins/contaminants (Ground water)	High	High
	Ground water depletion	Very High	Low
	Habitat destruction or conversion	High	High
	Nutrient loading	Very High	Very High
	Sedimentation	Very High	Very High
	Habitat fragmentation	High	High
	Altered hydrology	High	Medium
Ground Water-Driven Streams and Riparian Corridors	Sedimentation	Very High	High
	Thermal alteration	Medium	High
	Habitat destruction or conversion	High	High

Conservation Target	Stress	Severity	Scope
	Altered hydrology	High	Medium
	Nutrient loading	Medium	Medium
	Habitat disturbance	Medium	High
	Habitat fragmentation	High	High
Wildlife Core Habitat and Corridors	Habitat destruction or conversion	Very High	High
	Habitat disturbance	High	High
	Habitat fragmentation	High	High
	Altered composition/structure	Medium	High

Table 3: Critical Active Threats for the Cheboygan River Watershed

Active Threats Across Systems	Bogs, Fens, and Conifer-Hardwood Swamps	Michigan Monkey-Flower	Hungerford's Crawling Water Beetle	Lake Sturgeon	Lakes and Associated Wetlands	Lakes and Streams in Karst Terrain	Ground Water-Driven Streams and Riparian Corridors	Wildlife Core Habitat and Corridors	Overall Threat Rank
Residential development	High	Very High	Medium	High	Very High	Very High	Very High	Very High	**Very High**
Roads or utilities	High	Very High	High	Medium	-	Very High	Very High	High	**Very High**
Dams	-	-	High	Very High	Very High	-	High	-	**Very High**
Increased imperviousness	-	Very High	-	Medium	High	Very High	Medium	-	**Very High**
Shoreline alteration/hardening	-	Very High	-	-	Very High	-	-	-	**Very High**
Oil or gas	High	-	-	-	-	Very High	High	Medium	**High**
Agricultural practices	High	-	-	Low	Medium	Very High	Medium	-	**High**
Dredging and filling	-	-	-	High	Very High	-	-	-	**High**
Forestry practices	Medium	-	Medium	-	-	Very High	Medium	Medium	**High**
Invasive/alien species	Low	Medium	-	-	Very High	-	-	-	**High**
Inappropriate disposal of potentially hazardous substances by homeowners	-	-	-	-	-	Very High	-	-	**High**
Recreational Use	-	Medium	-	Low	Medium	High	Medium	-	**Medium**
Artificially high deer populations	High	-	-	-	-	-	-	Medium	**Medium**
Beaver dam removal	-	-	High	-	-	-	-	-	**Medium**
Fencing	-	-	-	-	-	-	-	High	**Medium**
Commercial/Recreational Development	-	-	-	-	-	-	-	High	**Medium**
Threat Status for Targets and Site	**High**	**Very High**	**High**	**High**	**Very High**	**Very High**	**Very High**	**Very High**	**Very High**

5. Conservation Strategies

Each of the potential conservation strategies was analyzed by the conservation planning team and prioritized based on Leverage, Lead organization, Ease, and Cost of Implementation.

Leverage: The most effective strategies are catalytic in nature-a little bit of effort or a small investment triggers positive work or resources from others, and other new opportunities. High-leverage strategies pave the way for other strategies.

Lead Person and Institution: Perhaps the single most important factor of success is finding the right person to take the lead and the responsibility to implement the strategy.

Ease and Lack of Complexity: The more complex the strategy, the more likely that unanticipated outside events will substantially affect the outcome. For this reason, it is wise to invest in some relatively small, simple, do-able strategies. Evidence of success will then help encourage your conservation partners to undertake challenges that are more complex.

Costs of Implementation - Commitment of Limited Discretionary Resources: There are limited human and financial resources to invest in the future. Special attention should be paid to the commitment of limited discretionary resources required to implement a conservation strategy. While discretionary resources are limited, there may be opportunities to secure new resources that might be earmarked for a particular strategy.

Immediate Strategies

Stabilize and Upgrade Road/Stream Crossings
The focus of this strategy is addressing constrictions on water flow, sedimentation, runoff, and other hydrological alterations caused by road/stream crossings. Roads may be related to oil and gas, residential or commercial development. Some roads (e.g., East Mullet Lake Road) act like dams constricting the flow of water between wetlands and lakes. Stabilize or upgrade, and in some cases, remove crossings. Determine appropriate actions on a case-by-case basis. This strategy assumes that improved road/stream crossings will decrease sediment and chemical inputs affecting the targets and can improve the hydrologic regime in areas where it has been altered by roads.

Leverage: High. Strategy has high visibility on public roads.

Lead: Very High

Ease: Very High

Cost: Very High

Protect Land Through Coordinated Strategies
Develop land protection strategies for each key target (e.g., key buffer lands, corridors, shoreline tracts, tracts to prevent subdividing around oil and gas leases, or identified habitat – such as the East Branch of the Maple River and critical areas along Burt Lake shoreline for the Michigan monkey-flower). Protection tools may include conservation easements, conservation buyers, and acquisition. Negotiations with landowners can be undertaken by the LTC and Headwaters with support of TNC. Work with ranches and hunt clubs to obtain conservation easements on large, intact habitat. Also consider grants to increase state ownership from the Natural Resources Trust Fund. This strategy assumes that protected lands will remove or lessen threats to targets, or in some cases prevent additional degradation.

Leverage: Very High. Publicly visible results; allows for immediate management of the land; may have high leverage towards other strategies depending on the parcel characteristics and location.

Lead: Very High

Ease: Very High

Cost: Very High. Land is expensive, although pursuing a mix of land protection strategies may lower cost.

Establish and Enforce Sound Planning and Zoning
The goal of this strategy is to get a critical mass of governments involved in zoning so that conservation-oriented planning and zoning becomes more "accepted" throughout the region. May be most effective by focusing efforts on the west side of the Watershed and moving towards the east side later. This strategy should include the following actions:

- Establish ordinances so that all properties need BMP's to get permits, and establish regulatory review process for ground water, stormwater runoff, wetland and land protection. Develop BMPs for sedimentation and erosion.
- Monitor compliance to zoning regulations.
- Work with local units of government on developing local wetland ordinances and developing zoning requirements for setbacks and riparian buffers, and stormwater management.
- Work with local governments to establish no-wake zones and regulate motorized use in sensitive habitat areas.
- Work with counties to develop an ordinance requiring septic testing at point of sale.
- Provide planners, permit reviewers and other officials with information on threatened and endangered species locations and habitat requirements. Do further resource inventories of T&E species.
- Develop a "community watch" program that includes signage and fines to increase enforcement.

The strategy assumes that local regulations fill the gaps in state regulations, and that regulations provide a level of protection on all parcels in the Watershed (not just on select parcels).

Leverage: Very High. Strategy helps to improve state regulations.

Lead: High. Strategy can be coordinated with the People and Land grant.

Ease: High. There is a growing momentum for conservation in the region.

Cost: High

Implement Shoreline BMPs

The focus of this strategy is to reduce water resource impacts on already developed parcels. It assumes that education will translate into changed behaviors and professional practices. It further assumes that traditional erosion control that hardens shorelines causes problems at the land-water interface, whereas biotechnical erosion control protects the shoreline from erosion and restores riparian habitat.

- Work with residential and commercial landowners, contractors, landscapers, Chemlawn, and other private businesses to preserve and restore the land-water interface. Create setbacks and buffer strips. Develop procedures for lawn care (to minimize clearing and herbicide use), stormwater management, setbacks and buffer strips, and septic systems.
- Implement biotechnical erosion control on streambanks and lakeshores (does not refer to bulkheads, large rock rip-rap, and other non-vegetative erosion control). Stabilize and improve riparian access sites for anglers and canoeists. Work with restoration committees, where existing. Utilize CMI and 319 funding where possible and update Watershed management plans so that all Watersheds in the Cheboygan River Watershed can be eligible for 319 funds. Use this plan to leverage funds.
- Set up septic testing program and use contact as an opportunity to educate landowners.
- Use education and technical assistance as tools to implement riparian and shoreline management with the goal of providing people with the tools and awareness to induce a change in behavior.

Leverage: Very High. Strategy will leverage local ordinances, stewardship opportunities with landowners, retrofitting existing developed areas.

Lead: Very High

Ease: Very High. Sites have already been identified and we have a good sense of the work that needs to be done. TOMWC is currently working to update all CMI and 319 plans.

Cost: Very High

Promote Economic Benefits and Opportunities Associated with Resource Protection

This strategy focuses on public education and developing an understanding of why people come to the North Country to spend their time and money and what needs to be done to preserve those qualities. While a change in peoples' behavior is desirable as a "next step," that is not the goal of the current strategy. The strategy is to be accomplished by working with chambers of Commerce, trade associations, and realtors to market the benefits of natural resource protection; by using signage at strategic locations as an education tool; and by empowering workers at recreational facilities to educate customers (e.g., brochures at canoe rental facilities). Also consider potential economic development projects such as ecotourism, the "Sturgeon Experience Festival," promoting karst terrain as a unique ecological system, and other opportunities for environmentally sustainable businesses. This strategy assumes that by expanding economically sound business opportunities, entrepreneurs will be able to take advantage of "natural capital" in a way that creates a marketplace for protection.

Leverage: Very High. Strategy connects to several other strategies.

Lead: Medium

Ease: High. Need to determine the best way to reach people.

Cost: Medium

Implement BMPs and Retrofit Existing Developed Areas to Reduce Stormwater Input

The focus of this strategy is on advocacy for proper stormwater management. The object is to work with townships to pass ordinances on stormwater management, and to work with developers to demonstrate the advantages of stormwater management and avoiding imperviousness in ground water recharge areas. The strategy can be used as an opportunity to educate people living in these areas about the adverse impacts of stormwater flowing into their lakes and streams and encourage behaviors that reduce toxic inputs. This strategy will not abate inputs from other sources (such as atmospheric deposition, agriculture and forestry), and it assumes that stormwater is the largest source of controllable water pollution inputs into the Cheboygan River Watershed.

Leverage: Medium. Strategy has immediate, visible results, but doesn't provide much leverage for other strategies. Could help leverage roadstream crossings, streambank stabilization and local ordinances.

Lead: Very High

Ease: Medium. May be difficult to achieve because there are no regulatory requirements; instead strategy requires convincing people to give up certain conveniences.

Cost: Very High. Upgrading is difficult.

Ongoing Strategies

Practice Ecosystem Management
Research forestry BMPs and disseminate information; encourage foresters to adhere to state-established BMPs; and develop strategies to reduce artificially high deer populations and to prevent baiting in TB zones. Because a large proportion of the landscape is in state ownership, state land management can play a large role in improving the viability of conservation targets.

Leverage: High. Strategy influences local land use, but may be site or project-dependent.

Lead: Medium

Ease: Medium. Requires institutional change.

Cost: Medium. Cost will be in the implementation.

Ensure State and Federal Resource Regulations are Implemented and Enforced
Encourage the DNR and DEQ to review projects under ESA. Develop and implement enforcement strategies for additional regulations such as the National Environmental Policy Act, the Natural Rivers Program, the Inland Lakes and Streams Act, the Soil Erosion and Sedimentation Control Act, the Land Division Control Act, and the Flood Plains Control Act. Expand participation in wetland permit review and provide comment on applications. Members of the Cheboygan Watershed Partnership can act as the eyes and ears for the DNR and DEQ when conducting site visits. This strategy assumes that state and federal law provides a process to review potentially damaging projects and reduce or avoid the negative impacts.

Leverage: Very High. Permit review information can feed into land protection efforts on identified high priority parcels (properties that are more difficult to build on may be more open for other protection options).

Lead: Very High

Ease: Medium. Numerous permits to review across the Watershed; permit load increases as population increases.

Cost: High. To fully implement would require an additional full time employee.

Research and Inventory
For each of the targets, it is assumed that research and inventory will leverage other strategies that will actively abate stresses and sources of stress affecting that target because a greater understanding of the targets will allow for more focused conservation efforts in the future. The strategy further assumes that additional information will support more accurate viability assessments, and that the discovery of additional occurrences of the flower or the beetle will increase their viability rankings.

- Michigan monkey-flower: Research reproduction, historic habitat, and impacts from invasive species. Conduct additional inventories on private lands, including other seep sites downstream from the Maple River population. Encourage universities to study propagation and transplantation (perhaps leading to the development of an incentives program to encourage landowners to establish new populations).

- Hungerford's Crawling Water Beetle: Research habitat (how constricted are its habitat requirements?), life cycle, the assemblage of species that share this habitat, predation (by which species and to what extent?). Coordinate efforts with Brian Scholtens who is researching the beetle's habitat and life cycle.

- Karst Terrain: How much of a threat are oil and gas wells to this target? Research soils data on private lands. Identify vulnerable aquifers. Study hydrologic dynamics (Rainy Lake and others). Study the fate of agricultural chemicals in karst terrain. Research the oil and gas leasing process to determine whether non-development leases would be an efficient use of conservation resources.

Leverage: Very High

Lead: Very High

Ease: Very High

Cost: Very High

Conduct Household Refuse and Hazardous Waste Collection Programs
The objective of this strategy is to provide an alternative to dumping trash and pollutants into sinkholes. In the past, collection programs have been highly successful, but too infrequent. This strategy proposes establishing a regular program organized through the Department of Public Works or Conservation Districts. The program should include broad-based education and publicity. This strategy does not address other dumping that may occur (e.g., agricultural wastes).

Leverage: Medium. Strategy supports education efforts.

Lead: High
Ease: Very High. NEMCOG is already involved in these types of programs. Also, most solid waste departments have hazardous waste management as a requirement in their management plans.

Cost: High. Disposal rates can be very expensive.

Promote and Implement Conservation Design with Developers and Landowners
Promote the concept of conservation development by sharing models and providing examples of successful projects. The strategy involves working with developers on creating plans for conservation developments and fostering an awareness of appropriate land uses and 'special' areas. This should be developed in conjunction with the PAL grant obtained by TOMWC. The strategy assumes that well-planned and properly sited development will have a significantly lower impact on the conservation targets.

Leverage: Very High. This strategy has economic benefits and may leverage zoning and planning efforts.

Lead: High

Ease: Medium. Very Difficult. Requires overcoming many hurdles and mentality blocks ("it can't be done here" attitude).

Cost: High. Risk share with a developer as a demonstration project.

Encourage and Enable Stewardship on Private Land
The majority of lakeshore property and a large percentage of sensitive lands in the Watershed are privately owned. What landowners do on their property is critical to the health of the entire system. Work with existing landowners to encourage the implementation of wetland BMPs (e.g., buffer strips, setbacks, fertilizer use, and invasive species). For private landowners with Michigan monkey-flower habitat, promote the erection of signs and barriers to protect existing populations and seeps. This strategy provides an opportunity to educate landowners, which may open the door for conservation easements or management agreements in the future. The strategy assumes that landowners, once trained and educated, will voluntarily take steps to protect conservation values on their land.

Leverage: Very High. Property owners who manage their land will have significant influence on their neighbors.

Lead: Medium

Ease: Medium. As development increases, the number of landowners increases, and parcel size decreases, making this strategy more difficult to implement on a

Watershed-wide scale. Also, this strategy will require the development of individual strategies for each of the conservation targets.
Cost: High

Future Strategies

Address the Adverse Impacts of Dams
Promote alternative dam management techniques by working with dam owners and regulatory agencies on plans to replicate natural fluctuations in the lakes (especially at Alverno Dam relative to Black Lake) and natural flow regimes on rivers (such as the Pigeon River downstream of the Song of the Morning Ranch). Dams may need retrofitting to modify flow and/or allow fish passage. Pursue the removal of Kleber and Alverno Dams (Kleber Dam inundates high gradient spawning habitat. Alverno Dam needs further investigation to assess its impacts of removal). Investigate other opportunities to remove private dams. This strategy assumes that dam removal is the single most important strategy for restoring connectivity between the large, glacial lakes and restoring isolated sturgeon populations.

Leverage: High. This strategy will leverage other lake sturgeon strategies.

Lead: High

Ease: Medium

Cost: Very High

Implement Agricultural BMPs

- Demonstrate, and encourage adoption of BMP's.
- Research agricultural BMPs and disseminate information.
- Develop agricultural chemical waste collection programs.
- Act as a third party to support the Natural Resource Conservation Service (NRCS) and Conservation Districts to coordinate efforts between these agencies and farmers in establishing incentive programs to protect habitat and prevent soil erosion. Research agricultural BMPs, and demonstrate and encourage the adoption of BMPs. Develop agricultural chemical waste collection programs to prevent illegal dumping. This strategy assumes that BMPS will be practiced by a majority of private landowners, and that incentives from recognition, negotiated management agreements, and easements will foster adoption of the BMP's.

Leverage: Medium

Lead: High

Ease: High. Strong agricultural lobby.

Cost: High. Good funding exists, and some projects may be very low cost. BMPs in karst terrain involving chemical flows into the Ground water may be more expensive to implement.

Restore Riparian Wetlands
Nearly 75% of wetlands along the large lakes in the Watershed have been developed. The focus of this target is on large wetland complexes associated with lakes and streams. First, inventory potentially restorable wetlands to determine the most cost effective projects. Restoration actions will utilize cooperative funding and additional partners and resources such as, Natural Resource Conservation Service, Soil and Wetlands Conservation Districts, and the North American Wetlands Conservation Act. This strategy assumes that wetlands provide a myriad of functions that support aquatic ecosystem health.

Leverage: Medium. Strategy works hand-in-hand with land protection and may leverage shoreline BMPS, but most projects will be small and localized.

Lead: Medium

Ease: Medium. Ease of implementation is project-dependent. Also requires convincing landowners.

Cost: High. Cost is site-dependent, but strategy should focus on the most cost-effective projects.

Work with DNR Fisheries and Maintain Beetle Habitat at Identified Sites
Work with DNR Fisheries to maintain segments of certain streams as coldwater fisheries and others as beetle habitat. Coordinate efforts with the UM Biological Station to maintain populations that occur on their land. Educate private landowners about the beetle and encourage them to leave beaver dams where they support beetle habitat. This strategy assumes that we have sufficient knowledge of the beetle's habitat to manage it properly.

Leverage: Medium. Site-specific.

Lead: High

Ease: High

Cost: Medium

Table 4: Priority Conservation Strategies

Strategies Across Systems	Bogs, Fens, and Conifer-Hardwood Swamps	Michigan Monkey-Flower	Hungerford's Crawling Water Beetle	Lake Sturgeon	Lakes and Associated Wetlands	Lakes and Streams in Karst Terrain	Ground Water-Driven Streams and Riparian Corridors	Wildlife Core Habitat and Corridors	Strategy Benefit Rank
Establish and enforce sound planning and zoning requirements for all conservation targets.	Very High	Very High	High	Very High	Very High	Very High	Very High	Very High	Very High
Promote and implement conservation design with developers and landowners.	Very High	Very High	Medium	High	Very High	Very High	Very High	Very High	Very High
Protect land through coordinated strategies.	High	Very High	Medium	High	Very High	Very High	Very High	Very High	Very High
Ensure state and federal resource regulations are implemented and enforced.	High	Very High	High	Very High	Very High	Very High	Very High	Very High	Very High
Encourage and enable stewardship on private land.	Very High	Very High	High	Very High	Very High	Very High	Very High	Very High	Very High
Restore riparian wetlands.	Very High	Very High	-	Very High	Very High	Very High	Medium	-	Very High
Implement shoreline BMPs.	-	Very High	High	High	Very High	Very High	Very High	-	Very High
Implement BMPs and retrofit existing developed areas to reduce stormwater input.	-	Very High	-	High	Very High	Very High	Very High	-	Very High
Stabilize and upgrade road crossings at streams and drainage ways.	High	Very High	High	Medium	Very High	Very High	High	-	Very High
Research and Inventory.	High	Very High	Very High	Low	-	Very High	-	Medium	Very High
Address adverse impacts of dams.	-	-	High	Very High	Very High	-	High	-	Very High
Practice ecosystem management.	High	-	Medium	-	Very High	Very High	Medium	Medium	Very High
Promote economic benefits and opportunities associated with resource protection.	Medium	-	High	Low	-	Very High	-	Very High	Very High
Implement agricultural BMPs.	Medium	-	-	Low	Medium	Very High	Medium	-	High
Work with DNR fisheries to maintain habitat at known sites (HCWB and Lake Sturgeon).	-	-	Very High	-	-	-	-	-	High
Conduct household refuse and hazardous waste collection programs.	-	-	-	-	-	Very High	-	-	High

6. Conservation Capacity

As noted by the long list of stakeholders, and the established programs and staff expertise housed in the partner organizations, there is a high level of conservation capacity in this Watershed. Currently, there is funding by TNC for one full-time staff over the next two years to coordinate activities under this conservation plan. With the assistance of this funded coordinator, each of the primary partner organizations will be responsible for taking various specific strategies forward. This includes the development of strategic plans for each strategy and fundraising to implement those plans. In addition to the partners located in the Watershed, TNC has committed access to its professional staff to provide advice and consultation.

7. Next Steps

Conservation success is measured as substantial progress towards the long-term abatement of critical threats and the sustained maintenance or enhancement of the conservation targets' viability at sites identified for action. The next step for the partnership is to develop action plans and implement each of the top strategies. In addition, the plan will be reviewed and revised periodically to assess the effectiveness of these strategies and to incorporate adaptive management and new knowledge as it becomes available.

APPENDIX A
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APPENDIX B
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APPENDIX C
Stresses and Sources of Stress Documentation

Target #1: Bogs and Conifer Hardwood Swamps

Stresses

Habitat Fragmentation
Habitat destruction or conversion
Altered hydrology
Altered composition and structure
Excessive herbivory
Habitat disturbance

Sources of Stress

Oil and gas
High deer Populations
Poorly sited residential development
Forestry
Ag production and conversion
Invasive and alien species

Target #2: Michigan Monkey Flower

Stresses

Habitat destruction
Altered hydrology
Habitat disturbance
Sedimentation
Nutrient loading
Thermal alteration
Shading

Sources of Stress

Roads and utilities
Residential development
Invasive and alien species
Shoreline alteration
Ground water withdrawal
Lake level changes

Target #3: Hungerford's Crawling Water Beetle

Stresses

Modification of natural flow patterns
Habitat disturbance
Excessive predation
Sedimentation
Habitat destruction or conversion

Sources of Stress
Beaver dam removal
Incompatible fisheries management
Development of roads and utilities
Forestry practices
Second home/resort development
Dams

Target #4: Lake Sturgeon
Stresses
Sedimentation
Modification of water levels; changes in natural flow patterns
Habitat fragmentation
Excessive predation
Nutrient loading
Habitat disturbance
Habitat destruction or conversion

Sources of Stress
Dams
Over harvesting (poaching and legal harvest)
Residential development
Tribal harvesting
Roads and utilities
Ag production
Polluted (storm water) runoff
Recreational use

Target #5: Lakes and Associated Wetlands
Stresses
Habitat destruction or conversion
Nutrient loading
Habitat disturbance
Habitat fragmentation
Altered composition and structure
Toxins and contaminants
Sedimentation
Modification of water levels and changes in natural flow regime

Sources of Stress
Residential development
Shoreline hardening
Invasive and Alien Species
Storm water runoff
Ag practices
Operation of dams and locks

Dredging and filling
Recreational use

Target #6: Lakes and Streams in Karst Terrain

Stresses

Toxins/contaminants
Ground water depletion
Habitat destruction or conversion
Nutrient loading
Sedimentation

Sources of Stress

Inappropriate disposal of potentially hazardous substances by homeowners
Ag practices
Increased imperviousness
Residential use
Forestry practices
Oil and gas drilling
Roads

Target #7: Ground water Driven Streams and Riparian Corridors

Stresses

Sedimentation/erosion
Thermal alteration
Habitat destruction
Altered hydrology
Nutrient loading
Habitat disturbance

Sources of Stress

Residential development
Ag practices
Roads
Forestry practices
Storm water management
Recreational use
Oil and gas drilling
Dams

Target #8: Wildlife Corridors and Core Habitat

Stresses

Habitat destruction or conversion
Habitat disturbance
Habitat fragmentation

Sources of Stress
Residential development
Forestry practices
Development of roads or utilities
Oil and gas Operation
Fencing
ORV use
High deer populations
Commercial and recreational development

Appendix D
Ranking Scores for Viability, Stresses and Sources of Stress, and Strategies Analysis

A. Viability Score

This is a qualitative measure of the long-term viability of a conservation target based on our best scientific knowledge of their current status. The continued existence of a target will depend upon maintaining the natural processes that allowed them to establish and thrive in the past. Three factors—***size***, ***condition***, and ***landscape context***—should be considered in characterizing viable occurrences of the focal conservation targets. Characterizing these factors provides the basis for assessing stresses—the destruction, degradation, or impairment—that afflict the priority targets. It also aids in the development of conservation goals and restoration strategies.

Ranking
For each of these categories, please indicate a score of *very good*, *good*, *fair*, or *poor*.

Very Good. Excellent estimated viability relative to the target's desired future condition.
Good. Good estimated viability. A target's minimal acceptable condition.
Fair. Fair estimated viability. A 'fair' rating reflects a target's minimal restorable condition.
Poor. Poor estimated viability; or not viable.

These scores are simply based on expert opinion given the information available followed by brief explanations of the rating. If there is a reference that can be cited, please include it as part of the documentation.

Size: is a measure of the area or abundance of the conservation target's occurrence. For ecological systems and communities, size may simply be a measure of the occurrence's patch size or geographic coverage. For animal and plant species, size takes into account the area of occupancy and number of individuals. Minimum dynamic area, or the area needed to ensure survival or re-establishment of a target after natural disturbance, is another aspect of size.

- Explanation of ***Size*** score:
- What will improve the ***Size*** score (in terms of measurable progress)?: e.g., restore a 100 acre buffer around the site.
- What will cause a decline in the ***Size*** score?: e.g., a 15% decrease in the population at this site.

Condition: is an integrated measure of the composition, structure, and biotic interactions that characterize the occurrence. This includes factors such as reproduction, age structure, biological composition (i.e. presence of native vs. exotic spp; presence of characteristic patch types for ecological systems), and biotic interactions (i.e. levels of competition, predation, and disease).

- Explanation of ***Condition*** score:
- What will improve the ***Condition*** score?: e.g., a 20% decrease in invasive species
- What will cause a decline in the ***Condition*** score?: e.g., the spread of shoreline development to the north end of the lake.

Landscape Context: is an integrated measure of two factors: the dominant environmental regimes and processes that establish and maintain the target occurrence, and connectivity. *Dominant environmental regimes and processes* include hydrologic and water chemistry regimes (surface and groundwater), geomorphic processes, climatic regimes (temperature and precipitation), fire regimes, and many kinds of natural disturbance. *Connectivity* includes such factors as species targets having access to habitats and resources needed for life cycle completion, fragmentation of ecological communities and systems, and the ability of any target to respond to environmental change through dispersal, migration, or re-colonization.

- Explanation of ***Landscape Context*** score:
- What will improve the ***Landscape Context*** score?: e.g., the restoration of the natural flood regime by removing an upstream dam.
- What will cause a decline in the ***Landscape Context*** score?: e.g., a 20% conversion rate from agriculture to residential development within the watershed.

B. Stresses and Sources of Stress

We need to understand the *stresses* affecting the conservation targets—as distinct from *sources of stress*—in order to ensure that we develop effective conservation strategies. In essence, stress is the impairment or degradation of the size, condition, and landscape context of a conservation target, and results in reduced viability of the target. A source of stress is an extraneous factor, either human (e.g., policies, land uses) or biological (e.g., non-native species), that infringes upon a conservation target in a way that results in stress.

If we do not consciously alter our natural mode of expression, we will, for example, call a proposed road a threat in an estuarine system. We are then immediately inclined to the conclusion that we must stop construction of the road. Threat: road. Solution: stop road. However, if we separate the threat into stress and source, the stress isn't the road. The stress is, for example, loss of tidal flow. That formulation of stress inclines us to think, instead, of ways to keep tidal waters flowing through the pathway that is the proposed location of the road. Culverts may be the answe*r. (Beyond the Ar*k, by Bill Weeks, p. 46)

Stresses

What types of destruction, degradation, or impairment are significantly reducing the viability of each conservation target at the site?

1. Identify Major Stresses to the Conservation Targets
Every natural system is subjected to various disturbances. For our planning purposes, however, only the destruction, degradation or impairment of conservation targets resulting directly or indirectly from human causes should be considered a stress. Many or most stresses are caused directly by incompatible human uses of land, water, and natural resources; sometimes, incompatible human uses indirectly cause stress by exacerbating natural phenomena.

The stresses to consider should be happening now, or have high potential to occur within the next ten years. Do not consider past stresses that no longer affect the viability of the target, or those that are possible but have low potential to occur. The damage may be either a direct impact to the conservation target (i.e., degraded size or condition), or an indirect impact via impairment or exacerbation of an important natural process (i.e., degraded landscape context).

The stresses afflicting *each* conservation target need to be identified. It is important to be as precise as possible in identifying the stresses; this will help focus the subsequent identification of sources of stress, and minimize double counting of stresses.

Ilustrative List of Stresses

Habitat destruction or conversion	Thermal alteration
Habitat fragmentation	Groundwater depletion
Habitat disturbance	Resource depletion
Alteration of natural fire regimes	Extraordinary competition for resources
Nutrient loading	Excessive herbivory
Toxins/contaminants	Altered composition/structure
Extraordinary predation/parasitism/disease	Modification of natural flow patterns

2. Rank the Stresses
The relative seriousness of a stress is a function of the following two factors:
Severity of damage: What level of damage over at least some portion of the target occurrence can reasonably be expected within 10 years under current circumstances (given the continuation of the existing management/conservation situation).

> *Very High*. The stress is likely to *destroy or eliminate* the conservation target over some portion of the target's occurrence at the site.
> *High*. The stress is likely to *seriously degrade* the conservation target over some portion of the target's occurrence at the site.
> *Medium*. The stress is likely to *moderately degrade* the conservation target over some portion of the target's occurrence at the site.
> *Low*. The stress is likely to *only slightly impair* the conservation target over some portion of the target's occurrence at the site.

Scope of Damage: What is the geographic scope of impact on the conservation target at the site that can reasonably be expected within 10 years under current circumstances (given the continuation of the existing situation).

Very High. The stress is likely to be *very widespread or pervasive in its scop*e, and affect the conservation target *throughout the target's occurrences* at the site.

High. The stress is likely to be *widespread in its scop*e, and affect the conservation target at *many of its locations* at the site.

Medium. The stress is likely to be *localized in its scop*e, and affect the conservation target at *some of the target's locations* at the site.

Low. The stress is likely to be *very localized in its scop*e, and affect the conservation target at a *limited portion of the target's location* at the site.

For each conservation target, list **up to eight** stresses. It is not necessary to include every conceivable stress, but only those which are current (or likely to become a problem within the next ten years), proximate, and cause particular concern. Avoid listing stresses to a given system that are largely redundant (e.g. habitat destruction; habitat fragmentation; habitat degradation). It is important to document the rationale for selecting stresses, and for the assigned severity and scope rankings.

Sources of Stress

What is causing the most destruction, degradation, or impairment of the priority conservation target(s) at the site?

For each stress afflicting a given conservation target, there are one or more causes or sources of the stress. For example, nutrient loading is a stress to many aquatic ecosystems, where excess nutrients in the water draw off oxygen and therefore kill fish and other aquatic life. However, the nutrient loading might be caused by many different sources, such as farm fertilizers, animal feed lots, septic systems, sewage treatment facilities, or suburban runoff.

When multiple sources all contribute to a given stress, we want to focus our threat abatement strategies on the source or sources that are most responsible for the stress. We also want to focus on those sources that, if allowed to occur at a site, will cause long-term impacts (e.g., housing development).

1. Identify Sources of Stress

Each stress must have at least one source, and may have multiple sources. When identifying sources of stress, it is important to distinguish between "active" and "historical" sources. An active source is expected to deliver *additional* stresses to a conservation target within the next ten years. These include ongoing sources as well as those that are likely to become active within the ten-year timeframe. Historical sources are no longer active, and thus are expected to deliver *no additional* stresses to a conservation target. An historical source should be listed if the stresses caused by the source are expected to persist over the next ten years. For example, the condition (i.e., composition, structure, continuity) of a forested

system may have been degraded by past timber harvest. Through change in land ownership or timber management policy, timber harvest is no longer occurring—the source of stress has been abated. However, the condition of the forest system is still degraded from past timber harvest—the forest is still stressed—and is not expected to recover by itself within the next ten years. In this instance, the stress would be identified as altered composition/structure, the "historical" source of stress would be identified as incompatible timber harvest practices, and there would be no "active" source of stress.
Also, it is important to identify the most proximate sources (e.g., incompatible timber harvest) rather than ultimate or indirect sources (e.g., human population growth). Indirect sources of stress will be identified and considered when developing conservation strategies.

Finally, it is critical to identify the source precisely, because addressing each different source often requires a very different conservation strategy. For example, many priority systems are stressed by incompatible residential development. However, different aspects of incompatible residential development are relevant to different stresses. In one riverine system, the highest ranked stress was hardening of the shoreline. The apparent source of stress was second home development along the river. However, the density of development, the pattern of sprawl, the septic systems, and the fragmentation associated with second home development were not the critical sources—rather it was the actual bulkheads and groins built along the riverbank. A strategy to address this particular threat could be much more precise, effective, and accomplishable than a strategy to "control growth" in this rural area.

Illustrative List of Sources of Stress

Agricultural and Forestry	**Point Source Pollution**
Incompatible crop production practices Incompatible livestock production practices Incompatible grazing practices Incompatible forestry practices	Industrial discharge Livestock feedlot Incompatible wastewater treatment Marina development
Land Development	**Resource Extraction**
Incompatible primary home development Incompatible second home/resort development Incompatible development or roads/utilities Conversion to agriculture or silviculture	Incompatible mining practices Incompatible oil or gas drilling Overfishing or overhunting Poaching or commercial collecting
Water Management	**Land/Resource Management**
Dam construction Construction of ditches, dikes, drainage or diversion systems	Fire suppression Incompatible management of/for certain species

Water Management Continued	Recreation
Channelization of rivers or streams Incompatible operation of dams or reservoirs Incompatible operation of drainage or diversion systems Excessive groundwater withdrawal Shoreline stabilization	Incompatible recreational use Recreational vehicles
	Biological
	Parasites/pathogens Invasive/alien species

2. Rank the Sources

The relative seriousness of a source is a function of the following factors:

Degree of contribution to the stress: The contribution of a source, acting alone, to the full expression of a stress (as determined in the stress assessment), assuming the continuation of the existing management/conservation situation.

Very High. The source is a *very large* contributor of the particular stress.
High. The source is a *large* contributor of the particular stress.
Medium. The source is a *moderate* contributor of the particular stress.
Low. The source is a *low* contributor of the particular stress.

Irreversibility of the stress: The reversibility of the stress caused by the source. Does (or did) the source produce a stress that is irreversible, reversible at extremely high cost, or reversible with moderate or little investment?

Very High. The source produces a stress that is not reversible, for all intents and purposes (e.g. wetland converted to shopping center).
High. The source produces a stress that is reversible, but not practically affordable (e.g. wetland converted to agriculture).
Medium. The source produces a stress that is reversible with a reasonable commitment of additional resources (e.g. ditching and draining of wetland).
Low. The source produces a stress that is easily reversible at relatively low cost (e.g. ORVs trespassing in wetland).

C. Strategies

The ultimate objective of our conservation strategies is to reduce the stresses that are degrading and impairing, and thus lowering the viability of, the focal conservation targets. There are two major paths for accomplishing this objective. The first is to abate the critical threats, i.e., remove the active sources of stress, under the assumption that the associated stress will decrease if the source is removed. However, in some instances, even if the active source is abated, the stress to the target may persist. In these instances, it will be necessary to deploy *restoration strategie*s, with the objective of directly reducing the persistent stress. Also, at times it will be necessary to deploy strategies that build capacity, engage stakeholders, or promote priority policy actions rather than directly abate threats or reduce persistent stresses. Such indirect strategies have high leverage in that they pave the way for more direct threat abatement and restoration strategies.

1. Consider the Array of Strategic Approaches

Land and Water Conservation

The objective of these strategies are to directly establish land and water uses and resource management that are compatible with the maintenance of the targeted systems, and ensuring their short- and long-term application.

- **Acquisition of Interest in Land or Water** (including conservation easements and management leases)
- **Adaptive Management of Public or Private Lands and Waters** (management, restoration and monitoring on public and private properties)

Public Policies

Some threats to biodiversity can be addressed most effectively through good public policy. Because threats operate at various scales, not all threats can be addressed simply through local policies. Regional and national policy initiatives —such as the combined efforts of Maryland, Virginia and Pennsylvania to clean up the Chesapeake Bay and revitalize its fisheries—are also needed. These policies must be founded on good information and public support.

Compatible Development Alternatives

Most threats to biodiversity ultimately are caused by incompatible human economic activities.

Compatible development is the production of goods and services, the creation and maintenance of businesses, and the pursuit of land uses that conserve biodiversity, enhance the local economy, and achieve community goals.

2. Develop a List of Potential Strategies

Consider conservation strategies that might directly reduce threats and directly enhance or restore the viability of affected conservation targets. In developing strategies, it is important to consider the following two key questions:

- What are the key characteristics (economic, political, cultural) of the local human communities, as related to the critical threats and conservation targets?
- Which individuals, group, of institutions are likely to affect of be affected by conservation action?

3. Rank the Proposed Strategies

Potential strategies to abate the critical threats and persistent stresses should be evaluated and ranked using three criteria: *Benefit*s, *Feasibility and Probability of Success*, and *Costs of Implementatio*n.

Benefits

Benefits result from *abating critical threats, reducing persistent stresse*s, and *developing opportunities and building support for conservation.* Benefits can be both direct (e.g., cows fenced out of stream, or size of target occurrence increased by fifty percent) and indirect (farmer/rancher education program launched). Some benefits that seem small or less tangible can provide an important foundation for future actions. If the results would likely occur anyhow, without special actions by you and your conservation partners, don't rank the benefits highly. To assess the potential benefits of a proposed conservation strategy, consider three factors:

• **Threat Abatement**
The degree to which the conservation strategy is likely to reduce the Threat rank of one or more threats with active sources. This benefit will accrue only through threat abatement strategies, which focus on active sources of stress.
• **Reduction of Persistent Stresses**
The degree to which the conservation strategy is likely to reduce the persistent stresses (i.e., those stresses with historical sources). This benefit will accrue only through restoration strategies, which focus on the direct reduction of stresses that have historical but no active sources.
• **Leverage**
Frequently, the most effective strategies are catalytic in nature—a little bit of effort or a small investment triggers positive work or resources from others, and other new opportunities. High-leverage strategies pave the way for other strategies.

Feasibility and Probability of Success
All other things being equal, a program should invest in the strategies that are the most likely to succeed, in light of potentially available human and financial resources, as well as existing circumstances. The probability of successful implementation depends on many variables, but two key factors are perhaps most critical:

• **Lead Person and Institution**
Perhaps the single most important factor of success is finding the right person to take the lead and the responsibility to implement the strategy.
• **Ease and Lack of Complexity**
The more complex the strategy, the more likely that unanticipated outside events will substantially affect the outcome. For this reason, it is wise to invest in some relatively small, simple, do-able strategies. Evidence of success will then help encourage your conservation partners to undertake challenges that are more complex.

Costs of Implementation
There is one cost factor to consider:

• **Commitment of Limited Discretionary Resources**
There are limited human and financial resources to invest in the future. Special attention should be paid to the commitment of limited discretionary resources required to implement a conservation strategy. While discretionary resources are limited, there may be opportunities to secure new resources that might be earmarked for a particular strategy.

4. Consider Top Priorities for Immediate Action
Working from the list of highest ranked strategies, select a small number for immediate implementation. Look for the strategies that will produce high benefits with the greatest chance of success and affordable costs. The best people and discretionary resources should be focused early on the highest leverage ideas. ***Pick early winner***s—those actions that are the most likely to succeed and offer tangible results. Strive to show early success that reinforces the interests and

issues important to partners and key sectors in the community. Success then tends to beget more success.

Pick big winners—Carefully consider strategies that may be big winners. Adequate resources and staff experience are needed to launch complex, high-leverage projects. In addition, a more difficult and complex strategy often needs a foundation of smaller successes. The temptation to tackle big projects must be weighed against the perils that the project could bog down or cause tension in fragile community or partner alliances.

- What actions are necessary to implement the conservation strategies? Who will do them, when will they be done, how long will they take, and how much will it cost?

- Where are the areas on the ground in which specific conservation strategies and actions apply?