Advancing Biodiversity Conservation in the Hudson River Estuary Watershed:

A Report on the Products of a Multi-Stakeholder Workshop Series

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Migratory fish: Kraft, C.E., D.M. Carlson, and S.C. Brown. 2003. *The On-line Fishes of New York State, Version 2.1*. Department of Natural Resources, Cornell University, Ithaca, NY, http://fish.dnr.cornell.edu/nyfish/fish.html
Zebra mussels: U.S. Geological Survey Archives, U.S. Geological Survey, www.forestryimages.org
Hemlock wooly adelgid: Connecticut Agricultural Experiment Station Archives, Connecticut Agricultural Experiment Station, www.forestryimages.org

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This report provides a summary of the products from a series of workshops. The process we used to facilitate the workshops is described in a companion report *Conservation of Biodiversity in the Hudson River Estuary – The Process: A Report on a Multi-Stakeholder Workshop Series Using a Modified Version of TNC's CAP Process.* Both reports and additional supporting materials are available online at http://conserveonline.org/workspaces/hrew.conserve.

1. Introduction

1.1 A Context for Conservation

The Hudson River Estuary (HRE) watershed is a diverse and unique landscape of both ecological and cultural importance. Due to the tidal influence, which extends 154 miles inland to a natural elevation break at the Troy dam, and which at times brings salt water as far north as Poughkeepsie, the river is home to a wide array of plant and animal species. The geologic history of the area has led to the creation of a variety of upland landscapes as well, from forested mountains and rocky cliffs to rolling sand dunes and fertile valleys. Thanks to this diversity, the watershed contains a number of significant elements of biodiversity. Occurrences can be found here of 9 federally listed species, including the endangered shortnose sturgeon, Karner blue butterfly, and Indiana bat. It is also home to 233 state-listed threatened and endangered species, the majority of which are plants. State-listed endangered animal species with occurrences in the watershed include, in addition to the federal list, the bog turtle, northern cricket frog, eastern mud turtle, peregrine falcon, and the short-eared owl. The watershed also contains a number of globally imperiled and vulnerable ecological communities such as freshwater tidal swamps, rich fens, pitch pine-scrub oak barrens, and mountain fir forests.

The Nature Conservancy uses an ecoregional planning process to set its conservation priorities at a very large scale. Ecoregions are large areas of land and water that contain geographically distinct habitats sharing species and ecological processes in common. The Conservancy uses ecoregions to set priorities for aquatic and terrestrial ecosystems, vegetation communities, and species, collectively referred to as conservation targets. Two ecoregions make up most of the Estuary watershed, the High Allegheny Plateau and the Lower New England/Northern Piedmont. The Estuary watershed encompasses many of the conservation targets for these ecoregions, including seven large, relatively unfragmented forest blocks, 19 tributary watersheds representing the region's diversity of watershed system types, 54 target vegetation community types, and 50 target species of plants and animals.

For all these reasons and more, it is vital to protect the Estuary and its watershed as a functioning landscape. We face a number of challenges, as the valley has a long history of human activity. In the 400 years since Henry Hudson first sailed up the river, it has been subjected to severe alterations from development, pollution, invasive species, dredging, fishing, damming of tributaries, filling of wetlands, and a variety of industrial and recreational uses. Since the environmental movement in the Hudson Valley began 35 years ago, some of these threats have been abated, although we continue to deal with their lingering effects as well as new and different kinds of threats that accompany the current era of growth in the valley. Presently 73% of the watershed remains in natural land cover, and the pace of development is expected to increase in the near future. Ecoregional-scale planning tells us where the important components of biodiversity occur, but it does not tell us how to protect them. This requires a different kind of planning process, one conducted at a scale appropriate to the system, and which engages the larger conservation community. It is for this reason that the Conservancy decided to convene a multi-stakeholder workshop series on conservation planning for the HRE watershed in the spring of 2005.

1.2 Overview of this Report

This report was created to document the results and products of the conservation planning workshops. It is intended to be used by the workshop participants and other interested parties as a draft for comment, in preparation for an implementation meeting on September 27th, 2005. The report is organized around the steps of the Conservation Action Planning (CAP) Adaptive Management Cycle (Figure 1), which was also used to organize the workshops. Each step will be described briefly and the main products of that step will be discussed. In many cases the full results of the work completed were too extensive to include in this document, in which case an example is given and the full product is available on the project webspace on Conserve Online under "Hudson River Estuary Watershed Conservation Planning". A detailed description of the planning process is available in a separate report, "Conservation of Biodiversity in the Hudson River Estuary – The Process".

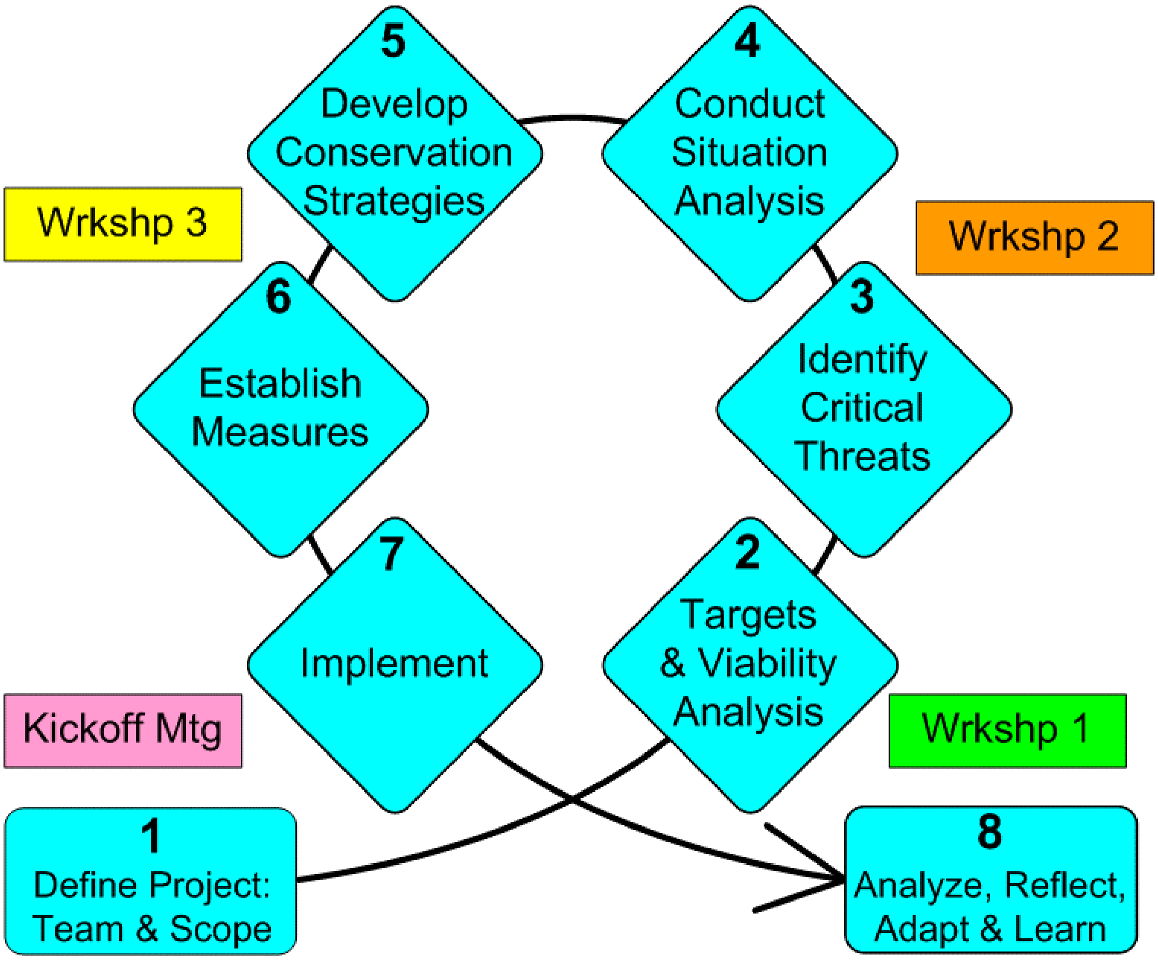


Figure 1. Conservation Action Planning (CAP) Adaptive Management Cycle, the project planning method used to organize the planning workshops and this report.

2. Conservation Planning and Adaptive Management

The CAP Adaptive Management Cycle is an iterative process which helps conservation projects develop and implement strategies, and then evaluate and learn from their experiences. The general steps of the process are to 1) define the project team and scope, 2) identify the conservation targets and assess their viability, 3) identify and assess the critical threats, 4) conduct a situation analysis, 5) develop conservation strategies, 6) establish measures, 7) implement the strategies and measures, and 8) analyze, reflect and learn from the results. The use of adaptive management means that the planning is never fully completed, but is continually refined, improved, and adapted over time. The workshops represent a first pass through this cycle, and the products are by necessity rough drafts. Future work will include a re-evaluation and refinement of the products to better reflect our growing knowledge and experience.

2.1 Define the Project Team and Scope

Given the large number of organizations that are active in conservation in the HRE watershed, we adopted an approach of making the process as open and inclusive as possible. With the help of a steering committee of key partners, the NYS DEC Hudson River Estuary Program, the Hudson River Foundation, Scenic Hudson, and the Institute of Ecosystem Studies, we compiled a list of 133 individuals from 89 organizations, representing NGOs, research institutions, and county, state, and federal government agencies, to invite to a kickoff meeting to inform them about the project and the planning process. Approximately half of those attended the kickoff meeting, a total of 61 people from 45 organizations. All those invited to the kickoff meeting were also invited to attend the subsequent series of workshops, and additional people were added to the list throughout the course of the workshops. In total 58 people participated in some part of the workshops themselves, representing 33 organizations. In addition to this there were a significant number who were not able to attend the workshops but requested to remain informed and who received the same updates and product materials as the participants.

One of the first tasks for the project team was to decide on the project scope. An initial scope proposed by The Nature Conservancy was adopted by the group during the first workshop. This scope consisted of the entire extent of the watershed that drains into the tidal portion of the Hudson River, from the Troy dam south to the New York Harbor (Figure 2). In adopting this scope the team agreed that potential targets could include both terrestrial and aquatic systems, and that the northern, non-tidal, portion of the Hudson River watershed above Troy would be excluded. However, it was noted that the upper watershed is important to the viability of the estuary and should be taken into account in threat and strategy assessments. The team also discussed the possibility of targets that lie only partially within the watershed, and it was agreed that assessments would include the full range of the targets and not only that portion that falls within the mapped extent of the basin. In this way the scope became a soft boundary for the team, guiding the selection of targets but allowing the consideration of threats and targets that extend beyond that scope.

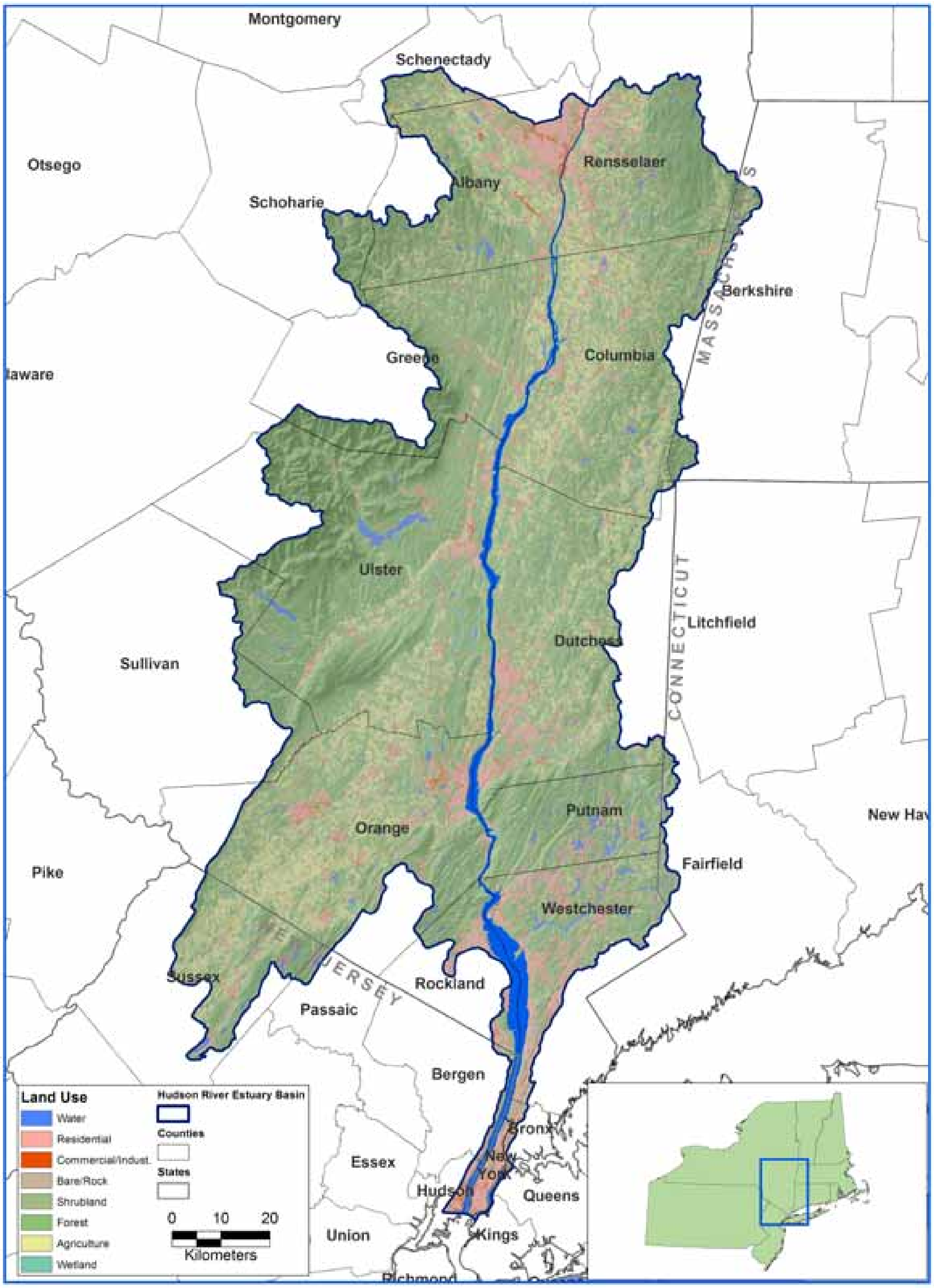


Figure 2. Scope of the project, the Hudson River Estuary watershed.

2.2 Identify Conservation Targets and Assess Viability

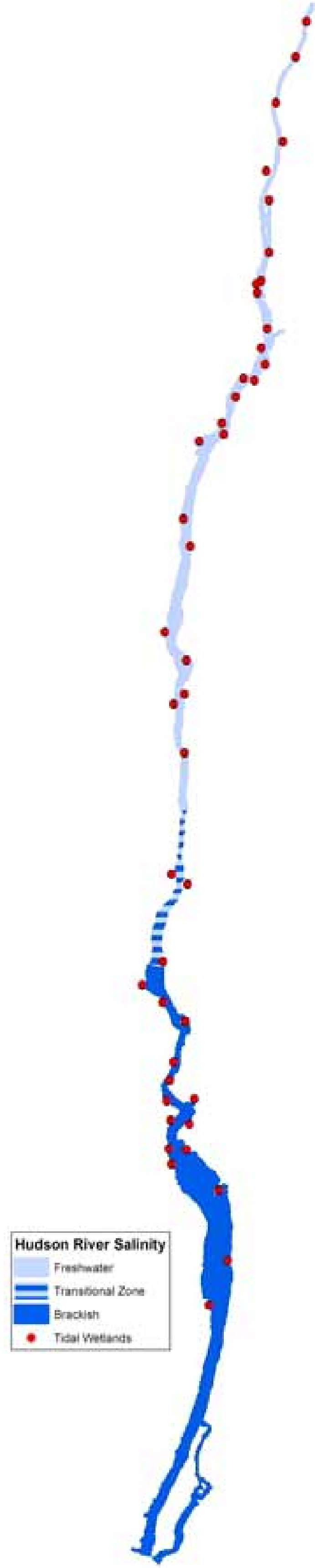
Conservation targets are species, communities, or ecological systems that represent the biological diversity of the project area. A good set of conservation targets should be designed to include those elements of the system that, if properly conserved, will result in the conservation of the full diversity of the landscape. Coarse-filter targets are intended to capture a large amount of smaller-scale biodiversity, both common and rare, within them, while fine-filter targets should include those small-scale elements that "fall through" the coarse filter and require individual attention.

For project management purposes, the Conservancy has tended to restrict the number of targets for a project to eight or less in order to facilitate tracking of each target. This restriction has been successful for the vast majority of Conservancy projects worldwide. For the Estuary watershed, the team selected seven targets through a group process of nomination and consolidation. The slot for a possible eighth target was left open for further discussion throughout the course of the workshops.

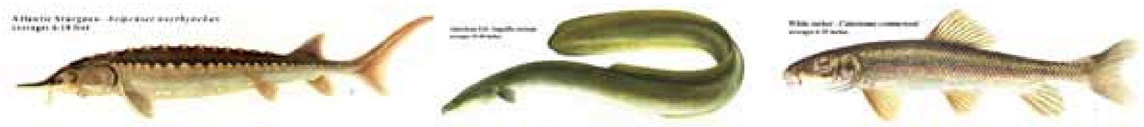
The seven targets for the HRE watershed are described below. Each target has been mapped to the best ability of the available spatial information, an important step which allowed the team to see the scale and distribution of the target as well as where major data gaps occur that need to be filled.

- **Estuary Ecosystem**

This key target includes the full tidal extent of the river, both brackish and freshwater reaches. Critical habitats within this target are the tidal wetlands that fringe the river, the shallow water habitats (defined as instream areas with a depth less than 3 m), upland areas in the river's islands and riparian zones, and the mainstem itself. The mainstem can be further broken down into four zones, based on salinity and the hardness of the substrate, which contain different types of plant and animal communities.



- **Migratory Fish**



"Migratory fish" is a general term which includes three distinct groups of species: diadromous fish (fish that move between fresh and salt water to complete their life cycle) that use only the mainstem of the river (e.g. American shad, Atlantic sturgeon, striped bass), diadromous fish that also use the tributaries (e.g. river herring and American eel), and potamodromous fish species that migrate between the freshwater mainstem and the tributaries (e.g. white suckers, white perch). All three of these groups have a common need for protection based on their requirement for connections between disparate habitats, but each is faced with slightly different threats.

- **Tributaries and Riparian Zones**

The Hudson River Estuary is fed by 64 main tributaries, which drain a range of landscapes. The largest of these tributary streams and their watersheds are indicated on Figure 3. Some tributaries have extensive tidal wetlands at their mouths and some provide crucial spawning habitat for migratory fish, as well as supporting a wide range of resident wildlife.

- **Non-tidal Wetlands**

This target is intended to capture all those wetland habitats that are non-tidal and so not included within the Estuary Ecosystem target. It includes all swamps, marshes, bogs, fens, and vernal pools throughout the project area. These habitats are important to a variety of plants, invertebrates, amphibians, birds, and mammals, as well as a key component of the aquatic systems of the watershed, modulating water flows, filtering stormwater, and controlling nutrient dynamics.

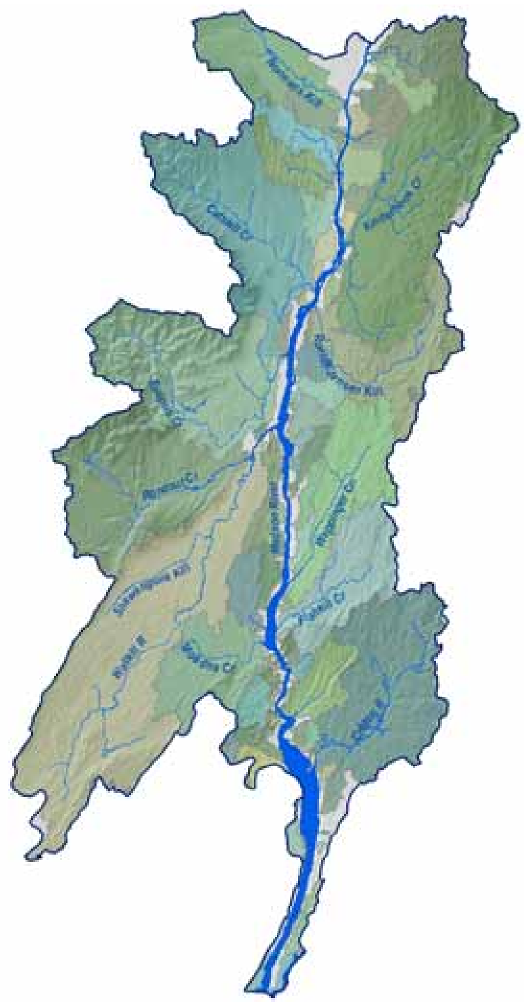


Figure 3. Tributary watersheds of the Hudson River Estuary.

- **Lakes and Ponds**

The watershed contains a number of naturally occurring lakes and ponds, due to the glacial influence on the topography of much of the basin. These habitats are significant contributors to the diversity of fish and other aquatic animals, and perform an important role in the cycling of nutrients and elements through the ecosystem. Different lakes and ponds have unique characteristics depending on their water chemistry, size, and hydrology.

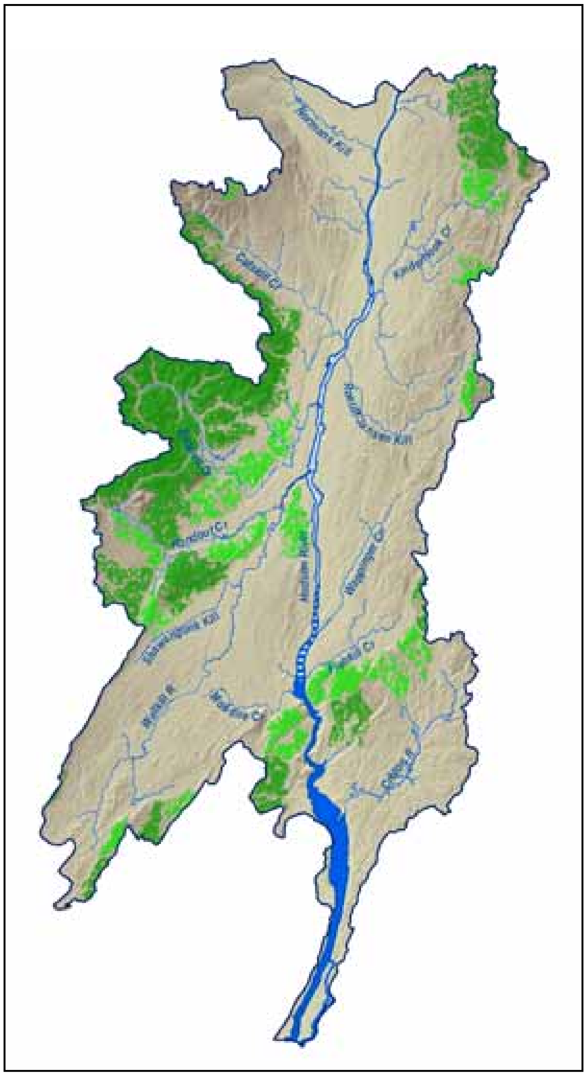


Figure 4. Large unfragmented forest blocks of the Hudson River Estuary. Dark green = >15,000 acres, bright green = > 6,000 acres.

- **Large Unfragmented Forests**

Unbroken blocks of forest are important habitats that support timber rattlesnakes, box turtles, Indiana bats, various species of warblers, and large mammals. This target includes matrix blocks of at least 15,000 acres, as well as smaller regional blocks greater than 6,000 acres in size. These blocks are primarily clustered in three regions of the watershed (Figure 4), the Rensselaer Plateau in the northeast, the Catskills on the western edge, and the Hudson Highlands which traverse the southern portion.

- **Non-Forested Upland Communities**

These are upland communities which are not captured in the forest blocks, but are rare, often small and patchily distributed, and support unique plant and animal diversity. These habitats tend to be dependent on disturbance processes of some kind and can be very vulnerable. These communities include grasslands, shrublands, pine barrens, and rocky ridge communities.

- **Eighth Target**

There were various nominations for an eighth target, including species or species groups such as oysters, the Indiana bat, turtles, and wide-ranging mammals, but no one species was able to gain strong support over the other options. There were also nominations of targets that did not fall within the Conservancy's standard definition of targets as species, communities or ecosystems. These included a "connectivity" target, intended to capture the need for adequate connections between the other targets for true ecosystem functionality, and an "urban ecosystems" target, intended to capture the contributions that urban areas make to biodiversity. Both of these targets garnered enough support to be developed further, and will continue to be worked on as sub-projects.

In order to assess the targets' viability, or ability to persist over the long term, the Conservancy has developed a system to help teams define what they consider a "healthy" state for each target. The benefit of this exercise is in understanding the current status of the targets, as well as having a clearly defined desired status as a measurable objective toward which to work. The process for doing this involves identifying key ecological attributes (KEAs), indicators, ranges of variation, and rating schemes for each target.

KEAs are characteristics of the target that are critical to its biology and that if altered would lead to the loss of the target. KEAs tend to fall into the broad categories of size, condition, and landscape context. Since KEAs are often not directly measurable, associated indicators are selected in order to develop a rating scheme by which to evaluate the target status.

Due to the complexity and scale of the targets selected, we allowed the teams to add an interim step and break their targets into strata which would be expected to have different KEAs, indicators, or rating levels. An example of the draft KEA and indicator lists produced in this session is shown in Table 1. For a full list of KEAs and indicators, please see the project website.

The usual next step in the process would be to determine natural ranges of variation for each of the indicators, and to determine what portions of that range correspond to varying levels of viability: poor, fair, good, and very good. Each group did this for at least one indicator as an exercise, but it was decided that a more accurate viability assessment would be possible after the team had identified the critical threats and determined status and effectiveness measures for the strategies, thus narrowing down the long list of potential KEAs and indicators that had been brainstormed. It was assumed that all of the targets were necessary components of the landscape, and that the team would need to address threats to each.

Table 1. Example KEAs and indicators from the workshops, showing the Non-Tidal Wetlands target broken down into five strata, the KEAs, and their associated indicators. The text in blue was added to the list between the workshops.

Target	Strata	KEA	Indicator examples
Non-Tidal Wetlands	1. Swamp 2. Marsh 3. Bog 4. Fen 5. Vernal pools	A. Hydrologic regime	A1. Duration of flooding (days) A2. Timing of flooding (season)
		B. Native/invasive species composition	B1. Percent cover of invasives B2. P/A of invasive spp
		C. Vegetation community	C1. Native spp richness
		D. Faunal Species composition (e.g., wood ducks, herps, key mammal species like fisher, mink, marten)	D1. Wood frog (presence/absence; number of egg masses) D2. Spotted salamander (presence/absence; number of egg masses) D3. Fairy shrimp (presence/absence)
		E. Connectivity to other natural systems – especially wetland and aquatic systems and upland forests	E1. Distance to nearest neighbor wetland
		F. Natural cover in upland drainage basin	F1. Small vernal pools (750' buffer width) F2. Connections with adjacent habitat (75% of perimeter intact)
		G. Water chemistry	G1. pH G2. conductance G3. nitrogen and phosphorus loading

2.3 Identify and Assess Critical Threats

Thirty-five threats were identified as reducing the viability of at least one target. These threats were ranked according to three criteria, scope, severity, and urgency, in order to gauge the degree of the threat. The ranking criteria used are described in Table 2. These three criteria were then rolled up into a single target rank for each threat.

Table 2. Descriptions of the criteria used to rank the threats and the ranking levels from low to very high for each one.

Criterion (Description)	**Ranking**			
	Low	**Medium**	**High**	**Very High**
Scope - Most commonly defined spatially as the proportion of the overall area of a project site or target occurrence likely to be affected by a threat under current circumstances.	Very localized in scope, affect the conservation target at a limited portion of the target's locations.	Localized in scope, affect the conservation target at some of the target's locations.	Widespread in scope, affect the conservation target at many of its locations.	Very widespread or pervasive in scope, affect the conservation target throughout the target's occurrences.
Severity - The level of damage to the conservation target that can reasonably be expected under current circumstances.	Slightly impair the conservation target over some portion of the target's occurrences.	Moderately degrade the conservation target over some portion of the target's occurrences.	Seriously degrade the conservation target over some portion of the target's occurrences.	Destroy or eliminate the conservation target over some portion of the target's occurrences.
Urgency - The importance of taking immediate action to counter the threat.	Does not need to be countered in the next 10 years.	Probably will need to be countered in the next 5-10 years, but does not need to be dealt with before then.	Must be countered in the next 5 years OR limited action in the next 5 years will likely mitigate much more intensive action in the future.	Must be countered today OR limited action today will likely mitigate much more intensive action in the future

After the threats were ranked for each target, we were able to consolidate threats that occurred for multiple targets and use an algorithm to roll the individual rankings up to an overall rank for that threat. Table 3 summarizes the target ranks and overall rank for each of the 35 threats identified. The "critical" threats, those with overall ranks of medium or higher, and which ranked high for at least one target, are described in more detail in the following pages.

Table 3. Threats to the HRE watershed and their ranks (low to very high) for each of the seven targets and overall.

Type	Estuary Ecosystem	Migratory Fish	Tributaries & Riparian Corridors	Non-Tidal Wetlands	Lakes and Ponds	Large Unfrag-mented Forests	Non-Forested Upland Communities	Overall
1. Invasive species	Very High	Very High	Very High	Medium	High	Medium	Medium	Very High
2. Road construction / expansion	-	-	-	-	High	Very High	Very High	Very High
3. Incompatible development	High	-	High	High	High	High	High	Very High
4. Climate change & sea-level rise	High	Very High	High	-	-	-	-	High
5. Shoreline modification	High	High	-	-	High	-	-	High
6. Altered hydrology	Medium	Low	High	High	Low	-	-	High
7. Pests & pathogens	Low	-	-	-	-	High	-	Medium
8. Toxic contaminants	Medium	Medium	High	Medium	Medium	-	-	Medium
9. Excess nutrients	Low	Low	Medium	Medium	High	-	-	Medium
10. Incompatible mowing regime	-	-	-	-	-	-	High	Medium
11. Deer overbrowse	-	-	-	-	-	High	-	Medium
12. Riparian zone modification	-	-	High	-	-	-	-	Medium
13. Loss of agriculture	-	-	-	-	-	-	High	Medium
14. Sediment regime change	Medium	-	High	-	-	-	-	Medium
15. Alteration of natural streams	-	-	High	-	-	-	-	Medium
16. Filling	-	Medium	-	High	-	-	-	Medium
17. Power plant intakes	-	High	-	-	-	-	-	Medium
18. Off-shore commercial fishing	-	High	-	-	-	-	-	Medium
19. Altered fire regime	-	-	-	-	-	-	Medium	Low
20. Thermal pollution	Medium	Low	-	-	-	-	-	Low
21. Dams as barriers	-	Low	Medium	-	-	-	-	Low
22. Acid rain	Low	-	-	-	Low	Low	Low	Low
23. Mining	-	-	-	-	-	Low	Low	Low
24. Boats and ATVs	Low	-	-	-	Low	Low	-	Low
25. Recreational fishing	-	Low	Low	-	-	-	-	Low
26. Draining wetlands	-	-	-	Low	-	-	-	Low
27. Poaching animals	-	-	-	-	-	Low	-	Low
28. Incompatible logging	-	-	-	-	-	Low	-	Low
29. Trampling	-	-	-	-	-	-	Low	Low
30. Subsidized species	-	-	-	-	-	-	Low	Low
31. Dredging	-	Low	-	-	-	-	-	Low
32. Estuarine commercial fishing	Low	Low	-	-	-	-	-	Low
33. Next generation chemicals	Low	-	-	-	-	-	-	Low
34. Vegetation removal	-	-	-	-	Low	-	-	Low
35. Natural succession	-	-	-	Low	-	-	-	Low

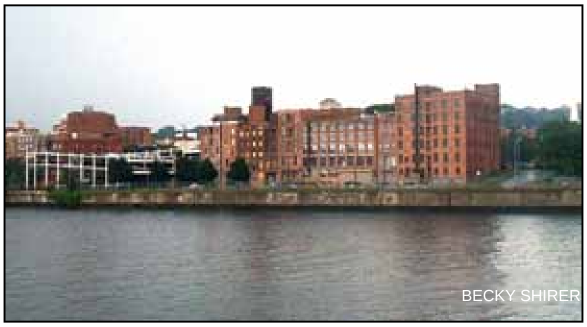
Critical Threats:

1. **Invasive species.** This was the only threat identified as affecting all of the seven targets. Invasive species are a concern because of their ability to alter habitat, outcompete native species, and disrupt ecosystem functions. The invasive species of concern may be plant or animal, terrestrial or aquatic, depending on the target. They have all been combined in one category because many of the general strategies to abate this threat would address the whole group. It was noted by some of the breakout groups that strategies should be developed to deal with both the current threat of existing invasive species and the likely future arrival of new species. Some of the specific species of concern include water chestnut, zebra mussels, *Phragmites*, and purple loosestrife.

2. **Road construction / expansion.** Roads were identified as a very high threat for the two terrestrial targets, as well a high threat to lakes and ponds through the associated increase in impervious surfaces. The building of new roads fragments habitats, decreasing the functional benefits of large unfragmented forest blocks and possibly disrupting animal movements. In addition, the widening and paving of roads increases the area of impervious surfaces which creates greater non-point source pollution and stormwater runoff.

3. **Incompatible development.** The exact interpretation of this threat for each target was slightly different but it generally refers to new and future development (as opposed to existing developed areas) that occurs in a sprawling manner, and that encroaches on sensitive areas without leaving sufficient buffers. This can include both residential and commercial development as well as poorly-sited agriculture. The impacts of such development include direct destruction and fragmentation of upland habitats and wetlands, as well as increased non-point source pollution and stormwater runoff into aquatic habitats.

4. **Climate change & sea-level rise.** The sea level rise that is expected to accompany changes in the global climate could have severe effects on the estuary itself, the connected tributaries, and the migratory fish that depend on both to complete their life cycles. Climate change is also likely to have effects on other targets, shifting species ranges, altering the timing of annual cycles, and increasing the frequency of catastrophic events. Works needs to be done to better model the effects of these global changes on the estuary, but we can take steps now to either prevent or be prepared for the worst case scenarios.



5. **Shoreline modification.** Development of the shoreline was considered separately from more general development for the estuary ecosystem, migratory fish, and lakes and ponds targets. In the case of the estuary, development on the shore leads to the particular threat of shoreline hardening, which alters the hydrologic regime of the river and separates it from its natural floodplain. Lakes are at risk from development along the shore even in otherwise pristine areas due to the demand for recreational access. This type of development has a direct and severe effect on the resource due to sheer proximity and the lack of buffers.

6. **Altered hydrology.** A threat of varying severity for all of the aquatic targets, the diversion of surface waters can take the form of small-scale community water use or large-scale water transfers that move large volumes of water between different stream basins. This threat can also manifest indirectly, through decreased groundwater levels and other modifications to the natural hydrologic cycle.

7. **Pests and pathogens.** A specific threat for the estuary with regard to a virus that infects oysters and a more general threat to forests through a number of insects and diseases that attack various tree species. Some specific species of concern are the emerald ash borer, the hemlock woolly adelgid, and the Asian longhorned beetle.

8. **Toxic contaminants.** Toxic contaminants take many forms, including organic compounds (e.g. PCBs, herbicides), metals (e.g. mercury), and very high concentrations of generally benign substances (e.g. road salt). Sources of toxins include industrial activity, point discharges, accidental spills, stormwater, wastewater, and atmospheric deposition. Many toxins remain in the system for long periods of time after the source has been abated. Acute high doses may be lethal to some species, while chronic levels of exposure can result in lowered reproductive success, greater susceptibility to disease, or altered ecosystem functions. Some of the breakout groups considered currently known toxins separately from those that might be developed or become pollutants in the future; this subcategory was considered to be a low threat overall but should be monitored closely.

9. **Excess nutrients.** Nutrient pollution in the form of excess amounts of nitrogen and phosphorus, often from agricultural runoff or untreated wastewater, can disturb the

nutrient cycling processes in aquatic systems and cause cultural eutrophication, in which excess algal growth leads to reduced oxygen levels. This is a particularly severe problem in lakes and ponds.

10. **Incompatible mowing regime.** The timing or frequency of mowing practices in hay fields may be disruptive to the reproductive success of various species of ground-nesting birds that depend on this habitat.

11. **Deer overbrowse.** Burgeoning deer populations cause damage to forest systems by severe overbrowsing of the understory vegetation. This leads to reduced plant species diversity, a shift in the plant community to species tolerant of repeated browsing, and a change in the physical structure of forest habitat.

12. **Riparian zone modification.** Modifications to the riparian zone around tributary streams have direct negative effects on stream habitat, including altered substrate from excess erosion, increased water temperatures from loss of shading vegetation, and altered macroinvertebrate communities and ecosystem functions. In addition, loss of forested riparian areas reduces habitat for a variety of birds, amphibians, and mammals.

13. **Loss of agriculture.** Replacement of agricultural fields with urban development leads to a loss of meadows, pastures, hayfields and shrublands which provide important habitat for bog turtles and certain species of birds and insects.

14. **Sediment regime change.** Alterations to the sediment regime in streams and rivers can greatly disrupt ecosystem processes and wildlife habitat. Excess sediment may be caused by disturbances in the upland or riparian areas, or by instream activities such as dredging or other channel modifications.

15. **Alteration of natural streams.** Natural streams have unobstructed flows and floodplains, intact riparian zones, and natural channel structure. Alteration of these physical characteristics of the stream harms its ability to support ecosystem functions and diverse plant and animal communities.

16. **Filling.** The dumping of large amounts of sediment in aquatic habitats occurs in the estuary, where sediment dredged from the river to clear shipping lanes is used to fill shallow water habitat, and in wetlands which are filled to create dry land for development. Both practices are destructive to these conservation targets.

17. **Power plant intakes.** Power plants are the cause of severe mortality in juvenile fish, due to their intake of large amounts of water from the river.

18. **Off-shore commercial fishing.** Commercial overfishing takes a large toll on the populations of migratory fish that spend part of their life cycle in the oceans. This was determined to be a greater problem than the lower levels of fishing that occur within the estuary itself.

2.4 Conduct Situation Analysis

In order to document our understanding of the social and ecological context surrounding the threats and targets, the team developed conceptual models for each target showing the connections between the threats and the factors assumed to be driving them (Figure 5). These models are by necessity incomplete, and represent the working assumptions of the project team, as opposed to actual ecological relationships. They are intended to be flexible tools that can be altered over time as our conception of the system develops.

The separate models by target can be combined to create a comprehensive model for the entire project area. Using the threat rankings, we mapped the critical threats' relationships to the targets to create an overall model (Figure 6). Each of these critical threats then has its own model (Figure 7) which can be used to track where on the chain of cause and effect strategies should intervene.

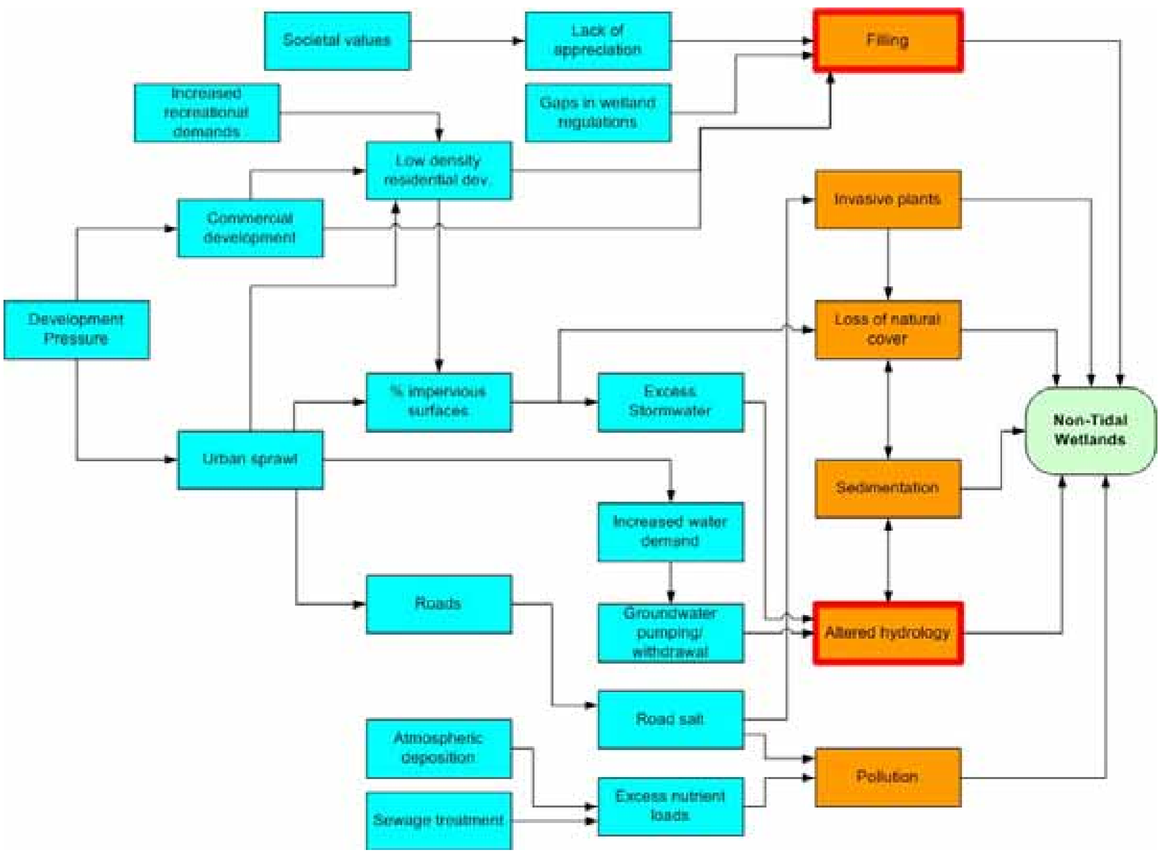


Figure 5. Sample conceptual model for the Non-Tidal Wetlands target. The flow of connections runs from the factors (blue boxes on the left), which lead directly or indirectly to the threats (orange boxes), which are themselves acting directly upon the target (green box on the right).

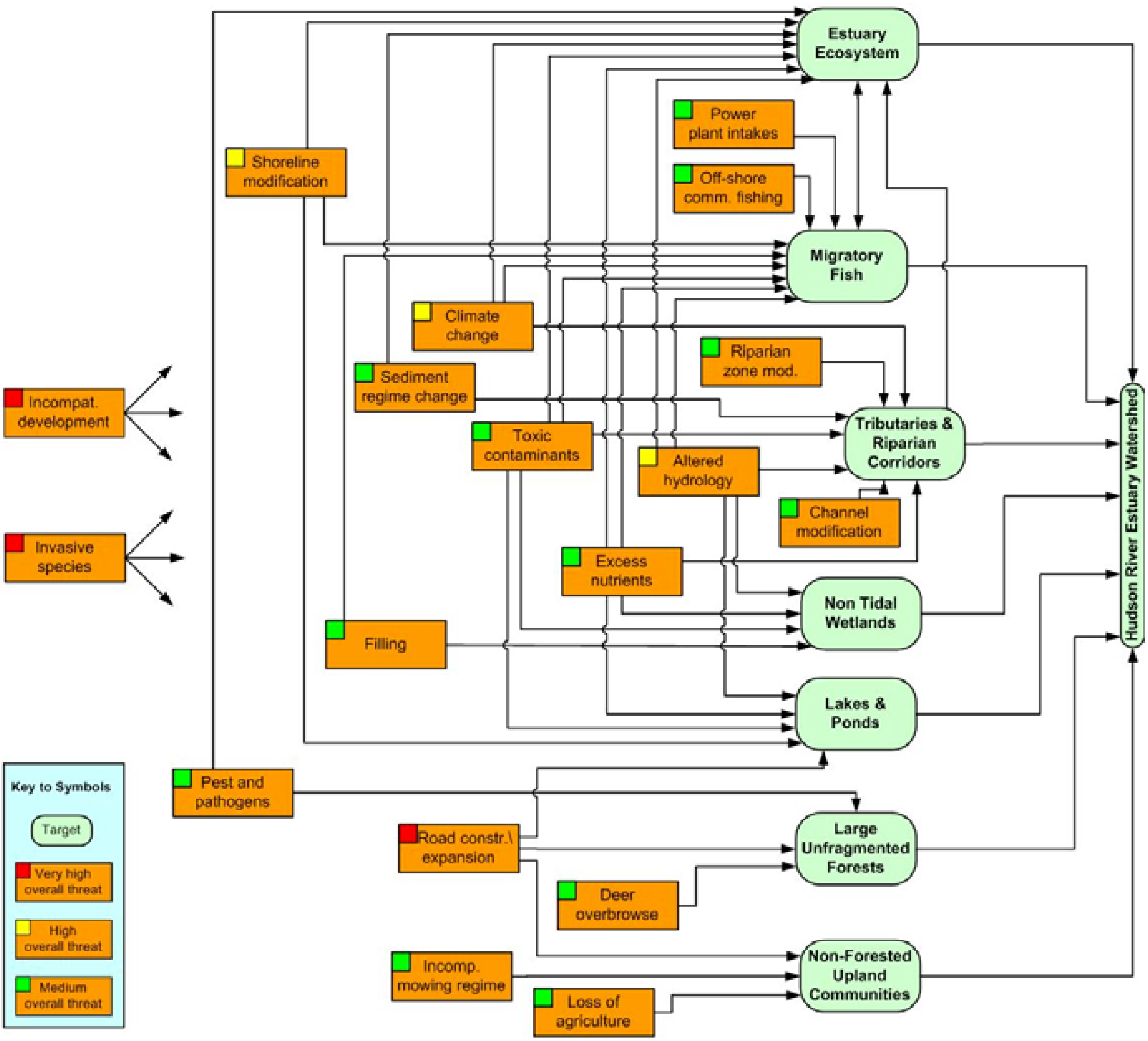


Figure 6. Overall conceptual model of the critical threats (rated medium or higher) and the targets. Threat rank is indicated by the colored squares in the corner of each threat box, using the same color code as in Table 3. The two very high threats on the left, development and invasive species, affect all targets, indicated by the multidirectional arrows.

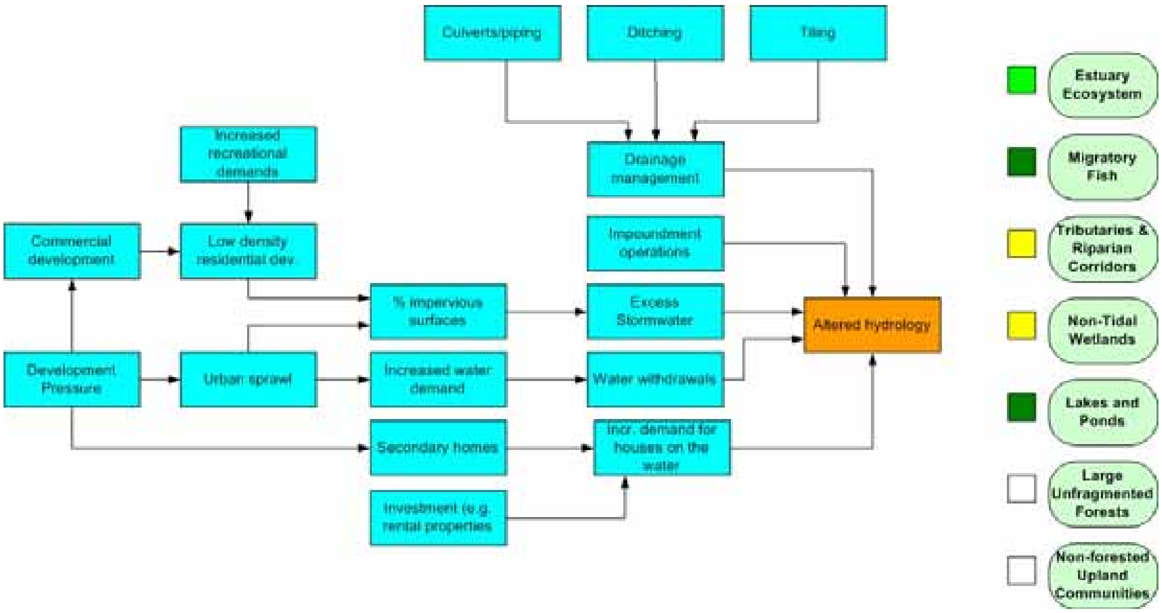


Figure 7. Example of a conceptual model for a threat, in this case altered hydrology. The seven targets are listed in the green boxes on the right, color coded by the rank of this threat for the target. Blank boxes indicate that the target is not affected by this threat.

2.5 Develop Conservation Strategies

Strategies consist of one or more measurable objectives, the associated strategic actions, and their action steps. Measurable objectives are detailed statements that describe the desired outcome of the strategy. Strategic actions are the general activities undertaken by the project team to achieve these objectives. Action steps are the specific tasks required to carry out each strategic action. See Table 4 for some examples of strategies developed by the project team during the workshops.

The breakout groups at the third workshop produced a list of 100 strategies, in varying stages of development, which were linked to the critical threats to the HRE watershed. This long list of possible actions needs to be prioritized to select those strategies the project team will pursue first. As a first step in this direction, the original list of 100 has been reorganized and condensed down to a list of 26 objectives within 9 general strategies. This draft list of potential strategies is attached in Appendix A. The project team will use the September 27th meeting to work on prioritization of these objectives and will decide on the next steps at that time.

Table 4. Examples of a measurable objective and strategic actions developed for four of the threats during the workshops.

Threat	**Measurable Objective**	**Strategic Actions**
Altered hydrology	By 2012, ensure review of water withdrawal above X is completed with consideration of hydrological and in-stream needs (ecological integrity, habitat, recreation, etc)	• Enhance monitoring assessment capability to allow determination of hydrologic needs • Determine hydrological needs for water bodies in project area at basin level • Advocate for adoption by NYS and local governments of objective through policy • Provide technical support for implementation of objective • Ensure uniform reporting of withdrawals
Global climate change	Projections of sea level rise will be incorporated into all state and federal habitat restoration plans and state and non-profit land acquisition plans by 2009	• IES/NOAA grant in process is accepted, and work to model sea level rise can be delivered to local communities. • Hold a conference/workshop with the Estuary Program, TNC, IES and HRES to advance GCC information for state and federal planners.
Road construction / expansion	By 200x?, increase alternative and public transportation options in the Hudson River Estuary Watershed	• Change allocation of Federal transportation money • Dialogue with DOT about alternatives/solutions • Planning to consolidate people and services • Affordable housing • Improve public transportation experience
Invasive species	Stop introduction and spread of invasive species along interior roads in a priority HRE unfragmented forest by 2008	• Survey the baseline condition • Identify the target species • Determine the causes of introduction and spread • Develop a control strategy • Provide training for highway workers • Establish an ongoing monitoring program

2.6 Establish Measures

Objectives need to measurable so that there is a clear way to determine progress and whether the actions taken are achieving the expected results. These effectiveness measures should be tied as directly as possible to the actions the team decides to undertake. There is also a need to measure indicators of general target condition, in order to detect any decline in viability status from as-yet-unknown causes. The Key Ecological Attributes and indicators developed in step 4 provide us with a potential list of these status measures. Both types of measures are necessary, and are a top priority to be fully developed following the September meeting to select priority strategies.

2.7 Implement

At the current stage in the process, the team is working on step 5 (strategies), which will be completed at the September meeting. The team will then decide which pieces of the plan to implement, how implementation should occur, and who will work on each part.

The current expectation is that small teams will mobilize around priority strategies, and will take on the responsibility for refining the strategic actions and actions steps and creating a plan of work to achieve them.

2.8 Analyze, Reflect, and Learn

We have already begun this step (remember, the process is iterative and flexible!) for the workshops themselves. The writing of this report and the companion process report have allowed us to reflect on the work completed so far, and we have learned many lessons about what worked well and what did not. An important tool in this step has been the evaluation surveys completed by the participants at the close of each workshop. Overall participants gave positive responses, particularly with regard to the facilitation and collaborative nature of the workshops. We also received a number of constructive criticisms and suggestions for improvement that helped us to adjust out approach.

In the future, the project team will reconvene at least annually in order to report on progress from each strategy team and to share lessons learned. At that point plans will be revised as needed to move forward more effectively. This continual evaluation and revision will assure that the project stays on track and is successful in meeting the goal of protecting the biodiversity of this important landscape.

3. What We Learned

Many products resulted from this planning process, both from the workshops themselves and from work done between workshops by Conservancy staff. Some of these products were additions or modifications to the standard planning process, and were part of our continual efforts to improve what we do.

One of the greatest departures from the standard process was to not do a viability assessment in conjunction with target selection and before moving on to threats. The list of potential indicators was too long, and the information on natural ranges of variation too incomplete, to be able to complete this analysis in a reasonable amount or time. The downside of this choice was that we did not have a commonly established understanding of how the system was doing overall or the relative statuses of the targets. We did not have a sense of which targets were in the worst shape or which attributes of the targets needed to be improved. This information might have helped in the selection of threats and strategies, but its lack did not prevent us from developing reasonable draft lists. Indicators come back into the process in the last step of establishing measures, for which the draft list of KEAs provide us with a useful starting point to think about measures of strategy effectiveness. It is in the development of a monitoring workplan for the final strategies that the strategy teams will decide which effectiveness and status indicators to implement, at which point we can begin to establish a baseline value of current viability status.

A major product developed after the first workshop on targets was the spatial mapping of each of the targets. These maps contributed to the second workshop on threats by allowing the participants to easily see the abundance, size, and distribution of each target. Going through the process of trying to map the targets also made the team quickly aware of what data sources were available and which targets had data gaps that would need to be filled as part of the strategies. The maps were used again in the third workshop, and helped the participants to begin thinking about prioritizing locations for the implementation of strategies.

The various conceptual models developed during and after the second workshop on threats aided the process in several ways. During the workshop, they were a good means of capturing the teams' understanding of the situation surrounding the targets. These models were then provided to the groups during the third workshops to help stimulate and organize discussion of where strategies should intervene. We have found that the models are more or less helpful to a person depending on their preferences for organizing information. However, they seem to be universally useful in detecting where factors and their associations seem incorrect or lacking. In this way, the models provide a tool for examining assumptions and determining where they need to be tested or re-evaluated. The synthesis of the models that was done between the workshops has produced two key results, the overall model of the critical threats for the watershed and models by threat that combine the thinking of more than one breakout group. The overall model is useful for getting a holistic view of the entire system, which is one of the specific goals of this project. The models by threat provide a more detailed perspective and eliminate much of the redundancy and overlap between models created for different targets.

A final important lesson for the team was the need to consolidate and refine strategies. Following the third workshop we had a list of 100 potential strategies which were developed to varying degrees. After considering several approaches we decided that before the team could begin to think about setting priorities, it was necessary for Conservancy staff to make a first iteration of a simplified list, grouping similar strategies and adjusting items' positions in the hierarchy of action step to objective. We were able to make a significant reduction, condensing the list down to 26 objectives grouped under 9 general strategies, without discarding any viable strategies. It is our hope that this product will be more useful to the team and more productive in moving us through the process than the original raw list.

4. A Final Word

This report documents the results of a collaborative effort by the conservation community to combine our individual values, knowledge, perspectives, and ideas to capture a communal picture of effective conservation in the Estuary watershed. By creating an open forum, we have tried to bring together a spectrum of diverse organizations in the watershed, and as a result have established a more comprehensive vision than we could otherwise have achieved. However, these products represent a work in progress, which we will continue to improve in the months and years to come. Following the meeting in September, this draft report will be revised and updated to reflect the results of the meeting and the feedback we receive. The resulting final report will be a resource to the working groups as we move forward with the implementation of priority strategies. With a vision so broad and comprehensive, it will require the focused efforts of many organizations to build on these foundations. We also hope that the lessons learned from our experiences will be valuable to others who wish to adopt a similar planning process for their own project. In order to protect biodiversity and maintain this valuable resource for future generations, all those who value the river and its watershed will need to work together to find solutions to surmount our common obstacles.

Appendix A. Draft Strategies

Condensed list of 26 draft objectives, grouped under 9 general strategies, with strategic actions where available. This list reflects the outcome of the third workshop on strategies, minimally modified by Conservancy staff for organization and clarity, and ordered roughly by threat severity, although no priority is implied. The not intended as a final list of what the Conservancy or its partners will do or should do in the next steps. The team is likely to remove, alter, and add to most of the items on this list as the working groups take shape.

Format:

A: Strategy
Targets:
Threats:
1.0 Objective
 1.1 Strategic action
 1.2 Strategic action

Key:

Regular text = originally a strategy (may have been upgraded to an objective)

Bold text = originally an objective (may have been downgraded to a strategic action)

Italic text = objective added to describe a cluster of strategic actions

A: Controlling problematic species

Targets: Estuary Ecosystem, Migratory Fish, Tributaries and Riparian Areas, Non-tidal Wetlands, Lakes and Ponds, Large Unfragmented Forests, Non-forested Upland Communities
Threats: Invasive species, Pests and pathogens, Deer overbrowse

1.0 *Prevention - Limit spread of species/diseases and eliminate sources of new introductions*
- 1.1 Educate boat owners about cleaning hulls.
- 1.2 **Stop introduction and spread of invasive species along interior roads in a priority* HRE unfragmented forest by 2008.**
- 1.3 Educate nurseries about invasive species.
- 1.4 Educate sellers and buyers of live exotic foods.
- 1.5 Reduce release of bait fish.
- 1.6 Reduce use of invasives in park and town plantings.
- 1.7 Stop intentional introductions through nurseries with a statewide policy.
- 1.8 **No commercial ship releases its untreated ballast in the Hudson River Estuary by 2010.**
- 1.9 Control illegal trail creation.
- 1.10 Incorporate invasive species control into trail planning.
- 1.11 Ensure adequate inspection at points of entry.
- 1.12 Support eradication of the emerald ash borer in Ohio.
- 1.13 Prevent spread of sudden oak death syndrome to the northeast.

2.0 *Early detection and rapid response - Establish a comprehensive monitoring and eradication program*
- 2.1 Establish statewide definition of invasive species.
- 2.2 Increase early detection and removal.
- 2.3 Enhance alert programs for managers.
- 2.4 Increase intensity of USDA Forest Service Forest Inventory and Analysis (FIA) plot inventory.

3.0 *Management - Evaluate established species/diseases and manage those identified as a severe threat*
- 3.1 Determine severity of threat from specific invasive species.
- 3.2 Determine where invasives are and set priorities.
- 3.3 Remove water chestnut to improve habitat for fish spawning.
- 3.4 Control woolly adelgid in key areas (esp. hemlock forests in state parks).
- 3.5 Ensure funding for eradication of Asian longhorn beetle, especially in New York City.
- 3.6 Evaluate biocontrol options.
- 3.7 Protect genetic stock of species threatened by invasion.

4.0 *Reduce deer populations*
- 4.1 Change public perception of coyotes.
- 4.2 Tighten hunting regulations on coyotes.
- 4.3 Controlled hunts.

4.4 Create incentives to encourage hunters to take more deer (options to sell or donate).
4.5 Increase hunting limits.
4.6 Make hunting safety courses more accessible.
4.7 Reduce loss of lands available for hunting.
4.8 Stop decline in hunting culture.
4.9 Identify and articulate the connection between deer and biodiversity and educate the public.

B: Limiting incompatible development

Targets: Estuary Ecosystem, Tributaries and Riparian Areas, Non-Tidal Wetlands, Lakes & Ponds, Large Unfragmented Forests, Non-forested Upland Communities
Threats: Incompatible development, Road construction/expansion

5.0 **By 2010, all professional planners that serve the Hudson Valley apply knowledge about biodiversity resources in their planning proposals.**
 5.1 Intervention point: Local zoning and planning (single purpose zoning)

6.0 *Economic strategies to limit development*
 6.1 Intervention point: Desire to grow tax base
 6.2 Intervention point: Failure of rural economy
 6.3 Intervention point: Second homes
 6.4 Intervention point: Tax structure driving land use

C: Dealing with global climate change

Targets: Estuary Ecosystem, Migratory Fish, Tributaries and Riparian Areas, Non-Tidal Wetlands, Lakes & Ponds, Large Unfragmented Forests, Non-forested Upland Communities
Threats: Global climate change, Road construction/expansion

7.0 **Achieve new vehicle fleet fuel efficiency standards of X mpg (CAFÉ standards) within 2 years following California's ratification.**

8.0 **Build public support for policy change so that X% of policy makers and opinion leaders identify sea level rise as a serious threat to shorelines and intertidal wetlands.**
 8.1 Increase local awareness of impacts to biodiversity in the Hudson River Valley from this threat by holding at least one conference/workshop within 2 years.
 8.2 Increase local awareness of this threat by increasing the number of "stories" on GCC in local Hudson River Valley media to 20 per year.

9.0 **Model the impacts of sea level rise on tidal wetlands and vegetative shallows in the Estuary system in order to 1) inform land acquisition, 2) educate the public and build support for policies, and 3) inform resource management.**

10.0 **Establish a biodiversity reserve design for the HREW sensitive to sea level rise and other potential impacts from GCC by 2009.**

11.0 **Projections of sea level rise will be incorporated into all state and federal habitat restoration plans and state and non-profit land acquisition plans by 2009.**

12.0 Support the Regional Greenhouse Gas Initiative (RGGI)
- 12.1 Advance alternative energy sources (wind power in L.I. and the Gunks).
- 12.2 Improve carbon sequestration.
- 12.3 Deal with stationary sources.

13.0 Locally support national lobbying efforts.

14.0 **By 200x?, increase alternative and public transportation options in the Hudson River Estuary Watershed**
- 14.1 Intervention point: Federal transportation funding
- 14.2 Intervention point: Perceived need for more/wider roads
- 14.3 Intervention point: State funding and planning
- 14.4 Intervention point: Traffic congestion

D: Protecting floodplains and buffers

Targets: Tributaries and Riparian Areas, Non-tidal Wetlands
Threats: Alteration of natural streams

15.0 *Protect/reestablish functional floodplains*
- 15.1 Advocate and support town wetland, stream, and floodplain protection.
- 15.2 Advocate for shifting floodplain permit authority to the state from the towns.
- 15.3 Include margin of safety in floodplain permitting to account for climate change and development.
- 15.4 Protect/reestablish functional flood plains by advocating and providing technical assistance to communities.
- 15.5 Support creation of more accurate floodplain maps using the best available technology.

E: Restoring natural flows

Targets: Estuary Ecosystem, Migratory Fish, Tributaries and Riparian Areas, Non-tidal Wetlands, Lakes and Ponds
Threats: Altered hydrology, Sediment regime change, Alteration of natural streams

16.0 Strengthen "Protection of Water" permits by extending application to all streams in project area including riparian zone.

17.0 Protect/restore basin water budget to near reference condition.

- 17.1 **By 2012, ensure review of water withdrawal above de minimis is completed with consideration of hydrological and in-stream needs (ecological integrity, habitat, recreation, etc).**
- 17.2 Ensure reservoir operators meet stream flow criteria.
- 17.3 Where possible, allow stormwater to infiltrate on-site as opposed to mixing with waste water.
- 17.4 Reduce water per capita consumption by 20% by 2020
- 17.5 **In priority watersheds, by 2015, maintain/restore ability of stream to move water and sediment in manner that protects targets.**

18.0 Maintain natural recharge areas through protection of x acres of forest, wetland and riparian corridors.

- 18.1 Encourage development in naturally impervious areas.
- 18.2 Incentivize recharge area protection
- 18.3 Limit impervious surfaces and promote infiltration.

F: Eliminating pollutants

Targets: Estuary Ecosystem, Migratory Fish, Tributaries and Riparian Areas, Non-tidal Wetlands, Lakes and Ponds
Threats: Excess nutrients, Toxic contaminants, Road construction / expansion

19.0 Reduce and manage sources of nutrient pollution when/where feasible.

- 19.1 Identify and quantify sources of nutrients capable of threatening each target.
- 19.2 Work with NYS (and others?) to reduce allowable nutrient non-point and point input that threatens targets.

20.0 *Eliminate current sources of known toxic contaminants*

- 20.1 Advocate for reduced use/introduction of identified toxic contaminants.
- 20.2 Identify and quantify sources of contaminants linked to each target.
- 20.3 Remediate or abate sources where/when feasible.
- 20.4 Monitor target response to remediation/abatement action.
- 20.5 Intervention point: Road salt

21.0 Assess degree of threat to targets of new types of contaminants (e.g. pharmaceuticals, hormone mimics).

G: Protecting migratory fish

Targets: Migratory Fish
Threats: Dredging, Power plant intakes

22.0 **No navigational dredging of environmentally sensitive aquatic habitat for migratory fish by 2009.**

23.0 **Reduce the overall proportion of mortality to juvenile migratory fish (esp. shad yoy) attributable to power plants to an ecologically insignificant level (e.g. ~5% in yoy shad) by 2009.**
- 23.1 Build new power plants.
- 23.2 Develop alternative energy sources to reduce demand.
- 23.3 Eliminate power plant.
- 23.4 Go to close-cycle cooling.
- 23.5 Use technology/ management to reduce mortality.

H: Protecting early-successional habitats

Targets: Non-forested Upland Communities (strata: Grasslands)
Threats: Incompatible mowing regime

24.0 *Develop a regional management plan to protect grasslands, accounting for geographical variation within the basin and for different human activities.*
- 24.1 Survey existing habitat.
- 24.2 Evaluate relative impact of farmers vs. non-commercial landowners.
- 24.3 Identify state and municipal approaches to incentive programs.
- 24.4 Reach out to bird clubs and land trusts for information.
- 24.5 Develop recommendations based on the region, accounting for geographic variation.
- 24.6 Set criteria for site selection and design.

I: Changing the social context

Targets: All
Threats: All

25.0 More coalition building between stakeholders.

26.0 *Reduce consumption of resources*
- 26.1 Intervention point: Changing consumer behavior
- 26.2 Intervention point: Redistribution of people (get them to live near work)
- 26.3 Intervention point: Societal values