Priority Conservation Area and Cumulative Resource Assessment Integration Methods

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Introduction and Background

Habitat loss, fragmentation, and degradation represent the most significant threats to the effective conservation of wildlife species and natural, communities. At the same time, however, the capacity to purchase, conserve, and manage lands has diminished significantly due to declining budgets and rising land costs. This problem is compounded by the rapid conversion of lands from traditional rural and agricultural uses, which may support a broad diversity of wildlife, to industrial or residential uses, which create landscapes inhospitable to many species and aquatic systems. This condition is especially clear in Virginia where—by one estimate—current land conversion rates will develop more land over the next 40 years than has been developed in the past 400 years (Benedict *et al.* 2004). Undoubtedly, habitat loss and fragmentation cannot be stopped. Rather, their repercussions must be managed proactively via well-informed, comprehensive planning that recognizes the critical importance of conserving and managing terrestrial and aquatic species habitats and the ecosystem functions they help constitute. This function is the foundation for a healthy Green Infrastructure.

Two major ideas have become clearer alongside our understanding of the impacts of habitat loss and fragmentation. First, most land conservation happens locally. This is due in part to the fact that specific decisions about how parcels of land will be used are made locally, and at this level, public input and funding possibilities are most closely linked with the conservation of a specific place. Second, all lands/resources are not equal in their contribution to a healthy functioning ecological network. Each conservation opportunity displays a unique set of conservation values that can be used to weigh the benefits of conserving one parcel over another. Considering the reality that funding for conservation is typically very limited at the local level, having tools to identify conservation opportunities that maximize our ability to conserve and manage the most important areas in the most financially sound ways is key.

Virginia natural resources agencies have independently quantified important conservation opportunities. Specific conservation tools used for this purpose include the Virginia Conservation Lands Need Assessment (VCLNA) which was developed by the Virginia Department of Conservation and Recreation – Division of Natural Heritage (DCR-DNH) and the Virginia Wildlife Action Plan, developed by the Virginia Department of Game and Inland Fisheries (DGIF). Both the Ecological Model (aka the Virginia Natural Landscape Assessment or VaNLA) of the VCLNA and the mapped tiered-species habitats from the Wildlife Action Plan identified conservation priorities spatially. However, each of these efforts were formed with different perspectives and assumptions and therefore, presented very different results. Concurrently, Virginia Commonwealth University's Center for Environmental Studies (VCU-CES) has developed methods to rate aquatic resource integrity based on fish and macro-invertebrate community sampling and the VIMS College of William and Mary Center for Coastal Resource Management Cumulative Resource Assessment have developed an Aquatic Priority Conservation Area data layer showing where important aquatic resources exist. This provided another way to identify conservation priorities. With several tools for mapping conservation priorities, local planners needed to fully evaluate all available options at the risk of under representing a specific conservation perspective. Synthesis was needed to present a unified method of prioritizing conservation opportunities.

The Coastal Virginia Ecological Value Assessment (VEVA) is a GIS data layer developed to integrate the Priority Conservation Areas data layer (VA-DGIF, VA-DCR DNH and VCU CES) with Virginia Healthy Waters data and with the Cumulative Resource Assessment (VIMS College of William and Mary Center for Coastal Resource Management). The effort was undertaken to synthesize important natural resource information in one geospatial layer for natural resource management, land use management and awareness. This dataset is intended to guide conservation planning and efforts. This dataset is not intended to replace on the ground surveys or consultations with biologists as appropriate.

The Coastal Virginia Ecological Value Assessment (VEVA) dataset delineates priority conservation areas ranked by level of importance based on VA Dept. of Game and Inland Fisheries' Priority Wildlife Diversity Conservation Areas, VA Dept of Conservation and Recreation Division of Natural Heritage Conservation Sites Layer (CSL) and Natural Lands Network (NLN), VCU Center for Environmental Studies aquatic resource integrity layer and VA Dept. of Conservation and Recreation Division of Soil and Water Health Waters data, and VIMS College of William and Mary Center for Coastal Resource Management Cumulative Resource Assessment layer. These ecological resources are defined as lands, aquatic resources and surface waters indentified as important for conservation of Virginia's wildlife, plants, aquatic communities and resources and natural communities. The data are ranked on a scale of 1 to 5, with a 5 representing the highest conservation priority. The identified lands/waters can be used to prioritize areas for preservation, protection or specific management action.

VEVA Data Inputs

DCR- Natural Heritage Plan PCA Components

Virginia DCR-DNH prepared two data layers from data in the Natural Heritage Plan to contribute to the PCA compilation. These layers were selected because together they provide a fine filter and a coarse filter conservation panning tool. In short, coarse filter tools are designed to conserve high percentages of species by conserving adequate diversity, distribution, and abundance of ecological communities, ecological land units (e.g., alliances of ecological communities, physical environments and landscape-level ecological phenomena). Coarse filter tools are complimented by fine filter approaches, which focus on specific habitats of individual rare species, or species that specialize on a small and/or unique habitat type. For the PCA, DCR-DNH prepared data layers derived from DCR-DNH Conservation Sites (Conservation Sites ranked by B-rank; fine filter) and the Virginia Natural Landscape Assessment (VaNLA) (Virginia Natural Land Network; coarse filter). The following text briefly describes these two PCA inputs.

Virginia Natural Land Network – Coarse Filter

The Virginia Natural Land Network is a focused subset of lands identified in the VaNLA, a landscape-scale GIS analysis for identifying, prioritizing, and linking natural habitats in Virginia, which was developed by the DCR-DNH with funding from the Virginia Coastal Zone Management Program (NOAA Grant # NA05NOS4191180, Task 92.05 and NOAA Grant # NA03NO54190104, Task 95.01). Using land cover data derived from satellite imagery, the VaNLA identifies un-fragmented natural habitats called Ecological Cores, or large patches of natural land cover with at least 100 acres of interior conditions. Cores consist mainly of upland forests and forested wetlands statewide, but also marshes, beaches, and dunes in the coastal plain. Large, medium, and small Ecological Cores are identified, along with smaller Habitat Fragments that may be important in more urban localities. Ecological Cores provide habitat for a wide range of species, from those dependent upon interior forests to habitat generalists, as well as species that utilize marsh, dune, and beach habitats. Cores also provide benefits in terms of open space, recreation, water quality (including drinking water protection), and carbon sequestration, along with the associated economic benefits of these functions.

All VaNLA cores are given an ecological integrity score. This score is derived from a ranking method resulting from the calculation of several attributes from all cores that assess a core's relative contribution to ecosystem functions (e.g. rare terrestrial and aquatic species locations from the SWAP and Natural Heritage Plan, locations of rare community types, total core area, length of core interior streams, variety of unmodified wetlands, etc.). Via this process, each ecological core was assigned an ecological integrity score of C1 – Outstanding to C5 – General.

In the interest of identifying an entire ecological network upon which to base conservation decisions, landscape corridors were also identified using GIS to identify the most suitable linkages between the two highest ranks of cores (C1 andC2). Suitable corridors that link cores allow animal movement between cores and help to facilitate seed and pollen transfer between cores. In addition to indentifying links between C1 and C2 cores, corridors also integrated all landscape cores that they intersected (C3, C4 and C5 cores) as habitat nodes. These nodes provide stepping stones for plant and animal populations over time and help to assure that lands identified as important to core linkages also contribute to the available habitats for some species within the ecological network. More detailed methods and background for the VaNLA can be found on the DCR-DNH website at http://www.dcr.virginia.gov/natural_heritage/vclnavnla.shtml

Portions of the VaNLA were selected to provide the coarse filter contribution to the greater PCA. Referred to as the Virginia Natural Land Network (NLN), this subset of lands consists of a GIS layer of:

- all the highest ranked cores (C1 and C2) in the Coastal Zone, each ranked by ecological integrity,
- all landscape corridors providing linkages between these cores, and
- all cores (ranks C3 – C5) that intersect landscape corridors.

The NLN was provided with rankings of ecological integrity from low (1) to high (5) for incorporation into the PCA. All included cores maintained their VaNLA Ecological Integrity scores, and all corridors were given a rank of 1 where they did not intersect a VaNLA core. The NLN is shown in Figure 1.

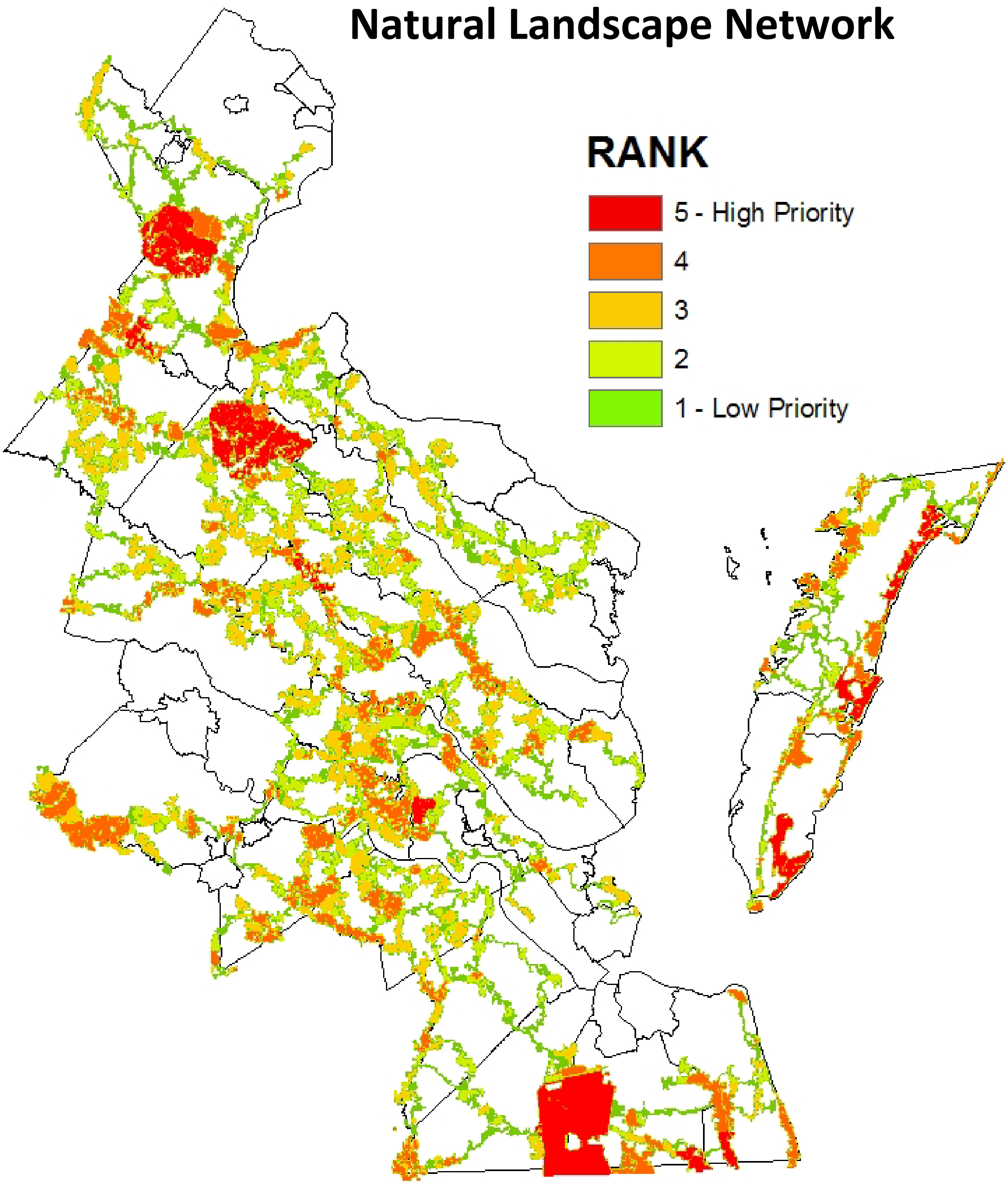


Figure 1. Natural Landscape Network for the Coastal Zone of Virginia.

Virginia Conservation Sites – Fine Filter

The DCR-DNH maintains a GIS layer and database of Virginia's Conservation Sites, a central component of the Natural Heritage Plan. A conservation site is a planning boundary delineating the Virginia Natural Heritage Program's best determination of the land and water area occupied by one or more natural heritage resources (exemplary natural communities and rare species) and required to support their long-term survival. The size and dimensions of a conservation site are based on the habitat requirements of the natural heritage resources present and the physical features of the surrounding landscape. Features taken into consideration include underground and surface hydrology, slope, aspect, vegetation structure, current land uses, and potential threats from invasive species. Conservation sites do not necessarily preclude human activities. but the site's viability may be greatly influenced by human activities. Conservation sites may require ecological management, such as invasive species control or water management, in order to maintain or enhance their viability. Each conservation site is given a biodiversity significance ranking (B-rank) based on rarity, quality, and number of natural heritage resources it contains.

All conservation planning tools developed using DCR-DNH data rely in part on the locations of, and data tied to, DCR-DNH Conservation Sites. The Conservation Sties layer was selected as a DCR-DNH input to the PCA analysis to provide a fine filter conservation planning dataset to inform the greater PCA.

For the PCA, Biodiversity Ranks were calculated for all DCR-DNH Conservation Sites in the Virginia Coastal Zone based on most recent data as of January 2009. Conservation Sites were then ranked by their Biodiversity Rank scores, from 1 (low) to 5 (high). A revised GIS layer was developed based on this ranking and contributed to the greater PCA analysis. The ranked Conservation Sites are shown in Figure 2.

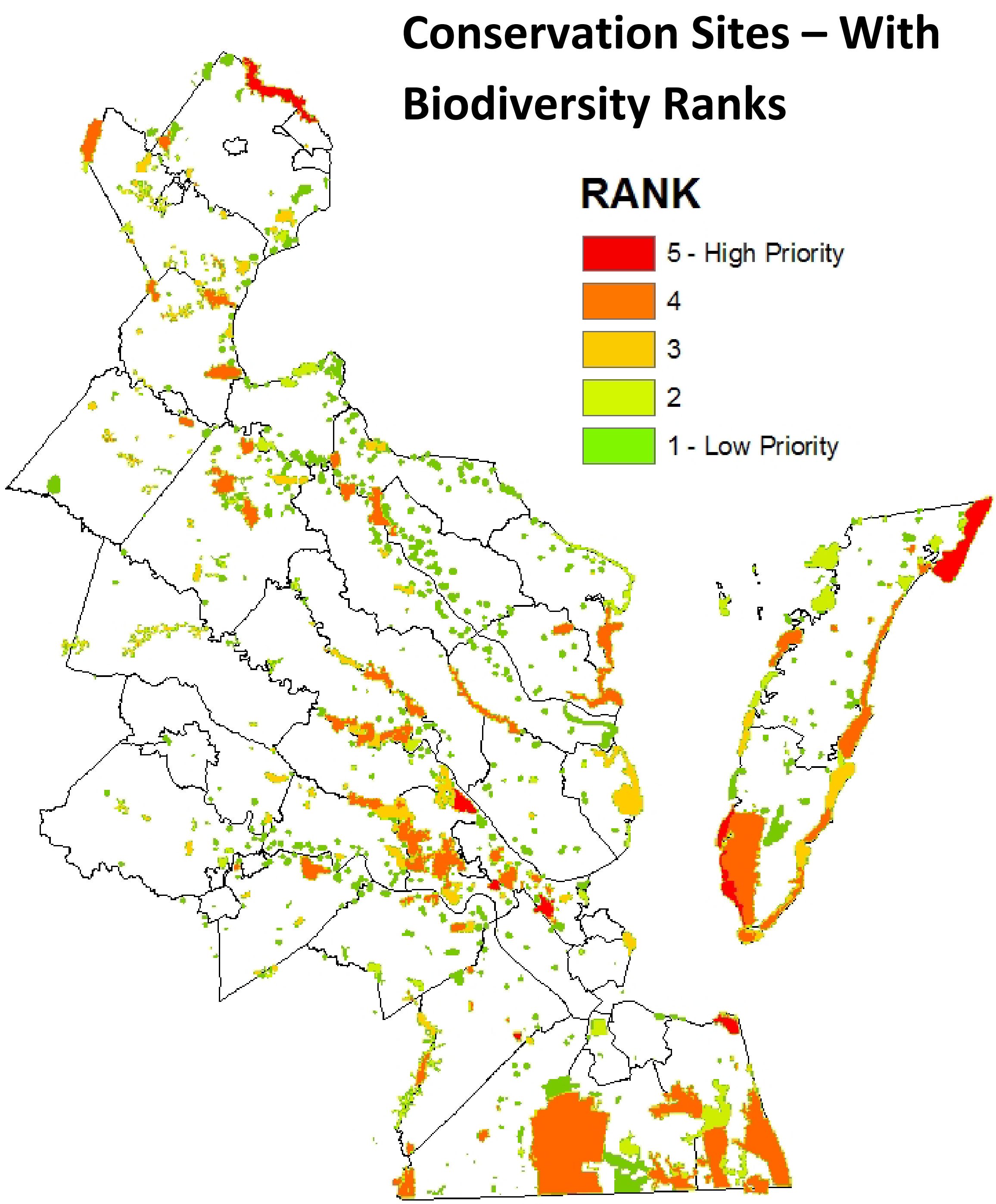


Figure 2. Conservation Sites with Biodiversity Ranks for the Coastal Zone of Virginia.

Summary DCR Components

While much more data are available, DCR-DNH sought to select the most succinctly comprehensive representation of the Natural Heritage Plan data, to inform the final PCA. The Conservation Sites provide a statewide snapshot of specific areas important to biodiversity conservation, and the NLN provides a coarser tool for planning to conserve and minimize negative impacts on lands that contribute to a landscape-level ecological network.

DGIF – Priority Wildlife Diversity Conservation Areas

The DGIF maintains several GIS datasets showing the location of important wildlife features. However, DGIF has never produced a map showing how these features should be prioritized and conserved. While, as part of the Wildlife Action Plan, the DGIF mapped habitats of over 250 species of greatest conservation need (Tiered Habitat), these do not include any protective buffer around habitats. Furthermore, there are general conservation actions included in the Wildlife Action Plan that benefit multiple species that had not been mapped. Therefore, it was necessary to create a new GIS dataset to compile wildlife conservation areas. This dataset was called Priority Wildlife Diversity Conservation Areas or PWDCA. The term *diversity* was included to reinforce the wildlife diversity or nongame wildlife conservation focus.

The first step was to determine appropriate existing GIS datasets that represent conservation opportunities. These datasets included: Anadromous Fish Use Waters, Colonial Waterbird Database, and Audubon Important Bird Areas. The DGIF's Coldwater Stream Survey dataset was also considered, but is primarily outside of the Coastal Zone.

The next step was to gather "mappable" conservation actions outlined in the Wildlife Action Plan. There were four explicit conservation actions that could be mapped:

1. *Acquire or protect needed habitats.* The DGIF mapped the habitats of over 250 species of greatest conservation need within the top two tiers of imperilment plus any state or federally listed species in a lower tier. These are called DGIF's Tiered Species Habitat. While this doesn't include the habitats needed to conserve all species of greatest conservation need, it does include a major portion of the most critically imperiled species.
2. *Protect large blocks of contiguous habitat.* The DCR-DNH identified cores of natural land cover within the Ecological Model of their VCLNA. These cores and related features represent contiguous or unfragmented habitat. These are also referred to as the VaNLA cores.
3. *Create forest or upland buffers around marshes and protect wooded wetlands.* Wetlands are identified in the U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory. Buffers can be created in GIS to identify buffers around these features.
4. *Protect and establish riparian buffers.* GIS data on streams can be buffered to delineate appropriate stream buffers. The best available stream data are the National Hydrography Dataset from U.S. Geological Survey (USGS).

Details on the existing GIS datasets, as well as datasets used to map conservation actions, are listed below:

Anadromous Fish Use Waters: This dataset maintained by DGIF and updated in 2006 identifies reaches that are confirmed or potential migration pathways, spawning grounds, or nursery areas for anadromous fish. The base layer hydrography for this dataset is the USGS National Hydrography Dataset, High (1:24,000) and Medium (1:100,000) resolution.

Colonial Waterbird Database: This dataset contains known occurrences of colony nesting waterbirds in Virginia. It includes data from the 2003 Colonial Waterbird survey conducted by the College of William and Mary's Center for Conservation Biology (CCB), data from the DGIF's Species Observations database and data from Cornell University.

Audubon Important Bird Areas (IBA): This dataset is maintained by the Audubon Society as part of a global effort to conserve bird biodiversity. There are 20 IBA's that fall within the Coastal Zone. They are created to encompass habitat important one or more species and are based on nominations from experts in the avian community.

DGIF's Tiered Species Habitat: Aquatic and terrestrial tiered confirmed and potential habitat layers were created as part of the Virginia Wildlife Action Plan. There are four tiers, representing levels of imperilment with I being the highest. All maps and information were reviewed by biologists. For more information, visit: http://bewild.virginia.org.

- Terrestrial confirmed habitat: This layer includes confirmed locations from DGIF's Species Observations database as well as data from DCR-DNH's Biotics Data System.
- Terrestrial Potential habitat: This layer represents areas with potential for supporting species. It is based on species distribution, species habitat requirements, existing spatial data and biologists' knowledge.
- Aquatic habitat: The aquatic layers are based on a Stream Reach Classification System using the 1:100,000 National Hydrography Dataset (NHD). Reaches in this dataset were assigned additional attributes useful for habitat evaluation such as size, gradient and elevation.
    - Confirmed habitat: Confirmed reaches have documented species occurrences.
    - Potential habitat: Potential reaches are assigned based on species distribution and the characteristics of confirmed reaches.

Note that the DGIF's Threatened and Endangered Species Waters dataset is essentially a subset of the aquatic habitat portion of the Tiered Species Habitat, for those individual listed species. Therefore this dataset was not included on its own.

National Wetlands Inventory: This dataset is maintained and downloaded from the USFWS. It was digitized from 1:24,000 topographic quads and attributed using the Cowardin Wetland Classification System.

National Hydrography Dataset: This dataset is maintained and downloaded from the U.S. Geologic Survey. The layer used to extract riparian areas was at the 1:100,000 scale.

VaNLA Cores: Layer created and distributed by the DCR-DNH for the Virginia Conservation Lands Needs Assessment, as part of the Virginia Natural Lands Network. It was published in 2006 and represents areas of un-fragmented natural habitat ranging in size and corresponding conservation value.

Once the initial GIS input layers were gathered, it was necessary to determine how they should be processed and prioritized. The list of relevant layers and habitat features was sent to 13 DGIF Wildlife Diversity biologists with broad questions in-mind including: *What areas in Virginia should be preserved?;*

What are the priority that should be managed in a specific way?; What areas should localities protect through local zoning or planning?; How should the Wildlife Diversity section prioritize land for acquisition? The biologists reviewed the list of mapped wildlife features, suggesting priorities for features, buffer distances and buffer priorities where appropriate. Priorities were on a scale of 1 to 10, with 10 being the highest. In addition, biologists identified any other features that should be included in the model. Specific areas were identified as having additional value as being unique terrestrial or aquatic features.

Input was received from all 13 biologists. The results of this survey were averaged. However, input from those biologists with specific taxonomic expertise was considered more appropriate than similar input from non-experts for individual taxa features. For example, avian biologists determined the priority rankings of Important Bird Areas and tiered bird species habitats while aquatic biologists had more input on riparian buffers rankings. Initial input was compiled and draft buffer distances and priorities were determined. A second round of input on these draft results followed. After feedback on the draft values was received and incorporated, final values were determined (see table below).

The final priorities used in the model are shown below:

Aquatic Tiered Habitat[1]			
Confirmed DGIF	Tier I spp reach	Priority	10
		Buffer	300
		Buffer priority	10
	Tier II spp reach	Priority	9
		Buffer	300
		Buffer priority	9
	Tier III spp reach	Priority	7
		Buffer	300
		Buffer priority	7
	Tier IV spp reach	Priority	5
		Buffer	300
		Buffer priority	5

Potential DGIF	Tier I spp reach	Priority	7
		Buffer	150
		Buffer priority	7
	Tier II spp reach	Priority	6
		Buffer	150
		Buffer priority	6
	Tier III spp reach	Priority	4
		Buffer	150
		Buffer priority	4
	Tier IV spp reach	Priority	3
		Buffer	150
		Buffer priority	3
Terrestrial Tiered Habitat[1]			
Confirmed DGIF (includes data from DCR-NH)	Tier I spp location	Priority[2]	10
		Buffer	200
		Buffer priority	10
	Tier II spp location	Priority[2]	9
		Buffer	200
		Buffer priority	9

	Tier III spp location	Priority[2]	7
		Buffer	200
		Buffer priority	7
	Tier IV spp location	Priority[2]	5
		Buffer	200
		Buffer priority	5
Potential DGIF	Tier I spp habitat	Priority	8
		Buffer	100
		Buffer priority	8
	Tier II spp habitat	Priority	6
		Buffer	100
		Buffer priority	6
	Tier III spp habitat	Priority	4
		Buffer	100
		Buffer priority	4
	Tier IV spp habitat	Priority	3
		Buffer	100
		Buffer priority	3

Audubon Society	Important Bird Areas	Priority[3]	10, 5
		Buffer Distance	0
		Buffer Priority	0
CWB DGIF, W&M's Center for Cons. Biology	Colonial Waterbirds	Priority	8
		Buffer Distance	300
		Buffer Priority	8
VaNLA Cores DCR-NH	Large	Priority	5
	Medium	Priority	4
	Small	Priority	4
	Fragments	Priority	3
Wetlands National Wetlands Inventory	Wooded	Priority	8
		Buffer Distance	200
		Buffer Priority	6
	Non-wooded	Priority	5
		Buffer Distance	150
		Buffer Priority	4
Anadromous Fish Use Areas	Confirmed	Priority	4
		Buffer	100

DGIF		Buffer priority	4
	Potential	Priority	2
		Buffer	100
		Buffer priority	2
Streams 1:100,000 NHD	Riparian Buffers	Priority	3
		Buffer	100
		Buffer priority	3
Unique Terrestrial Areas[4]		Priority	0.5, 1
Unique Aquatic Areas[5]		Priority	1

[1]Tier III and IV data is only included for Threatened and Endangered Species

[2]Birds were assigned priority of 1.

[3]Upper Blue Ridge IBA was assigned priority of 5, all others were 10.

[4]Maple Flats, Cat Ponds, Grafton Ponds, Breaks Interstate Park, Lower Bernard Island, Halfmoon Island, Webb Island, Parkers Island, Scarsborough Island, Finney's, Watts Island, Tangier Island, Goose Island, Clump Island, Great Fox Island South and Northeast Naval Annex were assigned a value of 1. An area on the Lower Peninsula with Canebrake habitat was assigned 0.5.

[5]Indian Creek, Paddy Run, Johns Creek/Mill Creek, Craig Creek, and Nottoway River

The features, buffer distances, and priority ranks were used to combine the GIS datasets into Priority Wildlife Diversity Conservation Areas. All geoprocessing was done using ESRI ArcGIS ArcInfo version 9.2.

The riparian areas were identified using line and polygon features from the NHD. Waterbody types of Sea/ocean pipeline were removed. Remaining features were buffered by 100m and assigned weights. Wetland areas were selected from the USFWS National Wetlands Inventory Data for wooded (types EFO, PFO) and non-wooded (types E2EM, E2SS, PSS, PEM and PUB) areas. Wetland polygons were buffered appropriately. Riparian and wooded polygons were unioned and dissolved resulting on the maximum value for each polygon

Important Bird Areas were not altered from original dataset; weights were assigned accordingly.

Anadromous fish areas were buffered (according the distances above) for both confirmed and potential. Data were unioned and dissolved on maximum value where areas overlapped.

VaNLA Cores from DCR-DNH were not altered, only assigned weights.

Unique terrestrial areas were selected from DCR-DNH's Conservation Lands layer, and from DCR's Jurisdictions layer. DGIF Biologists drew the peninsula area representing canebrake rattlesnake habitat. Unique aquatic layers were selected from the NHD.

For terrestrial and aquatic tiered data, confirmed and potential locations were buffered and assigned weights according to tier. Layers were unioned to identify areas of overlap. Data were imported into MS Access where duplicate species were removed and final weights were calculated for each polygon. Final weight was calculated as the highest weight, plus half the total of the additional weights in each polygon. Because Tiered Species Habitats had such a high priority, there was a danger of these data overshadowing other wildlife features. The use of highest species weight plus half the weights of additional species occurring at the same location reduced the overall influence of sites where several tiered species co-occur.

All layers were compiled and converted from vector polygons to a raster dataset according to final weight. The raster layers were summed to get a total score for all locations. Using the Standard Deviations classification method, the combined raster was broken into 5 categories, with 1 being lower priority and 5 being the highest conservation priority.

The input layers and draft PWDCA with the 1-5 categories were posted in an intranet map site, providing an opportunity for final review by DGIF biologists. The final PWDCA is shown in Figure 3.

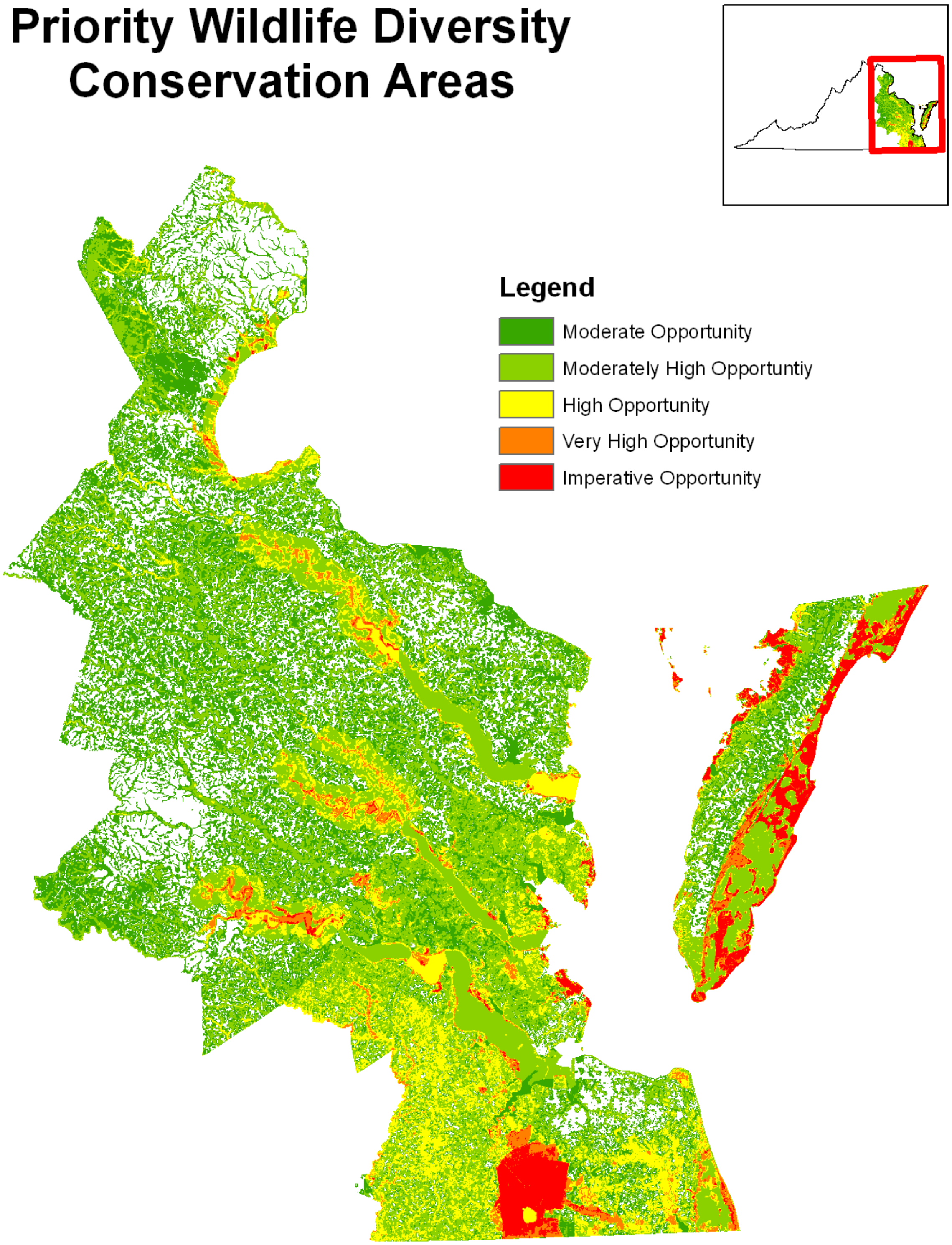


Figure 3. Priority Wildlife Diversity Conservation Areas for the Coastal Zone of Virginia.

VCU – Aquatic Resource Integrity Layer

This layer was created by Virginia Commonwealth University Center for Environmental Studies (VCU-CES) to aid in the characterization of stream health in the Commonwealth. This layer is a combination of both a local scale assessment and a watershed based approach to stream health. The assessment was aided by the Interactive Stream Assessment Resource (INSTAR).

Stream Reach Assessment:

Within each geo-referenced stream reach (150-200 m, depending on stream width), fishes, macroinvertebrates, and stream habitat data are collected. Data are compiled into databases and application macros calculate over 50 separate ecological metrics, including those typically generated for Index of Biotic Integrity (IBI) and Rapid Bioassessment Protocol (RBP) assessments. INSTAR evaluates the ecological health of stream reaches based on percent comparability of empirical data to the appropriate (e.g., basin, stream order) reference model. Stream health is calculated and placed in four categories: Exceptional, Healthy, Restoration Potential, and Compromised.

In addition to extensive stream community data collected by VCU biologists for INSTAR, appropriate data from other sources (e.g., agencies, universities) are screened for inclusion in the database, based on stringent QA criteria.

MIBI Watershed Assessment:

Watershed assessments include a broader range of validated qualitative (e.g., species lists) biotic data from various sources, including state and federal agencies. These data are used to generate watershed health using six metrics or variables for the Commonwealth's 1275 6^{th}-order watersheds. Watershed health is calculated and placed in four categories: Exceptional, Healthy, Restoration Potential, and Compromised.

Layer creation:

All 1:24,000 hydrology lines in the Commonwealth were rasterized to 30m pixels and the watershed health score was attributed on each pixel that was inside a watershed. The stream reaches were buffered and rasterized.

The healthy INSTAR sites were queried from the INSTAR database (where VSS >= 70). At each site, a watershed was generated using the Hydrologic Tools in Spatial Analyst. Each watershed was attributed with the VSS score of the watershed's pour point (the INSTAR site the watershed was generated for).

The buffered NHD data were attributed with the healthy waters watershed rank of 5 for Exceptional or 4 for Healthy where data exist.

The Aquatic Resource Integrity Layer was then created by merging the healthy waters watershed assessment with the MIBI watershed assessment layer. A Mosaic operation using the last option, setting the reach raster to last and taking those values and imposing them on the raster for the watershed values so the end result was a rasterized hydrology layer that had watershed health and healthy waters watershed health scores combined. The Aquatic Resource Integrity Layer with health categories is shown in Figure 4.

Aquatic Resource Integrity Layer

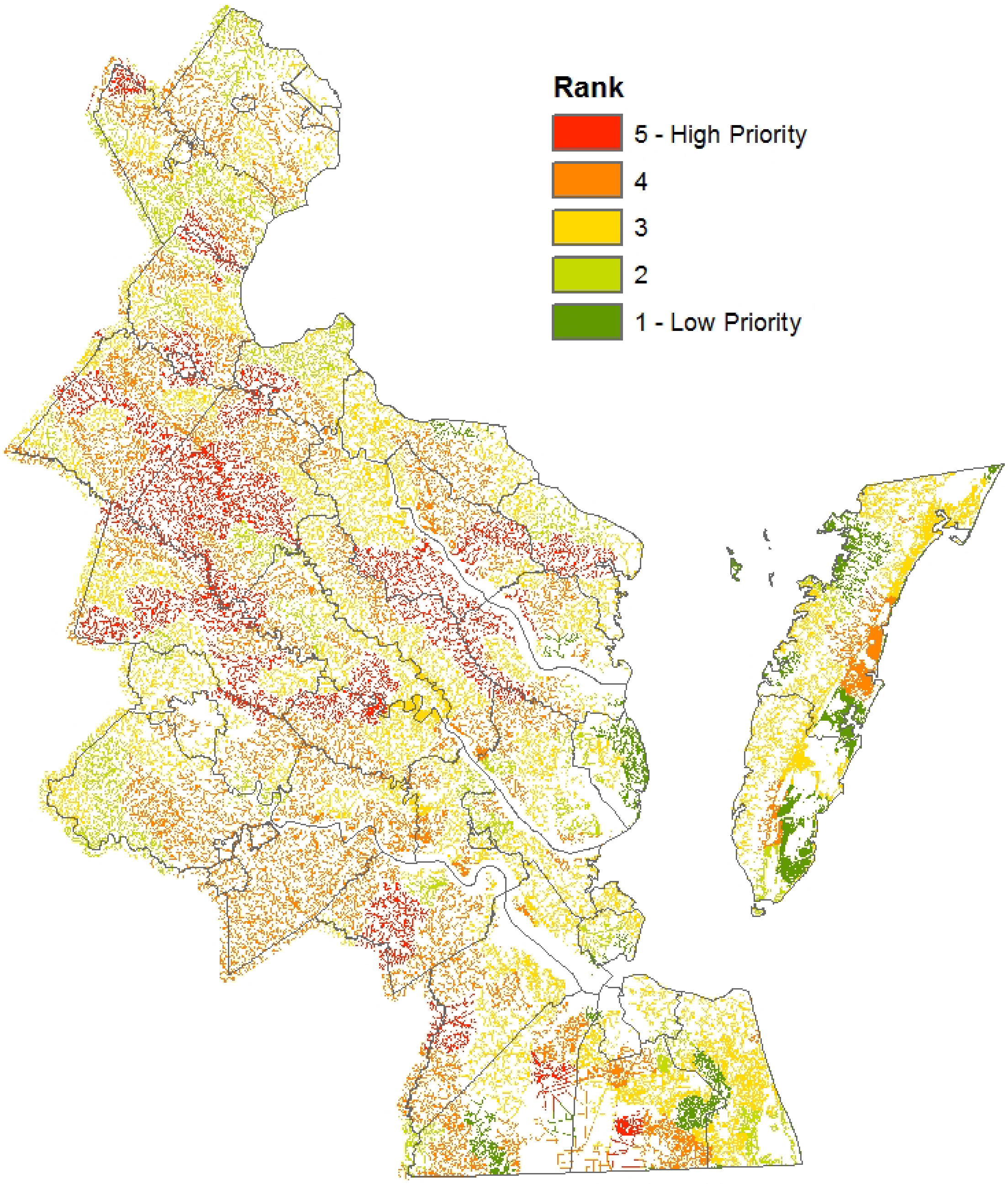


Figure 4. Aquatic Resource Integrity Layer. The raster values and health scores are as follows of 5= Exceptional, 4=Healthy, 3=Restoration Potential, and 2=Compromised.

Cumulative Resource Assessment (CRA)

The CRA data layers were obtained from VIMS. The CRA layers are a subset of the Aquatic Priority Conservation Areas developed by VIMs. The data layers used in the CRA were:

- Shellfish suitability = cz_shellfsuit
- Reef restoration sites = reefs09
- Oyster reefs = patchreef_cz
- Artificial fishing reef = fish_reef_30
- Seed areas = seedareas
- Aquaculture sites = aquasite_cz
- Turtle nest = turtlenest
- Sav = savbeds_sum.img
- Regulated areas = cz_regareas

Layer Creation:

Data were projected to Virginia Lambert NAD 1983 and resampled to 100 meter cell sizes. Class values were assigned to the rasters. The classes assigned to the APCA and their corresponding values are as followed:

- Exceptional Habitat Value: 3
- Very High Habitat Value: 2
- Good Habitat Value: 1

Recoded data such as:

3) Shellfish Suitability	4
4) Reef Restoration Sites	5
5) Oyster Reefs	5
6) Artificial Fishing Reef	3
9) Seed Areas	3
10) Aquaculture sites	4
11) Turtle Nest	5
12) SAV (1999 – 2008)	5
17) Regulated Areas	3

Using the ArcMap® tool set “Mosaic to New Raster Tool (Mosaic Method: Maximum)” rasters were superimposed and combined by cell (100m cell size). Using this technique, the output raster retains the maximum cell value on each overlapping cell. Therefore an area with only two resources that score a value of 3 each are not outweighed by an areas with 4 resources with values of 1 each.

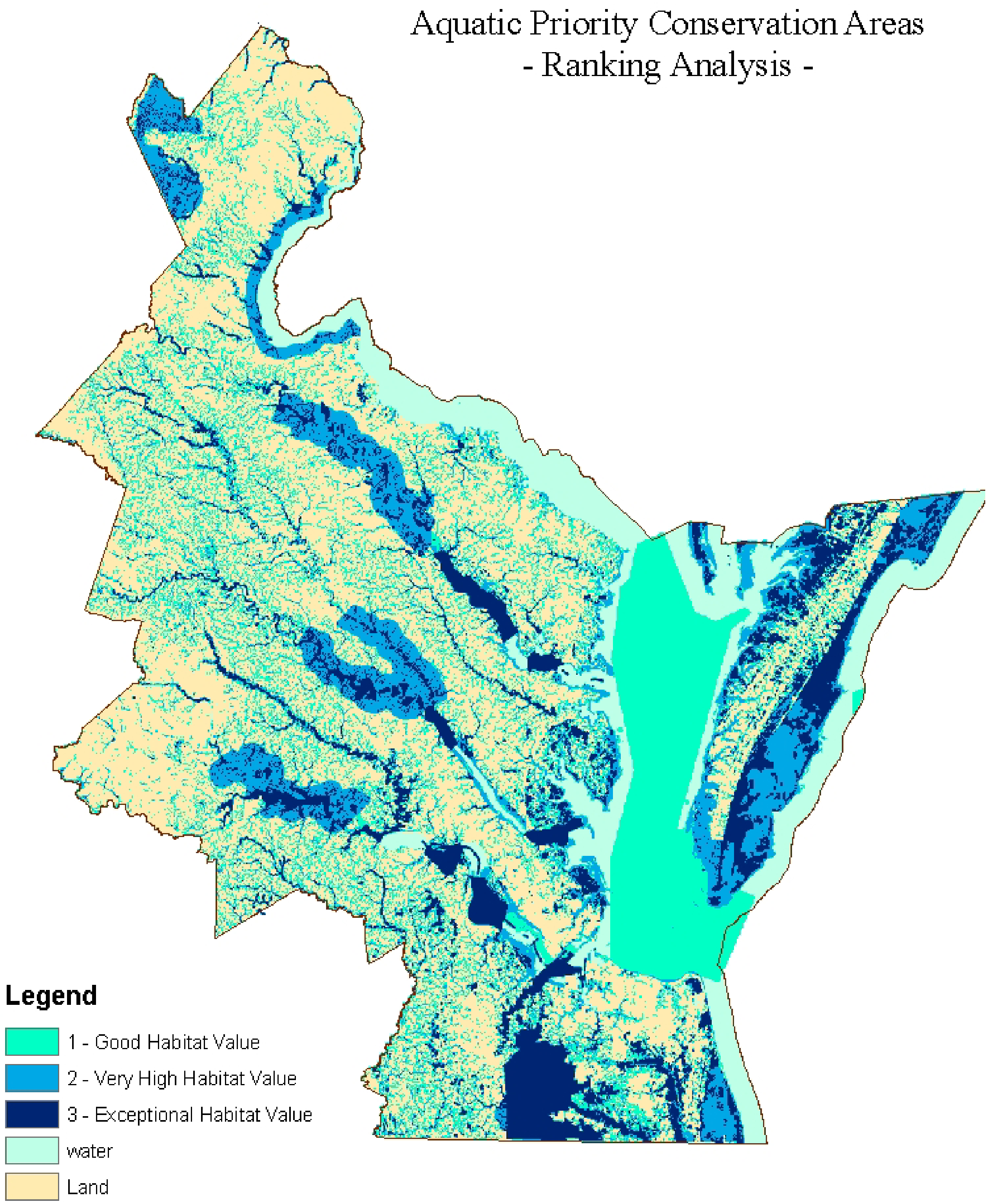


Figure 5. Cumulative Resource Assessment.

VEVA: Combining the Input Data Layers

VEVA Data Layer

All data were resampled to 100 meter cell size, where 1 cell represents a 100 meter by 100 meter ground area. The DGIF PWDCA layer, DNH natural land network and conservation sites and aquatic layer were combined using cell statistics, where the maximum value cell is output to a new data layer. A majority filter (majority, 4 neighbors) was run on the new PCA data layer to smooth the data and remove noise in the dataset. See Figure 6.

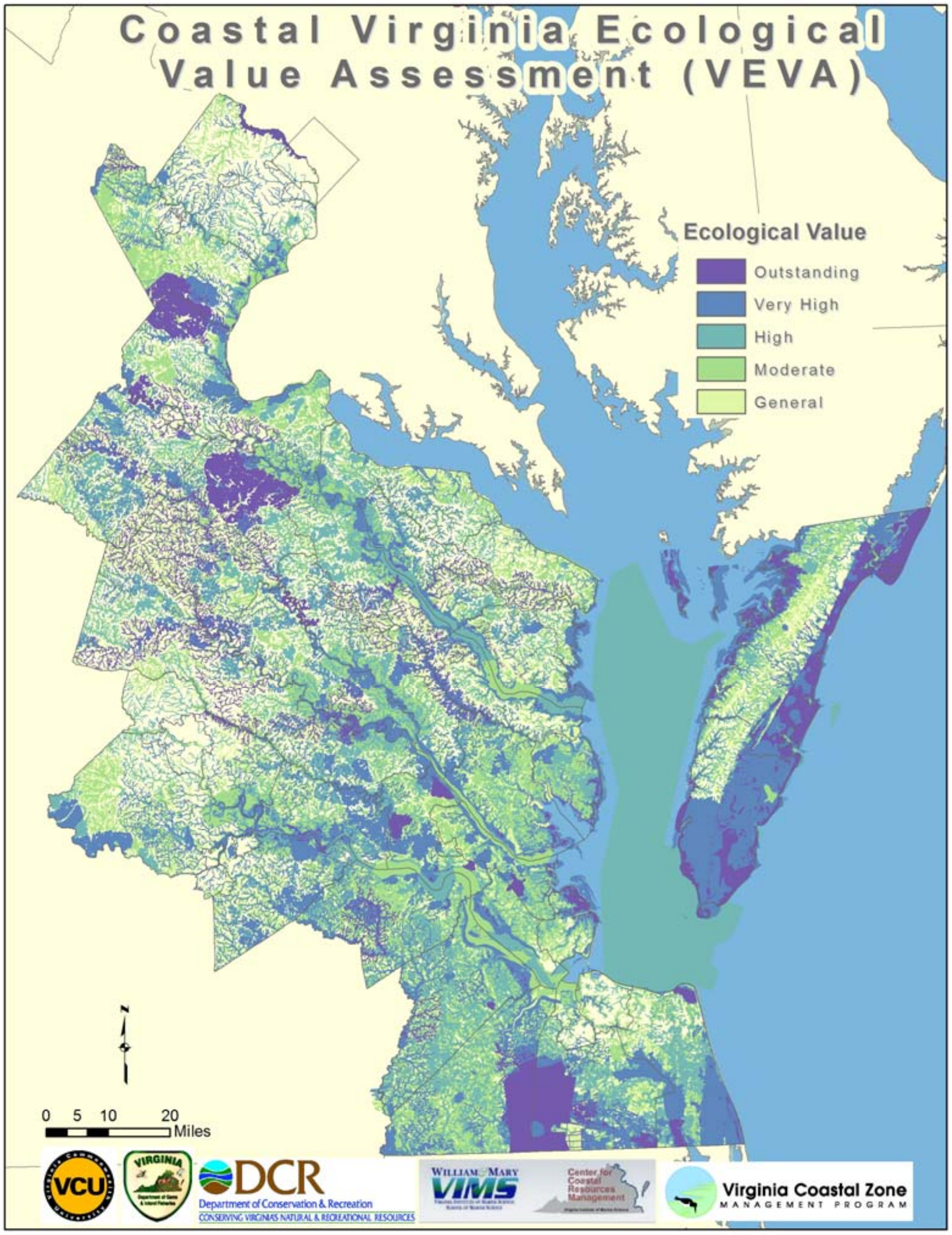


Figure 6. VEVA Final Data Layer.

VEVA Input Layer Attribute Table

The VEVA data layer is attributed with an ID field, a Rank field and a TableID field. The end user is not readily able to see which input layers are represented by the VEVA polygon entity. A table was generated by unioning all the input data layers in GIS then attributing the table to show for each VEVA polygon, what input layer is present at that particular polygon. The table generated is called VEVA_InputLayer_Presence and is available in DBF format (dbase IV), xls format (97 Excel) and xlsx format (2007 Excel). The table contains the following fields:

- TableID: Unique ID used to join or relate back to the VEVA.shp attribute table (a TableID field is present in the VEVA.shp)
- AQUATIC: A field attributed with a Y or NA. A Y indicates an entity from the Aquatic layer is present within the VEVA polygon. An NA indicates that at the time of model development, no aquatic elements had been identified at that particular location. An NA does not necessarily mean there are no important aquatic elements. An NA means the area may not have an aquatic element if a survey has been conducted in the area, or, that the area may not have been surveyed for important aquatic elements.
- CRA: A field attributed with a Y or NA. A Y indicates an entity from the CRA layer is present within the VEVA polygon. An NA indicates that at the time of model development, no CRA elements had been identified at that particular location. An NA does not necessarily mean there are no important CRA elements. An NA means the area may not have an CRA element if a survey has been conducted in the area, or, that the area may not have been surveyed for elements.
- CSL: A field attributed with a Y or NA. A Y indicates an entity from the CSL layer is present within the VEVA polygon. An NA indicates that at the time of model development, no elements had been identified at that particular location. An NA does not necessarily mean there are no important elements. An NA means the area may not have an element if a survey has been conducted in the area, or, that the area may not have been surveyed for important elements.
- NLN: A field attributed with a Y or NA. A Y indicates an entity from the NLN layer is present within the VEVA polygon. An NA indicates that at the time of model development, no NLN elements had been identified at that particular location. An NA does not necessarily mean there are no important elements. An NA means the area may not have an element if a survey has been conducted in the area, or, that the area may not have been surveyed for important aquatic elements.
- PWDCA: A field attributed with a Y or NA. A Y indicates an entity from the PWDCA layer is present within the VEVA polygon. An NA indicates that at the time of model development, no elements had been identified at that particular location. An NA does not necessarily mean there are no elements. An NA means the area may not have an element if a survey has been conducted in the area, or, that the area may not have been surveyed for important elements.

To work with the table and the VEVA data layer, join the table to the VEVA data layer on the TableID field.

Use Constraints

As with the development of any geospatial model, certain use constraints will exist due to the nature of geospatial modeling. The VEVA data layer was developed with a specific objective to guide conservation planning. To reach that goal, statewide datasets were used to develop the layer. It is difficult to handle case by case situations when working with statewide datasets simply because the integration of one specific case or rule for one specific area may skew the model for the remainder of the area. For example, optimally, it would be beneficial to remove all new development from the model; however, this data does not exist in GIS format for the state. Using data representative of select areas will skew the final model results as areas where there is development but where data has not been digitized will not get the same treatment in the model as areas that have been digitized resulting in a skewed final model.

If data was not representative of the entire study area and / or erroneously changed the ranking of areas because of data completeness or accuracy, the data were not included in the model.

It is important to remember this dataset is intended to guide conservation planning and efforts. This dataset is not intended to replace on the ground surveys or consultations with biologists as appropriate. This dataset serves as a compliment to existing local data that may not be integrated in the VEVA data layer.

In the following section, some basic methods are discussed to help the end user work with the VEVA data at finer scales and with local data not originally included in the VEVA data layer.

Scale

The VEVA data layer was derived for the Coastal Zone of Virginia. Input datasets include locally developed, fine resolution data that were resampled to a 100 meter cell size. This resample has made the product a coarser, smaller scale analysis. With minimal work, the VEVA layer can be refined to meet local planning needs.

Land Use Layer Development Date

Another constraint to the VEVA data layer is the date of the land use data used for some component development. As with all GIS data, as soon as data are created, they become dated. It is important that the end user be aware of the input datasets and be aware of their local data. Often, land use data becomes dated quickly with the introduction of new subdivisions and development. This information can be readily incorporated into the VEVA data layer.

Local Data

The scale used to develop VEVA makes incorporation of all specific local data difficult. Because each locality may identify characteristics important and unique to their specific area, there is no standard that can be applied at a statewide level to readily identify, process and incorporate the many, varied local datasets. Typically, local data may exist for specific areas, but may not exist at the statewide level. Local data can be incorporated into the VEVA layer and, VEVA can be used as an accompaniment to local planning processes.

Working with the VEVA Data Available via the Web

To aid in the planning process, the VEVA data layer may be used as a guide to identify where important ecological areas exist. By itself, the VEVA data layer represents a valid data layer with which to aid local, comprehensive, state-level and conservation planning. If an end user wishes to integrate additional data layers into VEVA, the user should be aware of the input datasets used to develop VEVA in order to ensure there is not capture and counting of redundant data layers that may already be incorporated into VEVA.

A straight forward approach would be to access the data layer through Coastal GEMS website available at http://www.deq.state.va.us/coastal/coastalgems.html.

A basemap is available in Coastal GEMS which will help the planner locate areas of interest. Additional natural resource datasets can be viewed and queried along with the VEVA data layer. The end user can use Coastal GEMS to identify priority conservation areas and see how those areas relate to the current planning practice. The user can then print maps for use in presentations or reports.

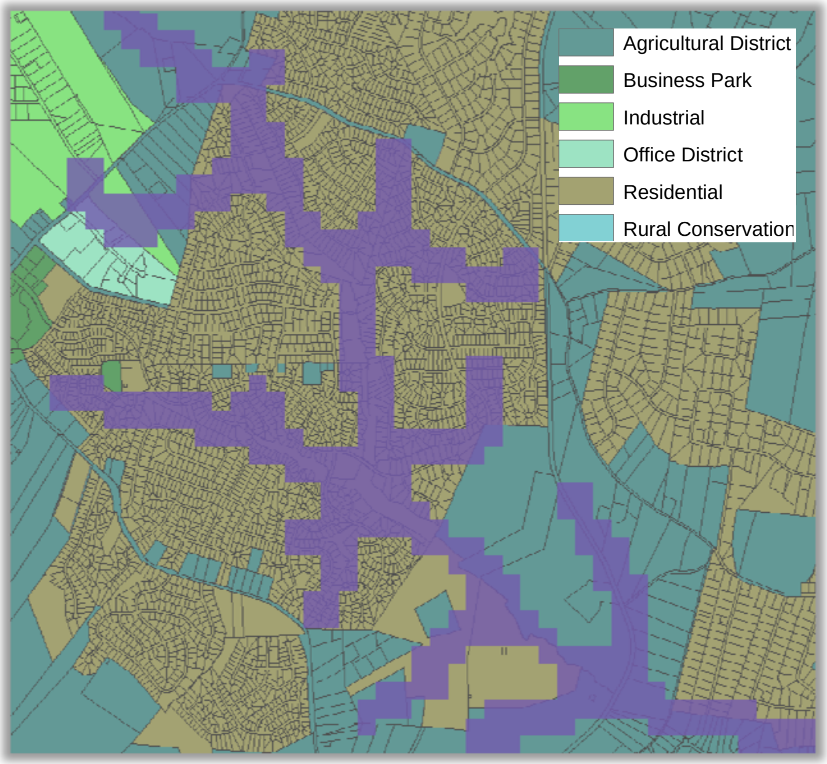
Working with the VEVA data in the ArcGIS Environment

The methods discussed below may be applied to incorporate more recent land use and local data with VEVA using GIS methods. The ArcGIS environment is equipped with various tools that provide the end user with a vast analytical working environment. There are many ways to incorporate local data into GIS datasets and the planning processes, each method unique to the specific end user.

Using VEVA to Identify Areas of Importance

As an example, with minimal effort, the end user can use the VEVA data layer to identify areas of outstanding ecological significance for a specific area by selecting a particular VEVA rank (s). The first step of the process would entail visually assessing high ranked VEVA areas in relation to the existing land use to see what type of impact existing or future land use may have on the outstanding ecological areas.

For example, in the graphic below, parcels symbolized to show zoning are displayed along with the "Outstanding" ecological rank from the VEVA layer overlaid (in purple):



The data can be used as part of the planning process to:

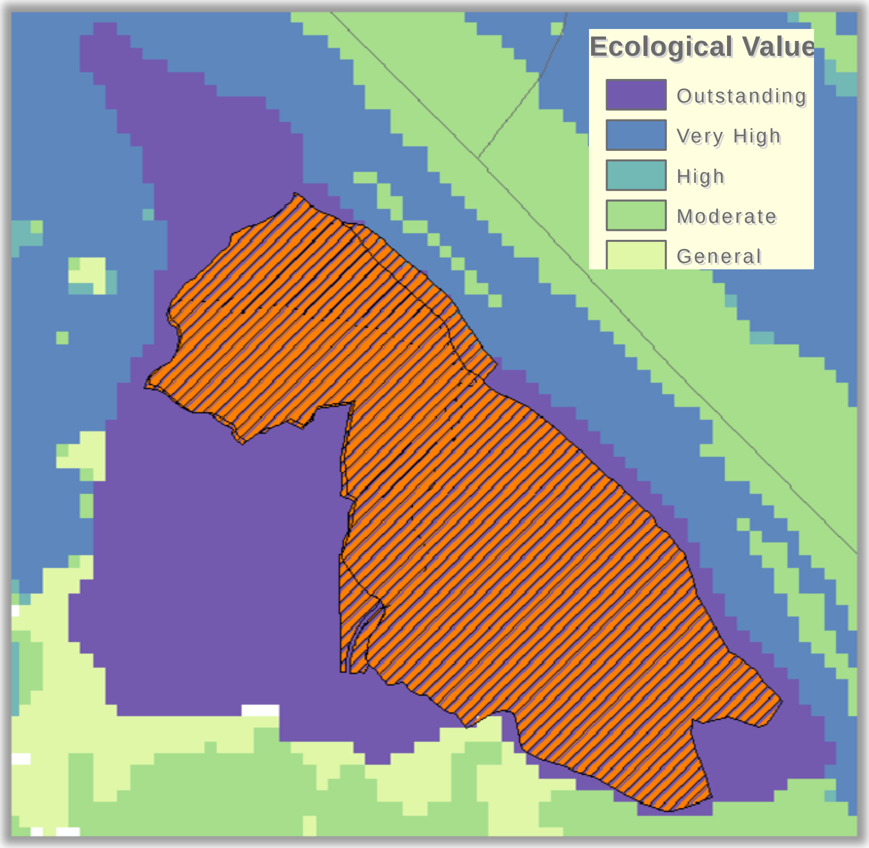
- Identify areas that could be considered for open space requirements
- Identify parcels that may be zoned conservation
- Identify areas for potential easements
- Identify areas suitable for low impact development measures
- Identify areas where additional development can be focused versus areas that can be conserved or zoned in a compatible use to preserving or conserving ecological integrity

Integrating Local Data

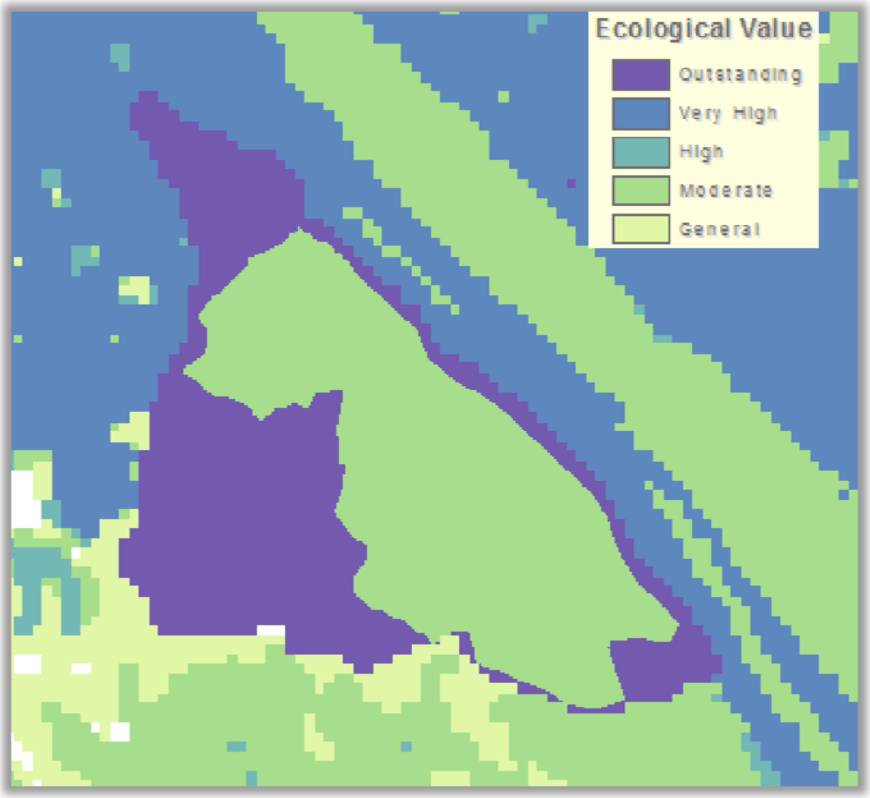
Local data not included in the VEVA data layer can be either added or removed, and used to adjust the value of specific entities. The Analysis Toolset in ArcGIS provides a variety of overlay tools that can be utilized to add or remove data to the VEVA data layer.

In the following example, the VEVA polygon is considered an outstanding element. The element may be considered outstanding based on a variety of criteria (large, contiguous forested area, habitat, important bird migratory path, etc.). The local data may indicate the entity is part of a heavily used artillery firing range and should not be considered outstanding, but perhaps lowered to moderate.

The graphic below shows the VEVA data layer symbolized based on rank with the artillery range overlaid in orange hatching:



The orange area can be integrated into the VEVA using an overlay too (dependent on the end user needs). In the following scenario, a union was used to combine the artillery polygon with the VEVA polygon. Once combined, the part of the VEVA that is an artillery area can be re-ranked to a moderate rank:



This same process would be used if the end user wanted to increase the value of a VEVA polygon entity, simply integrating the data and changing the rank value in ArcGIS with editing techniques. Data can also be removed from VEVA using local data to identify the pertinent area, integrating the local data and deleting that specific polygon area from the VEVA data layer.

Using the VEVA Layer to Derive a Local Model

The VEVA data layer can be used to derive local models. Individual components of the model can be obtained from the respective data developers. These data layers can be edited to include localized data, to remove particular data, and / or ranked according to local end needs. The data can be combined into one data layer representative of a locally derived ecological model.