High Allegheny Plateau (HAL) Ecoregional Plan

Final Draft Report

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Sensitive and confidential information has been removed for this ecoregional plan distribution

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1. EXECUTIVE SUMMARY

Brief description of the ecoregion

The High Allegheny Plateau Ecoregion is located along the southern tier of New York and the northern tier of Pennsylvania. It includes a small portion of New Jersey. Well known features in HAL include the Catskills, The Shawangunks, The Kittatinny Ridge, The Poconos, Allegany State Park, Allegheny National Forest, and a large mass of Pennsylvania state-owned land.

The ecoregion is defined by high elevation features at the northern end of the Appalachian Plateau. Most of the ecoregion is above 1200 feet. The general land form of the area is mid-elevation hills separated by numerous narrow stream-cut valleys.

One of the main features of the ecoregion is an abundance of rivers and streams. The Delaware, Susquehanna, and Allegheny Rivers and their many tributaries cover the entire ecoregion. The Delaware River drains into Delaware Bay; the Susquehanna flows into the Chesapeake Bay; the Allegheny flows into the Ohio and eventually into the Mississippi. These three different drainages contribute to the high overall aquatic diversity in the ecoregion.

The northern and eastern portions of the ecoregion were glaciated; the southwest portion was not. Many northern species and communities reach their southern limit in HAL, while many southern species extend into the ecoregion but not beyond. Species and communities associated with glaciated landforms occur in the north and east; biodiversity associated with older substrate and deeper erosional soils occurs in the southwest.

One of the main features of the ecoregion is its currently low population density, although major population centers are nearby. There are 1.7 million people living in the 16.9 million acres of HAL. The largest city is Binghamton, New York at 47,000. Only 250,000 people in HAL live in cities over 10,000. The overall population trend in HAL indicates that people are moving out of the ecoregion with the notable exception of the areas within reach of New York City by major highways.

There are large and significant managed areas in HAL, including three large intact forested areas: the Catskills, the Allegheny National Forest/Allegany State Park complex, and the Pennsylvania state land in central PA.

The planning process

The standard ecoregional planning methods developed and used by ECS in other Northeastern ecoregional plans have been applied to HAL. A Core Team made up of the four TNC operating units was assembled to guide the process and report interim results to each office. Five additional teams were assembled to develop targets or minimum standards and to select sites for matrix forests, aquatics, natural communities, animals, and plants. Information to select sites for matrix forests and aquatics was developed with guidance from outside experts. GIS assessment of the entire ecoregion for both matrix forests and aquatics was undertaken at the ECS GIS lab. Data for natural communities, animals, and plants were obtained from the three state Natural Heritage Programs. Only data currently included in these databases were used in this assessment. An assessment of viability was applied in review of these data. Numerous occurrences were not ultimately selected for conservation action. A lengthy list of future field survey needs was developed from old and incomplete Heritage occurrence information.

The portfolio

26 Tier 1 Forest Matrix Blocks; 27 Tier 2 Blocks
93 Priority 1 Aquatics System units; 72 Priority 2 units
253 Natural Community occurrences
74 Animals occurrences
88 Plant occurrences
238 “sites” based on Heritage site names and an overlay of matrix block units

- NJ — 15
- PA — 140
- NY — 83
- ENY — 27
- CWNY — 56

118/462 = 26% of selected Heritage occurrences are found within matrix blocks
75/93 = 81% of selected Priority 1 aquatics system units are associated (in some way) with matrix blocks.

Natural communities

A vegetation classification based on the National Vegetation Classification (NVC) maintained by NatureServe was prepared for HAL and reviewed during the assessment of the combined Heritage occurrences database for the ecoregion. A total of 109 vegetation types were identified in HAL. The combined databases included 509 occurrences. Goals for communities were based on the global distribution of the NVC type in relation to the ecoregion, distribution within HAL, and patch size. The ecoregion was stratified into glaciated and non glaciated subsections, as well as other subsection groupings to make sure that occurrences captured the full range of the NVC type. A total of 253 community occurrences (50%) were assessed as distinct and viable and included in the portfolio.

Fifty three matrix forest blocks in nine different physical settings defined by Ecological Land Units were chosen for the portfolio. Twenty-six of these are Tier 1 Blocks, identified as the best opportunities to undertake matrix forest conservation in the physical setting of the block. Goals for matrix forest in HAL were to identify at least one block in each of the nine ELU groupings and at least one block per subsection. Additional blocks were included if they were characterized by distinctive ELUs or if they were in outstanding condition as a matrix forest unit. The remaining 27 forest blocks are included in the portfolio as alternatives to the Tier 1 blocks. Each of these blocks will need to undergo significant assessment.

Aquatics

Ninety three aquatic system units were selected as Priority 1 sites in four Ecological Drainage Units in HAL. These rivers and streams, totaling a length of 3263 miles, were selected as conservation targets because of expert information and GIS data indicating good landscape condition for the system. Goals for aquatics in HAL were to identify one example of each major river in each ELU; one example of each Size 3, major tributary type; two examples of each Size 2 or minor tributary, and three examples of each Size 1 or headwater stream type. Seventy-two Priority 2 aquatic system units were selected as possible occurrences, pending further assessment. Many of these Priority 2 sites were not known to experts or TNC staff or were located in poorer landscape settings. Major field surveys will be needed to inform portfolio selection and site conservation planning.

Animals

Vertebrate and invertebrate targets were determined by an animal team made up of Heritage zoologists from each of the states. Eleven vertebrate targets and 22 invertebrate targets, ranked G1-G3G4 were chosen for HAL. A total of 215 occurrences of these species were include in the HAL assessment. A total of 74 occurrences (34%) were chosen for the portfolio. For 13 species, multiple viable occurrences were combined into metapopulations. Twenty one of these occurrences (18%) appear to define new conservation sites in which no other biodiversity features are currently identified for the portfolio. The animal working group identified 49 secondary animal targets in need of further assessment.

An assessment of bird conservation issues in HAL has been initiated. Working with a Partners in Flight (PIF) report for the Allegheny Plateau, a geographic area very similar to HAL, a list of potential bird species targets was developed. The PIF report includes specific areas where these birds or groups of birds are found in HAL. Data were also assembled from National Audubon's Important Bird Areas Project, available for New York and Pennsylvania, but not for New Jersey. In addition, breeding bird atlas information is available for each of the three states. No specific bird conservation areas were selected for HAL.

Plants

Plant targets were determined by a plant team made up of Heritage botanists from each of the states. Twenty-two vascular plant and 2 non-vascular plant species were chosen as targets for HAL. Nineteen of these species are ranked G1-G3G4; seven are ranked G4 or G5 and reflect declining populations or significant disjunct populations. A total of 121 Heritage occurrences of these 24 species were included in the analysis. Eighty-eight occurrences (73%) were chosen for the HAL portfolio. Twenty eight of these occurrences (30%) appear to define new conservation sites in which no other biodiversity features are currently identified in the portfolio. The plant working group identified 15 potential plant targets that warrant further assessment to determine whether they should be full targets for planning.

General overview of the portfolio

The overall portfolio consists of 581 occurrences (680 counting Tier 2 matrix blocks and Priority 2 aquatic system units) scattered over all parts of the ecoregion. The concentration of occurrences partly reflects conservation importance and partly reflects inventory effort. The Pennsylvania Heritage (PNDI) has developed much of its database through county inventories. Several of the counties in HAL have been inventoried; most have not. Several counties have very few Heritage occurrences. Large portions of the agricultural section of HAL in NY have not been inventoried at all. Heritage occurrences are concentrated in the Poconos, the Catskills, the Shawangunks, Allegany State Park, in New Jersey, and in the calcareous section of New York in the north-central part of the ecoregion.

Unquestionably, large parts of the ecoregion would benefit from additional Heritage survey work for species and natural communities. These include most matrix forest blocks and the counties along the border of NY and PA. Additional survey work for aquatic targets associated with field assessment of aquatic portfolio sites is likely to result in numerous new occurrences for the Heritage databases and for the HAL portfolio. Natural community inventory work would be most productive within matrix forest blocks since examples of all common upland forest communities are needed to reach goals, and are likely present in the range of matrix forest blocks. Small patch communities will require more detailed survey work.

Action plan

All features in the portfolio were sorted into strategic implementation groups: 1) partner lead, 2) TNC lead - no immediate action, and 3) TNC lead - 5 year action. Sites for all types of biodiversity were selected, scattered at locations throughout HAL. Forty-seven % of the matrix forest blocks were included; 65% of Natural Community Occurrences; 39% of Animal Occurrences; and 34% of Plant Occurrences. A total of 2478 stream miles were selected, including 70 stream system units of the 148 identified as Priority 1 and Priority 2 aquatic units. In several cases, notably the Catskills, the Delaware River, Allegany State Park and the mass of Pennsylvania state land, matrix forest blocks were grouped into larger conservation planing areas that included aquatic features and embedded Heritage occurrences selected for the portfolio.

2. INTRODUCTION, GOALS, AND DESCRIPTION OF THE ECOREGION

The goal of conservation in the High Allegheny Plateau Ecoregion is to ensure the long term viability of all native species and natural communities and to sustain the landscape configurations and ecological processes critical to ensuring their long term survival.

Conservation Goals

- Ensure the continued existence of the four matrix forest communities at appropriate scale and restore natural processes to promote development of mixed-age stands.
- Conserve multiple viable occurrences of all aquatic community types and associated species and restore hydrologic processes to promote healthy, functioning aquatic ecosystems.
- Protect multiple viable occurrences of all terrestrial communities through the development of a portfolio of conservation sites. The multiple occurrences should represent the range of variability found within each of the community types in the ecoregion.
- Include in the portfolio of sites viable occurrences of all G1-G3 and T1-T3 species, and declining G4-G5 species, with the goal of protecting multiple occurrences of these species in the full range of habitats in which they naturally occur.

The General Setting

The High Allegheny Plateau Ecoregion is defined primarily by a broad series of high elevation hills that form a plateau rising to 1700-2100 feet extending in the north from the Great Lakes Plains of Lake Ontario to the Ridge and Valley region of the Central Appalachians to the south and from the Lake Erie Plain in the west to the southeastern Pennsylvania lowlands and the Hudson River Valley. The High Allegheny Plateau (HAL) consists of nine Forest Service Subsections. The six subsections forming the central and western portion of HAL are moderately uniform in land form. Along the eastern portion of HAL, the two Catskills subsections and the Shawangunk/Kittatinny Ridge subsection are somewhat different in character in that they were formed by a different set of geological processes and have high elevation landforms, which extend to over 3000 feet and include numerous cliffs and talus slopes, absent from most of the rest of the ecoregion. Because the forest types of these three subsections are most similar to the other six subsections in HAL, these three subsections are combined into the High Allegheny Plateau rather than being combining into a disjunct part of the Northern Appalachian Ecoregion or a dissimilar part of Lower New England/Northern Piedmont Ecoregion.

The ecoregion is 51.6% in New York; 47.8% is in Pennsylvania; the remaining 0.6% is in the northwest corner of New Jersey. The High Allegheny Plateau includes nearly one quarter of both New York and Pennsylvania, but only 6% of New Jersey.

The ecoregion extends over 16.9 million acres and has the highest percentage of natural cover (81%) of any Northeastern ecoregion besides the Northern Appalachian Ecoregion. Deciduous forest covers 52% of HAL; 21% is covered by Mixed forests: coniferous forests cover 6%; and only 0.7% of the ecoregion is covered by wetlands. Agricultural uses account for 18% of HAL. Dairy farms are the principle agricultural use with row crops fields limited to floodplains. Only 1% of the ecoregion is covered by residential and urban development, industry, and transportation corridors.

Significant Natural and Cultural Features

The ecoregion is primarily made up of a series of hills cut from a huge plateau by hundreds of small streams coalescing into larger rivers. The hills have rounded, usually forested summits with gradually sloping sides and are separated by narrow valleys with well drained, rich soils favored by agriculture. The landscape is suitable to timber production on the hills and small farm agriculture, usually dairy farming, in the lowlands.

In the eastern part of HAL, significant features include the Catskills and the Poconos, as well as the Shawangunk Ridge which continues into New Jersey as the Kittatinny Ridge. In the west, HAL includes a mass of state-owned forested land in north-central Pennsylvania totaling nearly 2,000,000 acres, the Allegheny National Forest at over 370,000 acres, and Allegany State Park, the largest state park in New York at 65,000 acres.

All of HAL is influenced by major rivers. The upper drainages of three major northern US rivers extend across HAL. The Delaware River originates within HAL and drains the west and south slopes of the Catskill Mountains. The Susquehanna and its West Branch drain central New York and the hills of north-central Pennsylvania; The Allegheny River drains west-central New York and the western slopes of the HAL Pennsylvania hills. The Delaware and Susquehanna flow into the Atlantic; The Allegheny River flows west into the Ohio River and eventually the Mississippi. One small section of the northwestern part of HAL includes the upper drainage of the Genessee River which flows north into Lake Ontario. There are also sections of the upper watersheds of the streams flowing into Lake Erie in HAL. Aquatic features with affinities to both the East Coast and Midwest are significant characteristics of HAL. The high percentage of natural vegetation cover and the diverse confluence of different drainages makes HAL an ecoregion with significant aquatic biodiversity.

HAL includes both glaciated and non-glaciated features. The south-central and western parts of HAL were not glaciated and are made up of older eroded features and remnant bedrock exposes. The rest of HAL includes a full range of glaciated features including end moraine, eskers, drumlins, kame terraces, kettleholes, and other features associated with the terminus of the ice sheet advance and deposits associated with glacial meltwater flow. The northern and eastern parts of HAL have numerous lakes, ponds, and shallow wetlands associated with glaciation. The south-central and western parts have few natural lakes and ponds. The only non-glaciated part of New York is around the Allegany State Park in western HAL. Because HAL is moderately high elevation and extends east-west, there are many communities and species that reach either their northern or southern range limits within HAL. HAL is the southern limit for many bog species, including *Vaccinium macrocarpon*. The extension of Midwestern watersheds into HAL also means that there are several species, mainly aquatics, that reach their eastern range limit in HAL.

The climate of the ecoregion is characteristic of high elevation areas in the mid-Atlantic region with hot, humid summers and cold winters with moderate snowfall. Lake-effect snow off Lake Erie occasionally extends into the extreme western part of the ecoregion. There is usually a continuous cover of snow throughout the winter. Characteristic of the East, there are periodic droughts that occur principally in the summer and can have profound impacts on vegetation and aquatic systems. The hills do create some rain shadow effect with higher levels of rainfall in the western hills and the west slopes of the Catskills. The Pocono Plateau also received slightly higher rainfall than other areas. The growing season is shorter than in surrounding areas because

of the general elevation effect on temperature. The growing season in one Potter County PA site is as short as 100 days. A shorter growing season also influences species distributions.

Significant natural processes include tornadoes which occur occasionally throughout the ecoregion, but are more frequent in the west. Ice storms occur with some regularity opening the forest canopy. Hurricanes impact mostly the eastern part of HAL, although occasionally infrequent storms can cause significant wind damage and severe flooding such as occurred during Hurricane Agnes in 1972. Fires have occurred throughout HAL but are more common in the eastern sections on dry ridgetops. Several areas currently dominated by pitch pine have burned regularly. Large fires are known, but infrequent, in the more mesic forests of western Pennsylvania.

Natural vegetation

The dominant vegetation type of HAL is Beech-maple forest in lower elevation mesic sites and Appalachian oak on drier sites. Oak-hickory occupies many south-facing, dry slopes. In the eastern part of the ecoregion, pine barrens occur on rocky ridgetops and on the Pocono Plateau. Richer forests occur in the southwest part of the ecoregion with *Liriodendron* and *Magnolia* in more mesic sites. Spruce fir occurs at high elevation sites in the Catskills.

Timber management has modified forest composition significantly. Hemlocks were targeted by the tannery industry many years ago and have returned only sporadically throughout the ecoregion. There are small scattered old growth hemlock forest remnants in Allegany State Park and along the steep slopes of the West Branch of the Susquehanna River. Most of the western Pennsylvania forests are managed for cherry.

Forest pathogens have also dramatically modified the forest of HAL. American chestnut was found throughout the ecoregion and has been nearly eliminated. American beech is dominant in many forested areas and significantly impacted by Beech bark disease. Gypsy moths reduce oak vigor and during severe prolonged outbreaks may kill oaks. Sugar maples are also in decline.

High deer populations have also impacted forests in HAL. The deer herds in New York and Pennsylvania have been managed for many years at high population levels resulting in overbrowse of understory species. Over large parts of HAL, particularly in the west, there is no canopy species recruitment and few shrubs and herbaceous plants. Many forests have a clear understory with a very simplified species composition. State land managers have acknowledged the problem of deer overbrowse and there are efforts underway to address the issue.

The pre-colonial forest was vast and nearly continuous across the ecoregion with woodlands on dry ridgetops in the east and some open communities along major rivers with floods and ice scour. The low mountains in the west were all nearly consistently covered with a dense canopy.

Rare animals in HAL

Most of the rare and significant animals that characterize HAL are associated with the major rivers. A high diversity of mussels, fish and dragonflies occur in HAL related to different drainages, including mid Atlantic coast and the Mississippi and to large remnant forest. Woodrats are scattered through steep rocky sections of the east with large talus slopes. Timber rattlesnakes are also common in these areas. Bog turtles are found at several locations in the southeast part of the ecoregion in remnant wetland complexes. Significant birds include Bicknell’s thrush in the Catskills, Cerulean warbler and Swainson’s thrush in floodplain corridors and grassland nesting birds in old fields and at sites owned by public agencies such as

airports. Bear and bobcat are common over most of the ecoregion. Deer are abundant throughout. Elk have been reintroduced to western Pennsylvania and are expanding in number. Five federally listed animal species occur in HAL: Peregrine falcon, Bald eagle, Dwarf wedgemussel, Bog turtle, and Indiana bat.

Rare plants in HAL

The flora of HAL is typical of the Northeast and not very distinctive with a few notable exceptions. Most species are characteristic of the generic mixed coniferous/deciduous forests of the Northeast. Among the unusual species are *Aconitum noveboracense* in the Catskills, which occurs along headwater streams, *Trollius laxus* spp *laxus* which occurs in fens. Both species are locally abundant and globally rare. Also distinctive within HAL are *Scirpus ancistrochaetus* in Pennsylvania *and Carex polymorpha* in the Poconos. There are three federally-listed species in the ecoregion: *Scirpus ancistrochaetus, Aconitum noveboracense* and *Isotria medeoloides*.

Rare HAL natural communities

The only globally rare natural communities in HAL are the dwarf pine ridges in the Shawangunks and the variants of pine barrens in the Poconos. Unusual, but not globally rare communities include fens, ridgetop woodlands and talus slopes. Northern bogs and black spruce wetlands reach their southern range limit in HAL and there are several Atlantic white cedar swamps which are unusual at sites away from the seacoast.

Many natural communities previously characteristic of HAL are now absent or much reduced in extant. Floodplain forest were once common along the major river corridors. These have been largely converted to agriculture, villages, or transportation corridors. Many rivers have been regulated and no longer flood dramatically.

Hemlocks and white pines are much reduced in extent and no longer a major component of their historical communities. The loss of chestnut, healthy beech and American elm have all altered forest composition and structure.

People in HAL

In the highly populated Northeast, HAL has a noticeable lack of big cites and associated suburbs. From Landsat imagery at 65,000 feet at night, the ecoregion is defined as being the dark area surrounded by intense development. The largest city is Binghamton, New York with 47,000 people. Other cities include Elmira, Corning, and Johnson City, NY, and Bradford and Warren, Pennsylvania. A total of 1,773,000 people live in HAL, a density of 61 people per sq. mile on average, second only to NAP in the Northeast in low population density.

There are very few suburban areas within the ecoregion. Only 215,000 live in cities with populations over 10,000. Only along Rte 17 near Binghamton are there suburban landscapes. The Poconos area is, however, increasingly becoming more suburban in character with second homes on large lots and commuter neighborhoods.

Population trends indicate that the overall population for much of HAL is likely to decline significantly over the next 50 years with the greatest losses in the northern and western parts of the ecoregion. Significant increases are projected in the southeast around the Poconos. Between 1990 and 2000, the population of HAL increased by only 67,000 people or 3.3%. Significant population increases occurred in Monroe and Pike Counties in Pennsylvania around the Poconos. Decreases were evident throughout the remainder of the ecoregion. The population of the whole

ecoregion is projected to increase by 38% over the next 50 years with most growth occurring in the southeast and eastern parts of the ecoregion and minor decreases occurring elsewhere.

While there are no large cities within HAL, the borders of the ecoregion are not far from major population centers. Scranton, located within the Reading Prong of the Central Appalachian Plateau Ecoregion is centered only 8 miles from HAL. Interestingly, there are, however, few suburban areas outside the Scranton/Wilkes-Barre Valley that extend into the nearby, higher elevation parts of HAL. Albany, NY is 12 miles from the HAL border; Syracuse is 25 miles, Rochester is 40 miles; New York City is only 70 miles to the east. Currently, HAL with its higher elevation landforms is just beyond the suburban reach of these population centers.

Land use in HAL

There were few permanent Indian settlements in HAL, except along major rivers in the eastern part of the ecoregion. The entire area was hunted seasonally and rich in wildlife. Beaver were a major target in the early colonial period.

European settlement in HAL began in the eastern part of the Catskills nearest the Hudson River in the early 1700s and spread slowly into nearby areas over the next 50 years. After the Revolutionary War and the reduction in hostilities from Indian, settlement expanded up the major river corridors beginning with the Delaware and extending south from the Mohawk. Initially, small farms were established in the narrow fertile valleys with expansion up hillsides. Eventually land was cleared and small farms covered the landscape in the eastern portion of the ecoregion. Settlement in the Catskills was limited to low elevation areas.

The principal industry for most of the 19th century was logging to feed the expansion needs of major East Coast cities. Canals were constructed along river corridors to facilitate transport of raw materials. Later railroads were built linking the timber resources of the West to Eastern markets. Most of central and western part of the ecoregion in NY and the north-central part of Pennsylvania were eventually cleared and used for farming. The areas with poorest soils were soon abandoned. Most forests in these areas are now second or third growth.

Settlement of the western part of the ecoregion in Pennsylvania was much later and never as widespread, limited only to the narrow river valleys. In these areas, the forest was cleared, but quickly grew back.

In the 1850s, oil was discovered along Oil Creek in the far western portion of HAL, beginning extensive exploitation of oil and gas deposits in the western sections of PA and NY. Many of these wells remain in operation today and have shaped the development of roads and pollution impacts on streams. Extensive sections of Western PA are recovering strip mines. Coal was also dug from many of the areas in Western PA, although the major coal fields lie just outside of HAL.

3. MANAGED AREAS IN THE HIGH ALLEGHENY

There are extensive tracts of managed areas scattered in all parts of HAL. A map of HAL managed areas is included with this report (05-man_area.pdf). This map is based on several different GIS datalayers and includes comprehensive data for federal and state properties, but less complete data for county, town, and privately-owned conservation land. For these latter categories all calculations are low.

Nearly 20% of the total acreage of the ecoregion is held by public agencies and private organizations with a conservation mission. A review of managed areas by state appears in Table M1.

Table M1. Review of Managed Areas within HAL by State

State	Managed Area type	Acreage	% of State within HAL
NJ	Federal	32,000	
	State	33,000	
	Private	approx.2,000	
	Total	65,000	64.4
NY	Federal	260	
	State	821,000	
	Municipal	34,000	
	Private	16,000	
	Total	837,000	9.6
PA	Federal	543,000	
	State	1,803,000	
	County	5,000	
	Private	30,000	
	Total	2,381,000	29.4
All managed areas		**3,319,000**	
Acreage of Entire Ecoregion		**16,894,000**	
Percentage of Ecoregion in Managed Area = 19.6%			

The small section of NJ included within HAL is 64% managed area. Most of this land is within the Delaware Water Gap. There are also large state properties and several TNC preserves.

In Pennsylvania, 29% of the ecoregion is included within managed areas. Large state lands held primarily as state forests and state gamelands form a nearly continuous mass of forested land in the south-central part of the ecoregion. Allegheny National Forest, just west of the state land, extends this mass of forested land for another fifty miles. Most of these public lands are separated only by state roads and minor agricultural development along low-lying river corridors. There are also large tracts of state land in the eastern part of HAL in Pennsylvania around the Poconos and in Pike County. These tracts are more severely fragmented by roads and

other development. Most of the Pennsylvania part of HAL immediately adjacent to the New York border has few areas with public ownership. This part of HAL is at lower elevation and highly dissected by small farms and wood lots.

Nearly 10% of New York in HAL is held in managed areas. The Catskills is by far the largest managed area included within HAL in New York. Most of the state-designated areas included within the Catskill "Blueline" is within HAL. Only a small portion of the eastern side of the Catskills is located within LNE. There are extensive private lands with the "Blueline," but over 280,000 acres is owned by New York State. Allegany State Park at nearly 60,000 acres is the largest state park in New York. There are also numerous small state holdings in the north-central part of the ecoregion.

The ten largest managed areas in HAL appear in Table M2. Allegheny National Forest is the largest managed area in the ecoregion at 372,000 acres. Six of the ten largest managed areas are Pennsylvania state forests. Overall, there are 31 managed areas in HAL over 10,000 acres; 26 are state owned, 4 are federal and one is owned by New York City as a part of its Upstate New York water supply system.

Table M2. Ten largest managed areas in HAL.

Managed Area Name	Ownership type	State(s)	Acreage
Allegheny National Forest	Federal	PA	372,000
The Catskills	NY State	NY	284,000
Sproul State Forest	PA State	PA	153,000
Tioga State Forest	PA State	PA	138,000
Susquehannock State Forest	PA State	PA	136,000
Tiadaghton State Forest	PA State	PA	113,000
Allegany State Park	NY State	NY	60,000
Delaware Water Gap	Federal	PA/NJ	56,000
Wyoming State Forest	PA State	PA	53,000
Delaware State Forest	PA State	PA	52,000

These extensive managed areas in HAL present significant conservation opportunities. Many of the highest quality matrix forests and good condition aquatic features are associated with these areas.

4. FINE FILTER TARGETS

Rare, Threatened or Declining Species Assessment

Target selection

The first task for both the Plant and Animal Working Groups was to select target species for analysis. Species were selected as targets because they were are globally rare or because it was considered that the identification of sites for coarse filter targets such as natural communities, matrix forests, or aquatic systems would not adequately capture viable occurrences for these species in portfolio sites. All G1-G3G4 and T1-T3 species known in the ecoregion were considered as potential targets. Other G4 and G5 species were nominated for discussion by each of the state programs.

Several of these species were rejected as targets by the group based on questions about the taxonomic status of the species. Several species were removed as targets because they were considered to be more common throughout their range than reflected in the current global rank. The global rank for these species needs to be updated. One species was considered to be misidentified; several were not tracked in all three states and distribution information was considered to be inadequate. Several of these species were retained on a potential target list for future consideration.

The HAL plant target list includes 22 vascular plants and 2 non vascular plants (Table P+AT1).

Table P+AT1. Primary Plant Target Species List with Rangewide Distribution Categories

PRIMARY VASCULAR PLANT TARGET SPECIES (22)				
GNAME (Global Name)	**GCOMNAME (Global Common Name)**	**ELCODE**	**GRANK**	**DISTRIBUTION**
ACONITUM NOVEBORACENSE	NORTHERN WILD MONKSHOOD	PDRAN01070	G3	Limited
ADOXA MOSCHATELLINA	MUSK-ROOT	PDADO01010	G5	Peripheral
CALAMAGROSTIS PERPLEXA	WOOD REED GRASS	PMPOA17180	G1Q	Restricted
CAREX LUPULIFORMIS	FALSE HOP SEDGE	PMCYP037T0	G4	Widespread
CAREX POLYMORPHA	VARIABLE SEDGE	PMCYP03AW0	G3	Limited
CAREX SCHWEINITZII	SCHWEINITZ'S SEDGE	PMCYP03C60	G3	Widespread
CAREX WIEGANDII	WIEGAND'S SEDGE	PMCYP03ES0	G3	Widespread
CHENOPODIUM FOGGII	FOGG'S GOOSEFOOT	PDCHE090J0	G3Q	Widespread
CLAYTONIA VIRGINICA VAR HAMMONDIAE	HAMMOND'S YELLOW SPRING BEAUTY	PDPOR030Q3	G5T1	Restricted
COREMA CONRADII	BROOM CROWBERRY	PDEMP02010	G4	Peripheral
DRYOPTERIS FRAGRANS	FRAGRANT CLIFF WOOD-FERN	PPDRY0A0C0	G5	Peripheral
ISOTRIA MEDEOLOIDES	SMALL WHORLED POGONIA	PMORC1F010	G2	Widespread
JUNCUS ENSIFOLIUS	THREE-STAMENED RUSH	PMJUN01130	G5	Peripheral
MONTIA CHAMISSOI	CHAMISSO'S MINER'S-LETTUCE	PDPOR05020	G5	Peripheral
PLATANTHERA HOOKERI	HOOKER ORCHIS	PMORC1Y0A0	G5	Widespread
POA LANGUIDA	DROOPING BLUEGRASS	PMPOA4Z1C0	G3G4Q	Widespread
POA PALUDIGENA	BOG BLUEGRASS	PMPOA4Z1W0	G3	Widespread
POLEMONIUM VANBRUNTIAE	JACOB'S LADDER	PDPLM0E0L0	G3	Limited
SCIRPUS ANCISTROCHAETUS	NORTHEASTERN BULRUSH	PMCYP0Q030	G3	Widespread
SEDUM ROSEA	ROSEROOT STONECROP	PDCRA0A170	G5	Peripheral
TRIPHORA TRIANTHOPHORA	NODDING POGONIA	PMORC2F050	G3G4	Widespread

TROLLIUS LAXUS SSP LAXUS	SPREADING GLOBEFLOWER	PDRAN0P022	G4T3	Widespread
PRIMARY NON VASCULAR PLANT TARGET SPECIES (2)				
GNAME (Global Name)	**GCOMNAME (Global Common Name)**	**ELCODE**	**GRANK**	**DISTRIBUTION**
SPHAGNUM ANDERSONIANUM		NBMUS6Z1Q0	G3?	Limited
SPHAGNUM ANGERMANICUM		NBMUS6Z010	G3G4	Limited

Sixteen of the plant species targets are globally rare and ranked G1-G3G4 (or T1-T3); eight are secure globally and ranked G4 or G5. Three plant target species are federally listed: *Aconitum noveboracense*, *Scirpus ancistrochaetus*, and *Isotria medeoloides.* Two targets: *Calamagrostis perplexa* and *Claytonia virginica* var. *hammondiae* are identified as restricted to HAL. Both are known from only one population. Five species (three vascular and two non vascular) are designated as Limited in distribution with HAL one of the important locations for these species. All other species are widespread in distribution or peripheral within HAL.

The HAL animals target list includes 11 vertebrate species and 22 invertebrate species (Table P+AT2).

Table P+AT2. Primary Animal Target Species List with Rangewide Distribution Categories

PRIMARY VERTEBRATE TARGET SPECIES (11)				
GNAME (Global Name)	**GCOMNAME (Global Common Name)**	**ELCODE**	**GRANK**	**DISTRIBUTION**
CLEMMYS MUHLENBERGII	BOG TURTLE	ARAAD02040	G3	Widespread
ETHEOSTOMA MACULATUM	SPOTTED DARTER	AFCQC02420	G2	Limited
ETHEOSTOMA TIPPECANOE	TIPPECANOE DARTER	AFCQC02800	G3	Limited
ICHTHYOMYZON BDELLIUM	OHIO LAMPREY	AFBAA01010	G3G4	Peripheral
ICHTHYOMYZON GREELEYI	MOUNTAIN BROOK LAMPREY	AFBAA01050	G3G4	Peripheral
MYOTIS LEIBII	EASTERN SMALL-FOOTED MYOTIS	AMACC01130	G3	Widespread
MYOTIS SODALIS	INDIANA BAT	AMACC01100	G2	Widespread
NEOTOMA MAGISTER	ALLEGHENY WOODRAT	AMAFF08100	G3G4	Peripheral
NOTURUS STIGMOSUS	NORTHERN MADTOM	AFCKA02220	G3	Widespread
PERCINA MACROCEPHALA	LONGHEAD DARTER	AFCQC04120	G3	Widespread
SISTRURUS CATENATUS CATENATUS	EASTERN MASSASAUGA	ARADE03011	G3G4T3	Peripheral
PRIMARY INVERTEBRATE TARGET SPECIES (22)				
GNAME (Global Name)	**GCOMNAME (Global Common Name)**	**ELCODE**	**GRANK**	**DISTRIBUTION**
ALASMIDONTA HETERODON	DWARF WEDGEMUSSEL	IMBIV02030	G1G2	Widespread
ALASMIDONTA VARICOSA	BROOK FLOATER	IMBIV02100	G3	Widespread
CHAETAGLAEA CERATA	A NOCTUID MOTH	IILEYFM010	G3G4	Widespread
CHEUMATOPSYCHE HELMA	HELMA'S NET-SPINNING CADDISFLY	IITRI22040	G1G3	Peripheral
CICINDELA ANCOCISCONENSIS	A TIGER BEETLE	IICOL02070	G3	Widespread
CICINDELA MARGINIPENNIS	COBBLESTONE TIGER BEETLE	IICOL02060	G2G3	Widespread
ENALLAGMA LATERALE	NEW ENGLAND BLUET	IIODO71020	G3	Peripheral

EPIOBLASMA TORULOSA RANGIANA	NORTHERN RIFFLESHELL	IMBIV16184	G2T2	Limited
ERYNNIS PERSIUS PERSIUS	PERSIUS DUSKY WING	IILEP37171	G5T2T3	Widespread
FUSCONAIA SUBROTUNDA	LONGSOLID	IMBIV17120	G3	Widespread
GOMPHUS QUADRICOLOR	RAPIDS CLUBTAIL	IIODO08380	G3G4	Widespread
GOMPHUS SEPTIMA	SEPTIMA'S CLUBTAIL	IIODO08190	G2	Restricted
GOMPHUS VIRIDIFRONS	GREEN-FACED CLUBTAIL	IIODO08460	G3	Widespread
ITAME SP 1	BARRENS ITAME (c.f. I. INEXTRICATA)	IILEU09X10	G3	Widespread
LASMIGONA SUBVIRIDIS	GREEN FLOATER	IMBIV22060	G3	Widespread
OPHIOGOMPHUS ANOMALUS	EXTRA-STRIPED SNAKETAIL	IIODO12020	G3	Widespread
OPHIOGOMPHUS HOWEI	PYGMY SNAKEFAIL	IIODO12090	G3	Widespread
PAPAIPEMA SP 1	FLYPOISON BORER MOTH	IILEYC0X10	G2G3	Limited
PLEUROBEMA CLAVA	CLUBSHELL	IMBIV35060	G4	Peripheral
PSECTRAGLAEA CARNOSA	PINK SALLOW	IILEYFN010	G3	Widespread
PYRGUS WYANDOT	SOUTHERN GRIZZLED SKIPPER	IILEP38090	G2	Limited
VILLOSA FABALIS	RAYED BEAN	IMBIV47050	G1G2	Widespread

All animal targets are ranked as globally rare, G1-G3G4 (or T1-T3). Three targets are Federally listed: *Clemmys muhlenbergii*, *Myotis leibii*, and *Alasmidonta heterodon*. Only one animal species is identified as "Restricted" to HAL: *Gomphus septima*. Four species (*Epioblasma torulosa rangiana, Papaipema* sp. 1, *Etheostoma maculatum*, and *Etheostoma tippecanoe*,) are designated as having "Limited" distributions including HAL. All other species are "Widespread" or "Peripheral" in HAL. Two species (*Epioblasma triquetra* and *Quadrula cylindrica*) are globally rare and found in HAL, but were not included in this assessment because their occurrences are associated with French Creek which is primarily in Western Allegheny Plateau (WAP) Ecoregion and in the far western part of the ecoregion. These species and their HAL occurrences have been included in the WAP ecoregional plan.

A list of potential additional targets was developed during the assessment process for both plants and animals. These lists are made up of a broad range of species types including species needing more taxonomic work, species not well inventoried in the ecoregion, species of unknown global rarity, species tracked in one state but not in others, species which may be undergoing decline, and species which may be misidentified. The discussion concerning these taxa was recorded to assist in future assessments of HAL targets. The potential target list for plants in HAL includes 15 species and appears in Table P+AT3.

Table P+AT3. Potential Plant Target Species (Listed alphabetically by Global Name)

GNAME (GLOBAL NAME)	GCOMNAME (Global Common Name)	ELCODE	GRANK
AMELANCHIER BARTRAMIANA	BARTRAM SHADBUSH	PDROS05030	G5
CAREX COLLINSII	COLIN'S SEDGE	PMCYP032W0	G4
CHAMAECYPARIS THYOIDES	ATLANTIC WHITE CEDAR	PGCUP03030	G4
CHAMAELIRIUM LUTEUM	DEVIL'S-BIT	PMLIL0F010	G5
CRATAEGUS PENNSYLVANICA	A HAWTHORN	PDROS0H3V0	G3?Q
CRYPTOGRAMMA STELLERI	FRAGILE ROCKBRAKE	PPADI0B020	G5
FRASERA CAROLINIENSIS	CAROLINA GENTIAN	PDGEN05030	G5
GLYCERIA OBTUSA	BLUNT MANNA-GRASS	PMPOA2Y0C0	G5

HASTEOLA SUAVEOLENS	SWEET-SCENTED INDIAN-PLANTAIN	PDASTDX010	G3
HUPERZIA POROPHILA	ROCK CLUBMOSS	PPLYC02080	G4
JUNCUS MILITARIS	BAYONET RUSH	PMJUN011Y0	G4
POLYSTICHUM BRAUNII	BRAUN'S HOLLY-FERN	PPDRY0R040	G5
POTAMOGETON CONFERVOIDES	ALGAE-LIKE PONDWEED	PMPOT03050	G3G4
RIBES LACUSTRE	BRISTLY BLACK CURRANT	PDGRO020T0	G5
TRICHOMANES INTRICATUM	A FILMY-FERN	PPHYM020V0	G3G4

The potential targets list for animals includes 49 species (13 vertebrates and 36 invertebrates) and appears in Table P+AT4.

Table P+AT4. Potential Animal Target Species (Listed alphabetically by Global Name)

VERTEBRATE SPECIES (13)			
ELCODE	**GNAME (Global Name)**	**GCOMNAME (Global Common Name)**	**GRANK**
ABNKC12060	ACCIPITER GENTILIS	NORTHERN GOSHAWK	G5
AFCKA06030	AMEIURUS MELAS	BLACK BULLHEAD	G5
ARADE02040	CROTALUS HORRIDUS	TIMBER RATTLESNAKE	G4
AMABA04010	CRYPTOTIS PARVA	LEAST SHREW	G5
ABPBX03230	DENDROICA STRIATA	BLACKPOLL WARBLER	G5
ABPAE33010	EMPIDONAX FLAVIVENTRIS	YELLOW-BELLIED FLYCATCHER	G5
AFCQB10030	ENNEACANTHUS OBESUS	BANDED SUNFISH	G5
AFCQB11080	LEPOMIS MEGALOTIS	LONGEAR SUNFISH	G5
AFCJB28310	NOTROPIS CHALYBAEUS	IRONCOLOR SHINER	G4
AFCJB31020	PHOXINUS EOS	NORTHERN REDBELLY DACE	G5
ABNME05020	RALLUS ELEGANS	KING RAIL	G4G5
ABNME05030	RALLUS LIMICOLA	VIRGINIA RAIL	G5
AMAEB01090	SYLVILAGUS OBSCURUS	APPALACHIAN COTTONTAIL	G4
INVERTEBRATE SPECIES (36)			
ELCODE	**GNAME (Global Name)**	**GCOMNAME (Global Common Name)**	**GRANK**
IILEYAQ180	ACRONICTA ALBARUFA	BARRENS DAGGER MOTH	G3G4
IIODO14110	AESHNA MUTATA	SPATTERDOCK DARNER	G3G4
IIODO15030	ANAX LONGIPES	COMET DARNER	G5
IMBIV04080	ANODONTA IMPLICATA	ALEWIFE FLOATER	G5
IILEYLP110	ANOMOGYNA ELIMATA	SOUTHERN VARIABLE DART MOTH	G5
IILEYBB010	APAMEA BURGESSI	A NOCTUID MOTH	G4
IILEYB9070	APAMEA CRISTATA	A NOCTUID MOTH	G4
IILEYGR010	APHARETRA DENTATA	A NOCTUID MOTH	G4
IILEYM1010	APLECTOIDES CONDITA	A NOCTUID MOTH	G4
IIODO68010	ARGIA BIPUNCTULATA	SEEPAGE DANCER	G4
IIODO68020	ARGIA TIBIALIS	BLUE-TIPPED DANCER	G5
IILEPJ9150	CHLOSYNE HARRISII	HARRIS'S CHECKERSPOT	G4
IIODO70010	COENAGRION RESOLUTUM	TAIGA BLUET	G5
IILEPA8140	COLIAS INTERIOR	PINK-EDGED SULPHUR	G5
IILEY02100	DATANA RANAECEPS	A HAND-MAID MOTH	G3G4
IILEYLC020	DIARSIA RUBIFERA	RUBIFERA DART	G5
IILEP77030	EUPHYES DION	DION SKIPPER	G4
IILEU0S060	GLENA COGNATARIA	BLUEBERRY GRAY	G4

IIODO08410	GOMPHUS ABBREVIATUS	SPINE-CROWNED CLUBTAIL	G3G4
IILEW0M040	HEMILEUCA MAIA	THE BUCKMOTH	G5
IMBIV21050	LAMPSILIS CARIOSA	YELLOW LAMPMUSSEL	G3G4
IILEYFE440	LITHOPHANE THAXTERI	THAXTER'S PINION MOTH	G4
IILEU1S030	LYCIA RACHELAE	TWILIGHT MOTH	G4
IMBIV27030	MARGARITIFERA MARGARITIFERA	EASTERN PEARLSHELL	G4
IILEYFK030	METAXAGLAEA SEMITARIA	FOOTPATH SALLOW MOTH	G5
IIODO50010	NANNOTHEMIS BELLA	ELFIN SKIMMER	G4
IILEYAH070	PANTHEA SP 1	A MOTH	G4
IILEYHL040	SIDERIDIS MARYX	A MOTH	G4
IIODO32080	SOMATOCHLORA FORCIPATA	FORCIPATE EMERALD	G5
IIODO32130	SOMATOCHLORA INCURVATA	INCURVATE EMERALD	G4
IILEX0B170	SPHINX GORDIUS	GORDIAN SPHINX	G4
IILEY8T030	SYNGRAPHA EPIGAEA	A NOCTUID MOTH	G5
IILEY7P260	ZALE CUREMA	A NOCTUID MOTH	G3G4
IILEY7PX10	ZALE SP 1	PINE BARRENS ZALE	G3Q
IILEY7P190	ZALE SUBMEDIANA	A NOCTUID MOTH	G4
IILEY43110	ZANCLOGNATHA MARTHA	PINE BARRENS ZANCLOGNATHA	G4

Each target species was assigned to one of four rangewide distribution categories (Table P+AT5**)** for the purpose of establishing conservation goals. The Plant and Animal Working Groups assigned these categories, using distribution information available from NatureServe, the Heritage Programs, and from other sources available at ECS.

Table P+AT5. Rangewide Distribution Categories for Species Targets

Restricted/Endemic	Occurs in only one ecoregion
Limited	Occurs in the ecoregion and in one other or only a few adjacent ecoregions
Widespread	Widely distributed in more than three ecoregions
Peripheral or Disjunct	More commonly found in other ecoregions

Data assembly

Occurrences for each target species were assembled at ECS from the three state Heritage Programs through data sharing agreements. Spreadsheets for plant and animal targets were prepared for group discussion, using information available on the Element Occurrence Record. These data included: a unique occurrence identification number, the species name, global rank, site name, occurrence quality rank, and date of last observation. Tables of all occurrences were provided to each working group team member with ecoregional distribution maps.

Viability analysis

All occurrences chosen for the ecoregional portfolio should be viable, defined as having the ability to persist over time. Using the criteria developed by in Element Occurrence Rank Specifications , size, condition, and landscape context are integrated into an EO (Element Occurrence) rank which is defined as:

A= Excellent estimated viability
B= Good estimated viability
C= Fair estimated viability
D= Not viable

Most EO ranks for element occurrences currently assigned by the state Heritage Program staff reflect evaluations conducted using standard field forms and ranking criteria that were in use at the time that the occurrence was first documented by a field biologist. A similar assessment was used to evaluate the importance of each occurrence. Quality, condition, viability, and defensibility were used to determine an overall occurrence rank. These criteria were often not defined, resulting in variable EO Ranks for similar occurrences across state lines.

The initial intention of the first phase of ecoregional planning was that EO Rank Specifications would be written for all target species. It has, however, not been possible to complete this complex task. The Species Working Groups evaluated the rank of each occurrence with any available information. Notes were collected during these meetings and were returned to the individual Heritage Program offices for use in updating Element Occurrence Records.

Conservation goals

Conservation goals for species targets in ecoregional planning are defined as the number of occurrences and their distribution necessary to ensure the long-term survival of the species in the ecoregion. These goals should be determined base on the different biology and ecology of each species. Because it has not been possible to conduct rangewide assessments for each species, generic goals have been established for the interim until more species specific goals can be developed. Conservation goals for species in HAL follow the same standards used in other Northeastern ecoregions. Conservation goals are based on the global rarity and rangewide distribution of each species (Table P+AT6).

Table P+AT6. Conservation goals for species based on rarity and global distribution.

	G1	G2	G3-G5
Restricted	20	20	20
Limited	10	10	10
Peripheral	5	5	5
Widespread	5	5	5

Twenty populations (occurrences) were chosen to be the minimum number necessary to ensure the long-term survival of a species throughout its range (Barber and Anderson, Lower New England/Northern Piedmont Ecoregional Plan). Where a species has a distribution “Restricted” to one ecoregion, all of these 20 occurrences must be within that ecoregion. When the range of a globally rare species extends across more than one ecoregion, the assumption was made that occurrences of that species would be included in multiple ecoregions, requiring fewer in each ecoregion. For species with “Limited” distribution, the ecoregional goal was set at 10. For species with “Widespread” or “Peripheral/Disjunct” distributions, the goal was set at 5 for the entire ecoregion.

In terms of stratification within the ecoregion, the goal was established that there should be at least one occurrence in the portfolio for each subsection in which a species has been known to occur historically, i.e. where there is or has been habitat for the species. The goal is met for each species when both the numerical and stratification standards are met.

It is important to note that these goals make several assumptions at this stage that will require future assessment. These goals require that species that are a target in one ecoregion are targeted species in all ecoregions in which they occur. That is likely the case for G1-G3 species, but not a certainty. For G4 and G5 species targets, it is likely that these species are not targets in most other ecoregions. After the completion of the full set of first iteration ecoregional plans, species target goals should be reevaluated. Rangewide planning should eventually be undertaken for all targets.

Portfolio Status for Plant Species in HAL

The Plant Working Group assessed a total of 121 (See Table P+AT7) occurrences for the 24 target plant species in HAL. Eighty-eight occurrences (73%) were selected for the HAL portfolio. Goals and portfolio status for plant targets in HAL are presented in Table P+AT7**.**

Table P+AT7 Primary Plant Target Species: Goals, Portfolio Status, And Goals Met

PRIMARY VASCULAR PLANT TARGET SPECIES (22)						
GNAME (Global Name)	**GCOMNAME (Global Common Name)**	**Rangewide Distribution**	**# of EORs in HAL**	**Minimum Needed for Goals**	**# of EORs Accepted**	**Goal Met**
ACONITUM NOVEBORACENSE	NORTHERN WILD MONKSHOOD	Limited	8	10	8	N
ADOXA MOSCHATELLINA	MUSK-ROOT	Peripheral	5	5	3	N
CALAMAGROSTIS PERPLEXA	WOOD REED GRASS	Restricted	1	20	1	N
CAREX LUPULIFORMIS	FALSE HOP SEDGE	Widespread	2	5	1	N
CAREX POLYMORPHA	VARIABLE SEDGE	Limited	6	10	6	N
CAREX SCHWEINITZII	SCHWEINITZ'S SEDGE	Widespread	6	5	4	N
CAREX WIEGANDII	WIEGAND'S SEDGE	Widespread	2	5	2	N
CHENOPODIUM FOGGII	FOGG'S GOOSEFOOT	Widespread	1	5	0	N
CLAYTONIA VIRGINICA VAR HAMMONDIAE	HAMMOND'S YELLOW SPRING BEAUTY	Restricted	1	20	1	N
COREMA CONRADII	BROOM CROWBERRY	Peripheral	2	5	2	N
DRYOPTERIS FRAGRANS	FRAGRANT CLIFF WOOD-FERN	Peripheral	3	5	3	N
ISOTRIA MEDEOLOIDES	SMALL WHORLED POGONIA	Widespread	2	5	2	N
JUNCUS ENSIFOLIUS	THREE-STAMENED RUSH	Peripheral	2	5	1	N
MONTIA CHAMISSOI	CHAMISSO'S MINER'S-LETTUCE	Peripheral	3	5	2	N
PLATANTHERA HOOKERI	HOOKER ORCHIS	Widespread	3	5	0	N
POA LANGUIDA	DROOPING BLUEGRASS	Widespread	1	5	0	N
POA PALUDIGENA	BOG BLUEGRASS	Widespread	6	5	5	Y
POLEMONIUM VANBRUNTIAE	JACOB'S LADDER	Limited	25	10	13	Y
SCIRPUS ANCISTROCHAETUS	NORTHEASTERN BULRUSH	Widespread	1	5	4	N
SEDUM ROSEA	ROSEROOT STONECROP	Peripheral	4	5	3	N
TRIPHORA TRIANTHOPHORA	NODDING POGONIA	Widespread	6	5	6	Y
TROLLIUS LAXUS SSP LAXUS	SPREADING GLOBEFLOWER	Widespread	24	5	14	Y
SUBTOTAL			**114**	**155**	**81**	--
PRIMARY NON VASCULAR PLANT TARGET SPECIES (2)						
GNAME (Global Name)	**GCOMNAME (Global Common Name)**	**Rangewide Distribution**	**# of EORs in HAL**	**Minimum Needed for Goals**	**# of EORs Accepted**	**Goal Met**

SPHAGNUM ANDERSONIANUM		Limited	4	10	4	N
SPHAGNUM ANGERMANICUM		Limited	3	10	3	N
SUBTOTAL			**7**	**20**	**7**	**--**
GRAND TOTAL			**121**	**175**	**88**	--

Only four species met their goal: *Poa paludigena*, *Polemonium vanbruntiae*, *Triphora trianthophora*, and *Trollius laxus* spp *laxus.* New York is the center of distribution for *Trollius laxus* spp *laxus*. Of the 22 occurrences assessed as viable in HAL, only 14 were selected for the portfolio. Eight occurrences located in marginal habitat were not selected. Likewise, New York is the center of distribution for *Polemonium vanbruntiae*. Two viable occurrences for *Polemonium* in marginal habitat were not selected for the portfolio. For all other species, all viable occurrences were selected for the HAL portfolio.

The overall goal for plants in HAL was to locate and identify 175 populations (see Table P+AT7). Half of the goal (88 of 175 or 50%) for plant targets was met in this first iteration of the HAL plan.

Comments on the HAL plant portfolio

The plant data used in the development of the HAL portfolio were in overall good condition and easy to evaluate. The HAL botanists knew the species tracked well and had a good sense of what remains left to document their states.

Goals for the two species "Restricted" to HAL are currently unattainable. Both species (*Calamagrostis perplexa* and *Claytonia virginica* var. *hammondiae*) appear to be good taxa, but are only known from one population. The goal for these species in HAL is 20 populations. It is expected that no other populations will be found. Thus these targets are unlikely to persist over centuries without restoration work.

It is the opinion of the HAL botanists that several species designated as targets will be found at new sites with continued inventories. These species include: *Scirpus ancistrochaetus*, *Triphora trianthophora*, *Chenopodium foggii*, and *Juncus ensifolius*. Many of the other species are well known and have been the subject of detailed searches.

Plant occurrences for targets are concentrated in the calcareous region in New York, the Catskills, along the Kittatinny ridge and vicinity, and in the Poconos. There are large sections of western Pennsylvania and the New York/Pennsylvania border counties where there have been few surveys. These areas should receive additional attention.

Portfolio Status for Animals in HAL

The HAL Animal Working Group assessed 158 occurrences including metapopulations for the 33 targets species. Seventy-four occurrences for 27 species were selected for the portfolio. Goals for animals targets in HAL are presented in Table P+AT8**.**

Table P+AT8. HAL Primary Animal Target Species: Goals and Goals Met

PRIMARY VERTEBRATE TARGET SPECIES (11)												
GNAME (Global Name)	GCOMNAME (Global Common Name)	ELCODE	RANGEWIDE	GRANK	GOAL minimum	# OF EORs	# OF EORs (converted to include	Explanation of Conversion	# of EORs ACCEPTED	COMMENTS for EORs ACCEPTED	NUMERICAL GOAL MET?	DISTRIBUTION GOAL

CLEMMYS MUHLENBERGII	BOG TURTLE	ARAAD02040	W	G3	5	38	24	22 eors + 2 metapops of 6 and 10 eors	2	Both Metapops incl.	N	N
ETHEOSTOMA MACULATUM	SPOTTED DARTER	AFCQC02420	L	G2	10	2	1	1 metapopulation of 2 eors	1	Metapop. included	N	Y
ETHEOSTOMA TIPPECANOE	TIPPECANOE DARTER	AFCQC02800	L	G3	10	5	1	1 metapopulation of 5 eors	1	Metapop. included	N	Y
ICHTHYOMYZON BDELLIUM	OHIO LAMPREY	AFBAA01010	P	G3G4	5	15	14	13 eor + 1 metapop of 2 eors	8	Metapop. included	Y	Y
ICHTHYOMYZON GREELEYI	MOUNTAIN BROOK LAMPREY	AFBAA01050	P	G3G4	5	5	5	---	0	---	N	N
MYOTIS LEIBII	EASTERN SMALL-FOOTED MYOTIS	AMACC01130	W	G3	5	4	4	---	1	---	N	N
MYOTIS SODALIS	INDIANA BAT	AMACC01100	W	G2	5	1	1	---	0	---	N	N
NEOTOMA MAGISTER	ALLEGHENY WOODRAT	AMAFF08100	P	G3G4	5	17	17	---	5	---	Y	N
NOTURUS STIGMOSUS	NORTHERN MADTOM	AFCKA02220	W	G3	5	1	1	---	1	---	N	Y
PERCINA MACROCEPHALA	LONGHEAD DARTER	AFCQC04120	W	G3	5	10	5	4 eors + 1 metapop. of 4 eors	5	Metapop. included	Y	Y
SISTRURUS CATENATUS CATENATUS	EASTERN MASSASAUGA	ARADE03011	P	G3G4T3	5	6	6	---	0	---	N	N
SUBOTAL					65	104	79	---	24			

PRIMARY INVERTEBRATE TARGET SPECIES (22)

GNAME (Global Name)	GCOMNAME (Global Common Name)	ELCODE	RANGEWIDE DISTRIBUTI	GRANK	GOAL minimum	# OF EORs	# OF EORs (converted to include	Explanation of Conversion	# of EORs ACCEPTED	COMMENTS for EORs ACCEPTED	NUMERICAL GOAL MET?	DISTRIBUTION GOAL
ALASMIDONTA HETERODON	DWARF WEDGEMUSSEL	IMBIV02030	W	G1G2	5	8	2	1 + 1 metapopulation of 7 eors	2	Metapop. included	N	Y
ALASMIDONTA VARICOSA	BROOK FLOATER	IMBIV02100	W	G3	5	8	8	---	7	---	Y	N
CHAETAGLAEA CERATA	A NOCTUID MOTH	IILEYFM010	W	G3G4	5	3	3	---	3	---	N	Y
CHEUMATOPSYCHE HELMA	HELMA'S NET-SPINNING CADDISFLY	IITRI22040	P	G1G3	5	1	1	---	1	---	N	Y
CICINDELA ANCOCISCONENSIS	A TIGER BEETLE	IICOL02070	W	G3	5	3	3	---	3	---	N	Y
CICINDELA MARGINIPENNIS	COBBLESTONE TIGER BEETLE	IICOL02060	W	G2G3	5	3	3	---	3	---	N	Y
ENALLAGMA LATERALE	NEW ENGLAND BLUET	IIODO71020	P	G3	5	3	2	1 + 1 metapopulation of 2 eors	1	Metapop. included	N	N
EPIOBLASMA TORULOSA RANGIANA	NORTHERN RIFFLESHELL	IMBIV16184	L	G2T2	10	3	1	1 metapopulation of 3 eors	1	Metapop. included	N	Y
ERYNNIS PERSIUS PERSIUS	PERSIUS DUSKY WING	IILEP37171	W	G5T2T3	5	2	2	---	1		N	N
FUSCONAIA SUBROTUNDA	LONGSOLID	IMBIV17120	W	G3	5	2	2	---	0		N	N
GOMPHUS QUADRICOLOR	RAPIDS CLUBTAIL	IIODO08380	W	G3G4	5	7	2	1st metapop. 2 eors, 2nd metapop. of 5 eors	2	Both metapops. included	N	Y
GOMPHUS SEPTIMA	SEPTIMA'S CLUBTAIL	IIODO08190	R	G2	20	0	0	---	0		N	N
GOMPHUS VIRIDIFRONS	GREEN-FACED CLUBTAIL	IIODO08460	W	G3	5	11	6	5 eors + 1 metapop. of 6 eors	6	Metapop. included	Y	Y
ITAME SP 1	BARRENS ITAME (c.f. I. INEXTRICATA)	IILEU09X10	W	G3	5	4	4	---	2		N	N
LASMIGONA SUBVIRIDIS	GREEN FLOATER	IMBIV22060	W	G3	5	27	27	---	7		Y	Y
OPHIOGOMPHUS ANOMALUS	EXTRA-STRIPED SNAKETAIL	IIODO12020	W	G3	5	3	3	---	3		N	Y
OPHIOGOMPHUS HOWEI	PYGMY SNAKEFAIL	IIODO12090	W	G3	5	1	1	---	1		N	Y
PAPAIPEMA SP 1	FLYPOISON BORER MOTH	IILEYC0X10	L	G2G3	10	6	5	4 eors + 1 metapop. of 2 eors	3	Metapop. included	N	N
PLEUROBEMA CLAVA	CLUBSHELL	IMBIV35060	P	G4	5	3	1	1 metapop. of 3 eors	1	Metapop. included	N	Y
PSECTRAGLAEA CARNOSA	PINK SALLOW	IILEYFN010	W	G3	5	4	2	2 eors + 1 metapop. of 2 eors	2	Metapop. included	N	N
PYRGUS WYANDOT	SOUTHERN GRIZZLED SKIPPER	IILEP38090	L	G2	10	0	0	---	0		N	Y
VILLOSA FABALIS	RAYED BEAN	IMBIV47050	W	G1G2	5	1	1	---	1		N	Y
SUBTOTAL					140	103	79	---	50			
GRAND TOTAL					205	207	158		74			

* Rangewide Distribution Symbols: L Limited; P Peripheral, R Restricted, W Widespread

Six species known to have occurred in HAL within the last 30 years did not have any occurrences selected (*Ichthyomyzon greeleyi, Myotis sodalis, Sistrurus catenatus catenatus, Fusconaia subrotunda, Gomphus septima, and Pyrgus wyandot*). Four species (*Ichthyomyzon bdellium, Percina macrocephala, Gomphus viridifrons*, and *Lasmigona subviridis*) met both numerical and distributional goals for the ecoregion. Two other species (*Neotoma magister* and *Alasmidonta varicosa*) met numerical goals, but failed to meet the distributional goal. Fifteen species met the distributional goal, but failed to meet the numerical goal.

The overall goal for animals in HAL was 205 occurrences. The HAL first iteration portfolio identifies 33% of the viable animal populations to meet the plan goals, 68 of 205 occurrences. Six occurrences were included in the portfolio that were beyond the goals set for four species.

Comments on the HAL animal portfolio

The data used in the development of the HAL portfolio were variable in detail and difficult to evaluate. Data were collected by a wide variety of surveyors. Some occurrence information was old; some was very sketchy. It was often hard to evaluate an occurrence beyond that a collection had been made at a specific site. Much of these type of data were set aside and occurrences were not included in the portfolio. Comments were collected that reflect needed additional information for future assessment.

For 13 of the species identified as targets, some individual occurrences were grouped into metapopulation concepts. For example, 16 bog turtle occurrences from the New Jersey and Pennsylvania databases were grouped into two populations. Species whose viable occurrences were in some way grouped into metapopulations during this assessment include:

Clemmys muhlenbergii
Etheostoma maculatum
Etheostoma tippecanoe
Ichthyomyzon bdellium
Percina marcrocephala
Alasmidonta heterodon
Enallagma laterale
Epioblasma torulosa rangiana
Gomphus quadricolor
Gomphus viridifrons
Papaipema sp. 1
Pleurobema clava
Psectraglaea carnosa

For six species, no occurrences appear in the portfolio at all. For *Pyrgus wyandot* there are no currently known populations. Data for *Gomphus septima* have been collected, but have not yet been processed by New York Heritage and have not been included in this plan. Four other species: *Ichthyomyzon greeleyi*, *Myotis leibeii*, *Fusconaia subrotunda*, and *Sistrurus catenatus* are believed to still be extant in HAL, but additional field work is needed to confirm locations and population viability, before portfolio sites can be chosen.

The animal occurrences in the HAL portfolio are concentrated along the major rivers: the Delaware, the Susquehanna, and the Allegheny, along the Clarion River in Western Pennsylvania, and Olean Creek in New York, and in the eastern parts of the ecoregion.

Additional field work for most species is needed to confirm the continued existence of many species and individual populations and to improve an understanding of viability for these occurrences. There are likely more occurrences for many of these species, particularly those associated with aquatic systems.

Assessing and integrating the appropriate bird target species is not complete. A list of PIF priority species for HAL is shown in Table BT1.

TABLE BT-1. Draft Bird Target List Based on Allegheny Plateau PIF Report

High Continental Priority- High Regional Responsibility
Henslow's sparrow
Bicknell's thrush
Wood thrush
Canada warbler
American woodcock
Black-billed cuckoo
Black-throated blue warbler
Field sparrow
Louisiana waterthrush
Scarlet tanager
High Continental Priority- Low Regional Responsibility
Golden-winged warbler
Cerulean warbler
Worm-eating warbler
High Regional Concern
Eastern wood-pewee
American kestrel
Eastern towhee
Least flycatcher
Sharp-shinned hawk
High Regional Responsibility
Blue-winged warbler
Bobolink
Rose-breasted grosbeak
High Regional Threats
American black duck
Red-headed woodpecker
Sedge wren
Yellow-bellied flycatcher
Upland sandpiper
Northern harrier
Short-eared owl
Arranged by habitat with priority set by PIF plan (species differ some from the first part of this list-only species with high PIF scores are included)
Agricultural grasslands
Henslow's sparrow
Upland sandpiper
American kestrel
Bobolink
Shrub-early succession
Golden-winged warbler
American woodcock
Field sparrow
Boreal mountaintop and bog
Bicknell's thrush
Yellow-bellied flycatcher
Riparian-deciduous forest
Cerulean warbler
Worm-eating warbler

	Wood thrush
	Louisiana waterthrush
	Canada warbler
	Black-throated blue warbler
Freshwater wetlands	
	American black duck
	King rail
	American bittern
	Black tern

Next Steps for HAL Species Assessment

1. Data collected during this assessment were returned to the Heritage Programs. Element occurrences should be updated to reflect any new information obtained during development of this plan about viability and occurrences grouped into metapopulations.
2. Species targets lists should be assembled for all Northeastern ecoregions and evaluated to make sure that the globally-rare species are addressed in all ecoregions and that globally-secure species are appropriately included. Comments concerning taxonomic and identification problems, inadequate inventories, and aging surveys should be collected and addressed.
3. Numerical and distributional goals for species should be reevaluated and coordinated across ecoregional boundaries. For most species, goals should be tailored to known extant and suspected populations, as well as available habitat. Information should be collected to address minimum viable populations size. For some species which may be highly sensitive to global warming, sites should be selected to allow movement of populations over time.
4. For select species, particularly those that are globally rare, restoration should be considered. At a minimum, for Federally-listed species, introductions and reintroduction sites should be identified. All goals should be adjusted to reflect any detailed information included in Federal recovery plans, as they are developed.
5. Viability assessments should be reevaluated as more information becomes available. The basis of the viability assessment for species in this plan was the judgment of the Heritage ecologists. While this was the best information currently available, many occurrences were documented with very sketchy data and the ecologists were not personally familiar with specific populations, During the Site conservation planning process, population viability should be reassessed and new information added to the Heritage databases.
6. Field work should continue for all species to update current occurrence data and locate new populations. Particular attention should be focused on aquatic species, animals targets that have not been seen in many years, and species which occupy large areas for which only presence/absence information is currently available.
7. Those sections of the ecoregion that have not been subject to detailed surveys should be assessed. These areas include all rivers and streams, the large forested areas in central and western Pennsylvania, and the counties along the New York/Pennsylvania border.

5. NATURAL (TERRESTRIAL) COMMUNITIES ASSESSMENT (PART 1)

Target Selection

All natural terrestrial vegetation community types are identified as conservation targets in the ecoregion. Aquatic communities are analyzed separately. A description of the aquatics selection process and results appear in the aquatics systems and species chapter.

The goal for terrestrial communities is to conserve viable, high quality examples of all communities at their appropriate scales, in numbers relative to their importance in terms of abundance and distribution within the ecoregion and throughout the range of the community. Terrestrial community targets were set at the *association* level of the National Vegetation Classification (NVC Grossman et al., 1998). An association is defined by the structure and composition of the overstory and understory vegetation layers, as well as the environmental setting.

Communities vary greatly in terms of their size of occurrence and ecological specificity; some types cover large areas of varying topography, geology, and hydrology, while others occur only in small patches under unusual environmental conditions.

Matrix (or dominant) **communities** may extend over very large areas of 1000 to many millions of acres, often covering 80% or more of the undeveloped landscape. Matrix communities are generally forests in the Eastern United States, and have broad ecological amplitudes, shaped by regional-scale processes. They are important as coarse filters for most common species, wide-ranging fauna such as large herbivores, predators, and forest interior and migratory birds. These communities have been analyzed separately in HAL. (Matrix forests are addressed in the next section).

Nested within the matrix forests are smaller-scale patch communities with more specific ecological amplitudes and often more restricted species. **Large patch** communities may cover large areas, often 100-1000 acres, but are usually defined by specific edaphic conditions or disturbance regimes. These communities often have a set of characteristic fauna, and serve as resource patches for fauna associated with the matrix communities.

Even more restricted are **small patch** communities which have very narrow ecological amplitudes and occur where a number of local conditions come together in a precise way. Although their boundaries are often easy to delineate, these community types are usually inextricably linked to the landscapes in which they occur. They may not be viable over the long term without preservation of the larger system in which they are embedded. It is important to assess the viability of small patch communities based on processes and landscape context threats to the community. Small patch communities often occur in extreme or unusual conditions that are stressful for most common species. These communities can serve as refuges for species that are poor competitors under more typical environmental conditions. Small patch communities often support rare plants and animals and may be rare themselves. There is also strong evidence that small patch communities serve as coarse filters for some specific invertebrate fauna.

In addition to matrix forests, large patch communities and small patch communities, several natural community types can be described as **"linear communities."** Linear communities in HAL most often occur along rivers. A number of wetland associations found along the major

river in HAL can best be described as linear. These communities can range in size from only a few acres to 100's of acres.

Development of a Vegetation Classification for HAL

The methodology used to develop an ecoregional vegetation classification in other Northeastern ecoregions (NAP, NAC, LNE, CBY, and CAP) was applied to the HAL Ecoregion to define the full complement of associations that occur in the ecoregion. All associations within the NVC are described with their potential distribution by subsection, assessed by interviews with Heritage Program ecologists (Grossman et al. 1998). All associations that might possibly occur in HAL were assembled into a single draft document representing a first approximation of associations in the ecoregion This assemblage resulted in a set of 140 associations.

This document served as the basis for discussion by a team of ecologists made up of representatives from each of the HAL states (NJ, NY, and PA). A review of descriptive data for these natural communities specific to HAL was led by staff from the Eastern Conservation Science Office. The team was asked to:

1. Assess whether each association is known to occur or potentially occur within the ecoregion
2. Determine the distribution for each association by subsection within the ecoregion
3. Determine the patch size (matrix, large patch, small patch, or linear) for each association
4. Evaluate the distribution of each association within the ecoregion in relation to its global distribution (Widespread - found in many ecoregions; Peripheral - found in HAL but primarily found in other ecoregions; Limited - found in HAL and in only a very few other ecoregions; Restricted - found only in HAL)
5. Describe the substrate type and other features of the physical setting (e.g., elevation range, aspect, surface geology) for each association to facilitate making connections between associations and Ecological Land Units (ELUs)
6. Adjust descriptions of NVC associations to reflect the floristic composition and physical setting of the association specific to HAL
7. Identify any associations not represented in the NVC subset already linked to the HAL ecoregion. Some of these associations were already present in the NVC, but not formally connected to HAL; others were not yet described. For these "new" associations, a place-holder name was created and a description written which will later be combined and coordinated with other newly identified associations from other ecoregions in an update of the NVC.

Of the 140 associations initially described for HAL in the NVC, 34 were evaluated as not occurring in HAL. Three associations not previously identified as within HAL were added, and several associations were described for consideration for inclusion in a revised NVC. Every association within HAL was also categorized into a coarser scale vegetation system or **group** (see Appendix nc1 and below), of which 14 were initially identified. A total of 109 associations known or thought to occur in the HAL ecoregion were described through these efforts. These results were assembled into a single document for HAL natural communities and reviewed by the participating ecologists (Sneddon et al., 2000).

In the course of assembling Heritage occurrence data, linking occurrences to NVC associations, and conducting viability analyses (see below) over several months, additional consultations occurred between ECS ecologists and state Community Ecologists which resulted in a slightly revised ecoregional classification. Three associations were added to the classification. Thus, a total of 109 associations were included in this plan (Appendix nc1). By comparison, 126 associations were described for CAP and 153 for LNE.

Three (possibly four) associations within HAL were described as matrix forming (see matrix forest chapter).

Fourteen NVC types were described as large patch (or which may occur as large patch), 65 were described as small patch, and 8 were described as linear (Table NC-1, Appendix nc1). For 36 associations, the patch size was either uncertain or believed to be intermediate between patch types (Appendix nc1); hence the number of associations tallied by patch size exceeds the total number of associations with the ecoregion (see Table NC-1). For 21of the types, the patch type was assigned based on best available knowledge, but with less certainty than for the majority of the types (see discussion in Assessing Viability section below). For a small number of types the patch size was completely unknown at the time of this assessment, but these cases were too few to affect the overall results presented here.

Data Assembly

Data were assembled at the ECS Office for the three states within the ecoregion. A total of 509 occurrences were in this dataset: 20 for NJ, 282 for PA, and 206 for NY. Each of these occurrences was initially identified within their respective state classifications, and thus needed to be linked ("crosswalked" or "tagged") to the NVC classification developed for HAL. Each occurrence was crosswalked by the state Heritage ecologist, or by staff from ECS with review by the state ecologist. Each association was also categorized as one of the 14 vegetation systems or groups. Some occurrences were easily connected to a specific association; others were a mosaic of identifiable associations and could be considered to be occurrences of multiple associations; for some it was not possible to crosswalk them to the HAL classification given available data. In the cases where it was not possible to connect an occurrence to a specific association, but it was clear that the occurrence was high quality and able to be matched to a coarser scale level of classification, occurrences were tied to the appropriate vegetation **group**.

Unlike many community occurrences in other ecoregions, most community occurrences documented by the Natural Heritage Programs in HAL were very detailed and scaled similarly to associations within the NVC, so that occurrences could be effectively crosswalked to specific associations. For 38 of the occurrences (7%), however, it was necessary to limit analysis to the coarser-scale Group level (Appendix nc1).

In several cases**,** a documented Heritage occurrence was determined not to represent a natural community and so was set aside from the analysis. There were several BCD occurrence records where the habitat of a rare species which occurred in an anthropogenic setting had been described as a natural community by the field biologist; these were discarded. It also became apparent that duplicate records existed in several state databases, due to differences in nomenclature for early community EORs; these, too, were eliminated. A total of oooo natural community occurrences in HAL were subjected to viability analysis and evaluated for inclusion in the ecoregional portfolio.

Assessing Viability

To assess the viability of natural communities, all occurrences were assigned to one of five ranks: Y = viable, Y? = probably viable; ?= unknown; N? = probably not viable; N= not viable. Occurrences rated Y and Y? were included in the ecoregional community assessment. All occurrences with a ? should be assessed further by additional field work or discussion among scientists familiar with the occurrences. This assessment was initially undertaken by staff at ECS (ERO) and then reviewed by members of the ecology team for each state.

The viability assessment was based on four factors, including three criteria traditionally used by Natural Heritage Programs to evaluate Element Occurrences:

- **The age** of the documented occurrences (When was the community last seen?)
- **The size** of the occurrence in relation to patch size for the NVC type
- **The condition** of the community occurrence
- **The landscape context** of the occurrence

Age of element occurrence records: All element occurrence records with a LASTOBS (last observation) date before 1988 were assigned at most a "?," because it was unclear if the occurrence data remained valid. Heritage ecologists were asked whether more recent visits have confirmed the continued condition of the occurrence or whether there is reason to think that the occurrence has not changed over time.

Size: Information was obtained directly from the "Size" field on the EOR. Many EORs, however, did not include an actual acreage figure; some included comments such as "large," "very small," or "biggest I've seen." This information was collected in the spreadsheet, when no other information was available. Additional information was also provided by the state ecologists during their review.

Condition: The overall EO rank (A-D) is often a good measure of the condition of the occurrence. In some cases there were also comments within the EOR regarding processes, disturbances, and weeds. This information was added to the general comments field in the spreadsheet.

Landscape quality or context was evaluated in two ways. Landscape context information found within the EOR was recorded in the comments field. A GIS assessment was also conducted for each community occurrence using an evaluation of a 1000-acre circular buffer centered at the centrum of the occurrence. The landscape context for each large patch, small patch, and linear patch community occurrence was assessed using GIS landscape cover data. This "landscape" was ranked on a scale of 1-4 with 1 being "excellent" and 4 being "poor."

These landscape context values characterized each occurrence as:

1. Surrounded by > 90% natural land with <5% (50 acres) of low and high density residential development and industrial development and < 5000 meters of any type of fragmenting features.
2. Surrounded by >80% natural lands with <5% (50 acres) of low and high density residential development and industrial development and < 5000 meters of any type of fragmenting features.

3. Surrounded by >60% natural lands with <5% (50 acres) of low and high density residential development and industrial development and < 10000 meters of any type of fragmenting features.
4. Surrounding area < 60% natural land or > 50 acres of more intensely developed than in class or > 10000 meters of any type of fragmenting feature.

Each state ecologist reviewed the assessment of the 1000-acre landscape context for each occurrence. Generally, the results reflected other information already available from the occurrence forms and validated the occurrence rank. The analysis of the 1000-acre block around occurrence centers was judged to be large enough to characterize the landscape setting of most occurrences. In a few cases, particularly for small patch, globally rare communities, 1000 acres was considered to be too large to assess context. These occurrences were evaluated individually using the judgment of the ecologists.

An algorithm was used to assess viability for large patch, small patch and linear communities, based on four possible combinations of size, condition, and landscape context (Table NC-1). Different size standards were used for matrix (generally > 1000 ac), large and linear patch (>100 ac), and small patch (generally > 25 ac, but variable) communities. The combinations were intended to maximize the probability that an occurrence was viable, functional as a coarse filter, and associated with a reasonably intact site. Occurrences that ranked low for one criterion had to be ranked high for one or both of the other criteria in order to be considered viable. No occurrence with a condition rank of "D" rank was included in the analysis. During this process, recommendations were made to revise some Heritage ranks that appear as a "D" on current element occurrence records. Each occurrence with a landscape context value of "4" was assessed individually and required explanation from an ecologist concerning its viability if it remained in the analysis. Some of these occurrences were discarded entirely; some were assigned to a category to receive additional field attention before they can be included in future iterations of portfolio development. All of the data collected for these analyses have been captured in a spreadsheet included with this ecoregional plan and have been returned to the Natural Heritage Programs.

Table NC-1. Natural community (small, large, and linear patch) viability ranking grid.

Landscape context	Condition/Rank	Size: Large (linear) patch	Size: Small (linear) patch	Viability estimate
1	A, AB, B,	>100	>0	Yes
1	BC,C, ?, E			Maybe = ?
2	A,AB,B	>100	>0	Yes
2	BC,C,?,E			Maybe = ?
3	A,AB,B	>100	>25	Yes
3	BC,C,?,E,			No
4	A,AB,B	>100	>50	Maybe = ?
4	BC,C,?,E			No
1,2,3,4	D			No

Note that linear patch communities were variously evaluated on small or large patch size criteria depending on an understanding of the growth and habitat characteristics of the vegetation type. Also, where there was uncertainty about the classification of a community to patch type (e.g., large vs. small), generally the more conservative criteria were applied.

Setting Conservation Goals

Qualitative conservation goals for terrestrial communities in HAL included: 1) selecting occurrences that represented the highest-quality examples of each natural community type; 2) selecting occurrences that met or exceeded minimum size and viability criteria, and; 3) representing the range of expression of each community in the ecoregion in numbers relative to its importance within the ecoregion and throughout its range.

Quantitative (numerical) goals for natural community occurrences in HAL were established using an approach developed in other Northeastern ecoregions. Patch size type and the range-wide distribution of a community were used to determine the number of occurrences needed to preserve an association throughout the ecoregion and the spatial distribution of occurrences (i.e., stratification) necessary to represent both the range-wide rarity and environmental variability of each community type.

Stratification

As in other ecoregions, HAL was divided into groups of subsections to reflect the range of physiographic variability throughout the ecoregion.

For the purposes of stratification, HAL subsections were grouped to reflect similar ecological settings. Four levels were created. Level 1 refers to anywhere within the ecoregion. The first and most fundamental ecological separation in HAL is between subsections that are within the glaciated portion of the ecoregion and those that were never subject to glaciation. For the most common widespread communities at a minimum, occurrences should be distributed in both of these units (Level 2), if in fact, the association occurs in both units. Level 3 divides the ecoregion into four groups, reflecting glaciation, elevation, and bedrock differences. Level 4, reserved for Restricted associations, further divides the lower elevation subsections reflecting differences between the rugged terrain in the vicinity of the Poconos and the Middle Delaware River and the more gently sloping, rolling hills of the northern subsections of HAL.

Conservation goals

Conservation goals for terrestrial communities in HAL were set to reflect that Restricted and Limited associations in HAL should be distributed in the ecoregion more broadly than Peripheral and Widespread communities, because a high percentage of the global range of these communities occurs in the ecoregion. For those communities whose distribution is thought to be Restricted to HAL, occurrences should be located as broadly as possible, in all five sections shown in Level 4 of Table NC-2.

Table NC-2. Sectional and subsectional classification (USFS categories) and geographic extent in HAL ecoregion.

Stratification of High Allegheny Plateau by sectional and subsectional classification (USFS categories)					
High Allegheny Plateau					**Level 1**
Non-glaciated	**Glaciated**				**Level 2**
Western PA Highlands-Ga/Gb	**Catskills**-Ea	**Kittatinny**-Bd	**Allegheny Lowlands**		**Level 3**
Western PA Highlands-Ga/Gb	**Catskills**-Ea	**Kittatinny**-Bd	**NY Lowlands and Catskill Hills** Eb/Fb/Fa	**Poconos/ Neversink**-Fc/Fd	**Level 4**

For those communities categorized as Limited to HAL (found in HAL and one other ecoregion), the goal was set at Level 3, with four subsection groups. For the more widely distributed Widespread and Peripheral communities, the stratification level was Level 2, occurrences distributed in both glaciated and non-glaciated susbsections. Level 1 with occurrences anywhere in the ecoregion is limited to those widespread or peripheral communities that only occur in either the glaciated or non-glaciated parts of HAL. Within these stratification units, the number of occurrences was set at four per unit for large patch and linear communities and five per unit for small patch communities (Table NC-3).

Table NC-3. Minimum conservation goals for HAL natural communities as a function of patch size and rangewide distribution of the type.

		Patch Size	
Rangewide Distribution	**Minimum Stratification (Level)**	**Large or Linear (4)**	**Small (5)**
Restricted	4 (5 groups of subsections)	20	25
Limited	3 (4 groups of subsections)	16	20
Widespread	2 (2 groups of subsections)	4*	5*
Peripheral	2 (2 groups of subsections)	4*	5*

* For Widespread and Peripheral associations the total ecoregional goal is 4 for Large Patch and 5 for Small Patch associations. If the association occurs in both glaciated and non glaciated parts of HAL, then these occurrences must be distributed in both units.

The combination of stratification levels across the ecoregion and minimum number of occurrences per section produces a set of numerical conservation goals for natural community targets in HAL that ranges from four to 25 (Table NC-3).

Results: Summary of HAL Natural Community Portfolio by Group

Of the total of 509 Heritage natural community occurrences in the HAL database, 253, or 50%, were assessed as viable and included in the HAL portfolio. These Heritage element occurrence records represent 264 occurrences of NVC types. The number of occurrences of NVC types in HAL does not equal the number of element occurrences identified as viable and included in the portfolio because some documented Heritage occurrences consisted of multiple viable NVC associations. This was particularly true of black spruce bogs and dwarf shrub gobs, which are most often documented as complexes of NVC types. In those cases where data provided in the element occurrences record were detailed or where the staff ecologist personally knew the occurrence, all NVC types included at the site were included in the portfolio and counted toward community goals.

Fifty nine NVC associations of the total of 109 are included in the portfolio. Ten NVC types had examples within the HAL database, but none of these occurrences were considered to be viable. Forty NVC types were not represented by any occurrences in the database. Eight Heritage

community occurrences were included in the portfolio that could not be connected to a specific NVC association but were connected to a vegetation group.

Communities best represented in the portfolio include those that have been considered globally rare and the focus of Heritage surveys. These communities include bogs, fens, black spruce wetlands, ridgetops and rocky summits, and cliffs. Recent Heritage work has increased the numbers of some of the more common forest associations, particularly for deciduous forests which are dominant in HAL.

There are many groups that are very poorly represented in the portfolio that will require extensive additional field work to meet ecoregional goals. There are no occurrences of marshes and wet meadows or springs and seeps and very few occurrences of talus slope woodlands, floodplain forests, or the broad range of communities in HAL related to streams, rivers, lakes, and ponds.

Summary of results by NVC group

A summary of the success of capturing natural communities in the HAL portfolio by group is presented in Table MMM and below, with observations on inventory needs, likelihood of additional occurrences at other portfolio sites, and restoration potential.

Table MMM. Assessment of HAL Portfolio for Natural Communities in relation to Goals by Group.

Group #	Group Name	# NVC types in HAL	#NVC types with EORs	Total # of Occurrences	Total # viable	Goal for Group	% of Goal Met
1	Bogs and Acid Fens	6	4	99	51	60	35
2	Calcareous Fens	8	5	30	10	110	5
3	Cliffs (not wooded)	2	1	9	5	10	50
4	Deciduous or Mixed Woodlands	3	2	10	7	65	11
5	Floodplain Forests and Rivershores	15	8	36	16	155	10
6	Marshes and Wet Meadows	5	4	7	0	24	0
7	Palustrine Forests and Woodlands	23	16	86	50	339	15
8	Ponds and Lakes	4	2	15	3	20	15
9	Ridgetops and Rocky Summits	13	11	46	34	169	20
10	Rivers and Streams	4	1	1	1	20	5
11	Seeps and Springs	1	0	0	0	5	0
12	Terrestrial Coniferous Forests	5	2	16	12	65	18
13	Terrestrial Deciduous Forests	12	6	33	27	114	54
14	Terrestrial Mixed Forests	8	6	18	13	65	20
	All NVC Types	109	68	416	264	1221	22

Group 1- Bogs and Acid Fens: 6 NVC Types. Goal: 60. Total in portfolio: 51 Progress: Good. Bogs and acid fens have been the target of many of the inventory projects in the glaciated portion of HAL. This is the southern limit of these communities and also the southern limit of several of the major species found in these Heritage communities. Most of the work to date has focused on the dwarf shrub bog aspect (NVC type 6225) of this assemblage. Most occurrences in the database are probably mosaics of several communities in this group and may also include examples of Group 7 Palustrine Forests and Woodlands, as well. There are undoubtedly many

more examples of these communities within HAL. All of them will be in the glaciated part of the ecoregion, mainly in the Catskills and in eastern Pennsylvania. Some may remain in good condition even in very small patches. Surveys within matrix forest blocks should lead to additional occurrences for the portfolio. There is an excess of one dwarf shrub bog NVC association in the portfolio (Goal=5; Viable in the portfolio=27).

Group 2: Calcareous Fens. 8 NVC Types. Goal: 110. Total in portfolio: 10. Progress: Good-(the goals are highly inflated). The number of fens in HAL is limited by the low percentage of calcareous bedrock areas within the ecoregion. Within those areas in New York and New Jerseys where fens are found significant attention has been focused on the documentation and management of fens and fen-related communities. Viability has been a major concern for most fen occurrences. Because fens occur in alkaline environments, upland soils near fens are generally well suited for agriculture, row crops in areas with good soil development, and pastures in areas with thinner, rocky soil. Many fens are found in a generally agricultural landscape. Some have cornfields at the upland edge. Cows are often grazing in wetlands on alkaline soil in plant communities that might be good fens with fewer disturbances. Despite considerable nearby impacts, many of these fens have persisted for years without serious loss of native species diversity or invasion by weeds. There are likely very few additional fens to document with increased field work. Restoration may be possible in some areas. It may be difficult to reach the current goals set for these associations**.** The goals for this group are dramatically inflated by the limited and restricted distribution of some of these NVC types. While restoration may be possible at some sites to increase numbers of occurrences in the portfolio, the very limited extent of available habitat will restrict the possible number of occurrences. Additional work is also needed to connect currently documented occurrences to NVC types.

Group 3: Cliffs (not wooded). 2 NVC types. Goal: 10. Total in portfolio: 5. Progress: Good. With the exception of the Shawangunks, cliffs have received little attention in HAL. There are significant areas with cliffs in the Catskills, along the Shawangunk/Kittatinny Ridge, along the major rivers where shale deposits have been eroded, and along the steep cut valleys of the West Branch of the Susquehanna River. Elsewhere in HAL, despite moderate elevation hills, most slopes are gradually tapered without rock exposures. The diversity of cliffs within HAL has not been assessed well, mainly because these are sparsely vegetated areas and most inventory work has focused on forest and woodland communities in HAL. There are likely other NVC cliff types in HAL. Many more examples of good quality cliff communities will likely be found within the many matrix forest blocks with steeply sloped mountains, particularly in the Catskill and in north-central Pennsylvania.

Group 4: Deciduous or Mixed Woodlands. **3 NVC types. Goal: 65. Total in portfolio: 7. Progress: Poor.** Most dry woodland communities are found on thin soils along upper slopes and on rocky summits. These NVC types are grouped together in Group 9: Ridgetops and Rocky Summits. This group in HAL is limited to talus slope woodlands and low elevation areas with poor, rocky soil. These community types are believed to exist throughout the ecoregion. These communities are not well understood in HAL in terms of vegetation types or distribution. Areas with woodrats or rattlesnakes probably support these types of communities. Many examples will be small patch in HAL and likely in good condition. Many matrix forest blocks likely support good examples of Deciduous or Mixed Woodlands.

Group 5: Floodplain Forests and Rivershores. 15 NVC types. Goal: 155. Total in Portfolio: 16. Progress: Poor. This is a broadly defined and poorly understood group in HAL. Floodplain

Forests and Rivershore could easily be subdivided, since most of the rivershore communities are dry upland grass- and shrub-dominated open canopy communities that are associated with rivershore processes, particularly ice scour in the winter, and only slightly related to floodplain forest communities. Detailed work by the Heritage Programs in LNE and CAP has characterized most of the community types represented in this group. The distribution and composition of these associations in HAL are not well understood. To create goals for these types, a conservative estimate of distribution was used when there were incomplete data. It was assumed that the NVC types were at rarest "Limited" to HAL because these types were first described in other ecoregions. Many are probably Widespread. Floodplain forest work is planned in both NY and PA that will lead to a refinement of the NVC types in HAL, better distribution information, and new occurrences for the databases. It is likely that many of the NVC types described for Hal to date will be combined and rewritten leading to fewer overall types in the ecoregion. Because there are extensive networks of rivers and streams throughout HAL, there are also numerous floodplain forests. Most of the sites have, however, been altered dramatically because original floodplain forest sites provide ideal locations for agriculture or residential or commercial development. Virtually all of these areas in HAL have been cleared over times. Only a few have been allowed to revert to natural forest. Most of these occurrences are small. Floodplain forest types that were formerly large patch are probably extant only as small patches. Restoration will be needed to establish floodplain forest community examples at historical scales. However, little is known of biodiversity in these formerly extensive forests in HAL.

Group 6: Marshes and Wet Meadows: 5 NVC types. Goal: 24. Total in portfolio: 0. Progress: No progress. Marshes and wet meadows have not been the focus of any Heritage field work in HAL. Most of the marshes and wet meadows in HAL are successional and associated with floodplains, beaver activity, or human disturbance. These communities have received little conservation attention. The five NVC types are broadly defined. Additional field work on marshes and wet meadows associated with continued aquatic assessment will likely define new NVC types already known from other ecoregions.

Group 7: Palustrine Forests and Woodlands: 23 NVC types. Goal: 339. Total in portfolio: 50. Progress: Fair (considering goals are inflated) Palustrine forests and woodlands have not been well studied in HAL. Survey projects in LNE and CAP have identified numerous NVC types that may be present in HAL. After surveys within the ecoregion, it is probable that many NVC types in this group will be combined and rewritten. Goals for this group are highly inflated due to the high number of NVC types currently described in HAL and insufficient data to make an accurate assessment of distribution. Notable among these associations in HAL are Atlantic white cedar dominated communities that extend into the eastern portion of HAL and Northern white cedar communities that reach their southern limit in the calcareous part of the ecoregion. Many of the palustrine forest and woodlands in HAL have been filled or drained. Most occurrences are now present as small patch communities, which were previously larger. Many of the remnant examples are associated with the numerous rivers within the ecoregion. Surveys within matrix forest blocks should identify many of the best examples of these communities remaining in the ecoregion.

Group 8: Ponds and Lakes: 4 NVC types. Goal: 20. Total in portfolio: 3. Progress: Poor. Very little inventory work has been conducted in the ponds and lakes of HAL. Only two NVC types associated with these features have been identified. There are certainly many more associations within the ecoregion related to ponds and lakes. It is probable that none of these are

unique to HAL, and that all are widespread and small patch. Little information has been compiled about important species associated with lakes and ponds in the ecoregion.

The southern limit of glaciation runs through HAL. The northern and eastern parts of the ecoregion were glaciated and have numerous ponds and lakes related to glacial landforms. Most large lakes, particularly in the Catskills, have been modified with dams and are either reservoirs or flood control features. The unglaciated portion of HAL in the southwest have very few natural ponds and lakes.

Group 9: Ridgetops and Rocky Summits: 13 NVC types. Goal: 169. Total in portfolio: 34. Progress: Good (goals are inflated). The eastern sections of HAL support numerous hills and ridges with open canopy communities. Many of these summits are in good condition and support unusual species and communities. Several ridgetop communities that have been identified as globally rare have been well surveyed. A general rocky summit inventory effort was undertaken in New York that added numerous occurrences in the eastern part of HAL to the database. There are fewer open canopy rocky summit community occurrences in the non glaciated southwestern part of the ecoregion. Better distribution information about these communities is likely to indicate limitation to the range of these association in HAL and will reduce general goals for this group. It is also likely that for some of these associations, all occurrences have been documented and that goals for these community types will need to be adjusted to reflect natural distribution and abundance. Restoration is not like to play a major role in the establishment of new occurrences although fire management is needed in several types that have been fire-suppressed for many years.

Group 10: Rivers and Streams: 4 NVC types. Goal: 20. Total in portfolio: 1. Progress: No progress. This group refers to vegetated areas within rivers and streams and the palustrine graminoid/herbaceous borders of rivers and streams. The numerous rivers and streams in HAL have not been inventoried at all for natural communities, except for the more upland types of communities associated with flooding and ice scour. These communities appear in Group 5: Floodplain forest and rivershores. There are many occurrences of emergent vegetation in shallow, slow moving sections of streams and rivers, and many instream aquatic community occurrences dominated by plants. These need additional assessment in terms of the NVC and documentation of occurrences. Most of these occurrences will be small patch, but there may be some large patch occurrences associated with slow moving, shallow sections of the major rivers.

Group 11: Seeps and Springs: 1 NVC type. Goal: 5. Total in portfolio: 0. Progress: No progress. Seeps and springs occur as small patch communities throughout HAL. No inventories have been conducted in these communities to date. The related communities associated with waterfalls have also not been documented, although Pennsylvania carried occurrences of waterfalls as a physical feature in the database and has begun an NVC assessment of these small patch communities. Good examples should be found in the matrix forest blocks identified in HAL.

Group 12: Terrestrial Coniferous Forests: 5 NVC types. Goal: 65. Number in portfolio: 12. Progress: Fair. Terrestrial conifer-dominated forests occur mainly at high elevations and in the eastern part of HAL. There have been detailed surveys of the spruce-fir forest of the Catskills, but fewer surveys of the pine and hemlock forests scattered along ravines throughout the Catskills and in other steep terrain in the eastern parts of HAL and on the steep slopes along the West Branch of the Susquehanna River. Past logging has significantly altered many of these

forests. More recently, effects of the wooly adelgid have decimated some hemlock stands. The wooly adelgid currently occurs in the southeast and eastern sections of the ecoregion, but has not yet advanced into central Pennsylvania and western New York, where hemlocks are more scattered. Additional inventory work in matrix forest blocks will result in many new occurrences for the portfolio. The Pine-hemlock forest (6328) is probably no longer present as a large patch community over much of its range in HAL.

Group 13: Terrestrial Deciduous Forests: 12 NVC types. Goal: 114. Number in portfolio: 20. Progress: Fair. Terrestrial deciduous forests dominate much of the remaining natural areas of HAL. All the current matrix forest types are in this group. Because the initial focus of Heritage Programs was on globally rare natural communities, few terrestrial deciduous forests have been inventoried until recently. These forest have also been significantly altered by excessive logging, management for particular species, notably cherry and oak, forest pathogens, and severe deer browse. Chestnuts were once dominant in several of these community types and are now nearly absent. Beech has declined severely as a result of beach bark disease. Gypsy moths have reduced oak dominance locally and even killed trees over some large areas. Many forest occurrences in HAL have a continuous canopy, but lack much of the diversity of the former forest communities. Restoration of many of these associations may be necessary to reestablish some forest processes. Occurrences of most of these associations will be abundant within matrix forest blocks. Additional NVC types may be identified for this group. Some types may be combined and altered significantly with additional field work. In the statistics for this group, it is assumed that examples of all matrix forming associations will be found in selected matrix forest blocks.

Group 14: Terrestrial Mixed Forests: 8 NVC types. Goal: 65. Number in portfolio: 13. Progress: Fair. Terrestrial mixed forests, like Deciduous forests, are widespread and common in HAL. Because none of these associations are globally rare, only limited field work has been conducted to document these communities. These associations have also been severely altered from their condition prior to European settlement by selective logging, clearing for agriculture, forest pathogens, and excessive deer browse. Many occurrences of these associations will be found in matrix forest blocks. Many of these occurrences may be large, although significantly altered from their original compositions, structure and conditions.

Heritage occurrences not selected for the portfolio

From the combined Heritage state databases, 256 natural community occurrences were not included in the HAL portfolio.

There were a broad range of reasons why natural communities were not selected for the portfolio. Chief among these was that occurrences did not represent recognizable NVC associations. Occurrences of waterfalls and plunge pools and high gradient streams did not include any vegetation data. Nor in most cases did these occurrences include detailed condition information. Vernal pools were also not included, because within the NVC, vernal pools are generally very small and considered to be a part of the larger, usually forested, association in which they are located.

Many occurrences were eliminated because the data were very old. All occurrences with a LASTOBS (last observation) date before 1988 were questioned. If the ecologist in the state knew that the occurrence remained in good condition, the occurrences was included. If no additional data were available, the occurrences were not included, but annotated that the element

occurrence record needs to be updated. These occurrences, particularly those with a high occurrence rank, should be the first investigated to add community occurrences to the HAL portfolio.

Some Heritage occurrences lacked sufficient detail to be able to distinguish the NVC association or in a few cases even whether the occurrence was a forest, woodland , or open canopy community. These were annotated and not included in the assessment.

Several occurrences were not included because their size was too small to meet the minimum standards of the NVC association. The concept of patch size for specific NVC associations is only recently developed and has not been included in some Heritage documentation. There are numerous occurrence of natural communities that, while highly recognizable as a vegetation unit, are no longer able to persist over time, because they are irreparable fragmented or otherwise compromised and lack necessary ongoing processes. Several occurrences of matrix forest communities were very small, some under 100 acres, and not capable of maintaining the diversity and processes necessary to capture the full range of biodiversity expected in a matrix forest example. Similarly, several very small large patch community examples were discarded from the portfolio. In many cases, particularly for floodplain forests and the upland forests that occur at sites suitable for agriculture or residential/commercial development, remnant examples are very small and lack sufficient extent to allow all necessary processes to occur to maintain the natural community long term. In many of these cases, it will be necessary to identify restoration sites, if these natural communities are to be included in the portfolio. Remnant occurrences may play an important role as a nucleus for these restoration efforts, but to date these occurrences have not been include in this portfolio without further assessment of their potential.

Many occurrences were eliminated from the portfolio because of poor landscape context. Landscape context has for many years been a major component of assessing the rank of a Heritage community occurrence. In general, low quality context diminishes a rank, but often has not eliminated the documentation of a recognizable occurrence. Following an initial assessment by each state ecologist, the community database was returned to the ecologist with the GIS landscape assessment of the 1000 acres surrounding each occurrences. The ecologists were asked to look again at those occurrences with a landscape context of “3,” highly developed or “4,” intensely developed. Many of these occurrences, particularly for large patch communities, were not included in the portfolio. Those occurrences with a low landscape context value that were included in the portfolio were generally small patch communities which are believed to be capable of persisting in very small areas because the processes needed to maintain the community are very local and not highly impacted by surrounding conditions.

Comments were recorded for all community occurrences that were not included in the portfolio and returned to the Heritage Programs. Of the 256 natural community occurrences in HAL that were not selected, 71 of these are labeled with a “?” in a column describing viability. All of these occurrences would benefit from additional assessment, usually including a field visit. This group of occurrences is one of the best sources of additional occurrences for the HAL portfolio to meet community goals.

Geographically, Heritage occurrences not included in the portfolio are found throughout the ecoregion with highest concentrations in central and western Pennsylvania, in the calcareous section of central New York, and at scattered small sites in the agricultural areas of central and western New York and Pennsylvania.

General observations about the HAL natural community assessment

Goals: Stratification and numerical goals for communities in HAL are based on having good information on global distribution and patch size for each NVC association. The HAL ecoregion occurs in parts of each of the three participating states that are not known well to the ecologists. Most of the data included on distribution and patch size are estimates. The link between state classifications and the NVC require new ways of looking at plant communities for many ecologists. Furthermore, most state ecologists are not familiar with the full range of associations outside their state. A conservative approach was used in calculating numerical goals from estimated patch size and distribution. Many of the associations in HAL are probably more widespread than noted. Additional refinement of the distribution of NVC associations is likely to reduce numerical goals for many groups.

The goals set for several NVC types are unrealistically high and should be modified downward to reflect the potential distribution of biodiversity in the ecoregion. For example, there are several small patch communities that are believed to be restricted to HAL. These are particularly rare communities and it is important that the HAL portfolio recognize their relative importance within the ecoregion. In many cases, there is, however, very limited available habitat of these communities. For example, the dwarf pine community in the Shawangunks (NVC- 6079) is found only at this one site. It is described as a small patch restricted community with a goal of 25 occurrences in the ecoregion. There is only one occurrence in the portfolio and no other occurrences are reasonably expected to be found anywhere. There are other similar examples within the classification, particularly for the globally rare communities that have been well studied throughout their ranges. Numerical goals should be adjusted for these communities to reflect current occurrences and any potential occurrences that might benefit from restoration.

Additional field work is needed to meet goals for most communities in HAL. There is a significant opportunity to document many of these communities that are represented in the portfolio at levels below their goals by conducting field surveys associated with matrix forest blocks and aquatic systems conservation action. Most viable occurrences of communities in HAL will be associated with these areas and will benefit from conservation associated with other ecoregional targets.

The HAL NVC needs additional work that will further clarify goals. Many of the associations currently ascribed to HAL will be modified as the ecoregion becomes better known. Palustrine forests and woodlands and floodplain forests are poorly understood in the ecoregion. All HAL NVC types in these groups were first described from other ecoregions and believed to extend into HAL. More detailed work on these groups in HAL should define fewer NVC types and clarify what appears to be a proliferation of wetland types resulting from a series of projects in neighboring ecoregions. It is likely that the 38 NVC types in these two groups can be combined into far fewer associations and descriptions effectively broadened to create a more even approach to these communities. Many of the occurrences of these communities are highly altered by filling, changes in hydrology, or past land use. Restoration is likely to be an important tool in capturing the biodiversity in these communities at their former scale.

Other communities poorly understood in the HAL classification include cliffs, talus slope woodlands, and the full range of non-forested communities associated with the many rivers and streams in HAL.

Next Steps for Natural Communities in HAL

1. Continue to refine the HAL NVC.
2. Continue inventory work on HAL associations, particularly focusing on poorly understood groups.
3. Continue to make connections between NVC associations and the physical features associated with ELUs.
4. Create more usable versions of the HAL NVC that can become a part of standard Heritage documentation and TNC conservation action.
5. Create more efficient crosswalks between state classifications and the NVC, leading to the connection of all documented Heritage natural communities to NVC associations.
6. Encourage and enable the Heritage programs to update their natural community databases with information collected during this ecoregional planning process. Maintain the connections between field assessment of HAL portfolio sites and Heritage documentation.

6. NATURAL (TERRESTRIAL) COMMUNITIES (PART 2):MATRIX-FORMING FOREST SYSTEMS

Matrix forest sites were defined as large contiguous areas whose size and natural condition allow for the maintenance of dynamic ecological processes and meet the space requirements of breeding species associated with forest interior conditions. Included in the matrix forest areas are viable occurrences of matrix forest communities, embedded large and small patch communities, and embedded species populations (Poiani et al. 2000, Anderson et al.1999). The goal of the matrix forest selection process is to identify specific examples of the dominant forest ecosystems that represent all of the prominent biophysical gradients in the ecoregion and that, if protected and allowed to regain their natural condition, would serve as viable critical source areas for all species associated with the dominant forest systems.

Matrix forest systems in the High Allegheny Plateau ecoregion are comprised of a handful of dominant forest community types, including Northern hardwoods, Maple-birch- Beech forest, Oak Hickory forest and Allegheny oak forests. Included in the definition of matrix forest systems are also all the early and mid-successional stages of these forest types. Descriptions and technical names of all matrix forest types as well as the (approximately) 100 other forested and non forested community types are available in the High Allegheny Plateau community classification booklet (Lundgren et al. 2001) developed by the Heritage Ecologists in the participating states and region.

Viability criteria for matrix forest systems in the High Allegheny Plateau were developed based on the scale of expected natural disturbances and the size requirements of selected interior forest species within the ecoregion (See Anderson 1999 for full details on the methodology). To estimate the critical area needed to insure that a system can absorb, buffer, and recover from disturbance, (e.g. minimum dynamic area - Pickett and Thompson 1978), we first listed the expected catastrophic disturbances typical of the ecoregion. Next we scaled the *minimum* size criteria for forest areas to the size and extent of severe disturbance patches (total canopy removal) expected over one century (Table 1). To replicate the natural pattern of disturbed to undisturbed forests in the northeastern U.S., we used the guideline that an occurrence of a functional matrix forest should be about four times the size of the largest, most severely disturbed patch within the forest (the patch size of total canopy removal) (Anderson 1999, based on Foster and Boose1992, Canham and Loucks 1984, and Lorimer 1977).

Table 1. Characteristics of infrequent catastrophic disturbances in the Northeast.

Disturbance characteristic	Tornado	Hurri-cane	Down-bursts	Large Fires	Insect outbreak	Ice Storm	Flood
Duration	Minutes	Hours	Minutes	Weeks /months	Months	Days	Week /months
Return interval in years	100-300	60-200	?	400-6000	10	2	50-100
Maximum size of severe patches (acres)	5000	803	?	57-150	?	?	?
Size of total event in acres	1240 K-24710 K	12400 K – 5 M	1M	12,400K-24 M.	247,000K –200 M	12,400 K – 24 K.	12,400 K-124,000K

To identify the minimum size needs for associated species, we initially developed a list of species associated with the dominant forest systems in the High Allegheny Plateau. Subsequently we narrowed the list down to those species dependent on forest–interior for breeding. Examples

of those species include year- round residents preferring large tracts of old forests, e.g. Broad-winged Hawk as well as forest breeding neotropical migrants (Figure 1*).* Using literature and expert opinion, we then developed an estimate of acreage needs for 25 female breeding territories of each species and/or acreage to meet any area sensitive needs that have been demonstrated for individual species. *(Note the 25 female breeding territories does not refer to population size as most species require a much larger populations size (e.g. hundreds) to insure that there are 25 breeding pairs. This is simply an estimate of area needed to contain 25 breeding territories.)*

Wide ranging species and top carnivores (e.g. bobcat) that benefit from forest interior conditions but require a broader range of habitats and conditions for survival were considered but not explicitly included in the scaling of the forest area requirements. The needs of each of these species are being addressed in a species specific way through a combination of core areas, networks, and connecting lands.

To set a critical size threshold for matrix forest systems, we combined the minimum dynamic area for disturbances with the acreage need of forest interior dependent fauna onto a single linear axis (Figure 1). This allows an estimate of the effect of any particular size minimum on a variety of selected disturbances and faunal associates. For instance, an occurrence of 10,000 acres should be effective for 1) absorbing all types of expected severe wind and fire disturbances, 2) containing multiple breeding populations of all forest interior songbirds, and 3) containing 25 female territories of Broad-winged Hawk.

Using Figure 1, we set our minimum size criteria at 15,000 acres. At this point in time, 15000 acres is a *minimum* threshold and is not intended to suggest that 15000 acres is necessarily large enough for the reserve to succeed in all its objectives over time. The actual size needed for each reserve to succeed is dependent on what happens to the entire landscape of the ecoregion over the next two centuries. The 15000 acre standard *is* intended to define a size below which it is likely matrix forest protection will not succeed or will become increasingly expensive and labor intensive to maintain.

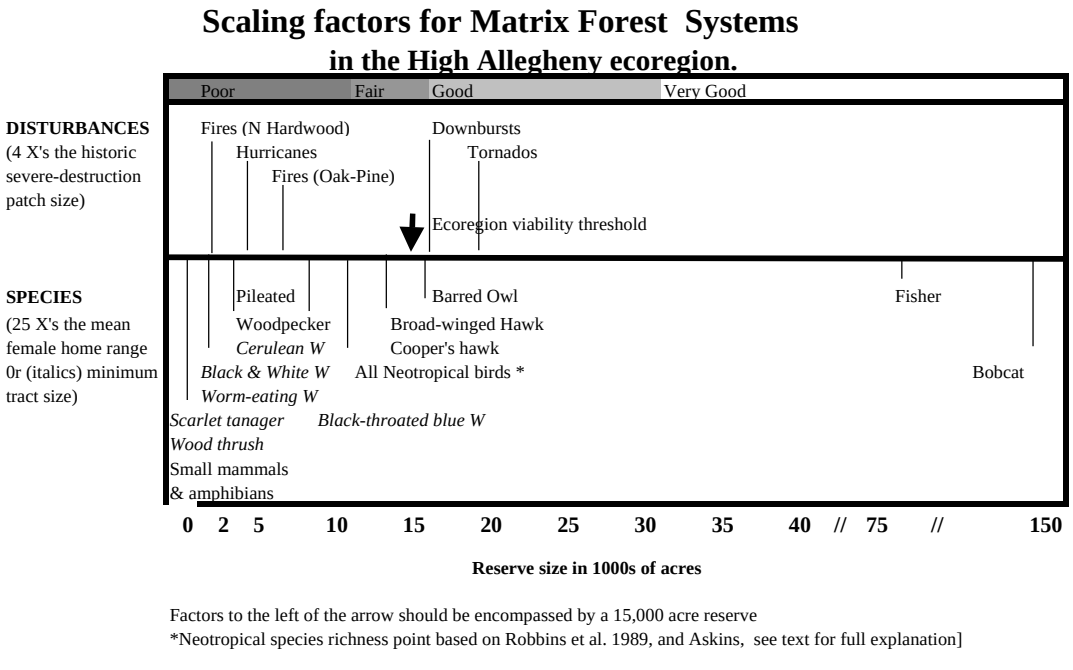

Figure 1. Scaling factors for matrix forest systems

Development and Selection of Matrix Forest Occurrences

Once the general matrix size standard was set, the matrix site selection process followed five sequential steps: 1) develop road-density and forest cover data layers for the ecoregion and delineate a set of potential matrix sites based on a spatially explicit analysis of road-bounded forest blocks; 2) revise the boundaries of these areas and determine which blocks meet the viability criteria by assessing the condition of each potential block through field and expert analysis at individual state meetings; 3) assess the biophysical composition within each block based on Ecological Land Units (ELUs) and cluster the blocks into ecologically similar groups based on similarities in ELU composition; 4) prioritize blocks within each ELU group into Conservation Priority Tiers based on forest diversity and condition, and then proximity to other features, biodiversity value, complementarity, feasibility, and threat.

STEP 1. Forest blocks were defined as contiguous areas of forest cover bounded by features such as roads, railroads, major utility lines, and major shorelines. The bounding features were chosen due to their ecological impact on biodiversity in terms of fragmentation, dispersion, edge-effects, and invasion of alien species. Blocks served as assessment and analysis units and a wide range of field and remotely sensed ecological attributes describing the blocks size, condition, diversity, and landscape context were collected (Table 2) .

Table 2. Data used in estimating the initial block boundaries

Block Bounding Feature Types
1. Primary highway with limited access: Interstate highways and some toll highways. Distinguished by the presence of interchanges, access ramps, and opposing traffic lanes separated by a median strip.
2. Primary road without limited access: Nationally and regionally important highways that do not have limited access. Mostly US highways but may include some state and county highways that

connect larger cities May be divided or undivided and have multilane or single lane characteristics.
3. Secondary and connecting road: Mostly state highways that connect smaller towns. Must be concrete or asphalt and are usually undivided with single-lane characteristics.
4. Local, neighborhood, and rural road: Used for local traffic and usually have a single lane or traffic in each direction. Includes paved and unpaved roads.
5. Waterbodies: Lakes and wide rivers.
6. Railroads
7. Major Utility Lines: Pipelines or Powerlines
8. Airport runways, permanent fences, ski lifts
Percent forest cover was estimated using the MRLC 30 m land cover data for the ecoregion> We defined natural cover as being any combination of the following cover classes: coniferous forest, deciduous forest, mixed forest, forested wetland and emergent wetland

STEP 2. State by state expert interview revised and supplemented the first estimate of potential blocks. Experts reviewed the compiled information on each potential block and revised site boundaries based on their knowledge of road conditions, and added additional information on the dominant forest types, forest condition and composition, land use, forestry practices, hydrologic features, rare species and patch communities, presence of old growth forest, and forest diversity. Information was collected and stored in a systematic way for each block using the questionnaire shown in Table 3. After a discussion of each block it was ranked o a 3-point scale (Yes, No, Maybe) as to whether it met the viability criteria. Blocks receiving a No were not included in any further analysis.

STEP 3. Expert interviews resulted in a smaller subset of potential blocks for evaluation. Site boundaries for these blocks were revised as determined at the expert workshops The composition of Ecological Land Units (ELUs) within each ecoblock was then analyzed to cluster the blocks into ecologically similar groups. Details on the development of the ELU data layer has been described elsewhere (Anderson 1999, Anderson et al. 1998). For the High Allegheny Plateau ecoregion the map was developed off a 90 meter digital elevation model using the categories shown in Table 4 .

Table 3. High Allegheny Plateau Block Questionnaire

Block name
Size, boundaries, combination
Condition
- Logging history: comments
- Current ownership/management/logging practices: comment
- Old growth?
- Managed areas: comment
- Cover class review, comments
- Road density, comments
- Block shape: comments
- Comments/rank

Ecological features
- Review EOs: comments
- Review ELU set: comments
- Expected communities: comments
- Review aquatic features list: comments

Condition of Aquatic features: comments
Unique features?
General Comments/rank
Landscape Assessment
Visual assessment, of relation to other block/developments etc

Grouping of the Matrix Forest Blocks by ELU Composition

The boundaries of the fifty seven potential matrix forest blocks were digitally overlaid with the ecological land unit data layer to determine the composition and quantities of each ELU present in each block. The results of this step were converted to a spreadsheet format (blocks = columns, ELUs = rows) and quantitatively grouped using standard multivariate analysis tools (TWINSPAN, DECORANA) available in the PCORD software package. This step was performed to determine which blocks were ecologically interchangeable and which blocks represented very different sets of ecological land features.

The analysis initially partitioned the blocks into three groups, A, B, and C.

Group A is made up of blocks occurring on fine-grained shale bedrock. These blocks are all at low to mid elevations within the ecoregion and are found in Western New York extending only slightly into Pennsylvania. The Group B blocks are all primarily on coarse-grained sandstone bedrock with a broad range of elevations. These blocks occur in Pennsylvania, New Jersey, and in the extreme eastern part of New York. Group C consists of a small subset of blocks located in the localized portion of HAL with calcareous bedrock.

Descriptions of each of these block groups follow (colors refer to Map 12: Ecological Land Units, showing ELU groups of matrix blocks):

Table 4. Ecological Land Units for the High Allegheny Plateau

ECOLOGICAL LAND UNIT (ELU)

Elevation class (in feet)		Geology Class	Topographic
1000 Very low	0 - 1000	100 Acidic Sedimentary	**10's Steep Slopes**
2000 Low	1000- 2000	200 Acidic Shale	10 Cliff
2500 Mid	2000-2500	300 Calcareous sedimentary	11 Steep slope
3250 High	2500-3250	400 Moderately Calc. Sed.	12 Slope crest
>3250 Alpine	>3250	500 Acidic Granitic	13 Upper slope
		600 Intermediate Granitic	14 Flat summit
		700 Ultramafic	**20's Side Slopes**
		800 Deep surficial	20 Sideslope - N / E
		900	21 Cove - N / E
			22 Sideslope - S / SW
			23 Cove - S / SW
			30's Flats
			30 Dry Flat Till or Patchy Sediment
			31 Dry Flat Fine Grained Sediment
			32 Wet/Moist Flat
			33 Slope bottom
			34 Dry Flat Coarse Grained Sediment
			40's Aquatic
			40 Stream
			41 River
			42 Lake

Example:
1000 Low + 700 Ultramafic+ 33 slope bottom = 1733
1733ELU1733 Very low, ultramafic slope bottom

Group A blocks

Group A1a (pale blue) consists of three low elevation blocks, each currently with moderate forest cover (81-85% cover). These blocks include scattered NY State Forest land and private forested land, which are actively being logged. There are numerous pine plantations. No Heritage inventory work has taken place in these blocks. Low elevation sites are generally used by small dairy farms. Only one of these blocks is large (Jersey Hill); all are moderately dissected by roads and would require significant restoration to support functional matrix forest characteristics.

Group A1b (dark blue) consists of five blocks at mid elevations for the ecoregion with good forest cover (87-92%). The dominant forest type is Allegheny oaks with oak hickory on south facing and drier sites. There are some remnant silver-maple ask swamps along some stream corridors. Both Trollius and Carex schweinitzii occur within this area reflecting local influence of alkaline substrate. All blocks under consideration are large, but moderately dissected by roads. The blocks near the Allegheny River are mainly privately owned and managed for timber production with few farms. These forests produce high quality cherry. The Bristol Hills block is a mosaic of public and private land with dairy farms at low elevation.

Group A2a (pale green) blocks occur in glaciated areas and have shallow soils on dry flats. Because the area was glaciated there are scattered wetland and glacially derived upland features. These blocks have not been inventoried by Heritage. The dominant forest types are believed to be Allegheny oak with oak hickory on drier sites. There are three blocks included in the assessment of this group; two of these are small (Connecticut Hills and Red House Run). All three have relatively low public ownership compared to many other blocks in HAL. All are moderately dissected by roads. Red House Run has low forest cover.

Group A2b (dark green) is made up of six blocks, all within the non glaciated part of HAL. These blocks have few wetlands and deeper soils at low elevation. Dominant forest types include Beech maple forest and Hemlock northern hardwoods. On drier sites Allegheny oaks are found; richer sites with deeper soils support Rich mesophytic forests. These blocks are locally dominated by cherry and have been managed for high quality hardwoods. There are a few areas of old growth. Cerulean warblers are found in good concentration along the Allegheny River. Swainson's thrush is also found within these blocks. Four of these blocks are large; one is small (Kinzua East-10K acres), but in great condition (99% natural cover and high percentage of managed area- 99.8%). Allegheny State Park is primarily owned by NY State, has high natural cover and has not been logged for many years. There is currently no logging going on in the park. There are numerous interior roads which dissect the forest into smaller units. The two Kinzua blocks are both within the Allegheny National Forest designation boundary. Kinzua West is in good forest cover, but has a low percentage of land in managed area.

Group B blocks

Group B2 (red) consists of six block in the Catskills that have the greatest abundance of mid elevation features in HAL and the only high elevation feature in the ecoregion. All of the B2 block are in great condition with a high percentage of managed area. The NY State has designated that all state owned land in the Catskills will be held as Forever Wild with no cutting of trees. This assemblage of six blocks constitutes that largest mass of natural area within HAL.

Group B1a (brown) is made up of low elevation blocks that have been glaciated. These blocks have the highest concentration of glacial features and associated wetlands in HAL. This group is by far the most heterogenous of all block groups in HAL. Tobyhanna in the Poconos supports only 13 ELU types, the second lowest in all of HAL, Kittatinny supports 82 ELU types, second highest in all of HAL. Vegetation types include shale cliff communities and talus slopes, ridgetop woodlands, Northern Appalachian shale barrens, a range of pine barrens, and chestnut oak forests. There are numerous wetlands, including black spruce bogs, Northern conifer swamps, kettlehole bogs, and Inland Atlantic white cedar swamps. Size and public ownership percentages also vary widely.

Blocks within **Group B1b2** (pink) are all located within the non glaciated part of HAL. These blocks have greater development of eroded features (residuum) at low and mid elevations than the blocks in B1b1 (orange). Many of the blocks in B1b2 have deeply cut narrow valleys established by the West Branch of the Susquehanna River. Dominant forest types include Hemlock northern hardwoods, Northern hardwoods and Appalachian oaks. There are scattered pockets of old growth. There are several woodrat sites. Introduced elk are in some blocks. Many sites are owned by Pennsylvania state forestry. Like the six Catskills, the forest blocks around Emporium constitute a significant forest matrix fragmented only by scattered state roads. There are, however, numerous smaller interior roads and scattered roads supporting gas wellfields. Group B1b2 includes some of the largest Pennsylvania state forest units and Tionesta and Hickory Creek within the Allegheny National Forest. In sum these block present great opportunities for forest matrix conservation.

The blocks within **B1b1** are quite varied with elevation features and low abundance of deep soils on dry flats. Dominant vegetation varied considerably from site to site, but includes hemlock northern hardwoods, chestnut oak forest, ridgetop pine barrens, spruce rocky summits, and oak hickory forest. Locally there are steep cliffs and talus slopes. Woodrats were found throughout

the areas with talus slopes. There are numerous wetlands including bogs. These blocks are as varied as the Northern Gunks block in NY which supports a pine barrens on thin high elevation sites to Blooming Grove in Pike County PA. These blocks currently support a varied group of forest types. One of the largest Pennsylvania State Forest units- Sproul is within this group.

Group C blocks

Group C (fuschia) consisted initially of four blocks that are located in the only significantly calcareous part of HAL. These blocks are clustered in the north-central part of the ecoregion and are a low to mid elevation extension of a band of calcareous bedrock exposures that runs along the northern border of HAL, primarily in the Great Lakes Ecoregion. These blocks are all low and mid elevation and are currently covered with second and third growth forests on upper slopes and summits. Most of these blocks were at one time completely cleared and used for agriculture, including row crops on low elevation areas with good soils and pastures at higher elevation Dominant forest types include oak-hickory and sugar maple-dominated hardwoods with high diversity spring ephemerals. There are large patches of hemlock northern hardwoods and Allegheny oak forest. These blocks have numerous wetlands including some of the only fens and other alkaline communities in HAL. Some of these wetlands have affinities to more northern communities, including spruce-fir swamps and black spruce tamarack swamps. The lower elevation parts of these block are primarily covered with small-scale dairy farms, many of which are abandoned. Some the state-owned tracts in these blocks are planted to pines which are known for their use by crossbills. All candidate blocks in this grouping would need significant restoration to become functional matrix forest blocks. Only one block was chosen for consideration in the portfolio.

STEP 4. A group meeting of core team members, state directors, and experts was held to review the ELU grouping of potential matrix sites and prioritize them by ELU group into Conservation Priority Tiers based on forest diversity and condition, and then proximity to other features, biodiversity value, complementarity, feasibility, and threat. Participants were provided with reports for each potential matrix site and gathered into teams for discussion. Each team was asked to rank all blocks within each ELU group and to select two Tier 1 Preferred Sites within their ELU grouping. Additional Tier 1 Preferred Sites were selected in some groups where two blocks were thought to be insufficient to capture the range of variability or geographic distribution. Additionally, a goal of two Tier 1 Preferred Sites was set for each ecoregion.

Matrix Forest Block Selection Results

MA 10/14/02, BZ 7/02

Each of the 57 candidate forest matrix blocks was evaluated during a meeting of the HAL Core Team. Members from each state in each block group evaluated blocks based on size, condition, ELU composition, biodiversity, and conservation opportunity.

Fifty-three matrix forest blocks were selected for the HAL portfolio. Twenty six of these were identified as Tier 1, defined as preferred blocks in an ELU block group; twenty seven were selected as Tier 2 blocks, defined as alternatives to Tier 1 blocks. Four proposed blocks, all within the calcareous part of the ecoregion (Group C) were rejected entirely for the portfolio as unsuitable for matrix forest conservation.

Five matrix block ELU Groups met the goal of two Tier 1 blocks for the portfolio; selections exceeded goals for three of these groups (Table OOO).

TABLE OOO. Goals and Status of Portfolio for Matrix Forest Block Groups in HAL

Block Group Code	Goal	# Tier 1	# Tier 2	# Needed for Portfolio
A1a	2	1	2	1*
A1b	2	2	1	1
A2a	2	1	2	1*
A2b	2	2	2	Goal met
B2	2	6	0	Goal exceeded
B1a	2	2	3	Goal met
B1b2	2	4	8	Goal exceeded
B1b1	2	6	6	Goal exceeded
C	2	1	0	1*

* All matrix blocks in these groups need extensive restoration

The Catskills (B2- 6 Tier 1 selections) and the blocks located in the mass of Pennsylvania state-owned land (B1b2 and B1b1- 10 Tier 1 selections) present unusual opportunities for matrix forest conservation in the Northeast. Several other blocks were added to Tier 1 for their groups because they included an assemblage of ELUs that were considered important to capture in the ecoregion. These blocks include Kittatinny, Northern Gunks, and Blooming Grove. Several Tier 2 blocks, which were marginal in terms of size, fragmentation, or forest quality, were also added to the portfolio because they included unusual ELU composition or significant conservation potential. These blocks include Tobyhanna, Mongaup, and Buckham Mountain.

All blocks selected for the portfolio, both Tier 1 and Tier 2, will require restoration to create minimum standards for disturbance regimes, area-sensitive species, and legacy features. Several blocks included in this portfolio will require extensive restoration to establish a functional matrix forest. These include all of the blocks in the northern part of New York, in Groups A1a, A2a, and C. These block groups include unique ELU groups and fragments of recovering forest with a mosaic of public ownership in a landscape with abandoned farms. There is potential with focused conservation effort within these areas for the reestablishment of functional forests.

A second goal in HAL for matrix forest conservation was that one block be selected within each subsection, reflecting the differences in physical settings captured by the Forest Service subsection divisions. Table iii. reviews the distribution of selected matrix blocks by subsection. For those blocks that occur in two subsections, the block is assigned to the subsection in which most of the block occurs. At least one block was chosen in each subsection. The greatest number of blocks was selected in the three westernmost subsections, primarily in the areas with large Pennsylvania state land holdings and in the vicinity of Allegany State Park. Nearly all of the Catskills high elevation subsection is included in matrix block units. All the matrix blocks selected in the northern Allegheny Plateau subsection (212Fb), which is primarily a mosaic of farms and small forest tracts, will require extensive restoration.

General statistics of the 53 matrix forest blocks in the HAL portfolio appear in Table RRR. The total acreage for Tier 1 blocks is 1.4 million acres, or 8 % of the entire ecoregion. Combined Tier 1 and Tier 2 blocks total 2.5 million acres or 15 %. Block size ranges from 10,000 acres at Kinzua East to 176,000 at Chittenango Highlands. The meaning of the acreage of these matrix blocks should be cautiously interpreted. Kinzua East is below the 15,000 acres standard for HAL matrix blocks, but is included because of high forest cover, nearly complete public ownership, and interest on the part of the Allegheny National Forest in matrix forest conservation. Conversely, Chittenango Highlands at 176,000 is highly fragmented with roads, has low public

ownership (23%), and moderate forest cover (78%). The large size of this matrix block reflects an area in which matrix forest conservation will be considered in a site conservation plan. There is no implied intention that all 176,000 acres will be subject to restoration. All other HAL blocks fall between these two extremes.

Table RRR. Basic Statistics for Matrix Forest Blocks in HAL

Tier 1 Matrix Forest Block												
Matrix Block Name	**Acres**	**ELU Group**	**Subsection**	**State 1**	**State 2**	**% Managed Area**	**% Forested**	**% Wetland**	**% Natural Cover**	**% Agriculture**	**% Developed**	**Miles of Interior Roads**
Kittatinny	28051.1	B1a	221Bd	NJ		41.3	84.9	1.5	88.5	10.1	11.5	126.4
Allegheny State Park	88760.6	A2b	212Ga	NY	PA	78.1	97.6	0.0	97.8	1.8	2.2	170.7
Bone Run	30271.9	A2b	212Ga	NY	PA	21.6	95.9	0.0	96.1	3.6	3.9	92.8
Bear Pen Vly	48807.6	B2	M212Eb	NY		19.9	94.7	0.0	94.7	5.1	5.3	115.1
Beaverkill	136172.8	B2	M212Ea	NY		53.0	97.5	0.2	98.0	2.0	2.0	241.6
Bristol Hills	24880.2	A1b	212Fb	NY		2.7	88.6	2.5	91.1	8.8	8.9	98.9
Bucktooth State Forest	29897.9	A1b	212Ga	NY		7.8	90.9	0.0	91.0	8.8	9.0	90.1
Cannonsville	18762.2	B1b1	M212Eb	NY		3.8	97.7	0.1	98.0	1.7	2.0	50.9
Catskill Escarpment	40547.6	B2	M212Ea	NY		55.0	97.2	0.2	97.9	1.6	2.1	102.0
Chenango Highlands	176380.0	C	212Fb	NY		22.9	77.6	0.5	79.5	20.1	20.5	589.3
Connecticut Hill	19998.7	A2a	212Fb	NY		55.6	89.5	0.9	90.5	9.1	9.5	68.2
Neversink Unique Area	30364.0	B1a	212Fc	NY		17.3	97.0	1.4	98.8	0.3	1.2	80.3
Nine Mile Creek	35758.4	A1b	212Ga	NY		11.6	91.9	0.0	91.9	8.0	8.1	104.9
Northern Gunks	32263.1	B1b1	221Bd	NY		59.7	97.5	0.3	98.5	0.9	1.5	108.4
Panther Mountain	122116.2	B2	M212Ea	NY		61.1	98.5	0.1	98.7	1.1	1.3	195.2
Rattlesnake Hill	20631.0	A1a	212Fa	NY		36.5	80.3	0.1	80.6	19.2	19.4	63.6
Sugarloaf	58613.8	B2	M212Ea	NY		50.3	98.6	0.2	98.9	0.5	1.1	125.4
West Kill Wilderness	51359.2	B2	M212Ea	NY		60.1	97.5	0.0	97.6	1.6	2.4	74.5
Blooming Grove	44492.1	B1b1	212Fc	PA		38.7	89.2	7.8	99.4	0.3	0.6	84.0
Emporium	98527.9	B1b2	212Gb	PA		78.3	97.8	0.0	98.3	1.4	1.7	209.3
Hammersley	112744.5	B1b2	212Gb	PA		91.5	98.3	0.1	98.8	1.1	1.2	191.8
Hickory Creek	28093.0	B1b2	212Ga	PA		99.9	98.7	0.5	99.6	0.4	0.4	61.6
Mountain Springs	89513.5	B1b1	212Fa	PA		57.7	96.9	0.8	98.5	1.5	1.5	151.7
Pine Creek	17522.3	B1b1	212Fa	PA		66.2	93.5	0.2	94.4	5.4	5.6	55.6
Tionesta	39167.3	B1b2	212Ga	PA		100.0	96.4	0.0	97.3	2.5	2.7	116.9
Wolf Run/Cedar Run	16075.3	B1b1	212Gb	PA		81.5	98.4	0.0	99.0	1.0	1.0	21.9
Tier 2 Matrix Forest Block												
Alma Hill	56094.5	A1b	212Fa	NY	PA	0.0	89.0	0.4	89.6	10.2	10.4	272.4
Chipmunk Run	30582.7	A2b	212Ga	NY	PA	0.0	92.6	0.4	92.9	5.7	7.1	162.3
Jersey Hill	79013.4	A1a	212Fa	NY		25.5	81.3	0.4	82.0	17.7	18.0	270.8
McCarty Hill	21249.8	A1b	212Ga	NY		27.8	86.8	0.0	86.7	12.2	13.3	86.3
Mongaup	19256.1	B1a	212Fc	NY		30.0	93.4	2.7	98.7	0.9	1.3	58.7
Schuyler County State Land	48050.2	A2a	212Fb	NY		39.8	88.6	0.0	88.8	10.8	11.2	157.2
Turnpike State Forest	19378.7	A1a	212Fa	NY		39.9	84.8	0.0	85.2	14.0	14.8	76.0
East of Chipmunk Run	33453.3	A2b	212Ga	PA	NY	0.0	95.5	0.6	96.2	3.3	3.8	210.8
Kinzua East	10455.4	A2b	212Ga	PA	NY	99.6	98.4	0.0	99.4	0.6	0.6	18.9
Kinzua West	25960.1	A2b	212Ga	PA	NY	35.2	95.2	0.0	96.7	3.1	3.3	77.2

Red House Run	17125.3	A2a	212Fa	PA	NY	0.0	71.0	0.0	71.1	28.6	28.9	54.6
Big Run	19319.1	B1b2	212Gb	PA		2.9	94.3	0.0	94.4	0.5	5.6	70.2
Bogg's Run	31234.8	B1b1	212Gb	PA		78.2	99.0	0.0	99.5	0.5	0.5	61.5
Buckham Mountain	32789.7	B1a	212Fc	PA		39.2	96.7	1.5	98.4	0.7	1.6	78.9
Butternut Hollow	35056.2	B1b2	212Gb	PA		93.3	98.2	0.0	98.3	1.7	1.7	93.5
Catherine Swamp	28701.1	B1b2	212Ga	PA		0.8	93.8	0.7	95.1	3.3	4.9	53.3
Cranberry Swamp	13403.2	B1b1	212Gb	PA		74.7	98.8	0.1	99.6	0.4	0.4	29.8
Dutchman Swamp	28894.1	B1b1	212Fa	PA		63.9	94.3	0.7	96.8	1.9	3.2	50.8
East Branch Dam	78639.4	B1b2	212Ga	PA		21.8	98.3	0.0	98.9	1.1	1.1	181.7
Gray's Run/McIntyre	46815.6	B1b1	212Fa	PA		52.0	95.7	0.1	96.5	2.9	3.5	124.2
Larry's Creek	20380.0	B1b1	212Gb	PA		13.7	95.0	0.0	95.1	4.3	4.9	48.2
Marshburg	37696.0	B1b2	212Ga	PA		72.7	98.7	0.0	99.2	0.7	0.8	92.3
Parker Run	48170.4	B1b2	212Gb	PA		39.7	97.6	0.0	97.8	1.6	2.2	83.2
Quehanna	98671.4	B1b2	212Gb	PA		47.4	99.5	0.0	99.6	0.3	0.4	166.9
Tobyhanna	16203.5	B1a	212Fd	PA		91.7	76.4	21.9	99.5	0.4	0.5	33.5
Trout Run	69475.8	B1b2	212Gb	PA		47.1	97.1	0.0	97.6	1.6	2.4	137.6
West Branch-Sproul	64962.9	B1b1	212Gb	PA		68.9	95.9	0.0	98.4	0.9	1.6	160.2

Most of the forest matrix blocks are currently in very good condition. Seventy five percent (40 blocks) support forest cover greater than 90%; only 6% (3 blocks) have forest cover under 80%. Only nine blocks that were selected have a percentage of land in agriculture greater than 10%. Seventy percent (37 blocks) have less than 5% acreage in agriculture. Only six selected blocks have residential and commercial development over 1%. Many HAL blocks are currently in great condition and have high potential for successful conservation work.

The ELU composition of Tier 1 and Tier 2 matrix forest blocks appears in each of the block reports. The 53 matrix blocks represent a good cross section of the ELUs within HAL. Of the 353 ELUs in the ecoregion, all but 20 are included within selected matrix blocks. These 20 ELUs are all in either the calcareous region in north-central New York or in the non-glaciated sections of western Pennsylvania where residuum has accumulated along major river corridors. All of these ELUs are suitable for agriculture or developed into villages or transportation corridors. An analysis of elevation for the matrix blocks relative to the ecoregion as a whole revealed that the selected blocks represent all the highest elevation sites: 79% of the areas 2500-3250 feet and 15% of areas 2000-2500. Only the lowest two elevation units (under 1000 feet and 1000-2000 feet) are represented in percentages less then for the whole ecoregion. These are the most developed parts of the ecoregion.

Statistics for managed areas in HAL matrix blocks appear on each block report. The total area of the 53 HAL matrix blocks is 2,466,185 acres. Forty six percent of this acreage is publicly owned. Twenty-three percent (12 blocks) have greater than 70% public ownership; 9% (5 blocks) are greater than 90% in public ownership. Thirty three (18 blocks) have less than 30% public land; 17% (9 blocks) have less than 10%; 8% (4 blocks) have no public land at all.

This assessment includes matrix forest blocks selected for HAL during the development of this ecoregional plan. There are other matrix forest blocks selected in adjacent ecoregions that extend into HAL. Swartswood in NJ in adjacent to the Kittatinny block and straddles the HAL/LNE boundary. Four blocks were selected during the WAP planning process that extend into the western part of HAL.

General comments on HAL matrix blocks

The 53 matrix forest blocks in HAL reflect the diversity of ELU types present in HAL and are well distributed throughout the ecoregion. Site conservation planning will be an essential step to identify where within these draft matrix blocks effective forest matrix conservation can be undertaken. Emphasis will be needed on both current good conditions and ELU composition, which will often not correlate. Site conservation planning will need to identify areas that are large enough to sustain important forest processes, configured to maximize area sensitive species needs and capture the broadest possible assortment of ELUs.

This selection of Tier 1 and Tier 2 matrix forest blocks represents a first effort to identify sizable units within HAL where matrix forest conservation might take place. Greater familiarization with these sites and an increased knowledge of the goals of matrix forest conservation in the East, including size, shape, and condition within the conservation unit, will better inform the selection of sites.

This assessment did not directly address issues of wide-ranging species, connectivity, or global climate change. All of these landscape issues should be addressed at a time when these first iteration HAL matrix blocks are combined with blocks selected for adjacent ecoregions. Through this process it has been recognized that within HAL there are greater opportunities for matrix forest conservation than in all adjacent ecoregions (WAP, CAP, LNE, and Great Lakes). The value of masses of matrix forest blocks has been recognized in the selection of the Catskills, Western PA, and the area around Allegany State Park as Action sites.

Next Steps for Matrix Forest Blocks in HAL

1. Connect ELUs to communities and assess distribution and groupings in the ecoregion. Do these matrix block selections act as coarse filters and in fact represent the full range of community diversity within HAL?
2. Determine which ELU types are not represented in the portfolio and assess potential for restoration. There are 20 ELUs not represented in any selected matrix forest block. There are also many lower elevation, flatter ELUs that are under represented relative to their abundance in the ecoregion. These ELUs should be identified and located. An assessment should be undertaken to determine the feasibility of creating new blocks or expanding existing bocks to include these features in the portfolio.
3. Recirculate matrix forest selections to the experts for review. Experts were involved in the first phase of identifying potential matrix forest blocks, but have not reviewed the final selections. There will be likely adjustments in block selections and boundaries based on new expert opinion.
4. Become familiar with matrix forest blocks and develop conservation plans. The first step in developing site conservation plans for matrix forests will be to assess current condition, composition, threats, and potential for each block. Rapid ecological assessments should be undertaken for each block to evaluate where more detailed inventories are needed.
5. Continue evaluation of matrix block characteristics. The selection of matrix forest blocks is driven by the characteristics of what are understood to be the important features that need to be conserved in these areas. Disturbance regimes, which define and maintain matrix forests, are poorly known in HAL. More work needs to be done to compile disturbance histories and

ecological effects within the ecoregion. There may be geographic differences between far western Pennsylvania and the Catskills that need to be understood to refine the minimum dynamic areas of matrix forests in HAL. The needs of areas sensitive species also are considered in scaling matrix forest. More information is needed on what these species are in HAL. And what do they need within matrix forests? What minimum standards are needed to assure that these selected matrix forests are functioning as source areas of other conservation areas and the general ecoregion?

6. Conduct multi-ecoregional cooperative plans for matrix forests, focused on similar matrix forest types or settings, include assessment of threats, goals, and strategies. There are clear similarities among many of the matrix forest blocks in HAL and in adjacent ecoregions. Field assessments, research on matrix forest characteristics, and development of conservation strategies will benefit from assessments of multiple sites. Similar matrix blocks should be grouped and analyzed base on ELU characteristics, ownership, threats, and restoration needs.
7. Conduct assessment of matrix blocks for wide ranging species and global climate change.

7. AQUATIC SYSTEMS AND SPECIES

George Schuler, minor edits by Mark Anderson

Introduction

TNC's ecoregional planning

The aquatic portion of this ecoregional plan involved the identification of all unique aquatic ecological settings within the ecoregion and the compilation and analysis of the most up-to-date biological data.

The key steps were to:

- Select conservation targets
- Develop stratification units to guide the selection conservation targets in all ecological settings
- Set conservation goals for targets
- Assess viability of conservation targets
- Design portfolio

Major rivers within HAL

Allegheny River – The Allegheny River drains much of the region west of the Appalachians then flows westward to join the Mississippi. The river flows 325 miles and drains 11,778 square miles, flowing north from its source near Coudersport, PA, through Olean, NY, before turning south and entering the huge Allegheny Reservoir on the Pennsylvania/New York border. Below the reservoir, the river flows another 200 miles before it joins the Monongahela River in Pittsburgh to form the Ohio River, which empties into the Mississippi and eventually flows into the Gulf of Mexico below New Orleans, Louisiana.

Nearly 72 percent of the Allegheny River watershed is covered in forest. Along its course the river and its tributaries cross through both glaciated and unglaciated landforms. This journey gives the river much of its unique physical and biological characteristics. The Allegheny River also passes through 22 counties, 2 states, the Allegheny National Forest, Allegany State Forest (NY), thousands of acres of state game lands, and 85-miles of Allegheny National Wild and Scenic River corridor.

*Delaware Rive*r – The Delaware is the longest undammed river east of the Mississippi, extending 330 miles from the confluence of its East and West branches at Hancock, New York to the mouth of the Delaware Bay. Along its course, 216 tributaries feed the river, the largest being the Schuylkill and Lehigh Rivers in southeastern Pennsylvania. In all, the basin contains 13, 539 square miles, draining parts of Pennsylvania (6, 422 square miles or 50.3%); New York (2,3,62 square miles, 18.5%); New Jersey (2,969 square miles, or 23.3%) and Delaware (1,002 square miles, 7.9%).

Over 17 million people rely on the waters of the Delaware River Basin for drinking and industrial use and the Delaware Bay is but a day's drive away for about 40 percent of the people living in the United States. Yet the basin drains only four-tenths of one percent of the total land area of the continental United States. Three reaches of the Delaware have been included in the National Wild and Scenic Rivers System resulting in nearly three-quarters of the non-tidal Delaware River being included in the NWSRS (73 miles from Hancock, NY to Milrift, PA; 40

miles from Port Jervis, NY to Stroudsburg, PA and 65 miles from Delaware Water Gap, PA to Washington, Crossing, PA).

Susquehanna River – The Susquehanna River drains 27, 510 miles, covering half the land area of Pennsylvania and portions of New York and Maryland. The river flows 444 miles from its headwaters at Otsego Lake near Cooperstown, New York to Havre de Grace, Maryland, where the river meets the Chesapeake Bay. The Susquehanna represents the longest commercially non-navigable river in North America. It is also the largest river lying entirely in the United States that drains into the Atlantic Ocean (the river is nearly one mile wide at Harrisburg, PA).

Despite the fact that nearly 60% of the Susquehanna River Basin is forested the basin is one of the most flood-prone watersheds in the entire nation. Since the early 1800s, the main stem of the Susquehanna has flooded every 20 years, on average. Even the Native Americans who once lived in the area told of frequent floods.

The Susquehanna River comprises 43% of the Chesapeake Bay's drainage area and represents the largest tributary of the Chesapeake Bay, providing 90 percent of the freshwater flows to the upper half of the bay and 50 percent overall.

Selecting Ecoregional Targets

Developing Ecological Drainage Units (EDU)

Ecological Drainage Units (EDUs) are groups of watersheds (8-digit catalog units as defined by USGS) that share a common zoogeographic history and physiographic and climatic characteristics. It is expected that each EDU will contain sets of aquatic system types with similar patterns of drainage density, gradient, hydrologic characteristics, and connectivity. In the United States, ecoregional planning teams have defined EDUs based on two main sources of information: zoogeography from Hocutt and Wiley, World Wildlife Fund's aquatic ecoregions, and the US Forest Service; and ecoregional section and subsection attributes defined by the US Forest Service. Identifying and describing EDUs allows us to stratify ecoregions into smaller units so ecoregional planning teams can better evaluate patterns of aquatic community diversity. Furthermore, EDUs provide a means to stratify the ecoregion to set conservation goals (Bryer, 2001).

Within HAL, four Ecological Drainage Units (EDUs) were identified from east to west as follows: Upper Delaware, Upper Susquehanna, Western Susquehanna, and Upper Allegheny. Portions of 3 other EDUs cross into HAL but the HAL ecoregional planning team anticipates that these EDUs, which are mostly contained within neighboring ecoregions, will be included in the planning efforts for the appropriate ecoregion.

Species targets

The aquatic species targets for HAL were selected according to criteria established by the appropriate ecoregional planning sub-team. These criteria prioritized imperiled, endemic and declining species - those that warrant urgent attention. Species location information was obtained primarily from the Natural Heritage Program databases with additional information about fish coming from state fisheries databases and NatureServe's *Summary of National Fish Distribution by 8-digit Watershed.* The identification of regional- and intermediate-scale fish species targets (see Tables 1 and 2) is hoped to compliment data on imperiled, endemic and declining species and assure that common species are also captured in the ecoregional portfolio.

Table 1. Regional-Scale Fish Species Found In HAL

Regional Scale Fish Species	*Upper Delaware EDU*	*Upper Susquehanna EDU*	*Upper Allegheny EDU*	*Western Susquehanna EDU*
Alewife	✔	✔		
American eel	✔	✔	✔	✔
American shad	✔	✔		
Sea lamprey	✔	✔		
Striped bass	✔			

**Source: Summary of National Fish Distribution by 8-digit Watershed. Larry Masters, ABI.*

Table 2. Intermediate-Scale Fish Species Found In HAL

Intermediate Scale Fish Species	*Upper Delaware EDU*	*Upper Susquehanna EDU*	*Western Susquehanna EDU*	*Upper Allegheny EDU*
Brook Trout	✔	✔	✔	✔
Creek chubsucker	✔	✔	✔	
Gizzard shad	✔			
White sucker	✔	✔	✔	✔
River redhorse				✔
Paddlefish				✔

**Source: Summary of National Fish Distribution by 8-digit Watershed. Larry Masters, ABI.*
Note: incomplete/DRAFT list requires review.

Coarse filter targets

Developing Aquatic Ecological Systems (AES) – Within HAL no freshwater community or ecosystem classification existed before The Nature Conservancy's ecoregional planning effort. The Nature Conservancy's Eastern Resources Office, with assistance from TNC's Freshwater Initiative and members of the HAL aquatic planning team, developed coarse-filter ecological system targets using a classification framework derived from ERO's Ecological Land Unit (ELU) analysis and the Freshwater Initiative's hierarchical approach. This multi-scale, landscape-based classification framework for freshwater ecosystems is based upon hierarchy theory, and several key principles of and empirical studies in freshwater ecology (Anderson and Olivero, 2001; Bryer 2001). This GIS based platform, allowed the partitioning and mapping of environmental patterns from the stream reach to regional basins that strongly influence the distribution of freshwater biodiversity.

Aquatic Ecological Systems serve as a more general classification and stratification level for ecoregional planning purposes than The Nature Conservancy's stream reach macrohabitat classification. Aquatic Ecological Systems (AES) are defined as dynamic spatial assemblages of aquatic ecological communities that occur together in an aquatic landscape with similar geomorphological patterns, are tied together by similar ecological processes (e.g., hydrologic and nutrient regimes, access to floodplains) or environmental gradients (e.g., temperature, chemical and habitat volume), and form a robust, cohesive and distinguishable unit on a hydrography map. The Nature Conservancy's Eastern Resource Office, with assistance from other Conservancy staff and partners, identified AES within each Ecological Drainage Unit by developing a coarse-scale classification of riverine and lacustrine environments based on biophysical GIS data. This

classification unit is intended to represent different aquatic environmental settings and serves to provide stratification across an Ecological Drainage Unit. Different aquatic communities are expected to currently occur or develop over evolutionary time within each system given the different environmental setting of each AES. AES thus serve as coarse filters for representation and conservation of all current and potential aquatic species and communities in the ecoregion.

In each HAL Ecological Drainage Unit, the Eastern Resource Office developed AES for size 1, 2, and 3 streams and rivers. Stream sizes are based on size classes developed for ERO's macrohabitat classification that provided the lowest level of detailed reach specific classification.

Setting Conservation Goals

The Nature Conservancy's assumption is that the conservation of multiple examples of each aquatic species target stratified across its geographic range is necessary to capture the variability of the target and its environment and to provide replication to insure persistence in the face of environmental stochasticity and the likely effects of climate change (TNC 2000). The HAL aquatic planning team placed most of its efforts towards developing goals for the ecoregion's AES. Goals for species and natural communities, mostly based on data from the Association for Biodiversity Information and the PA and NY Natural Heritage Programs, were developed by the appropriate HAL plant, animal or natural community teams.

Goals for ecoregional planning can be divided into two categories – numeric goals and design goals. Numeric goals address issues of abundance and distribution of biological diversity. Design goals address issues of portfolio design.

> *Distribution Goals Objective:* Capture multiple occurrences of each aquatic ecological system within each Ecological Drainage Unit to ensure representative conservation of biodiversity.
>
> *Abundance Goals Objective:* Capture "sufficient" redundancy of ecological system types within each EDU. Redundancy of the EDUs at the scale of the ecoregion is irrelevant since each EDU considered independent and non-replicable.
>
> *Design Goals Objective:* Create a functional network of hydrologically connected aquatic ecological systems and other elements of biodiversity to ensure representative and functional conservation areas within *and across* terrestrial-based ecoregions.

Distribution goals

Aquatic ecological systems should capture "adequate representation" of macrohabitat types across major environmental gradients at the Ecological Drainage Unit level. The HAL aquatics planning team agreed upon the recommendation that the portfolio should contain macrohabitat types representing 100% of the following major environmental gradients at the EDU level: (1) elevation, (2) landform and (3) geology.

Abundance goals

Abundance goals for HAL aquatics are intended to capture multiple examples of each aquatic ecological system type within each EDU. The number of examples is determined by the relative increase in probability of environmental or stochastic events reducing the ecological integrity of these system types. As system size decreases, the number of replicates needed increases. Since no data or guidelines exist to inform the number of replicates needed, a conservative approach

was taken – increasing by a single unit per level. See Table 3 for abundance (numeric) goals for HAL aquatic ecological systems.

Table 3. Abundance Goals for HAL Aquatic Ecological Systems.

Aquatic Ecological System Type	*Goal per EDU*
Headwater streams (size 1 system types)	Minimum of 3 examples per system type per EDU
Medium-sized tributaries (size 2 system types)	Minimum of 2 examples per system type per EDU
Small rivers (size 3 system types)	Minimum of 1 example per system type per EDU
Large rivers (size 4 system types)	1 per EDU

Design goals

The primary criteria driving the design goal for the HAL aquatic portfolio is to provide the best examples of connectivity for regional-scale fish species (Table 4) known to occur in each EDU. The goal will be to provide at least one connected suite of aquatic ecological systems (system sizes 4 through 1) within each EDU where each of the regional-scale fish species has current or historic distribution.

Table 4. Regional Scale Fish Species Found in HAL

Regional Scale Fish Species	*Upper Delaware EDU*	*Upper Susquehanna EDU*	*Upper Allegheny EDU*	*Western Susquehanna EDU*
Alewife	✔	✔		
American eel	✔	✔	✔	✔
American shad	✔	✔		
Sea lamprey	✔	✔		
Striped bass	✔			

**Source: Summary of National Fish Distribution by 8-digit Watershed. Larry Masters, ABI.*

A secondary criterion driving the design goal for the HAL aquatic portfolio is to provide the best pattern of connectivity for intermediate-scale fish species which occur in systems size 2, 3 and 1 systems. The goal will be to provide at least one connected suite of aquatic ecological systems within each EDU. See Table 5 for HAL intermediate scale species

Table 5. Intermediate Scale Fish Species Found in HAL

Intermediate Scale Fish Species	*Upper Delaware EDU*	*Upper Susquehanna EDU*	*Western Susquehanna EDU*	*Upper Allegheny EDU*
Brook Trout	✔	✔	✔	✔
Creek chubsucker	✔	✔	✔	
Gizzard shad	✔			
White sucker	✔	✔	✔	✔
River redhorse				✔
Paddlefish				✔

**Source: Summary of National Fish Distribution by 8-digit Watershed. Larry Masters, ABI.*
***Note:** incomplete/DRAFT list requires review.*

Assessing Viability

Conservation targets are elements of biological diversity that are considered important for conservation. Conservation targets can occur at multiple levels of biological organization – including species, natural communities, and ecological systems. One of the most significant challenges to planning teams posed by aquatic conservation targets is the need for a more standardized language and methodology for describing non species-level aquatic conservation targets and their status. In particular, it has been especially challenging to develop an effective and credible method for estimating their viability (i.e., the probability of persistence over the long term).

Previously, assessing the viability of aquatic species (or the ecological integrity of communities and/or ecological systems), has presented unique challenges to ecoregional planning teams. Teams have often learned that their attempts to assess viability or integrity are little more than a screening process which they hope correlates with viability and/or integrity. Others have found, much more work is necessary to truly assess viability for a range of species, and there is little actual guidance on assessing the "viability" of communities and ecological systems. For now, The Conservancy is working on the assumption that through the use of informed estimates, our attempts characterize the status of biodiversity will correlate closely with more comprehensive viability assessments when the necessary information and resources become available. However, conservation efforts must move forward with a methodology that will at least make progress in the direction of more credible status assessments that will be used in an effective manner to inform our planning process.

Expert derived data

Use of external experts was a critical and necessary component of all HAL aquatic conservation assessments. To engage experts in a meaningful and effective manner, planning teams provided adequate direction and guidance to insure consistency and integrity in data collection. This was particularly critical in a) *defining* what is meant by the "status" of an occurrence, and b) *describing* the status of an occurrence so that the information can be used to "screen" conservation targets in order to set priorities.

Although initially developed by The Conservancy for terrestrial viability assessment, three useful descriptive categories have been used to describe and assess the status of conservation target occurrences at all scales: 1) size, 2) condition, and 3) landscape context. To do this effectively, descriptions of the varying status levels are required to set standards to minimize variability in interpretation among TNC and non-TNC staff and experts. The HAL aquatics planning team adopted a status assessment divided into four descriptive categories: "Very Good," "Good," "Fair," or "Poor." The team also developed general descriptions for each status rating to bring further consistency to the expert review process.

The Nature Conservancy publication titled "*The 5-S Framework for Site Conservation: A Practitioner's Handbook for Site Conservation Planning"* (TNC 2000) provided the HAL aquatic planning team with a good starting point for defining the status of conservation targets. The following definitions are based on this work, and have been modified slightly for an aquatic focus.

Size – a measure of the area or abundance of the conservation target's occurrence.

- *For animal and plant species* size is the area of occupancy and/or the number of individuals in a population.
- *For ecological systems and natural communities* size is the patch size or geographic coverage. Assessments of size for natural communities and ecological systems should consider the area necessary to maintain the functionality of dominant ecological processes considered in "Landscape Context," the area required to maintain area-sensitive species identified as key factors under "Condition," as well as the Minimum Dynamic Area of the target. The *Minimum Dynamic Area* is the size of the area needed for a conservation target to recover from natural disturbances, such as a hurricane, fire, or flood.

Size (roughly analogous to stream length) is the component with the weakest applicability in aquatic systems. It is useful to think of size in aquatic systems or communities in terms of the species-specific life history needs known to occur in these areas. For example, consider if headwater streams of a given system are large enough to conserve ample spawning habitat for trout, or are side channel wetlands large and numerous enough to support adequate annual recruitment of sturgeon nursery stock.

Condition – a measure of the biological composition, structure, and biotic interactions that characterize the target. This includes factors such as:

- Reproduction, dispersal, and age structure of specific populations of concern.
- Biological composition (e.g., presence of native versus exotic species, presence of various habitat/abiotic community types within a system).
- Structure (e.g., habitat composition – pool-riffle-run, substrate diversity, sediment load, bank erosion, riparian canopy, groundcover, etc.)
- Biotic interactions (e.g., competition, herbivory, predation, and disease).

Condition information from experts can be broken into two general categories: information on map-based assessment and information not accessible through map-based assessment. For example, a watershed condition analysis is provided to planning teams. This remotely-assessed, map-based approach requires substantial ground-truthing to be useful and effective. As is the case with most assessments of this nature, it is expected that such an assessment will work well for some systems and not for others. Expert input is needed to validate, and correct, this initial draft condition assessment.

In addition, it is known that some factors can dramatically alter condition assessments such as the degree of invasive species contamination, current condition or management of dams, extent of harvesting impacts from fisheries management, and the extent of pollution from non-point sources. Information on these topics is important to collect during expert review.

Landscape context – an integrated measure of two factors:

- *Dominant ecological processes and environmental regimes* that establish and maintain the target occurrence (e.g., hydrologic and water chemistry regimes, geomorphic processes, climatic regimes, fire regimes all within their natural ranges of variation and distribution)
- *Connectivity* that includes such factors as species having access to habitats/ 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.

Of particular importance is consideration of the natural flow regime and its role in assessing the viability of many larger, impacted river systems. Even if formal analysis have not been performed (e.g., Index of Hydrologic Assessment (IHA) analyses), teams should consider how the hydrologic regime of aquatic systems has changed over time.

In addition, the influence of connectivity on the mobility of aquatic species is a topic that merits special consideration in any status assessment of aquatic systems. Barriers to movement (e.g., dams, inadequate water flow conditions), or impediments to habitat occupancy or passage (e.g., poor water quality or unsuitable physical habitat) should be taken into consideration when evaluating aquatic regions for viability. This is further complicated by the fact that many species have differing habitat or passage requirements depending on varying life history stages.

Furthermore, the HAL aquatics planning team also considered the following guidelines while working with TNC and non-TNC staff to evaluate the status of conservation targets:

- degree of habitat fragmentation of a community or system;
- degree of exotic or invasive species;
- extent of habitat conversion or long-term human disturbance;
- whether natural disturbance regimes are intact – especially seasonal or annual flooding and drought;
- proximity of other conservation sites or managed areas to a potential conservation site for a community or system;
- connectivity of community to other areas of natural habitat;
- watershed land use patterns that may effect the stream reach.

GIS aquatic condition analysis

The HAL assessment of viability also included a GIS condition analysis performed by the Eastern Resource Office. Such condition analysis for watersheds and stream reaches is a subject of considerable ongoing research. ERO developed a set of attributes for watersheds that facilitated a rapid assessment of watersheds in terms of their general potential aquatic condition. This condition analysis used 22 variables related to land cover, roads, dams, and point sources to calculate the overall condition for each size 1, size2, and size 3 watershed.
The variables are listed as follows:

Watershed % Natural (forested, shrubland, wetland)	Watershed % Total Agriculture
Watershed % Hay/Pasture	Watershed % Row Crops
Watershed % Developed	Watershed % Impervious Surface (derived from land cover, see data sources)
100m Stream Buffer: % Natural	100m Stream Buffer: Impervious
Watershed: % Managed Land	# Road/stream Crossings/stream mile
Miles of Roads/ watershed square miles	100m Stream Buffer: Miles of Roads/Miles of Streams
Total # Dams	# of Dams > 20ft or stores > 1000 acre/feet
Maximum Dam Height	Maximum Dam Storage in acre/feet

# Dams/Miles of Stream	Dam Storage in Acre/Feet / Stream Miles
# Drinking Water Supplies (DWS)	Total Population Served by DWS
# DWS / Stream Miles	DWS Population Served/Stream Miles
Total Point Sources (CERCLIS, IFD, PCS, TRI, MINES)	Total BASINS Point Sources/Stream Mile
# CERCLIS (Superfund)/Stream Mile	# Industrial Facilities Discharge/Stream Mile
# Mines / Stream Mile	# PCS / Stream Mile
# TRI / Stream Mile	

This condition analysis highlighted general areas of potential high condition for aquatic systems for use by the HAL planning team and non-TNC experts.

Portfolio Assembly

For the HAL aquatic assembly process, the *connectivity* of an aquatic ecological system occurrence was based on the presence of physical barriers to migration for both regional and intermediate-scale fish species. Each occurrence selected through the assembly process was categorized as either Priority 1 or Priority 2.

***Priority 1*:** Priority 1 occurrences are in the portfolio. They are expert recommended systems that fall within the optimal condition analysis (% natural cover, road density, dams). Priority 1 occurrences count towards meeting ecoregional goals and can include "extra" occurrences which exceed goals).

Priority 2: Priority 2 occurrences are only *conditionally* in the portfolio. Priority 2 occurrences require more evaluation before being included in the portfolio as a Priority 1 occurrence. Priority 2 occurrences do not count towards meeting ecoregional goals.

The HAL aquatic assembly process was designed to provide connected networks of AES within each EDU. Connectivity was included at several scales for both the regional-scale and intermediate-scale fish species found within each EDU and across HAL. Since only one example of size 4 systems existed in each EDU each of these occurrences was automatically included in the portfolio, at least as a Priority 2 occurrence within its respective EDU.

The HAL aquatic planning team has highest confidence in the Priority 1 occurrences since they were established using a combination of best available expert information; available biological data sets, NHP information and GIS condition analysis. The HAL aquatic planning team strongly urges TNC Operating Units, partner organization and agencies to further gather and evaluate expert information and empirical and remote sensing data for Priority 2 occurrences. Further evaluation, in some cases, may result in a change in status for these occurrences, elevating them to Priority 1, or eliminating them from the portfolio altogether. It is the recommendation of the HAL aquatic planning team that there must be further rigorous evaluation of all Priority 2 occurrences before any decisions regarding conservation action or ecoregional goals are made.

Portfolio Results

Fine-filter targets: Species

Table 6. Fish Species Targets (Natural Heritage Program Data)

Scientific Name	Common Name	Distri-bution	Global Rank	HAL Goal	# Of EORs	# Viable EORs in HAL	Numeric Goal Met?
Etheostoma maculatum	Spotted Darter	L	G2	10	2	2	N
Etheostoma Tippecanoe	Tippecanoe Darter	L	G3	10	5	5	N
Ichthyomyzon bdellium	Ohio Lamprey	P	G3G4	5	15	9	Y
Ichthyomyzon greeleyi	Mountain Brook Lamprey	P	G3G4	5	5	0	N
Noturus stigmosus	Northern Madtom	W	G3	5	1	1	N
Percina macrocephala	Longhead Darter	W	G3	5	10	10	Y
Total					**38**	**27**	

Table 7. Invertebrate Species Targets (Natural Heritage Program Data)

Scientific Name	Common Name	Distri-bution	Global Rank	HAL Goal	# OF EO Records	# Viable EORs	Numeric Goal Met?
Alasmidonta heterodon	Dwarf wedgemussel	W	G1G2	5	8	8	Y
Alasmidonta varicosa	Brook floater	W	G3	5	8	7	Y
Cheumatopsyche helma	Helma's Net-Spinning Caddisfly	P	G1G3	5	1	1	N
Cicindela ancocisconensis	A Tiger Beetle	W	G3	5	3	3	N
Cicindela marginipennis	Cobblestone Tiger Beetle	W	G2G3	5	3	3	N
Enallagma laterale	New England Bluet	P	G3	5	3	2	N
Epioblasma torulosa rangiana	Nothern Riffleshell	L	G2T2	10	3	3	N
Gomphus quadricolor	Rapids Clubtail	W	G3G4	5	2	2	N
Gomphus septima	Septima's Clubtail	R	G2	20	0	0	N
Gomphus viridifrons	Green-faced Clubtail	W	G3	5	11	11	Y
Lasmigona subviridis	Green Floater	W	G3	5	27	7	Y
Ophiogomphus anomalus	Extra-Striped Snaketail	W	G3	5	3	3	N
Ophiogomphus howei	Pygmy Snaketail	W	G3	5	1	1	N
Pleurobema clava	Clubshell	P	G4	5	3	3	N
Villosa fabalis	Rayed Bean	W	G1G2	5	1	1	N
Total					**77**	**55**	

Coarse-filter targets: Aquatic ecological systems

Abundance Goals: There are a total of 22, 098 miles of streams represented in size 1, 2, 3 and 4 systems in the four High Allegheny Plateau Ecological Drainage Units included in this plan. Table 8 shows the number of selected occurrences for each size system and the corresponding number of stream miles.

Table 8. Summary of Occurrences Selected for the four major EDUs by System Type.

Size and type	# Priority 1 Occurrences Selected	Miles	# Priority 2 Occurrences Selected	Miles	Total # of Priority 1 and 2 Occurrences	Total miles
All size 1	36	1834	19	721	55	2555
All size 2	39	520	40	435	79	913
All size 3	15	441	10	162	25	603
All size 4	3	468	0	0	3	468
TOTAL	**93**	**3263**	**69**	**1318**	**162**	**4581**

The High Allegheny Plateau selection process identified 3,263 out of 22, 098 total miles of stream as Priority 1 aquatic system occurrences across the four major EDUs within the ecoregion (Tables 8 and 9).

Distribution Goals: One note, while an analysis has been done for each EDU with regards to the abundance and design goals none has yet been done for the distribution goal. Further analysis should be completed for Priority 1 and 2 occurrences to evaluate what percentage of macrohabitat types across major environmental gradients (elevation, landform and geology) at the Ecological Drainage Unit level are captured by selected occurrences. The distribution goal for HAL is to capture macrohabitat types representing 100% of the major environmental gradients.

Design Goals: At least one connected suite of aquatic ecological systems (system sizes 4 through 1) was developed in each of the four ecological drainage units analyzed for the High Allegheny Plateau, to provide connectivity to each of the best examples of each system type for the appropriate regional-scale and intermediate fish species with current or historic distribution in that EDU.

The size 4 system in the Western Susquehanna EDU was not included in the portfolio by the HAL team working to assemble the portfolio in that drainage. This however appears to be an oversight. All size 4 systems should be included in the portfolio at least as Priority 2 occurrences. It is recommended that the appropriate TNC OUs should evaluate the size 4 system occurrence of the Western Susquehanna as Priority 2 until more information is gathered regarding the system's viability/integrity and its eventual inclusion in the portfolio as a Priority 1 occurrence or complete elimination from the portfolio.

Table 9. Percentage of Total System Miles of Priority 1 Aquatic System Occurrences.

EDU Name	Size Class	Total Miles	Total Miles Selected As Priority 1 Systems	% Of total selected
Upper Allegheny	1	4132	449	11
Upper Susquehanna	1	9179	831	9
Upper Delaware	1	3091	170	5
Western Susquehanna	1	2578	384	15
Upper Allegheny	2	341	116	34
Upper Susquehanna	2	933	200	21
Upper Delaware	2	315	108	34
Western Susquehanna	2	192	96	50
Upper Allegheny	3	197	113	57
Upper Susquehanna	3	326	118	36
Upper Delaware	3	150	79	53
Western Susquehanna	3	146	131	90
Upper Allegheny	4	81	82	100
Upper Susquehanna	4	268	268	100
Upper Delaware	4	118	118	100
Western Susquehanna	4	53	0	0
TOTAL		**22098**	**3263**	

Upper Allegheny EDU

Abundance Goals: In the Allegheny River EDU numerical goals were met for only 7 of the 14 aquatic ecological system types found in the EDU. Table 10 illustrates how these goals were met, or not met, for each of the aquatic system types. Goals for most of the size 1 system types were not met. No Priority 1 occurrences were identified for two of the EDU's system types, system 2-13 and system 3-12.

Table 10. Aquatic System Priority 1 Occurrences for the Upper Allegheny EDU.

System Size	System Type	# Priority 1 Occurrences	Miles	HAL Goal	Status of Goal
1	13	2	56	3	-1
1	14	1	174	3	-2
1	15	3	87	3	met
1	16	1	17	3	-2
1	17	1	115	3	-2
	Size 1 System Total		**449**		
2	16	2	46	2	met
2	17	2	29	2	met
2	18	2	8	2	met
2	19	4	33	2	+2
2	20	0	0	2	-2
	Size 2 System Total		**116**		
3	11	1	35	1	met
3	12	0	0	1	-1
3	13	1	78	1	met
	Size 3 System Total		**113**		
4		1	82	1	met
	Size 4 System Total		**82**		

Priority 2 occurrences, which currently do not count towards HAL goals, increase the number of total aquatic system occurrences in all but a few cases. Goals for all of size 2 and 3 systems can be met with the addition of Priority 2 occurrences (Table 11). Further evaluation with regard to the viability of these occurrences may warrant a change of status so that they count towards reaching ecoregional goals. Even with the inclusion of all currently identified Priority 2 occurrences only one of the size 1 system types reaches its numeric goal. The shortage of viable occurrences of size 1 systems within the Allegheny River EDU represents a priority information gap and certainly requires further investigation and analysis to fill.

Table 11. Total Aquatic System Occurrences (Priority 1 and 2) for the Upper Allegheny EDU.

System Size	System Type	# Priority 2 Occurrences	Total Priority Occurrences (1 and 2)	HAL Goal	Status of Goal WITH Priority 2 Occurrences Included
1	13	0	2	3	-1
1	14	0	1	3	-2
1	15	0	3	3	met
1	16	1	2	3	-1
1	17	0	1	3	-2
	Size 1 System Total		**9**		
2	16	1	3	2	+1
2	17	2	4	2	+2
2	18	1	3	2	+1
2	19	0	4	2	+2
2	20	5	5	2	+3
	Size 2 System Total		**19**		
3	11	0	1	1	met
3	12	2	2	1	+1
3	13	0	1	1	met
	Size 3 System Total		**4**		
4			1	1	met
	Size 4 System Total		**1**		

Distribution Goals: The distribution goal analysis for AES in the Upper Allegheny EDU has not been completed. Further analysis should be completed for both Priority 1 and 2 occurrences within the EDU to evaluate what percentage of macrohabitat types across major environmental gradients (elevation, landform and geology) are captured by selected occurrences.

Note: the distribution goal for HAL is to capture macrohabitat types representing 100% of the major environmental gradients within an EDU.

Design Goals: The design goal for HAL was to provide at least one connected suite of aquatic ecological systems (system sizes 4 through 1) within each EDU. For the Upper Allegheny EDU two 4-3-2-1 connected suites were constructed from Priority 1 streams which achieved design goals for the portfolio.

The connected networks include the:

- Allegheny River → Tionesta Cr./Coon Cr./Salmon Cr. drainage
- Upper Allegheny River → Potato Cr./Oswayo Cr./Johnson Cr. drainage

Unlike the Potato Creek sub-drainage, the Johnson and Oswayo Creek sub basins, however, did not have any size 1 systems selected either as Priority 1 or Priority 2 occurrences.

Table 12. Connected Suites w/in Upper Allegheny EDU which meet HAL design goals (Priority 1 occurrences).

EDU	Design Goal	Connected Systems	Meets goal	Description *(mainstem to headwaters)*
Upper Allegheny	(1) 4-3-2-1 suite/EDU	4-3-2-1	Yes	Allegheny River → Tionesta Cr./Coon Cr./Salmon Cr.
		4-3-2-1	Yes	Upper Allegheny River → Potato Cr./Oswayo Cr./Johnson Cr.
Total	2			

A 4-3-2 connected suite was created from Priority 2 occurrences for the Oil Creek/Caldwell Creek sub drainage and the Brokenstraw Creek sub drainage. No size 1 systems were identified for either of these drainages. Pithole Creek, Little Valley Creek, Sandy Creek and East Sandy Creek all create 4-2 connected drainages in the lower portion of the Upper Allegheny River.

Table 13. Smaller connected suites and unconnected systems w/in Upper Allegheny EDU which meet HAL design goals (Priority 2 occurrences).

EDU	Design Goal	Connected Systems	Meets goal	Description *(mainstem to headwaters)*
Upper Allegheny	(1) 4-3-2-1 suite/EDU	4-3-2	No	Allegheny River → Oil Creek/Caldwell Cr.
		4-3-2	No	Allegheny River → Brokenstraw Creek
		2-1	No	Bear Creek → Bear Cr. headwaters
		2	No	Tunungwant Creek
		2	No	Allegheny Portage Creek

The Bear Creek drainage represents a 2-1 connected suite of Priority 2 streams not connected to a size 3 or 4 system. Likewise, Tunungwant Creek and Allegheny Portage Creek represent Priority 2 size 2 systems not connected to any other aquatic systems.

Table 14. Priority 1 Occurrence Names in the Upper Allegheny EDU

Allegheny R	Hand Brook	Pithole Creek
Allender Run	Havens Run	Porky Run
Beaver Run	Hemlock Creek	Potato Creek
Beehunter Creek	Henderson Run	Prather Run
Blacksmith Run	Indian Run	Queen Creek
Bova Creek	Irish Brook	Red House Brook
Boyer Brook	Jacks Run	Red Mill Brook
Brewer Run	Jaybuck Run	Rice Brook
Caldwell Creek	Johnson Creek	Robbins Brook
Camp Run	Lick Run	Salmon Creek
Campbell Creek	Lyman Run	Schoolhouse Run
Carrollton Run	Marvin Creek	South Branch Cole Creek
Cherry Run	Marvin Creek	South Branch Tionesta Creek
Coalbed Run	Middle Branch West Branch Cald	Taylor Field Branch
Cole Creek	Middle Hickory Creek	Three Bridge Run

Colegrove Brook	Mud Lick Run	Tionesta Creek
Coon Creek	North Branch Cole Creek	Tyler Brook
Daly Brook	North Branch Colegrove Brook	Walcott Brook
Dunderdale Creek	Olean Creek	West Branch Caldwell Creek
Dunham Run	Oswayo Creek	West Branch Potato Creek
East Hickory Creek	Penoke Run	West Pithole Creek
Golby Run	Pierce Brook	Wolf Run
Guiton Run	Pine Creek	Woodcock Run
Hamlin Run	Piney Run	

Table 15. Priority 2 Occurrence Names in the Upper Allegheny EDU

Allegheny Portage Creek	Maple Run
Bear Creek	Oil Creek
Bennett Brook	Pigeon Run
Bloody Run	Pine Creek
Brokenstraw Creek	Pine Run
Caldwell Creek	Pithole Creek
Crooked Run	Pole Road Run
Davidson Run	Red Lick Run
E Sandy Creek	Sandy Creek
Little Bear Creek	Shanty Run
Little Brokenstraw Creek	Spring Creek
Little Otter Creek	Tunungwant Creek
Little Valley Creek	West Branch Tunungwant Creek

Upper Delaware EDU

Abundance Goals: In the Upper Delaware ecological drainage unit numerical goals were met or exceeded for only 6 of the 12 aquatic ecological system types found in the EDU. Table 16 illustrates how these goals were met, exceeded or not met, for each of the aquatic system types in the EDU. For most of the size 1 system types goals were not met. No Priority 1 occurrences were identified for three of the EDU's system types, 1-3, 2-2, and 3-2.

Table 16. Aquatic System Priority 1 Occurrences for the Upper Delaware EDU.

System Size	System Type	# Priority 1 Occurrences	Miles	HAL Goal	Status of Goal
1	1	2	86	3	-1
1	2	2	9	3	-1
1	3	0	0	3	-3
1	4	3	75	3	met
	Size 1 System Total		**170**		
2	1	2	27	2	met
2	2	0	0	2	-2
2	3	1	36	2	-1
2	4	3	45	2	+1
	Size 2 System Total		**108**		
3	1	3	56	1	+2
3	2	0	0	1	-1
3	3	2	23	1	+1
	Size 3 System Total		**79**		
4		1	118	1	met
	Size 4 System Total		**118**		

Priority 2 occurrences, which currently do not count towards HAL goals, increase the number of total aquatic system occurrences in all but one instance. All of system size 1, 3 and 4 goals are met with the inclusion of Priority 2 occurrences (Table 17). Further evaluation with regard to the viability of these occurrences may warrant a change of status so that they count towards reaching ecoregional goals. Even with the inclusion of all currently identified Priority 2 occurrences, system type 2-2 (system size 2, type 2) does not reach its numeric goal.

Table 17. Total Aquatic System Occurrences (Priority 1 and 2) for the Upper Delaware EDU.

System Size	System Type	Total Priority Occurrences (1 and 2)	Total miles	HAL Goal	Status of Goal WITH Priority 2 Occurrences Included
1	1	4	150	3	+1
1	2	4	66	3	+1
1	3	3	69	3	met
1	4	5	106	3	+2
	Size 1 System Total		**391**		
2	1	4	57	2	+2
2	2	1	9	2	-1
2	3	5	72	2	+3
2	4	6	72	2	+4
	Size 2 System Total		**210**		
3	1	3	56	1	+2
3	2	1	20	1	met
3	3	2	23	1	+1
	Size 3 System Total		**99**		
4		1	118	1	met
	Size 4 System Total		**118**		

Distribution Goals: The distribution goal analysis for AES in the Upper Delaware EDU has not been completed. Further analysis should be completed for both Priority 1 and 2 occurrences within the EDU to evaluate what percentage of macrohabitat types across major environmental gradients (elevation, landform and geology) are captured by selected occurrences.

Design Goals: The design goal for HAL was to provide at least one connected suite of aquatic ecological systems (system sizes 4 through 1) within each EDU. For the Upper Delaware EDU two 4-3-2-1 connected suites of aquatic systems were constructed from Priority 1 occurrences which exceeds design goals for the portfolio (Table 18).

The connected networks included the:

- Delaware River → Neversink River → Bashakill Creek drainage
- Delaware River → E. Branch Delaware R. → Beaverkill River/Little Beaverkill drainage.

Table 18. Connected Suites w/in Upper Delaware EDU (Priority 1 occurrences).

EDU	Design Goal	Connected Systems	Meets goal	Description *(mainstem to headwaters)*
Upper Delaware	(1) 4-3-2-1 suite/EDU	4-3-2-1	Yes	Delaware River → Neversink River → Neversink R./Bashakill Cr.
		4-3-2-1	Yes	Delaware River → E. Branch Delaware R. → Beaverkill River/Little Beaverkill R.
		4-2-1	No	Delaware R. → Bushkill Cr. → headwaters

		4-2-1	No	Delaware R. → Flat Brook Cr. → headwaters
		4-3	No	Delaware R. → McMichael Cr.
Total	2			

The Broadhead Creek portion of the 4-3-2 Delaware River → Broadhead Creek connected suite listed in Table 19 is a Priority 2 occurrence. The size 3 system which connects Broadhead Creek to the Delaware River to create a potential 4-3-2-1 connected suite is a Priority 1 occurrence (McMichael Creek). The aquatic ecological systems within the Delaware River → Broadhead Creek drainage require more evaluation before including them in the portfolio as a connected suite.

Table 19. Connected suites and unconnected systems w/in Upper Delaware EDU (Priority 2 occurrences).

EDU	Design Goal	Connected Systems	Meets goal	Description *(mainstem to headwaters)*
Upper Delaware	(1) 4-3-2-1 suite/EDU	4-3-2	No	Delaware R. → Lackawaxan R. → Middle Cr.
		4-2-1	No	Delaware R. → Calicoon Cr.
		4-2-1	No	Delaware R. → Equinunk Cr.
		4-2	No	Delaware R. → Shohola Cr.
		4-2-1	No	Delaware R. → Pocono Cr.
		4-3-2*	No	Delaware R. → Broadhead Cr.
		2	No	Oquaga Cr.
		2-1	No	Little Delaware R.
		2-1	No	E. Branch Delaware R. → Dry Brook

Table 20. Priority 1 Occurrence Names in the Upper Delaware EDU

Alder Creek	High Falls Brook
BASHER KILL	LITTLE BEAVER KILL
BEAVER KILL	Little Flat Brook
Beerskill	MCMICHAEL CR
Biscuit Brook	NEVERSINK R
BUSH KILL	Parker Brook
Cattail Brook	Pigeon Brook
Criss Brook	Shandelee Brook
DELAWARE R	Stony Brook
Fall Brook	Tarkill Creek
FLAT BROOK	Willowemoc Creek
Forked Brook	Willsey Brook
Gumaer Brook	

Table 21. Priority 2 Occurrence Names in the Upper Delaware EDU

Alder Marsh Brook	Kinneyville Creek
BRODHEAD CR	LACKAWAXEN R
Brush Brook	LITTLE DELAWARE R

Buck Brook	Little Equinunk Creek
Bulgers Run	MCMICHAEL CR
Butz Run	MIDDLE CR
Calkins Creek	OQUAGA CR
CALLICOON CR	Paradise Creek
Cherry Creek	Pocono Creek
Coulter Brook	Riley Creek
Cranberry Creek	Rose Pond Branch
Crooked Creek	Salt River Brook
DELAWARE R	Sand Spring Run
DRY BK	Scot Run
Dry Sawmill Run	SHOHOLA CR
East Branch Dyberry Creek	Transue Run
EQUINUNK CR	Tyler Brook
Factory Creek	WALLENPAUPAUK CR
Gulf	Wolf Swamp Run

Upper Susquehanna EDU

Abundance Goals: For the Upper Susquehanna ecological drainage unit numerical goals were met or exceeded for 14 of the 19 aquatic ecological system types found in the EDU. Table 22 illustrates how these goals were met, exceeded or not met, for each aquatic system type. Numeric goals for only one of the size 3 system types was not met or exceeded and for system type 3-8, no Priority 1 occurrences were identified in the portfolio. No Priority 1 occurrence was identified for system type 2-12 either.

Table 22. Aquatic System Priority 1 Occurrences for the Upper Susquehanna EDU.

System Size	System Type	# Priority 1 Occurrences	Miles	HAL Goal	Status of Goal
1	5	4	125	3	+1
1	6	2	27	3	-1
1	7	4	105	3	+1
1	8	2	401	3	-1
1	9	2	173	3	-1
	Size 1 System Total		**831**		
2	5	2	48	2	Met
2	6	2	28	2	Met
2	7	2	28	2	Met
2	8	1	46	2	-1
2	9	2	34	2	Met
2	10	1	9	2	-1
2	11	1	7	2	-1
2	12	0	0	2	-2
	Size 2 System Total		**200**		
3	4	1	64	1	Met
3	5	1	32	1	Met
3	6	1	15	1	Met
3	7	0	0	1	-1
3	8	1	7	1	Met
	Size 3 System Total		**118**		
4		1	268	1	Met
	Size 4 System Total		**268**		

Priority 2 occurrences, which currently do not count towards HAL goals, increase the number of total aquatic system occurrences and would help to reach numeric goals in all but one instance (system type 1-9) (Table 23). Further evaluation with regard to the viability of these occurrences may warrant a change of status so that they count towards reaching ecoregional goals.

Table 23. Total Aquatic System Occurrences (Priority 1 and 2) for the Upper Susquehanna EDU.

System Size	System Type	Total Priority Occurrences (1 and 2)	Total miles	HAL Goal	Status of Goal
1	5	9	154	3	+6
1	6	2	27	3	-1
1	7	6	237	3	+3
1	8	3	418	3	met
1	9	2	173	3	-1
	Size 1 System Total		**1009**		
2	5	5	81	2	+3
2	6	4	41	2	+2
2	7	2	28	2	met
2	8	2	46	2	met
2	9	3	44	2	met
2	10	3	31	2	+1
2	11	5	75	2	+3
2	12	3	44	2	+1
	Size 2 System Total		**390**		
3	4	3	102	1	+2
3	5	1	32	1	met
3	6	2	22	1	+1
3	7	2	27	1	+1
3	8	2	46	1	+1
	Size 3 System Total		**229**		
4		1	268	1	met
	Size 4 System Total		**268**		

Distribution Goals: The distribution goal analysis for AES in the Upper Susquehanna EDU has not been completed. Further analysis should be completed for both Priority 1 and 2 occurrences within the EDU to evaluate what percentage of macrohabitat types across major environmental gradients (elevation, landform and geology) are captured by selected occurrences.

Design Goals: The design goal for HAL was to provide at least one connected suite of aquatic ecological systems (system sizes 4 through 1) within each EDU. For the Upper Susquehanna EDU four 4-3-2-1 connected suites of aquatic systems were constructed from Priority 1 occurrences exceeding the design goals for the ecoregion.

Table 24. Connected Suites w/in Upper Susquehanna EDU (Priority 1 occurrences).

EDU	Design Goal	Connected Systems	Meets goal	Description *(mainstem to headwaters)*
Upper Susquehanna	(1) 4-3-2-1 suite/EDU	4-3-2-1	Yes	Susquehanna R. → Tunkhannock Cr. → Martins Cr.
		4-3-2-1	Yes	Susquehanna R.→ Towanda Cr. → Schrader Cr.
		4-3-2-1	Yes	Susquehanna R. → Chenango R. → Genaganslet R. → Sangerfield R.
		4-3-2-1	Yes	Susquehanna R. → Unadilla R. → Butternut Cr./Beaver Cr.
		4-2-1	No	Susquehanna R. → Mehoopny Cr.
		2-1	No	E. BranchTioughnioga R.
		2-1	No	Catatonk Cr.
Total	4			

Table 25. Connected suites and unconnected systems w/in Upper Susquehanna EDU (Priority 2 occurrences).

EDU	Design Goal	Connected Systems	Meets goal	Description *(mainstem to headwaters)*
Upper Susquehanna	(1) 4-3-2-1 suite/EDU	4-3-2-1	No	Susquehanna R. → Owego Cr.
		4-3-2	No	Susquehanna R.→ Cohocton R. → Mud Cr./Five Mile Cr./Upper Cohocton R.
		4-3-2	No	Susquehanna R. → Canesteo R. → Bennettes Cr.
		4-2	No	Susquehanna R. → Nanticoke Cr.
		4-2	No	Susquehanna R. → Wysox Cr.
		2-1	No	Susquehanna R. → Wyalusing Cr.
		4-2-1	No	Otselic Cr. → Brakel Cr. Susquehanna R. → Wappasening Cr.
		3*	No	Tioghnioga R.

The Priority 2 occurrence of the Size 3 Tioghnioga River listed in Table 25 is unconnected as a Priority 2 occurrence, however, it provides connectivity for the P1 occurrence of the East Branch Tioghnioga River thereby creating a 4-3-2-1 connected to the Susquehanna River. These Priority 2 occurrences require more evaluation before including them in the portfolio and assembling them as a connected suite.

Table 26. Priority 1 Occurrence Names in the Upper Susquehanna EDU

Ackerly Creek	Five Streams	Millstone Creek	Sulphur Springs Creek
Albright Creek	GENEGANTSLET CR	Monroe Creek	SUSQUEHANNA R

BEAVER CR	Haights Creek	Nates Run	Thomas Run
Becker Brook	Handsome Brook	Nine Partners Creek	Tinker Creek
Bell Creek	Horton Creek	Number Six Brook	TIOUGHNIOGA CR
Bellas Brook	Hunt Creek	Oxbow Creek	TIOUGHNIOGA R
Billings Mill Brook	Idlewild Creek	Partners Creek	TOWANDA CR
Bliven Creek	Jones Creek	Pine Swamp Run	Tower Branch
Bull Run	Kasson Brook	Pond Brook	Tunkhannock Creek
Butler Creek	Kennedy Creek	Red Brook	UNADILLA R
BUTTERNUT CR	Kenney Brook	Rhiney Creek	Utley Brook
Carbon Run	LABRADOR CR	Rock Creek	White Brook
CATATONK CR	Leslie Creek	Rollinson Run	Willow Brook
Catlin Brook	Little Butler Creek	SANGERFIELD R	Wolf Run
CHEMUNG R	Little Creek	Schrader Creek	
CHENANGO R	Little Rhiney Creek	Sciota Brook	
CHENINGO CR	Little Schrader Creek	Shackham Brook	
Chilson Run	Lye Run	Silver Creek	
Coal Run	Martins Creek	Smith Cabin Run	
Dry Creek	McCraney Run	Snake Creek	
Dundaff Creek	MEHOOPANY CR	Somer Brook	
East Branch Field Brook	MICHIGAN CR	South Brook	
Fall Brook	Mill Creek	Sterling Brook	
Falls Creek	Millard Creek	Stony Brook	
Field Brook	Miller Brook	Sugar Run	

Table 27. Priority 2 Occurrence Names in Upper Susquehanna EDU

Babcock Run	NEILS CR
BENNETTES CR	OAKS CR
BRAKEL CR	OTSELIC R
Canisteo	OWEGO CR
CATATONK CR	Pendleton Creek
Chaffee Run	Prince Hollow Run
COHOCTON R	Russell Run
Corbin Creek	TIOGA R
FIVEMILE CR	TIOUGHNIOGA R
Little Falls Creek	TOWANDA CR
MESHOPPEN CR	Wappasening Creek
MUD CR	WYALUSING CR
NANTICOKE CR	WYSOX CR

Western Susquehanna EDU

Abundance Goals: For the Western Susquehanna ecological drainage unit numerical goals were met or exceeded for 3 of the 7 aquatic ecological system types identified. Table 28 illustrates how these goals were met, exceeded or not met, for each aquatic system. Numeric goals for the size 4 system type was not met, no Priority 1 or Priority 2 occurrences were identified.

Due to the assembly rules that were developed by the aquatic planning team for this ecoregion, this appears to be an oversight. All size 4 systems should be included in the portfolio at least as Priority 2 occurrences. It is recommended that the appropriate TNC OUs should evaluate the size

4 system of the Western Susquehanna as Priority 2 occurrences until more information is gathered regarding the system's viability/integrity and its eventual inclusion in the portfolio as a Priority 1 occurrence or complete elimination from the portfolio.

Table 28. Aquatic System Priority 1 Occurrences for the Western Susquehanna EDU.

System Size	System Type	# Priority 1 Occurrences	Miles	HAL Goal	Status of Goal
1	11	1	7	3	-2
1	12	6	377	3	+3
	Size 1 System Total		**384**		
2	13	11	93	2	+9
2	14	1	3	2	-1
	Size 2 System Total		**96**		
3	9	0	0	1	-1
3	10	4	131	1	+3
	Size 3 System Total		**131**		
4		0	0	1	-1
	Size 4 System Total		**0**		

The Priority 2 occurrences selected for the Western Susquehanna EDU, which currently do not count towards HAL goals, increase the number of total aquatic system occurrences and would help to reach numeric goals in two instances; systems type 2-14 and 3-9 (Table 29). Again, no Priority 2 occurrences were identified for the size 4 system in this EDU. Further evaluation with regard to the viability of these occurrences may warrant a change of status so that they count towards reaching ecoregional goals.

Table 29. Total Aquatic System Occurrences (Priority 1 and 2) for the Western Susquehanna EDU.

System Size	System Type	Total Priority Occurrences (1 and 2)	Total miles	HAL Goal	Status of Goal
1	11	1	7	3	-2
1	12	7	652	3	+4
	Size 1 System Total		**659**		
2	13	15	145	2	+13
2	14	2	10	2	Met
	Size 2 System Total		**155**		
3	9	1	4	1	Met
3	10	4	131	1	+3
	Size 3 System Total		**135**		
4		0	0	1	-1
	Size 4 System Total		**0**		

Distribution Goals: The distribution goal analysis for AES in the Western Susquehanna EDU has not been completed. Further analysis should be completed for both Priority 1 and 2 occurrences within the EDU to evaluate what percentage of macrohabitat types across major environmental gradients (elevation, landform and geology) are captured by selected occurrences.

Design Goals: The design goal for HAL was to provide at least one connected suite of aquatic ecological systems (system sizes 4 through 1) within each EDU. For the Western Susquehanna EDU two 4-3-2-1 connected suites of aquatic systems were constructed from Priority 1 occurrences which exceeds the design goals for the portfolio.

Table 30. Connected Suites w/in Western Susquehanna EDU (Priority 1 occurrences).

EDU	Design Goal	Connected Systems	Meets goal	Description *(mainstem to headwaters)*
Western Susquehanna	(1) 4-3-2-1 suite/EDU	4-3-2-1	Yes	W. Susquehanna R. → Pine Cr. → Slate Run/Cedar Run
		4-3-2-1	Yes	W. Susquehanna R.→ Kettle Cr. → Cross Fk./ Hammersley Fk.
		4-3-2*	No	W. Susquehanna R. → Sinnemahoning R. → Driftwood Cr.
		2	No	Left Br. Young Womans Cr.
		2	No	Bakers Run
Total	2			

The 4-3-2 connected suite of the W. Susquehanna R. → Sinnemahoning R. → Driftwood Creek becomes a complete 4-3-2-1 connected suite with the addition of the size 1 system occurrences contained in an adjacent matrix forest block. This would bring the total of connected suites which meet the ecoregion's design goals to three. However, none of the occurrences of these size

1 systems were selected during the aquatics assembly process and require significant further evaluation by TNC OUs and partners before inclusion into the aquatics portion of the portfolio.

Table 31. Connected suites and unconnected systems w/in Western Susquehanna EDU (Priority 2 occurrences).

EDU	Design Goal	Connected Systems	Meets goal	Description *(mainstem to headwaters)*
Western Susquehanna	(1) 4-3-2-1 suite/EDU	4-3-2	No	W. Susquehanna R. → Mosquito Cr./Black Moshannon Cr./Trout Run
		2-1*	No	Little Pine Cr. → Block House Run
		2-1*	No	Babbs Cr.
		2*	No	Upper Pine Cr.

The 2-1 connected suites of Little Pine Cr./Block House Run and Babbs Creek and the size 2 system of Upper Pine Creek listed in Table 31 all become part of a potential 4-3-2-1 connected suite when assembled with the Priority 1 occurrence of the size 3 system, Pine Creek. These Priority 2 occurrences require more evaluation before including them in the portfolio and assembling them as a connected suite.

Table 32. Priority 1 Occurrence Names in Western Susquehanna EDU

Baker Run	East Mine Hole Run	Left Fork Green Branch	Short Run
Bear Run	Elk Lick Run	Little Daugherty Run	SINNEMAHONING CR
Beaverdam Run	Elm Camp Run	Little Fourmile Run	SINNEMAHONING PORTAGE CR
Bell Branch	English Run	Little Indian Run	Slate Run
BENNETTE BR	Fahnestock Run	Little Kettle Creek	Sliders Branch
Big Spring Brook	First Big Fork	Little Lyman Run	Solomon Run
Billings Branch	FIRST FK	Little Slate Run	Spicewood Run
Boedler Branch	Fourmile Run	Lloyd Run	Straight Run
Bohen Run	Francis Branch	Lock Branch	Sulphur Run
Bolich Run	FREEMAN RUN	Long Run	SUSQUEHANNA R
Browns Run	Frying Pan Run	Lower Pine Bottom Run	Trout Run
Bruner Branch	Gamble Run	McClure Run	Upper Pine Bottom Run
Buck Run	Germania Branch	McCoy Run	Veley Fork
Bunnell Run	Gravel Lick Run	Miller Run	Walters Run
Cedar Run	Greene Branch	Mine Hole Run	WEST CR
Cherry Run	Hammersley Fork	Naval Run	Windfall Run
Cow Run	Hevner Run	Nelson Branch	Wingerter Run
CROSS FK	Hogstock Run	Page Run	Wykoff Branch
Cushman Branch	Hopper Run	PINE CR	Yochum Run
Daugherty Branch	Indian Camp Run	Red Rock Run	Young Womans Creek
Daugherty Run	Indian Run	Red Run	
DRIFTWOOD BR	KETTLE CR	Rexford Branch	
Driftwood Branch Sinnemahoning	Left Branch Fourmile Run	Right Branch Fourmile Run	
Dyke Run	Left Branch Young Womans Creek	Sawmill Run	
East Branch Cedar Run	Left Fork Beaverdam Run	Shanty Run	

Table 33. Priority 2 Occurrence Names in the Western Susquehanna EDU

BABB CR	English Run	Opossum Run
Bark Cabin Run	Flicks Run	Otter Run
Bear Run	Fourmile Run	PINE CR
Bennys Run	Hackett Fork	Pine Run
Big Run	Harrison Run	Ramsey Run
Black Moshannon Creek	Jacobs Run	Right Fork Mill Run
Blacks Creek	Lick Creek	Rock Run
BLOCK HOUSE CR	LICK RUN	Rogers Run
Blockhouse Creek	Lick Run	Sand Run
Bonnell Run	Little Fall Creek	Sebring Branch
Bonnell Run	LITTLE PINE CR	Shingle Mill Branch
Boone Run	Love Run	Silver Branch
Buckeye Run	McKees Run	South Creek
Bull Run	Mill Run	Steam Valley Run
Callahan Run	MOSHANNON CR	SUSQUEHANNA R
Carsons Run	Mosquito Creek	TEXAS CR
Custard Run	Muddy Run	Three Springs Run
Dam Run	Naval Run	Tombs Run
Dixie Run	Nickel Run	Trout Run
Dyke Creek	North Fork Tombs Run	Truman Run
		Wolf Run

How to interpret these results

All of the occurrences of Priority 1 and Priority 2 aquatic ecological systems identified in this plan as part of the ecoregional portfolio signify The Nature Conservancy's attempt to identify the best examples of aquatic biodiversity across the ecoregion. These occurrences should serve as a first iteration starting point for conserving the best examples of representative biodiversity throughout the High Allegheny Plateau. The aquatics portion of the HAL ecoregion plan presents a framework for thinking about conservation of aquatic systems, particularly in an ecoregion with heavily fragmented and disconnected aquatic systems.

Next Steps

Most, if not all, of the occurrences of aquatic ecological systems noted in this section of the HAL plan require a significant amount of additional assessment and evaluation with regards to the biodiversity represented by these coarse filter targets.

The following are some recommended next steps for filling data gaps and further analysis:

- Compile additional ecological data sources (macroinvertebrate, herptile atlases, fishery data sets, etc.) to develop a more complete list of species and community targets as well as improve understanding of AES
- Complete analysis of distribution goals for each EDU
- Better define/describe the biological, physical, and process components of HAL AES to better assess their significance in representing aquatic biodiversity at the EDU and ecoregional scales.
- Develop more ecologically based viability criteria and goals for HAL AES

Moreover, it is recommended that TNC and actively involved partners hold additional meetings and workshops with experts/partners to:

- Further evaluate the validity of and refine HAL AES and coarse-filter goals
- Refine GIS condition analysis and coordinate its use as a planning tool and as an adaptive tool to measure success at conservation areas and across the ecoregion for TNC and partners
- Review portfolio occurrence selection,
- Gather additional expert opinion data on aquatic systems throughout the ecoregion
- Refine and further implement use of HAL aquatic information database

The current condition and landscape context for each of the AES occurrences should be further documented and evaluated. Much of this work could be completed by additional expert workshops and interviews that could add information about stresses, sources of stress, conservation work currently underway, partners and potential partners within each EDU and across the ecoregion.

Additional planning needs include:

- Continue to assemble uniform data sets for use in ecoregional and conservation area planning which can be distributed to TNC OUs and partners working throughout the ecoregion *and* routinely updated with new information
- Detailed, multi-scale stresses and sources analysis
- Ecoregion, EDU and state-wide multi-scale strategies
- Develop a uniform criteria based process for prioritization of all ecoregional portfolio priorities (information gaps, conservation strategies, etc.)
- Identify, and include in future revisions of the HAL ecoregional plan, conservation work currently underway on aquatic targets (species, communities and ecological systems)
- Develop methodology and protocol for adding new information to the ecoregional data sets and rerunning analysis, and portfolio selection,
- Develop a series of impact (impact of specific conservation actions on the target occurrences) and process “measures of success” for the ecoregion
- Develop a timeline for next evaluation of at least the aquatics portion of the HAL ecoregional plan and portfolio.

The HAL aquatic planning team urges consideration of two broad recommendations for the next iteration of the aquatic portion of the HAL ecoregional plan: (1) more partner involvement to achieve significant buy-in to The Conservancy’s process and product(s) and (2) a standardized process for ecoregional aquatics planning across HAL so that data and decisions are comparable across EDU, ecoregion and state boundaries.

The ecoregional planning process is inherently iterative and dynamic in nature; as new data become available and ecological conditions change in the ecoregion, the portfolio must change to reflect these and ensure conservation happens with the best available knowledge.

8. ACTION PLAN

All features in the portfolio were sorted into strategic implementation groups: 1) partner lead, 2) TNC lead – no immediate action, and 3) TNC lead – 5 year action. During separate meetings for each of the TNC operating units, each occurrence or cluster of occurrences of Heritage elements, plants, animals, and natural communities, matrix forest units, and aquatic system units was evaluated for several characteristics. A brief review of these features follows:

1. **Biodiversity importance** was evaluated on a scale of 1-3: high, medium, and low. *High* = Having a broad range of conservation targets, high number of individual occurrences, large scale features, or globally rare elements.
   Medium = Moderate range of biodiversity features, multiple occurrences, or moderate importance in terms of globally rare elements.
   Low = Having only one or two target occurrences, often species or natural communities in small or large patches without significant landscape context.
2. **Threats/urgency.** Evaluated as High, Medium or Low. What are the major threats facing this site? Will action be needed at this site in the next few years?
3. **Feasibility.** What is the potential for effective conservation action? Who currently owns the site? Is there program capacity to undertake this type of work?
4. Who should take the **lead in conservation action** at this site?
5. Is this a **high priority for action** in the next 5-10 years? Yes or No.

Notes were taken during each of these meetings and returned to the operating units for quality control.

At a meeting of the entire group, selections were made for the ecoregion based on these initial discussions and an overview of the ecoregion as a whole. Overall, Action sites selected within HAL represent a significant portion of the biodiversity characterized in this plan and capture examples of all the types of biodiversity that will, over time, need attention in the ecoregion.

Table LLL. Review of Action Site Biodiversity by State.

	NJ	ENY	CWNY	PA	Total	% of total
Plant Occurrences	3	21	7	10	41	34
Animal Occurrences	4	9	6	42	61	39
Natural Community Occurrences	11	62	30	62	165	65
Matrix Forest Blocks	1	8	7	9	25	47
Aquatic Stream Miles	81	311	489	1597	2478	11*

* Percent of total stream miles in the ecoregion

Matrix forest blocks

A total of 25 matrix forests blocks were selected as Action sites. Twenty one of these are Tier 1 matrix forest blocks, 84% of the total of Tier 1 blocks. Four were Tier 2 blocks, 14% of all Tier 2 blocks. Seven of the nine Ecological Land Unit (ELU) groupings of matrix forests are represented in these selections. The two groupings that were not included, both in the agricultural part of New York, require significant restoration. Matrix blocks chosen in Action sites are located in all parts of HAL, with the greatest concentrations in the Catskills, the Allegany State Park region, and the central portion of the mass of Pennsylvania state-owned lands around Emporium. In four areas, matrix forest blocks were combined to facilitate conservation planning.

Natural communities

A total of 165 of the 253 natural community occurrences selected for the HAL portfolio (65%) were included in Action sites. Most natural community occurrences selected for Action sites are associated with matrix forest blocks with the exception of a series of large and small patch communities in the Poconos and in Madison County, Pennsylvania, where TNC has been active for many years. Much of the representation of communities in both the HAL database and in these Action sites reflects the bias of selective inventories within HAL.

Aquatic system units

Of the 148 aquatic system units identified in the four Ecological Drainage Units (EDUs) assessed within HAL, 70 or 47% were chosen as Action sites. Aquatic action sites were selected in all parts of HAL including each of the EDUs and in areas associated with each of the four major river segments in the ecoregion. Major portions of the Allegheny and Delaware Rivers are included. Only limited sections of the Susquehanna and West Branch of the Susquehanna were identified as Action sites. A total of 2478 stream miles are included in these selections: 800 miles in New York, 81 in New Jersey and 1597 in Pennsylvania

Animals

A total of 61 occurrences of the 158 animal occurrences identified in HAL (39%) were selected in Action sites. Many of these selections are associated with aquatic systems. The ecoregion has a high diversity of mussels, fish, and dragonflies, which help define many of its important aquatic features.

Plants

A total of 41 occurrences of the 121 plant occurrences identified in HAL (34%) were selected in Action sites. Fewer plant occurrences than communities or animals occurrences are included in Action sites because many of the plants documented within the database are known from historical records and often found at isolated, small patch sites. Plants included within Action sites are generally associated with matrix blocks, particularly the Catskills, Shawangunks in NY, the Kittatinny Ridge in NJ, and the Poconos.

9. HAL THREATS

1. Forest fragmentation- from a range of causes.
2. Forest simplification- Reduced species dominance. Loss of chestnut, beech undergoing reduction, loss of hemlocks, elms, poor oak regeneration, shift to sugar maple and red maple and cherry in some managed forests.
3. Global warming.
4. Acid precipitation.
5. Second home development: Catskills, Poconos, Western PA hills. Pike and Wayne county are considered to be “good real estate” markets.
6. Deer overpopulation—not as bad in the Catskills as in other areas. Bad in NJ and Western PA, and Allegany State Park.
7. Invasive species issues.
8. Forest pathogens: Hemlock wooley adelgid; gypsy moth; beech bark disease, etc.
9. Highway expansion- Rte 17 becoming Rte 86.
10. New types of development: Casinos, warehouses, racetracks.
11. Oil and Gas leasing,expansion and maintenance
12. Residential development—NYC sprawl, other areas with suburban expansion

Other threats:

13. Gas transmission lines
14. Fire suppression
15. Road management- think ASP and wider roads
16. Wise use
17. Increased logging
18. Woodrat disease
19. Turtle poaching
20. Oak regeneration- related to deer overbrowse
21. Excessive or inappropriate game species management

10. CONSERVATION OPPORTUNITIES IN HAL

1. Depopulation over most of the ecoregion—notable exceptions (Poconos).
2. Location of ecoregion—edge of most things—center is far from population centers.
3. Public land acquisition money—NJ and NY; not much in PA right now.
4. New York City Water Supply money, plan is to acquire several 100,000 more acres.
5. A lot of land is in public ownership already— Catskills, PA state forests and gamelands, ANF, Delaware Water Gap.
6. Many new land trusts.
7. Many new conservation coalitions are in place or developing—watershed groups, Gunks, Delaware River, Catskills, Friends of the … Advocacy groups are in place in a few areas, recreation groups, old growth forest groups, limited logging groups, hiking groups.
8. New ecosystem thinking in State and Federal land management. Fishing, logging, oil and gas well development and maintenance. NPS, NFS, PA State Forestry, Catskills. There is a new PA state agency hire who is beginning the hard work of addressing the need to reduce the deer herd.
9. Dam removals and relicensing: Neversink story.
10. Restoration techniques—developing. Limited now, but interest is high and commitment strong.
11. Fire management thinking developing—NY has a fire manager. Planning has taken place in NY and PA at other sites. Some planning initiated in Poconos and Gunks.
12. New control measures for invasives being investigated. Adelgid control; Loosestrife biocontrol, Phragmites research underway, invasives groups forming.
13. Bog turtle plan out—work ongoing in NY and PA and some in NJ. Need to work together with a coalition focused on the plan and with USFWS support.
14. Catskills and ANF designations.
15. GIS info developing and sharing—TNC ECS has worked on ELUs and data layers for this plan. Will be available for use in planning and will hopefully be further developed over time.
16. Deer management need acknowledged within NY and PA. Uncertain about where this is going.
17. Changes in logging practices.
18. Gas and oil well line development continues, but with some regulation.
19. Species introductions— Uncertain; may play a role with Fed and State listed species: Bog turtle, dwarf wedge mussel.
20. Still few roads—Fewer major roads than in other areas, although there is a dense network of road in many PA state lands.) There is not many interstates and major state roads through the ecoregion. (81, 86, 88, ??).

11. HAL CROSS-BOUNDARY POSSIBILITIES

1. Assessment of aquatic portfolio sites.
2. Forest matrix block conservation in similar types of settings. NY, NJ, and PA.
3. Invasive species work- assessment, raising public awareness, developing control or avoidance methodology.
4. Delaware River- water shed related to aquatics, series of Matrix forest blocks, species interests. NY, PA and NJ. Work partly underway within TNC and numerous partners already focused on area and organized into various types of coalitions.
5. Shawangunk Ridge/Kittatinny Ridge- NY and NJ.
6. Bog turtle conservation. NJ and PA. (and NY in other ecoregions)
7. Wood rat conservation. NY and PA.
8. Dragonflies- assessment and development of conservation strategies.
9. Discussion of aquatic restoration concepts. Goals and feasibility. Methods. NY, PA, and NJ.
10. Mussel conservation—*Alasmidonta heterodon*. (Subset of aquatic conservation but federally listed species needs detailed work.)
11. Deer management.
12. Beaver management.
13. Response to loss of hemlock.
14. Floodplain forest restoration.
15. Fire management.
16. Inventories
17. Cooperative work with the Forest Service
18. Work with timber management operations.

12. HAL LESSONS LEARNED DURING PLANNING PROCESS

In no particular order:

1. Develop an identity for the ecoregion early in the process. The boundaries and character of the ecoregion are not necessarily well known to all participants.
2. Become very familiar with the ecoregion. The team leader may be the only person who is thinking about the multi-state ecoregion as a unit.
3. In each state and in each Heritage Program, establish a point person who will be responsive to requests. It may be appropriate to identify a point person in some other offices of TNC or in a partner organization.
4. Include partners early in the process. Keep them informed and share final products.
5. Maintain good data management. Set up files early and maintain good documentation of the process.
6. Be ready to deal with staff turn over. During this process, several key participants left and were replaced by new staff. There is a critical need to train new staff quickly in the process.
7. Provide funds to the Heritage Program for their participation. Arrange time and money in annual planning process. Make sure the demands made of participants are reasonable.
8. See that new information generated during the ecoregional planning process is added to the Heritage databases. Capture collective thinking. Currently there is no money to do this. Find out what money is needed to update EORs and EO specification and find and commit the money.
9. Develop comprehensive bird information with goals and sites selected for the portfolio. All three states have detailed bird information that needs to be pulled together and assessed. There are numerous people, mostly in state government and other NGOs, that will be willing to help.
10. Develop connectivity issues between portfolio sites. Address wide ranging species issues and global warming.
11. Assemble better managed area data for GIS analysis. Current data layers lack county and town conservation land and many NGO properties.
12. Develop better goals for species. The goals are currently intended to be generic, as place holders for individual recovery plans with rangewide assessments. The goals are very general and even misleading at this point.
13. Develop comprehensive assessments/inventories for aquatic features and matrix forests. Test assumptions in ecoregional assessment methods.
14. Connect ELUs better with natural communities to assess whether ELUs actually represent differences in biodiversity.
15. Seek feedback from experts on aquatic features and matrix forest block selections.
16. Obtain clerical assistance for the ecoregional plan leader to set up and run meetings and manage data sets and files.

17. Set up meetings far in advance and secure attendance by key participants. Remind them frequently that the meetings are still on the calendar.
18. Keep the maps simple. Create maps with multiple layer for analysis, but for most uses in meetings reduce map detail to the most significant information. May of the maps are very information rich and too difficult to present to working groups that are not actively engaged. Maps with too much detail become presentation tools and not working maps.
19. Maintain good communications. Experiment with conference call or a regular e-mail update to keep Core Team members informed and engaged.
20. Work with good models for other ecoregions. Talk regularly with leaders of other ecoregional planning efforts.
21. Visit state offices and develop a presentation that can be used broadly to share developing information about the ecoregion.
22. Allow plenty of time for requests for input. Send reminders near the due date with additional time to get the work done.
23. Maintain a shared timeline and update regularly. Make sure that the sequencing is correct.

13. NEXT STEPS FOR THE HAL PORTFOLIO ASSESSMENT

Next steps are presented at the end of each section for plants and animals, natural communities and matrix forests. The following reviews the major needs with the HAL plan to meet conservation goals and improve the conservation agenda for the ecoregion.

1. Assemble a team from all HAL states to assess the HAL first draft plans and develop a strategy for making revisions.
2. Assemble a working group to develop bird targets and a strategy to address bird conservation issues in HAL.
3. Assess wide-ranging species issues.
4. Roll together matrix blocks for HAL and adjacent ecoregions and develop concepts for connectivity among blocks. Select sites.
5. Evaluate the importance of the three masses of matrix forest blocks in HAL: The Catskills, the area around Allegany State Park, and the mass of state-owned land in Pennsylvania.
6. Review the current aquatics portfolio with experts.
7. Build out the aquatics assessment to the entire ecoregion.
8. Roll up species targets for all Northeastern ecoregions and reevaluate HAL targets.
9. Combine portfolio data for HAL with all abutting ecoregions and make sure that no features are omitted because they occur at the edge of the ecoregion.
10. Continue evaluation of matrix forest blocks. Do these meet minimum standards for matrix forests? What restoration is needed?
11. Assess all species targets using more information on rangewide distributions.
12. Improve species goals by developing rangewide assessments. Coordinate goals among ecoregions and develop conservation needs for species throughout their range.
13. Further refine the National Vegetation Classification for HAL.
14. Consider restoration for species and communities that do not meet conservation goals.
15. Assess the Site Conservation Planning needs of portfolio sites throughout the ecoregion and in adjacent ecoregions. Develop strategy to address similar sites.