APPENDIX C

Ecological and Biological Studies and Correspondence

VEGETATION AND WILDLIFE SURVEY

By: Environmental Design and Research, P.C.

January 2005

Vegetation and Wildlife Survey

Carroll Landfill Site

Town of Carroll
Chautauqua County, New York

Prepared For: J.A. Daigler & Associates
12 Leland Drive
Seneca Falls, New York 13148

Prepared By: Environmental Design & Research, P.C.
238 West Division Street
Syracuse, New York 13204

Date: January 2005

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INTRODUCTION

Environmental Design & Research, P.C. (EDR) was retained by J.A. Daigler & Associates to conduct a reconnaissance-level vegetation and wildlife survey on a 56 acre site in the Town of Carroll, Chautauqua County, New York. The property includes a mix of developed/disturbed land (closed and active construction and demolition [C&D] landfill) and undeveloped natural communities. The site is bounded by Dodge Road and residential properties to the east, by Sandberg Road and residential properties to the south, and by undeveloped forest to the north and west (Figure 1). An existing C&D landfill on site is proposed for expansion, and J.A. Daigler & Associates is preparing a Part 360 Application and a Draft Environmental Impact Statement (DEIS) for the project. The DEIS must include a description of existing flora, fauna, and ecological communities on site, and an assessment of potential project-related impacts on these resources. This report describes the methods and results of the vegetation and wildlife survey undertaken by EDR, and is intended to be included as an appendix for the DEIS currently being prepared for the project in accordance with the requirements of the New York State Environmental Quality Review Act (SEQR).

SITE DESCRIPTION

The project site is characterized by sloping/uneven topography, with elevation ranging from about 1750 to about 1880 feet above sea level. The site generally drains to the east to Storehouse Run. It is dominated by young even-aged deciduous forest, along with areas of successional old-field, successional shrubland, conifer plantation and wetland. Several intermittent streams/drainages also occur on site. The east/central portion of the site includes areas of closed and active C&D landfill and associated disturbed/developed areas used for surface mining/soil excavation, materials stockpiling/storage.

The area surrounding the project site is characterized by undeveloped deciduous forest and scattered rural residential development.

METHODS

Information on the plant and wildlife species likely to occur on the project site was collected by consulting existing data sources and through reconnaissance-level field surveys. A two-day vegetation and wildlife survey was performed on July 22-23, 2004 by John Hecklau and William Trembath of EDR (both Wildlife Biologists – see Vitae included in Appendix D). These surveys were the primary means of documenting species of plants and wildlife on the project site.

Birds observed on-site were recorded during the July site visit. Observation was visual (aided by binoculars) as well as auditory. Potential breeding birds were identified by consulting existing data sources such as the New York State (NYS) Breeding Bird Atlas (Andrle and Carroll 1987 and NYSDEC Web Site). Mammals were identified through direct observation of species and/or their sign (tracks, droppings, bones, etc.). Reptiles and amphibians that might occur on site were identified by consulting existing databases such as the NYS Amphibian and Reptile (Herp) Atlas (A. Breisch, pers. comm.), and through on-site investigation of wooded areas, wetlands, and streams. In searching for snakes and salamanders, rocks, logs and man-made debris were turned over and examined.

Ecological communities/wildlife habitat areas were identified based on aerial photographs and field reconnaissance. During fieldwork, vegetative cover (overstory, understory and ground cover) was categorized in terms of species composition and structural character.

The presence or absence of specific habitat elements, (e.g., standing and fallen deadwood, rock piles, mast sources etc.) was also noted.

RESULTS

Plant Species

During the field survey, a total of 112 different plant species were documented on the project site. A plant list (including scientific names) is presented in Appendix B. All of the species found during this survey are relatively common in New York State. No rare species were observed, and the majority of the study area appears unsuitable as habitat for rare plant species, due to natural physiographic conditions and various forms of disturbance (e.g., logging, earth moving/surface mining, landfilling, construction of roads, etc.) that have occurred, and continue to occur, on site. The plant communities in the study area are dominated by common native and exotic species. With the exception of certain on-site wetland communities, typical indicators of possible rare species occurrence (rich woodlands, prairie remnants, limestone outcrops, etc.) are lacking within the study area. U.S. Fish and Wildlife Service (USFWS) review of endangered and threatened species records indicated that no federally-listed or proposed endangered or threatened plant species are known to exist in the project area. (D. Stillwell, pers. comm. – Appendix A). New York State Department of Environmental Conservation (NYSDEC) review of Natural Heritage Program files also indicated no records of known occurrences of state-listed plants in the vicinity of the project site (B. Ketcham, pers. comm. – Appendix A).

Wildlife Species

Birds

The project site provides habitat for numerous species or resident and migratory birds, primarily those associated with successional, shrub-dominated cover types and forest edges. Field investigation on July 22-23, 2004 revealed the presence of 25 bird species on or immediately adjacent to the project site. Common species included American robin, gray catbird, hairy woodpecker, black-capped chickadee, rufous-sided towhee, blue jay, common crow, song sparrow, and wild turkey. A list of bird species observed on site including both common and scientific names, is included in Appendix B.

New York State Breeding Bird Atlas (BBA) data indicate that 64 bird species nest in the general area of the project site (Appendix B). These BBA data apply to a 5km^2 area (2 square miles), and therefore include large areas outside the project site. Based on species and habitat observed, the most common breeding birds on site are likely to be those associated with shrub-dominated communities and forest edge habitat. These would include species such as, gray catbird, American robin, and yellow warbler. Species requiring open meadow/grassland habitat or forest interior conditions are likely to be uncommon, due to the limited availability and small size of such habitat on site. No active or inactive raptor stick nests were observed.

Of all the bird species either identified on site or that could occur there based on range and habitat requirements or BBA data, none are listed as endangered or threatened by the USFWS and NYSDEC.

Mammals

Mammals are also an important component of the site's wildlife population. However, no existing data were available concerning mammal occurrence in the area. The occurrence of mammalian species on the project site was documented entirely through field survey. This effort revealed the presence of eight mammal species on site (Appendix B). These species were identified through direct observation of species and/or sign, and included red squirrel, eastern cottontail, whitetailed deer, raccoon, and porcupine. However, based on species range and on-site habitat conditions, over 35 mammal species could possibly occur on the project site. Because the field investigations performed on July 22-23, 2004 were done during daylight hours, there was no observation of nocturnal mammals such as bats and furbearers. However, common bats such as the eastern pipestrelle, little brown bat, and big brown bat are likely to occur on the project site due to the presence of open field areas and adjacent forest vegetation, which provide foraging and roosting areas for these species. Although not documented in this survey, widely distributed species of small mammals (mice, moles and shrews) along with furbearers, such as gray fox, eastern coyote, and weasels, also are likely to occur on site. No rare or unusual mammal species were observed, and the occurrence of such species is not considered likely based on the type of habitat that exists on site.

Reptiles and Amphibians

Based on NYS Herp Atlas data along with species range and habitat conditions, at least 25 species of reptiles and amphibians could occur on the project site. EDR's field investigation revealed the presence of five species on site. Most of these species were observed by searching on-site wetlands and streams. Observed species included green frog, bullfrog, red-backed salamander, American toad, and two-lined salamander (see Appendix B). Other typically common or easily observable species such as garter snake, spring peeper and wood frog were not observed during this survey, despite fairly thorough searching. This does not necessarily mean that these species are absent, but it does suggest that they are either uncommon or were not active at the time of the field survey. None of the species documented by the NYS Herp Atlas as occurring within the Town of Carroll are listed as endangered or threatened by the NYSDEC or the USFWS.

Fish

While fish species occupying Storehouse Run and its tributaries along the eastern property boundary were not specially inventoried (i.e. no netting or other collection activities were undertaken), causal observation revealed the presence of unidentified species of minnows. In addition, information from the NYSDEC indicates that the stream was surveyed by electroshocking at two sites along Dodge Road in 2004. These surveys revealed the presence of mottled sculpin, blacknose dace, creek chub and brown trout (Cornett, Unpubl.).

Ecological Communities/Wildlife Habitat

The project site includes deciduous and mixed forest, successional shrubland, successional old-field, conifer plantations, wetlands, intermittent streams/groundwater seeps, and disturbed/developed areas. A description of each community, including identification of dominant plant species and wildlife habitat features is presented below. The location of the various communities is illustrated in Figure 2. Representative photographs of the communities are presented in Appendix C.

Deciduous/Mixed Forest

Areas of deciduous forest are found throughout the site, but occur primarily in the western portion of the project site. This is the dominant ecological community on site and is characterized by relatively young, even-aged, second growth forest, similar to the successional northern hardwoods community described by Reschke (1990). Dominant overstory tree species include red maple, sugar maple, black cherry, black birch, white ash and eastern cottonwood. The understory is fairly open in most places due to shading produced by the overstory canopy. However, in some places a more broken overstory results in fairly dense understory vegetation. Common understory trees and shrubs include white ash, maples, black cherry, hawthorn, honeysuckle, ironwood brambles, and witch hazel. The ground plain is also fairly sparse, except in those locations where logging or other disturbance has created breaks in the overstory. Ground plain vegetation includes wild strawberry, poison ivy, hay-scented fern, may apple, wood fern, Christmas fern, and goldenrod (see Photos 1 and 2).

Mixed forest areas on site are restricted to fairly small patches located along the northeastern site boundary. These stands include a mix of more mature deciduous and coniferous overstory tree species, including white pine, red oak, eastern hemlock and red maple. This community is similar to the Allegheny oak forest and Appalachian oak-pine forest communities described by Reschke (1990). Understory and ground plain vegetation is more abundant and diverse than that found in most of the young deciduous forest on site, and include white pine, ironwood, shadbush, hemlock, Canada mayflower, partridge berry, pink lady's slipper, star flower, and wood fern (see Photo 3).

The mature forested areas on site include several habitat elements that make them attractive to wildlife. Although they are not abundant, mature oaks in these areas produce acorns, which are eaten by squirrels, deer, wild turkey, songbirds and small mammals. Rough barked trees (e.g. maples, and oaks) provide foraging sites for bark-probing birds (e.g. brown creeper, black-capped chickadee, black and white warbler), and food storage sites for species such as tufted titmouse and white-breasted nuthatch.

Another important feature of the more mature forested areas of the site is the occurrence of deadwood. Dead trees, branches and logs all provide food and cover for various wildlife species. Standing deadwood is essential to some species, while others require deadwood that has fallen to the ground. Because most of the forested areas on site are relatively young, the amount of standing and fallen deadwood on the project site is limited. It is most abundant in the patches of mixed forest that occur along the eastern edge of the site. The main function provided by fallen deadwood is as cover and as a site for feeding and reproduction. Fallen branches provide escape cover for birds and rabbits, while logs provide hiding cover and feeding sites for small mammals, reptiles and amphibians. Hollow logs are used as cover and food storage sites by species such as gray squirrel, red squirrel, eastern chipmunk and raccoon. Fallen deadwood also harbors numerous insects and crustaceans on which various wildlife species feed.

The patches of more mature mixed forest habitat on site also display high foliage height diversity and structural complexity. These characteristics are typically associated with high bird species diversity (MacArthur and MacArthur, 1961; MacArthur et al., 1966). However, the value of this forest habitat on site is limited by its relatively small size. Various studies have indicated that smaller or fragmented woodlots generally do not provide the habitat conditions required for forest interior bird species such as scarlet tanager, rose-breasted grosbeak, red-eyed vireo, ovenbird and black-and-white warbler. These species are more

likely to occur in the larger blocks of undisturbed forest located outside the site boundaries. However, the proximity of such habitat (especially to the north and west) may increase the likelihood of such species utilizing the project site for nesting, foraging, or as transients.

Successional Shrubland

Areas of successional shrubland are located primarily in the southeastern portion of the project site. This community is similar to the successional shrubland community described by Reschke (1990), and is dominated by shrubs and tree saplings, including gray dogwood, bush honeysuckle, brambles, common buckthorn, hawthorn, apple, red maple, black cherry, and white ash (see Photo 4). Old field herbaceous species also occur in this community, but make up less than 50% of the vegetation coverage. Common herbaceous species include asters, goldenrod, wild strawberry, old field cinquefoil, heal-all, and various grasses.

Areas with thick shrubs are essential for substantial songbird populations. Certain species, such as gray catbird, eastern kingbird, rufous-sided towhee, American goldfinch, indigo bunting, common yellowthroat and yellow warbler, specially require low bushy vegetation for nesting and escape cover. Species such as American robin, bluejay, northern cardinal, and brown-headed cowbird also prefer brushy edge habitat. Shrub species such as gray dogwood, honeysuckle, brambles and apple are common in this community, and produce fruit that is highly palatable to mammals such as raccoon, skunk and opossum and birds such as American robin, northern flicker, northern cardinal, and cedar waxwing. Shrub thickets and also provide food and cover for mammals such as white-tailed deer, red fox and eastern cottontail. Saplings and shrubs adjacent to open old field areas are also used as singing and hunting perches by songbirds and raptors.

Successional Old Field

Old field vegetation is present in the southeastern portion of the site and in disturbed areas around the landfill and material storage areas (see Photos 5 and 6). The largest contiguous area of old field vegetation is the closed/capped portion of the C&D landfill. This community type is similar to the successional old field community described in Reschke (1990). These areas are in the early stages of secondary succession and are dominated by grasses and forbs. Differences in plant species composition in areas of old field on the site are due to the type of past disturbance as well as the length of time that has elapsed since cessation of the disturbance. Dominant herbaceous species in this community include asters, Queen Anne's lace, Canada goldenrod, red clover, timothy, orchard grass, old field cinquefoil, wild strawberry and thistles. Shrubs and tree saplings are present in some portions of this community, but collectively comprise less than 50% of the total area cover. Characteristic shrub and tree sapling species include gray dogwood, hawthorn, blueberries, honeysuckle and red maple.

Large unmowed fields of grass and herbaceous vegetation, which provide habitat for open county bird species (e.g., eastern meadowlark, bobolink, and various species of grassland sparrow) do not occur on site. The smaller areas of old-field on site are used as hunting areas by raptors such as red-tailed hawk and great horned owl. The lack of overstory vegetation also allows use of old fields as singing grounds for breeding woodcock and foraging areas for aerial insectivores such as bats, swallows, and flycatchers. The herbaceous vegetation supports abundant insect populations, which serve as an important food source for nesting songbirds, and the vegetation itself provides forage in the form of seeds and foliage, which is utilized by sparrows, finches, small mammals, woodchuck, and cottontail rabbit. These species provide a prey base for predators such as hawks, owls, fox

and coyote. Tall grass and weeds are also used as escape cover by rabbits and as bedding and fawning area by deer.

Conifer Plantation

Several small areas of conifer plantation occur on the eastern side of the site. This community type is similar to the spruce/fir plantation described in Reschke (1990). The dominant tree species is Norway spruce and, due to the shade produced by the overstory, understory and groundlayer vegetation is sparse to non-existent (see Photo 7).

Habitats with at least a sprinkling of conifers are preferred by many bird species, such as solitary vireo, mourning dove, red-breasted nuthatch, cedar waxwing, and purple finch. Conifers provide food and/or nesting, escape, and winter cover for these species. However, solid blocks of conifers that lack understory vegetation generally are limited in terms of their wildlife habitat value. However, these areas do provide important thermal (winter) and escape cover for whitetail deer and eastern cottontail. They also provide preferred food (seeds) and cover for red squirrels, and their location near shrub thickets and herbaceous openings enhance the cover value of the plantations for a wide variety of bird and mammal species.

Wetlands and Streams

Wetlands on site include a diverse assemblage of community types. These communities include shrub swamp, sedge meadow, shallow emergent marsh, groundwater seep and intermittent stream (see Photos 8-11). These communities are described in detail in a separate wetland delineation report prepared for the site (EDR, 2005). The shrub-dominated wetlands on site are characterized by dense stands of meadowsweet, willow, and wild raisin, mixed with patches of sedges, rushes, rice cutgrass, blue vervain and jewelweed. Herbaceous wetlands on site are dominated by sedges, jewelweed, rice cutgrass, willowherb, boneset, sensitive fern, asters, cinnamon fern, and tear thumb. Some areas of sedge meadow and shrub swamp in the large wetland in the southeastern portion of the site include sphagnum moss and display some fen-like characteristics. Such wetlands can harbor rare plants, although none were observed at the time of the field investigation. Much of the on-site wetland is associated with intermittent streams and drainage channels. While the channels in these areas are typically devoid of vegetation, they are often bordered by a wetland fringe that includes herbaceous and shrub species, as well as tree saplings (elm and red maple) in some areas.

Wetlands and riparian zones (identified by the presence of vegetation requiring water or very moist conditions) are used by wildlife disproportionately more than other types of habitat. They also support abundant populations of insects and other invertebrates, which are the basic food items of many species of songbirds, wading birds and bats. Wetlands on site are variable in terms of hydrology, vegetation and their value to wildlife. Wet meadows and emergent marsh provide some limited cover for wading birds, songbirds, and frogs, and also support populations of insects and other invertebrates that serve as a food source for wildlife. Scrub-shrub wetlands provide abundant wildlife food and cover, primarily for upland wildlife species. Thick shrub cover provides cover, perches and feeding sites for numerous birds, including warblers, flycatchers and red-winged blackbirds and provides varying amounts of standing and fallen deadwood (e.g. dead elms). These areas also provide seasonal breeding habitat for amphibians.

Developed Areas

Several developed/disturbed areas occur in the north-central portion of the study area, including roads, buildings, inactive surface mine/soil excavation areas, material storage areas, and an active C&D landfill (see Photos 12-14). These areas are similar to several community types described in Reschke (1990) including unpaved road/path, landfill/dump, junkyard, and rural structure exterior. These communities have typically been excavated, filled, or exposed to repeated (and in places, on-going) disturbance. They are characterized by thinly scattered old field herbaceous species such as Canada goldenrod, Queen Anne's lace, daisy, common plantain, thistles, and coltsfoot. The periphery of these also include patches of shrubs and vines, including staghorn sumac, willows, multiflora rose, and wild grape. Disturbed and developed areas provide some wildlife habitat, especially around their edges or where they include patches of trees and/or shrubs. Patches of old field vegetation within areas are also used for foraging by certain birds and mammals (starling, eastern cottontail, voles, etc.). In addition, man-made debris and other material can provide cover for small mammals, snakes and salamanders. However, the habitat value of these areas is generally limited due to a lack of adequate cover and fairly intense human activity and disturbance. These areas typically receive irregular use by a limited number of wildlife species.

DISCUSSION/CONCLUSIONS

Listed Species

Field survey and existing data indicate that the wildlife species found on the project site are generally common throughout New York State. The only uncommon species documented in the area include red-shouldered hawk and cerulean warbler (BBA record). Both of these species are listed as "special concern" by the NYSDEC. Neither of these species was observed on the project site during the two-day field investigation in July 2004. Red shouldered hawks typically inhabit wooded swamps, river bottoms and lowlands (Terres, 1982). Although the project site includes small areas of forested wetland along intermittent streams, it lacks the mature floodplain forest habitat this species prefers. Cerulean warblers typically inhabit open hardwoods, either upland or along streams (Terres, 1982). This species shows a strong preference for the canopies of mature forest stands (Kerlinger, pers. comm.). Although successional forest habitat does occur on the site, the lack of mature forest vegetation suggests that the site is not preferred habitat for this species.

Existing Habitat Value

As described in the Results section, the project site is dominated by young forest and successional shrubland habitat. The occurrence of patches of more mature mixed forest, areas of conifer plantation, and successional old field vegetation increase habitat diversity and juxtaposition on site. This diversity is further enhanced by the presence of water resources (wetlands and intermittent streams) within the terrestrial communities. This diversity of habitat results in a fairly diverse wildlife community that includes songbirds, upland game birds, furbearers, small mammals and game species (e.g. cottontail and deer). Along with diversity of cover type, on-site habitat value is also enhanced by the presence of sizeable areas of contiguous forest habitat adjacent to the site. A large block of forest can provide forest interior conditions, which are required by certain species of songbirds (e.g., scarlet tanager, rose-breasted grosbeak, pileated woodpecker). This type of habitat also offers some level of seclusion and fulfills the home range requirements for larger or more wide-ranging species, such as hawks, gamebirds and deer.

However, the habitat value of the site is limited by several factors, including the following:

- The relatively young age and small size of the blocks of forested habitat on site, which limit its value for forest interior wildlife species.

- The lack of, or scarcity of, forest habitat features such as standing and fallen deadwood, den trees and mast-producing species that are essential habitat elements for certain forest wildlife species.

- Habitat disturbance caused by human activity on, adjacent and near to the site, including landfilling, cultivation, logging and truck deliveries.

All of these factors limit to some extent, the wildlife species that will utilize the site, either now or in the future.

CITATIONS/REFERENCES

Andrle, R.F. and J.R. Carroll. 1987. The atlas of breeding birds in New York State. Cornell University Press, Ithaca, NY.

Breisch, A. Sr. Wildlife Biologist, NYSDEC. Data from NYS Amphibian and Reptile (Herp) Atlas Project 1990 to 1998. Emailed to F. Panero on November 17, 2004.

Cornett, S. NYSDEC Region 9. Unpublished memorandum of September 7, 2004, titled: Survey of Stonehouse Run (Dodge Creek).

Environmental Design and Research, P.C. (EDR). 2005. Wetland Delineation Report – Carroll Landfill Site. Prepared for J.A. Daigler & Associates.

Kerlinger, P. Curry and Kerlinger. Telephone Conversation of January 5, 2005 with J. Hecklau.

Ketcham, B. Information Services, New York Natural Heritage Program. Letter of July 23, 2004 to B. Brazell.

MacArthur, R.H. and J.W. MacArthur. 1961. On bird species diversity. Ecology 42: 594-598.

MacArthur, R.H., H. Rechter and M. Cody. 1966. On the relation between habitat selection and species diversity. Amer. Natur. 100: 319-332.

New York State Department of Environmental Conservation (NYSDEC). 1989. Planning the management of New York's wildlife: Preliminary assessment of wildlife management needs (Draft). Bureau of Wildlife. Albany, New York.

NYSDEC Web Site – 2000-2004 Breeding Bird Atlas Data.

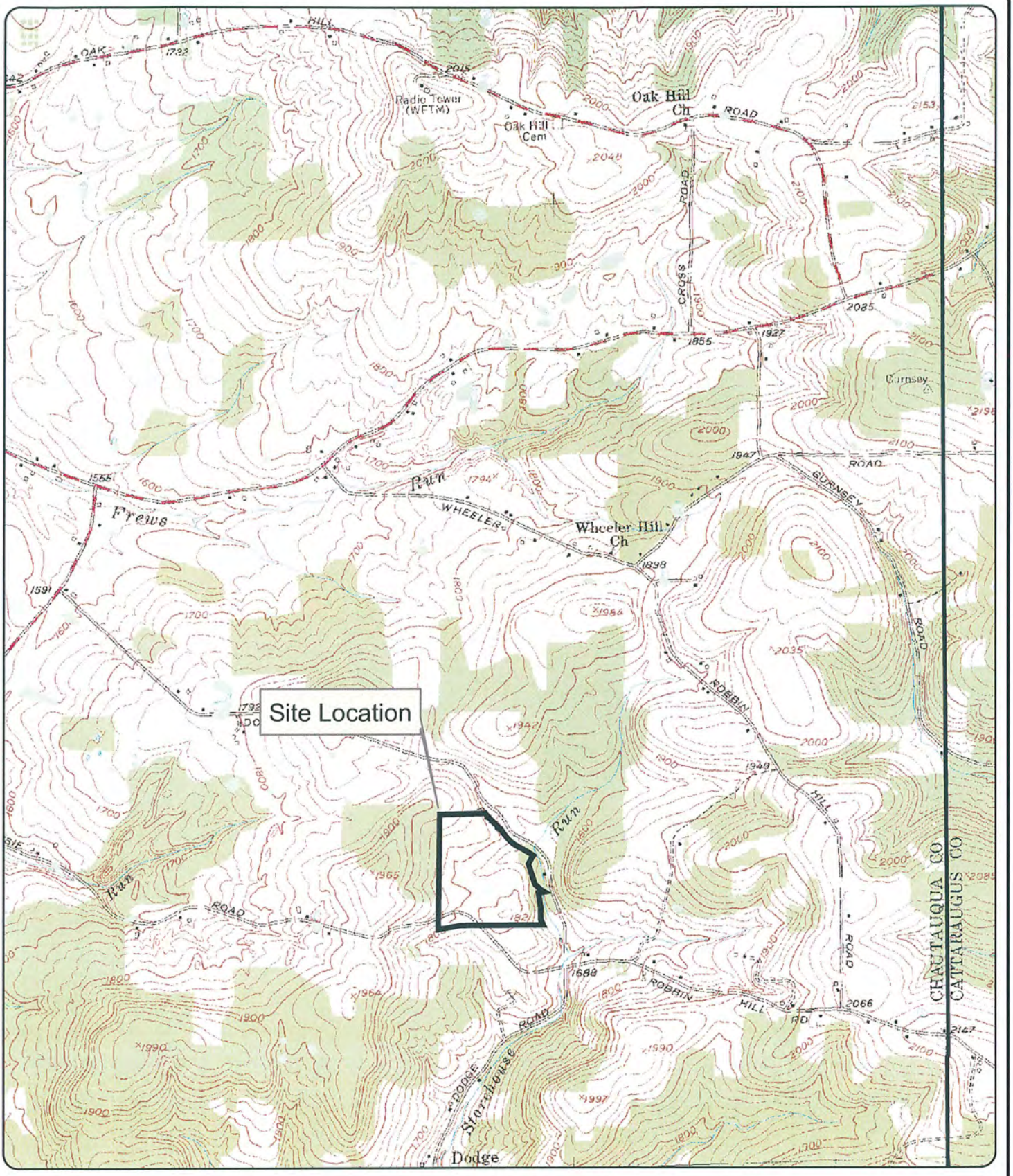
Reschke, C. 1990. Ecological communities of New York State. New York State Department of Environmental Conservation. Latham, NY.

Scott, V.E., K.E. Evans, D.R. Patton and C.P. Stone. 1977. Cavity-nesting birds of North American forests. USDA For. Serv. Agric. Handbook 511. Washington, D.C. 112 pp.

Stilwell, D. Field Supervisor, U.S. Fish and Wildlife Service. Letter of August 4, 2004 to B. Brazell.

Terres, J.K. 1982. The Audubon Society encyclopedia of North American birds. Alfred A. Knopf, New York, NY. 1109 pp.

FIGURES



Prepared By:

EDR PC

Figure 1: Site Location

Carroll Landfill

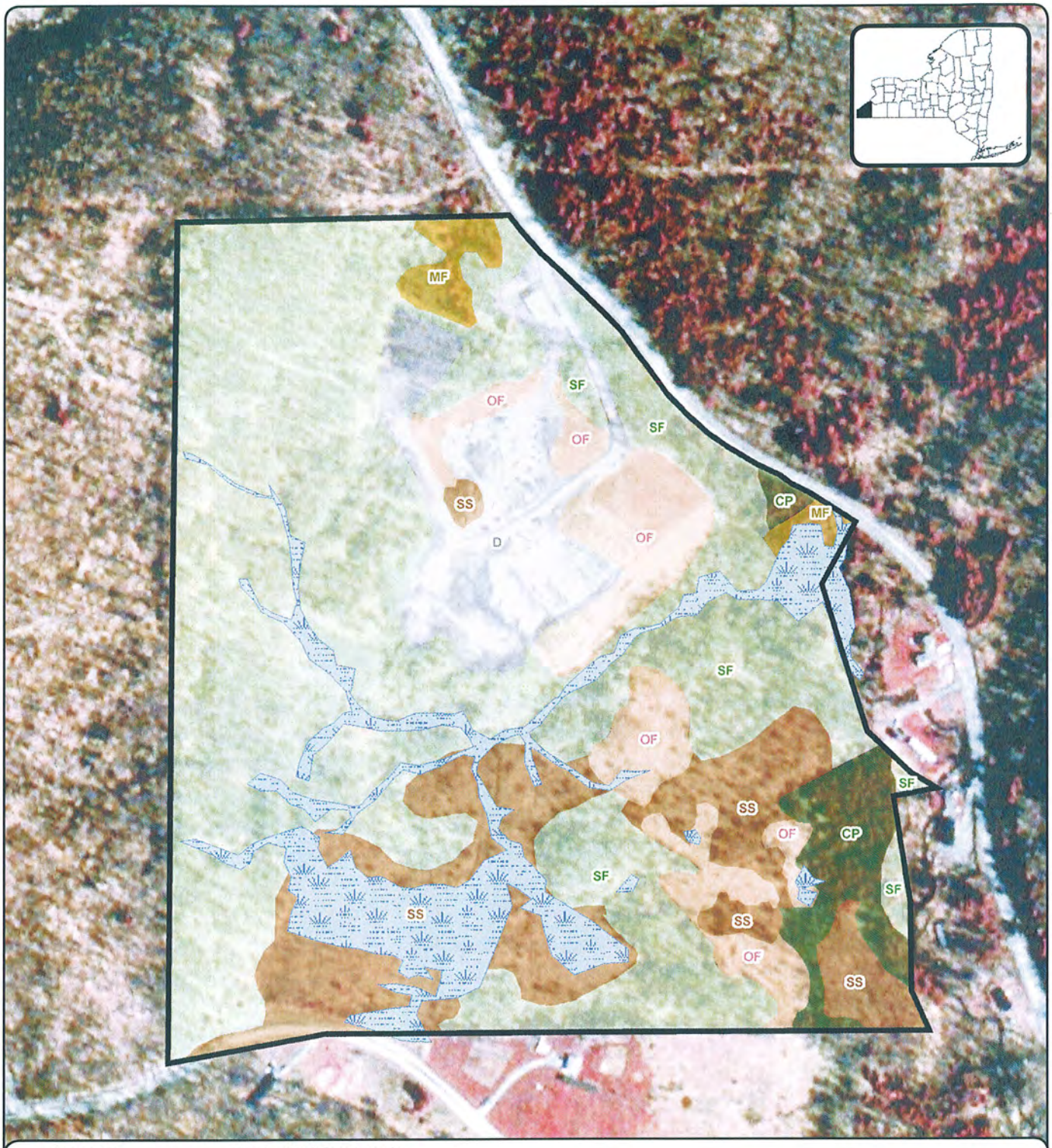
Town of Carroll
Chautauqua County, New York

North

Base Map: USGS 1:24,000 7.5' Ivory Quadrangle

0 500 1,000 2,000 3,000 4,000 Feet

November 2004



Legend

Ecological Community

- Property Line
- Wetland/Stream
- CP = Conifer Plantation
- D = Developed/Disturbed
- MF = Mixed Forest
- OF = Old Field
- SF = Successional Forest
- SS = Successional Shrubland

Prepared By:

EDR PC

Figure 2: Ecological Communities

Carroll Landfill

Town of Carroll
Chautauqua County, New York

NORTH

Base Map: 1 Meter Resolution Orthography

0 150 300 600 Feet

November 2004

APPENDIX A

Agency Correspondence

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3817 Luker Road
Cortland, NY 13045

August 4, 2004

Mr. Benjamin Brazell
Project Manager
Environmental Design & Research, P.C.
238 West Division Street
Syracuse, NY 13204

Attention: Ms. Diane Sullivan

Dear Mr. Brazell:

This responds to your letter of July 12, 2004, requesting information on the presence of Federally listed or proposed endangered or threatened species in the vicinity of the proposed Chautauqua Wetlands project on Dodge Road in the Town of Frewsburg, Chautauqua County, New York.

Except for occasional transient individuals, no Federally listed or proposed endangered or threatened species under our jurisdiction are known to exist in the project impact area. In addition, no habitat in the project impact area is currently designated or proposed "critical habitat" in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). Therefore, no further Endangered Species Act coordination or consultation with the U.S. Fish and Wildlife Service (Service) is required. Should project plans change, or if additional information on listed or proposed species or critical habitat becomes available, this determination may be reconsidered. The most recent compilation of Federally listed and proposed endangered and threatened species in New York* is available for your information.

The above comments pertaining to endangered species under our jurisdiction are provided pursuant to the Endangered Species Act. This response does not preclude additional Service comments under other legislation.

For additional information on fish and wildlife resources or State-listed species, we suggest you contact the appropriate New York State Department of Environmental Conservation regional office(s),* and:

New York State Department of Environmental Conservation
New York Natural Heritage Program Information Services
625 Broadway
Albany, NY 12233-4757
(518) 402-8935

Since wetlands may be present, you are advised that National Wetlands Inventory (NWI) maps may or may not be available for the project area. However, while the NWI maps are reasonably accurate, they should not be used in lieu of field surveys for determining the presence of wetlands or delineating wetland boundaries for Federal regulatory purposes. Copies of specific NWI maps can be obtained from:

Cornell Institute for Resource Information Systems
302 Rice Hall
Cornell University
Ithaca, NY 14853-5601
(607) 255-6520
web: http://iris.css.cornell.edu
email: cornell-iris@cornell.edu

Work in certain waters of the United States, including wetlands, may require a permit from the U.S. Army Corps of Engineers (Corps). If a permit is required, in reviewing the application pursuant to the Fish and Wildlife Coordination Act, the Service may concur, with or without recommending additional permit conditions, or recommend denial of the permit depending upon potential adverse impacts on fish and wildlife resources associated with project construction or implementation. The need for a Corps permit may be determined by contacting the appropriate Corps office(s).*

If you require additional information or assistance please contact Michael Stoll at (607) 753-9334.

Sincerely,

David A. Stilwell
Field Supervisor

*Additional information referred to above may be found on our website at: http://nyfo.fws.gov/es/esdesc.htm.

cc: NYSDEC, Allegany, NY (Environmental Permits)
NYSDEC, Albany, NY (Natural Heritage Program)
COE, Buffalo, NY

New York State Department of Environmental Conservation
Division of Fish, Wildlife & Marine Resources
New York Natural Heritage Program
625 Broadway, 5th floor, Albany, New York 12233-4757
Phone: (518) 402-8935 • **FAX:** (518) 402-8925
Website: www.dec.state.ny.us

Erin M. Crotty
Commissioner

July 23, 2004

Benjamin Brazell
Environmental Design & Research
238 West Division St
Syracuse, NY 13204

Dear Mr. Brazell:

In response to your recent request, we have reviewed the New York Natural Heritage Program databases with respect to an Environmental Assessment for the proposed Ecological Investigation on 56-acres of land, Proj. 1563, site as indicated on the map you provided, located in the Town of Frewsburg, Chautauqua County.

> We have no records of known occurrences of rare or state-listed animals or plants, significant natural communities, or other significant habitats, on or in the immediate vicinity of your sites.

The absence of data does not necessarily mean that rare or state-listed species, natural communities or other significant habitats do not exist on or adjacent to the proposed site. Rather, our files currently do not contain any information which indicates their presence. For most sites, comprehensive field surveys have not been conducted. For these reasons, we cannot provide a definitive statement on the presence or absence of rare or state-listed species, or of significant natural communities. This information should not be substituted for on-site surveys that may be required for environmental assessment.

Our databases are continually growing as records are added and updated. If this proposed project is still under development one year from now, we recommend that you contact us again so that we may update this response with the most current information.

This response applies only to known occurrences of rare or state-listed animals and Pplants, significant natural communities and other significant habitats maintained in the Natural Heritage Data bases. Your project may require additional review or permits; for information regarding other permits that may be required under state law for regulated areas or activities (e.g., regulated wetlands), please contact the appropriate NYS DEC Regional Office, Division of Environmental Permits, at the enclosed address.

Sincerely,

Betty Ketcham

Betty A. Ketcham, Information Services
New York Natural Heritage Program

Enc.
cc: Reg. 9, Wildlife Mgr.

New York State Department of Environmental Conservation
Division of Fish, Wildlife and Marine Resources, Region 9
182 East Union Street, Suite 3, Allegany, NY 14706
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John P. Cahill
Commissioner

MEMORANDUM

TO: File

FROM: Scott Cornett

SUBJECT: Survey of Storehouse Run (Dodge Creek)

DATE: September 7, 2004

The DEC Region 9 Fisheries office was requested by Div. Of Permits (Ken Taft) to collect fisheries data on Storehouse Run (WIN: PA-59). An application to expand an existing landfill adjacent to the creek has been received by DEC and up to date fisheries data is required for the permit evaluation process. The stream is classified as "C(t)" from the headwaters to where it enters Pennsylvania.

A review of our files, shows the stream was surveyed in 1938 and 1956. Prior to the 1956 survey, the stream was stocked with brown trout fingerlings. No trout were found at two sites in 1956 and the stocking was terminated. No further data had been collected since then.

On September 1, 2004, myself and Technician Matt Pachla surveyed the stream by electrofishing at two sites. The first site was done 0.3 miles upstream of T-1 (approximately 400 feet downstream of the upper crossing of Dodge Road). The following information was collected:
Time: 10:30 am
Water temp: 60 F
Air temp: 64 F
pH: 7.3
Conductivity: 180
Estimated flow: 0.25-0.5 cfs
Section sampled: 160 feet
Species collected: mottled sculpin, blacknose dace, creek chub, brown trout
All brown trout were of wild origin. Ten individuals were collected ranging from young-of-year at 3.2" to a 17.9" adult.
The stream bottom had a fairly heavy amount of fine sediment on it, though obvious sources were not seen above the site.

Site two was located about 0.6 miles down stream of site one, below a culvert crossing of Dodge Road. This was about 0.5 miles upstream of the state line. The following information was collected there:
Time: 11:15 am
Water temp: 61 F
Air temp: 68 F
pH; 7.5
Conductivity: 190
Estimated flow: 0.5-0.75 cfs
Section sampled: 490 feet
Species collected: Mottled sculpin, blacknose dace, creek chub, brown trout.
All brown trout were of wild origin. Four individuals were collected ranging from young-of-year at 2.9" to a 12.1" adult.
The stream bottom was also heavily silted at this site.

My overall impression of the stream is that at site one, brown trout seem to be fairly abundant, being found anywhere sufficient shelter was present. Sculpin and dace were also fairly abundant. Creek chubs were rare. The stream bottom had more than a normal amount of sediment. At site two, brown trout, sculpin and dace were much less abundant while creek chubs were very abundant. The stream bottom was more heavily silted than at site one and probably accounted for the increased abundance of creek chubs. The stream's riparian area appears to be well vegetated along most of its course and shading is very good. No evidence of beaver activity was seen.

This stream's proper classification should be "C (ts)" as there is a reproducing trout population present. I checked with Al Woomer of the PA Fish and Boat Commission and they had surveyed the PA section of the stream earlier in the summer and they also found a wild brown trout population to be present. If need be, I can obtain their survey data.

cc: Ken Taft
Michelle Lingenfelter

APPENDIX B

Wildlife and Plant Species List

WILDLIFE SPECIES LIST
Astrex (*) denotes those species documented on site

Bird Species

Herons, Bitterns	***Ardeidae***
great blue heron	*Ardea herodias*
green heron (green-backed)	*Butorides striatus*
American Vultures	***Cathartidae***
turkey vulture	*Cathartes aura*
Hawks	***Accipitridae***
sharp-shinned hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperii*
red-tailed hawk*	*Buteo jamaicensis*
American kestrel	*Falco sparverius*
red-shouldered hawk	*Buteo lineatus*
broad-winged hawk	*Buteo platypterus*
Grouse	***Tetraonidae***
ruffed grouse*	*Bonasa umbellus*
Quail	***Phasianidae***
ring-necked pheasant	*Phasianus colchicus*
Turkeys	***Meleagrididae***
wild turkey*	*Meleagris gallopavo*
Plovers	***Charadriidae***
killdeer	*Charadrius vociferus*
Sandpipers	***Scolopacidae***
spotted sandpiper	*Actitus macularia*
American woodcock	*Philohela minor*
Gulls, Terns	***Laridae***
herring gull	*Larus argentatus*
ring-billed gull	*Larus delawarensis*
Pigeons, Doves	***Columbidae***
rock dove	*Columba livia*
mourning dove*	*Zenaida macroura*
Cuckoos	***Cuculidae***
yellow-billed cuckoo	*Coccyzus americanus*
black-billed cuckoo	*Coccyzus erythropthalmus*
Typical Owls	***Strigidae***
eastern screech owl	*Otus asio*

great horned owl	*Bubo virginianus*
barred owl	*Strix varia*
Goat Suckers	***Caprimulgidae***
common nighthawk	*Chordeiles minor*
whip-poor-will*	*Caprimulgus vociferus*
Swifts	***Apodidae***
chimney swift	*Chaetura pelagica*
Hummingbirds	***Trochilidae***
ruby-throated hummingbird	*Archilochus colubris*
Kingfishers	***Alcedinidae***
belted kingfisher	*Ceryle alcyon*
Woodpeckers	***Picidae***
northern flicker*	*Colaptes auratus*
pileated woodpecker	*Dryocopus pileatus*
red-headed woodpecker	*Melanerpes erythrocephalus*
hairy woodpecker*	*Picoides villosus*
downy woodpecker*	*Picoides pubescens*
yellow-bellied sapsucker	*Sphyrapicus varius*
Flycatchers	***Tyrannidae***
eastern kingbird	*Tyrannus tyrannus*
great crested flycatcher	*Myiarchus crinitus*
eastern phoebe*	*Sayornis phoebe*
willow flycatcher	*Epidonax traillii*
least flycatcher	*Epidonax minimus*
alder flycatcher	*Epidonax alnorum*
eastern wood-pewee	*Contopus virens*
yellow-bellied flycatcher	*Empidonax flaventris*
Swallows	***Hirundinidae***
purple martin	*Progue subis*
tree swallow	*Tachycineta bicolor*
barn swallow	*Hirundo rustica*
northern rough-winged swallow	*Stelgidopteryx serripennis*
cliff swallow	*Hirundo pyrrhonotta*
Jays, Crows	***Corvidae***
blue jay*	*Cyanocitta cristata*
American crow*	*Corvus brachyrhynchos*
fish crow	*Corvus ossifragus*
common raven	*Corvus corax*
Titmice	***Paridae***
black-capped chickadee*	*Parus atricapillus*
tufted titmouse	*Parus bicolor*

Nuthatches	***Sittidae***
white-breasted nuthatch	*Sitta carolinensis*
red-breasted nuthatch	*Sitta canadensis*
Creepers	***Certhiidae***
brown creeper	*Certhia americana*
Wrens	***Troglodytidae***
Carolina wren	*Thryothorus ludovicianus*
house wren	*Troglodytes aedon*
winter wren	*Troglodytes troglodytes*
Mimic Thrushes	***Mimidae***
northern mockingbird	*Mimus polyglottos*
gray catbird*	*Dumetella carolinensis*
brown thrasher	*Toxostoma rufum*
Thrushes	***Turdidae***
American robin*	*Turdus migratorius*
wood thrush*	*Hylocichla mustelina*
veery	*Catharus fuscescens*
hermit thrush	*Catharus guttatus*
eastern bluebird	*Sialia sialis*
Kinglets	***Sylviidae***
blue-gray gnatcatcher	*Polioptila caerulea*
golden-crowned kinglet	*Regulus satrapa*
ruby-crowned kinglet	*Regulus calendula*
Waxwings	***Bombycillidae***
cedar waxwing*	*Bombycilla cedrorum*
Starlings	***Sturnidae***
European starling*	*Sturnus vulgaris*
Vireos	***Vireonidae***
solitary vireo	*Vireo solitarius*
red-eyed vireo	*Vireo olivaceus*
yellow-throated vireo	*Vireo flavifrons*
warbling vireo	*Vireo gilvus*
Philadephia vireo	*Vireo philadelphicus*
white-eyed vireo	*Vireo griseus*
Wood Warblers	***Parulidae***
black and white warbler	*Mniotilta varia*
blue-winged warbler	*Vermivora pinus*
yellow warbler	*Dendroica petechia*
magnolia warbler	*Dendroica magnolia*
black-throated blue warbler	*Dendroica caerulescens*
chestnut-sided warbler	*Dendroica pensylvanica*
black-throated green warbler	*Dendroica virens*

ovenbird	*Seiurus aurocapillus*
northern waterthrush	*Seiurus noveboracensis*
Louisiana waterthrush	*Seiurus motacilla*
common yellowthroat	*Geothlypis trichas*
Canada warbler	*Wilsonia canadensis*
yellow-breasted chat	*Icteria virens*
American redstart	*Setophaga ruticila*
Cape May warbler	*Dendroica tigrina*
Kentucky warbler	*Oporornis formosus*
cerulean warbler	*Dendroica cerulea*
Weaver Finches	***Ploceidae***
house sparrow*	*Passer domesticus*
Blackbirds	***Icteridae***
red-winged blackbird	*Agelaius phoeniceus*
Baltimore oriole	*Icterus galbula*
common grackle*	*Quiscalus quiscula*
brown-headed cowbird*	*Molothrus ater*
Tanagers	***Thraupidae***
scarlet tanager	*Piranga olivacea*
Finches	***Fringillidae***
northern cardinal*	*Cardinalis cardinalis*
rose-breasted grosbeak	*Pheucticus ludovicianus*
indigo bunting*	*Passerina cyanea*
house finch	*Carpodacus mexicanus*
purple finch	*Carpodacus purpureus*
American goldfinch	*Carduelis tristis*
pine siskin	*Carduelis pinus*
rufous-sided towhee*	*Pipilo erythrophthalmus*
dark-eyed junco	*Junco hyemalis*
snow bunting	*Plectrophenax nivalis*
chipping sparrow	*Spizella passerina*
field sparrow*	*Spizella pusilla*
swamp sparrow	*Melospiza georgiana*
song sparrow*	*Melospiza melodia*
white-throated sparrow	*Zonotrichia albicollis*
White-crowned sparrow	*Zonotrichia leucophrys*

Mammal Species

Opossums	***Didelphiidae***
opossum	*Didelphis virginiana*
Shrews	***Soricidae***
smoky shrew	*Sorex fumeus*
masked shrew	*Sorex cinereus*
shorttail shrew	*Blarina brevicauda*
least shrew	*Cryptotis parva*

Moles	***Talpidae***
eastern mole	*Scalopus aquaticus*
starnose mole	*Condylura cristata*
hairytail mole	*Parascalops breweri*
Plainnose Bats	***Vespertilionidae***
eastern pipistrel	*Pipistrellus subflavus*
big brown bat	*Eptesicus fuscus*
hoary bat	*Lasiurus cinereus*
red bat	*Lasiurus borealis*
little brown myotis	*Myotis lucifugus*
silver-haired bat	*Lasionycteris noctivagans*
Racoons	***Procyonidae***
raccoon*	*Procyon lotor*
Weasels	***Mustelidae***
shorttail weasel	*Mustela erminea*
longtail weasel	*Mustela frenata*
mink	*Mustela vison*
striped skunk	*Mephitis mephitis*
Dogs, Wolves, Foxes	***Canidae***
coyote*	*Canis latrans*
red fox	*Vulpes vulpes*
gray fox	*Urocyon cinereoargenteus*
Squirrels	***Sciuridae***
woodchuck*	*Marmota monax*
eastern chipmunk	*Tamias striatus*
eastern gray squirrel	*Sciurus carolinensis*
red squirrel*	*Tamiasciurus hudsonicus*
southern flying squirrel	*Glaucomys volans*
Mice, Rats, Lemmings, Volves	***Cricetidae***
deer mouse	*Peromyscus maniculatus*
white-footed mouse	*Peromyscus leucopus*
meadow vole*	*Microtus pennsylvanicus*
Old World Rats & Mice	***Muridae***
Norway rat	*Rattus norvegicus*
house mouse	*Mus musculus*
Jumping Mice	***Zapeoidae***
meadow jumping mouse	*Zapus hudsonicus*
woodland jumping mouse	*Napaeozapus insignis*
Porcupine	***Erethizontidae***
porcupine*	*Erethizon dorsatum*

Hares, Rabbits	***Leporidae***
eastern cottontail*	*Sylvilagus floridanus*
Deer	***Cervidae***
whitetail deer*	*Odocoileus virginianus*
Bears	***Ursidae***
black bear	*Ursus americanus*

Reptile and Amphibian Species

Colubrids	***Colubridae***
northern water snake	*Natrix sipedon sipedon*
northern brown snake	*Storeria dekayi dekayi*
eastern garter snake	*Thamnophis sirtalis sirtalis*
shrothead garter snake	*Thamnophis brachystoma*
northern red-bellied snake	*Storeria o. occipitomaculata*
eastern milk snake	*Lampropeltis triangulum triangulum*
smooth green snake	*Liochlorophis vernalis*
northern ringneck snake	*Diadophis punctatus edwardsi*
northern black racer	*Coluber constrictor constrictor*
Mole Salamanders	***Ambystomatidae***
blue-spotted salamander	*Ambystoma laterale*
Jefferson's salamander	*Ambystoma jeffersonianum*
spotted salamander	*Ambystoma maculatum*
Newts	***Salamandridae***
red-spotted newt	*Notophthalmus viridescens*
Lungless Salamanders	***Plethodontidae***
red-backed salamander*	*Plethodon cinereus cinereus*
northern two-lined salamander*	*Eurycea bislineata bislineata*
slimy salamander	*Plethodon glutinosus*
northern dusky salamander	*Desmognathus fuscus*
Allegheny dusky salamander	*Desmognathus ochrophaeus*
northern spring salamander	*Gyrinophilus p. porphyriticus*
Toads	***Bufonidae***
American toad*	*Bufo americanus*
Tree Frogs	***Hylidae***
spring peeper	*Pseudacris c. crucifer*
gray treefrog	*Hyla versicolor*
True Frogs	***Ranidae***
wood frog	*Rana sylvatica*
pickeral frog	*Rana palustris*
northern leopard frog	*Rana pipiens*
green frog*	*Rana clamitans melanota*
bull frog*	*Rana catesbeiana*

FISH SPECIES LIST[2]

Sculpins	***Cothidae***
mottled sculpin	*Cottus bairdii*
slimy sculpin	*Cottus cognatus*
Carps and Minnows	***Cyprinidae***
creek chub	*Semotilus atromaculatus*
blacknose dace	*Rhinicthys atratulus*
Trout	***Salmonidae***
brown trout	*Salmo trutta*

PLANT SPECIES LIST

Acer negundo	Boxelder
Acer rubrum	Red maple
Acer saccarinum	Silver maple
Acer saccharum	Sugar maple
Achillea millefolium	Yarrow
Alisma plantago-aquatica	Water-plantain
Alliaria petiolata	Garlic mustard
Amelanchier canadensis	Shadbush
Arctium minus	Common burdock
Asclepias syriaca	Common milkweed
Aster divaricatus	White wood aster
Aster novae-angliae	New England aster
Aster vimineus	Small white aster
Betula lenta	Sweet birch
Betula populifolia	Gray birch
Bidens spp.	Beggar's-tick
Brassica rapa	Field mustard
Calystegia sepium	Hedge-bindweed
Carex lurida	Sedge
Carex spp.	Sedge
Carex stricta	Sedge
Carex vulpinoidea	Sedge
Carpinus caroliniana	Ironwood
Chichorium intybus	Chickory
Chrysanthemum leucanthemum	Oxeye daisy
Circium arvense	Canada thistle
Cirsium vulgare	Bull-thistle
Clematis virginiana	Virgin's-bower
Cornus amomum	Silky dogwood
Cornus foemina	Gray dogwood
Cornus stolonifera	Redosier dogwood
Crataegus spp.	Hawthorn
Cypripedium acaule	Pink lady's slipper
Dactylis glomerata	Orchard grass
Daucus carota	Queen Anne's lace
Dipsacus sylvestris	Teasel
Dryopteris spp.	Wood fern
Epilobium spp.	Willow-herb
Equisetum arvense	Field horsetail
Erigeron philadelphicus	Daisy fleabane
Erythronium americanum	Yellow troutlily
Eupatorium perfoliatum	Boneset
Euthamia graminifolia	Flat-top goldenrod
Fagus grandifolia	American beech
Fragaria virginiana	Wild strawberry
Fraxinus americana	White ash
Gaylussacia baccata	Huckleberry

Geum canadense	Avens
Hamamelis virginiana	Witch-hazel
Impatiens capensis	Spotted jewelweed
Juncus effusus	Soft rush
Leersia oryzoides	Rice cutgrass
Lonicera spp	Bush honeysuckles
Lonicera tatarica	Tartarian honeysuckle
Lotus corniculata	Bird's-foot trefoil
Lycopodium spp.	Clubmoss/groundpine
Maianthemum canadensis	Wild lily-of-the-valley
Malus spp.	Apple
Melilotus alba	White sweet clover
Mentha spicata	Spearmint
Mimulus ringens	Monkey flower
Monotropa uniflora	Indian pipe
Oenothera biennis	Common evening primrose
Onoclea sensibilis	Sensitive fern
Osmunda cinnamomea	Cinnamon fern
Parthenocisus quinquefolia	Virginiana creeper
Phleum pratense	Timothy
Phytolacca americana	Pokeweed
Picea abies	Norway spruce
Pilea pumila	Clear weed
Pinus strobus	White pine
Plantago lanceolata	English plantain
Plantago major	Common plantain
Podophyllum peltatum	Mayapple
Polygonum sagittatum	Tearthumb
Polystichum acrostichoides	Christmas fern
Populus deltoides	Eastern cottonwood
Populus tremuloides	Trembling aspen
Potentilla simplex	Old-field cinquefoil
Prunella vulgaris	Heal-all
Prunus serotina	Black cherry
Quercus alba	White oak
Quercus rubra	Northern red oak
Ranunculus acris	Tall buttercup
Rhamnus cathartica	Common buckthorn
Rhus typhina	Staghorn sumac
Rosa multiflora	Multiflora rose
Rubus allegheniensis	Allegheny blackberry
Rubus alumnus	Blackberry
Rubus occidentalis	Black raspberry
Rumex crispus	Curly dock
Salix species	Willow
Scirpus atrovirens	Green bulrush
Scirpus cyperinus	Wool grass
Smilacina racemosa	False Solomon's seal
Solidago canadensis	Canada goldenrod

Solidago rugosa	Wrinkled (rough-stemmed) goldenrod
Sphagnum fallax	Sphaguum moss
Spiraea alba	Meadowsweet
Taraxacum officinale	Dandelion
Toxicodendron radicans	Poison ivy
Trientalis borealis	Star flower
Trifolium pratense	Red clover
Trifolium repens	White clover
Tsuga canadensis	Hemlock
Tussilago farfara	Coltsfoot
Ulmus americana	American elm
Vaccinium angustifolium	Lowbush blueberry
Vaccinium corymbosum	Highbush blueberry
Verbena hastata	Blue vervain
Viburnum cassanoides	Wild raisin
Viburnum lentago	Nannyberry
Vitis aestivalis	Wild grape

APPENDIX C

Representative Photos

Carroll Landfill
November 2004

Photo 1. Young Deciduous Forest

Photo 2. Young Deciduous Forest

Prepared By:

EDR PC

Photos

Photo 3. Mature Mixed Forest

Photo 4. Successional Shrubland

Prepared By:

EDR PC

Photos

Photo 5. Successional Old Field

Photo 6. Old Field Vegetation on Closed Landfill

Prepared By:

EDR PC

Photos

Photo 7. Conifer Plantation

Photo 8. Sedge Meadow

Prepared By:

EDR PC

Photos

Photo 9. Shrub Swamp

Photo 10. Groundwater Seep

Prepared By:

EDR PC

Photos

Photo 11. Intermittent Stream

Photo 12. Disturbed - C&D Landfill

Photo 13. Disturbed - Materials Storage Area

Photo 14. Disturbed - Access Road

Prepared By:

EDR PC

Photos

APPENDIX D

Curriculum Vitae

John D. Hecklau, Principal

Mr. Hecklau serves as EDR's Principal-in-Charge of Environmental Services. In this capacity, he has been involved in numerous environmental and visual impact assessment projects, many focusing on power generation and transmission. His 20+ years of experience include resource management planning, environmental impact analysis, wildlife management, visual impact analysis, and recreation planning.

EDUCATION:

- State University of New York, College of Environmental Science and Forestry, Syracuse, New York, *Master of Science in Environmental and Forest Biology,* Specializing in Wildlife Biology, 1982.
- Middlebury College, Middlebury, Vermont, *Bachelor of Arts in Biology*, 1979.

EMPLOYMENT HISTORY:

- *Principal/Senior Ecologist*, Environmental Design & Research, P.C., Syracuse, New York, 1995 to Present.
- *Ecologist*, Environmental Design & Research, P.C., Syracuse, New York, 1989 - 1994.
- *Self-Employed Environmental Consultant*, John D. Hecklau, Clinton, New York, 1988.
- *Resource Manager*, Environmental Programs Division, New York State Power Authority, Marcy, New York, 1984 - 1987.
- *Wildlife Biologist*, Connecticut Department of Environmental Protection, Burlington, Connecticut, 1983 -1984.
- *Wildlife Consultant*, Central Park Conservancy, New York, New York, 1982 - 1983.

PROFESSIONAL AFFILIATIONS:

- *Member*, The Wildlife Society.
- *Certified Wildlife Biologist,* The Wildlife Society.
- *Planning Board Member/Chairman*, Town of Kirkland, New York.

PUBLICATIONS:

Lamanna, B. and J. Hecklau, 2002, "The Windmills of Madison County." New York State Conservationist. 56(5): 8-11.

Hecklau, J.D., C. Palmero, E.T. Liverman and J. deWall Malefyt. 1987. Reducing the environmental impacts of stream crossings on a 345kV transmission line in New York. In W.R. Byrnes and H.A. Holt, eds. Fourth Symp. on Environmental Concerns in Rights-of-Way Manage. Purdue Univ., West Lafayette, IN.

Liverman, E.T., J.D. Hecklau and C. Palmero. 1987. Minimization of soil erosion and siltation during construction of the Marcy-South 345kV transmission facilities. pp. 241-253. In Erosion Control: You're Gambling Without It. Proc. of Conf. XVII. International Erosion Control Assoc., Pinole, CA. 335pp.

Hecklau, J.D. 1986. A wildlife survey and management plan for New York City's Central Park. pp. 238-239. In L.W. Adams and D.L. Leedy, eds. Integrating Man and Nature in the Metropolitan Environment. Proc. Natl. Symp. on Urban Wildl. Natl. Inst. for Urban Wildl., Columbia, MD. 249 pp.

Hecklau, J.D. 1985. Wildlife in Central Park: The problems and opportunities associated with wildlife management in an urban park setting. Trans. Northeast. Fish and Wildl. Conf. 42: 126-137.

Hecklau, J.D., W.F. Porter, and W.M. Shields. 1982. Feasibility of transplanting wild turkeys into areas of restricted forest cover and high human density. Trans. Northeast. Fish and Wildl. Conf. 39: 96-104.

PROFESSIONAL EXPERIENCE:

Environmental Design & Research, P.C.

Article VII Application - Flat Rock 230 kV Transmission Line Project – Oversaw preparation of Article VII application to New York State Public Service Commission (PSC) for 10.3-mile-long 230 kV transmission line corridor in Lewis County, New York. Conducted ecological, wetland, and visual fieldwork, prepared Visual Impact Assessment (VIA) report, and provided expert witness testimony on ecological and visual issues.

Flat Rock Wind Power Project Environmental Impact Statement – Coordinated State Environmental Quality Review (SEQR), including preparation of Draft and Final Environmental Impact Statements (DEIS/FEIS), for 300 MW (187-turbine) wind power project on the Tug Hill Plateau, Lewis County, New York. Oversaw production of all support studies and assisted with ecological, wetlands, agricultural, and visual fieldwork and data collection. Prepared VIA utilizing a modified version of the U.S. Army Corps of Engineers (ACOE) Visual Resources Assessment Procedure (VRAP). VIA included defining landscape similarity zones and viewer groups, identifying sensitive resources/receptors, and preparing viewshed maps and visual simulations. Simulations were used in a variety of public education/outreach sessions, and the project received broad public support.

Ecological and Visual Studies for Conjunction Empire Connection Transmission Line Corridor - Oversaw preparation of ecological and visual inventories and impact evaluations undertaken in support of the Article VII application for a proposed DC transmission line running parallel the New York State Thruway from south of Albany to New York City. The visual study assessed potential impacts of proposed overhead segments as well as converter stations for proposed underground transmission line segments. Met extremely tight 30-day schedule for completion of studies.

Reliant Energy Astoria Repowering Project Visual Assessment – Conducted VIA for proposed repowering of the existing Astoria Generating Project in Queens, New York. The study involved identification of landscape similarity zones and viewer groups, viewshed mapping, cross sections, and visual simulations. Assisted with development of visual impact mitigation options, and provided expert witness testimony.

TransEnergie Cross-Sound Cable Project Visual Impact Analysis – Coordinated study and prepared VIA report assessing visual impacts of submarine cable crossing of Long Island Sound. VIA focused on the visual impact of aboveground transition stations and associated structures in New Haven, Connecticut and Shoreham, New York.

Neptune Regional Transmission System Project Visual Analysis – Coordinated study and prepared VIA report assessing visual impacts of aboveground components of submarine/underground transmission line in New York City metropolitan area. VIA focused on the visual impact of transition stations in Manhattan and on Long Island.

Cape Wind Wind Power Project Visual Simulations – Oversaw production of visual simulations and other graphics/analysis for proposed 130-turbine offshore wind power facility near Cape Cod, Massachusetts. Prepared visual methodology write-up for project Environmental Impact Review (EIR) and presented methodology at a public/agency forum sponsored by the Massachusetts Technology Forum. The project's visual impact was a sensitive issue, subject to intense scrutiny. Graphics for project were featured in New York Times Magazine article.

Akzo-Nobel Hampton Corners Mine Visual Impact Assessment – Prepared comprehensive VIA for new rock salt mine in western New York. Project included background research, viewshed mapping, field evaluation (ballooning), computer-assisted visual simulations, and evaluation of impacts utilizing the ACOE VRAP.

GROWS Landfill and Modern Landfill Visual Analysis – Coordinated visual analysis of proposed horizontal and vertical expansion of two solid waste landfills for Waste Management of Pennsylvania. Both projects included viewshed analysis, field evaluation and preparation of simulations for internal decision-making purposes.

Tupper Lake Prison Visual Assessment – Prepared visual impact assessment for a proposed New York State maximum-security prison in the Town of Altamont in the Adirondack Park. Project included viewshed mapping, field evaluation, line-of sight cross sections, simulations and visual impact assessment utilizing the ACOE VRAP. Major issue was night time (lighting) impacts on seasonal residents and recreational users.

Madison Wind Power Project Environmental Studies and Permitting – Coordinated all environmental studies and permitting for the first commercial wind power generating facility in New York State. Prepared visual impact analysis, agricultural protection measures and all SEQR documentation for PG&E National Energy Group.

Fenner Wind Power Project Environmental Studies and Permitting – Coordinated all environmental studies and permitting for a 30 MW wind power generating facility in Central New York. Prepared visual impact analysis, agricultural protection measures and all SEQR documentation for Atlantic Renewable Energy Corporation.

Ramapo Energy Project Visual Impact Analysis and Ecological Study – Coordinated preparation of comprehensive visual impact analysis for a proposed 1,100 MW gas-fired power plant in Rockland County, New York. Study involved background data collection, viewshed mapping, line-of-sight cross sections, field evaluation, visual simulations, evaluation of visual impacts using the ACOE VRAP methodology, and exploration of various visual mitigation measures. Wrote the Visual Impact Assessment report, assisted with preparation of the visual section of the state license (Article X) application and provided expert witness testimony. Also assisted with ecological investigations and preparation of application text and testimony dealing with wildlife issues.

Linfield Energy Project Visual Analysis – Coordinated preparation of viewshed mapping, line-of-sight cross sections, field evaluation and preparation of computer-assisted visual simulations for a proposed gas-fired power plant in Limerick, Pennsylvania.

Towpath Environmental Recycling Center DEIS - Oversaw the preparation of a DEIS for a proposed landfill and recycling center in the Town of Albion, New York. Responsible for specific studies including the visual impact analysis, vegetation and wildlife inventory, community services, land use and zoning, and economic analysis. Also presented results of studies at public meetings and before an Administrative Law Judge at the SEQR Issues Conference.

St. Regis Mohawk Reservation Wetland Protection Program - Identified and evaluated of wetlands on the 15,000-acre St. Regis Mohawk Indian Reservation (Akwasasne) in Franklin County, New York. Project involved refining wetland mapping, developing a quantitative system for the evaluation of wetland functions, and providing recommendations for implementation of a wetland protection plan on the Reservation.

Town of Pittsford Greenprint Ecological Study - Developed, field tested, and implemented a townwide ecological inventory and evaluation procedure for the Town of Pittsford, New York. The procedure evaluated a site's ecological value based on the presence and quality of various features including wildlife habitat elements, botanical resources, and water resource features. Project involved field review and ranking of 94 separate properties totaling over 3,430 acres. Property rankings were then used to develop the Town of Pittsford "Greenprint", a comprehensive, town-wide resource

protection program that was awarded a 1998 National Planning Award from the American Planning Association.

Black Creek Park Ecological and Wetlands Study - Assisted with the development of a master plan for a largely undeveloped 1,500 acre County park, one third of which is made up of wetlands. Responsible for comprehensive study of the park's ecological resources, including field inventory of all wildlife, wetlands, and natural communities within the park, and an evaluation of the ecological significance/sensitivity of various areas. Also oversaw wetland delineation and state and federal wetland permitting.

Athens Power Project Visual and Ecological Studies - Evaluated visual resources and visual impacts associated with construction of a 1,080 MW power plant. Also delineated state and federal wetlands and documented ecological conditions on the project site and along proposed off-site utility (gas, water, and electric transmission) corridors associated with the project. Assisted with field data collection, agency liaison, and preparation of a wetland delineation report and functional analysis. Oversaw preparation of the Ecological Resources and Visual Resources sections of the Article X application, and provided expert witness testimony. Project was the first permitted under New York's Article X power plant siting regulations.

City Center Drive Environmental Impact Statement – Prepared a Generic Environmental Impact Statement for a proposed industrial park on a 128-acre site in the City of Watertown, Jefferson County, New York. Also conducted a Phase I Environmental Site Assessment and state and federal wetland delineation on the project site.

Canal Ponds Environmental Impact Statement - Prepared portions of a Generic Environmental Impact Statement (GEIS) for a proposed 305-acre office park in the Town of Greece, Monroe County, New York. Also conducted a vegetation and wildlife inventory, an on-site wetland delineation, and assisted with preparation and submittal of permit applications and mitigation plans.

St. Lawrence Gas Franchise Permit Applications - Prepared Environmental Impact Assessment Reports for proposed natural gas distribution systems in Lewis County and St. Lawrence County, New York. Reports included an inventory of environmental resources within the proposed franchise areas, as well as assessment of anticipated impacts and proposed mitigation measures. Lewis County project involved wetland delineation and permitting, and assistance with preparation of construction drawings.

Comprehensive Environmental Plans – Developed comprehensive environmental protection and enhancement plans for the upper Hudson, Sacandaga and Raquette River corridors. These corridors include 29 hydroelectric developments, 22 of which are owned and\or operated by Niagara Mohawk Power Corporation. Reports were prepared to assist with utility planning and relicensing efforts involving several of these projects.

Clay Source Development Environmental Studies - Evaluated environmental impacts of a proposed clay mining operation on a 570-acre site in the Towns of East Bloomfield and West Bloomfield, Ontario County, New York. Study involved a federal wetland delineation, a vegetation and wildlife inventory (including identification of endangered species/critical habitats), and preparation of the Terrestrial and Aquatic Ecology section of the Draft Environmental Impact Statement for the project.

Albany Pine Bush Preserve Comprehensive Management Plan and EIS – Developed and updated a comprehensive management plan for a unique inland pine barrens community in Albany County, New York. Project involved extensive data collection, public participation, and close coordination with members of the Albany Pine Bush Preserve Commission. Plan included management recommendations, an implementation plan, and a Environmental Impact Statement that addressed the potential impacts of plan implementation, including land acquisition, fire management, and increased public use.

Avoca Natural Gas Storage Project Environmental Studies - Evaluated the environmental impacts of a proposed natural gas storage project in Steuben and Schuyler Counties, New York. Project included wetland inventory and delineation, vegetation, fish and wildlife inventory (including identification of endangered species and critical habitats), viewshed/visibility analysis and preparation of ecological resource reports for the Federal Energy Regulatory Commission (FERC) license applications. Reports described ecological resources within study area, along with potential impacts to these resources resulting from construction and operation of the project, and proposed means of mitigating adverse impacts.

Mendon Ponds Park Ecological Study - Prepared ecological study of a County park in Rochester, New York. The park is a designated National Natural Landmark, well known for its variety of rare species and unique natural communities, including fens, bogs, oak openings, and prairie remnants. Study involved species inventory, analysis of ecological value of various areas of the park, and management recommendations for the protection and enhancement of the park's ecological resources.

Route 332 Environmental Studies – Prepared studies for the NYS Department of Transportation that examined the environmental impacts of the proposed widening of 7 miles of State Route 332 in Canandaigua, New York. Specific tasks included visual impact analysis, delineation of wetlands, quantitative evaluation of wetland functions and values, and inventory of vegetation and wildlife resources within the corridors. Environmental impact evaluation, agency liaison, and public presentations were also included as part of these projects.

Niagara Mohawk Hydro Relicensing - Provided assistance to Niagara Mohawk Power Corporation with FERC relicensing of various hydroelectric projects throughout New York State. Prepared a variety of plans, reports, position papers, studies, and responses to agency inquiries. Topics addressed have included land use and recreation, fisheries protection and enhancement, whitewater boating, open space conservation, aesthetic/visual impacts, and cultural resources management.

Have conducted numerous projects involving the delineation of wetlands in accordance with the procedures outlined in the 1989 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* and the 1987 *Corps of Engineers Wetlands Delineation Manual.* These projects have also typically involved state and federal wetland permitting, wetland mitigation, and/or wetland monitoring.

John D. Hecklau (self-employed)

Provided environmental/ecological consulting services to landscape architecture and planning firms Specific projects included preparation of 12 vegetation and wildlife inventories, four wetland studies, and three environmental damage assessments. Gathered ecological resource data for two regional land use plans, and wrote a Draft Environmental Impact Statement for a 28 lot residential subdivision in Dutchess County, New York.

New York State Power Authority

Provided environmental support and supervision during the planning, licensing and construction of a major 345kV transmission line. Specific duties included 1) conducting baseline environmental surveys and inventories, 2) reviewing and revising environmental/construction specifications, 3) providing liaison with state regulatory agencies, and 4) monitoring compliance with environmental regulations and commitments during construction.

Assisted with ongoing right-of-way management program, including revision of existing vegetation management specifications and criteria, field evaluation of vegetation inventory and management techniques, and assistance with development of computerized right-of-way database. Other responsibilities included initiation of various wildlife management programs and studies. These included 1) programs to improve wildlife habitat on right-of-ways and at generating facilities, 2) studies to assess impacts of transmission line construction on wildlife, and 3) an endangered species survey for a proposed 200 mile-long transmission line.

Connecticut Department of Environmental Protection

Prepared a comprehensive development and operation plan for a newly acquired 450-acre wildlife management area and proposed educational facility. Project included coordination of a wildlife species survey, analysis of habitat improvement needs, and conducting of a nationwide survey of existing conservation education facilities and programs.

Central Park Conservancy

Prepared fish and wildlife section of a master plan for the restoration and management of Central Park in New York City. Project included conducting an inventory of species and significant habitat areas within the 830-acre park. Report of findings was prepared, which included analysis of habitat value and recommendations for preserving and enhancing park wildlife habitats.

Manomet Bird Observatory

Assisted Director of Environmental Education with preparation and teaching of field and classroom courses regarding ornithology and marine biology. Also assisted research personnel with studies investigating songbird territoriality and shorebird migration.

Minnesota Department of Natural Resources

Conducted research project involving trapping and transplanting of radio-tagged wild turkeys. Investigated mortality, dispersal, and reproduction of birds in three separate populations. Also assisted DNR biologists in wildlife research projects involving trapping and tagging of whitetail deer, and surveys of ruffed grouse and waterfowl.

William A. Trembath, Project Manager

Mr. Trembath has more than 16 years of experience in environmental monitoring, natural resource management, environmental regulatory compliance, hazardous waste operations, industrial health and safety, emergency response, and wildlife damage management.

EDUCATION:

- State University of New York, College at Fredonia, Fredonia, New York, *Bachelor of Science in Biology,* Concentration in Ecological Studies, 1988.

EMPLOYMENT HISTORY:

- *Project Manager*, Environmental Design & Research, P.C., Rochester, New York, 2002 - Present.
- *Project Environmental Scientist*, URS/Dames & Moore Group, Orchard Park, New York, 1999 - 2002.
- *Staff Environmental Scientist*, Dames & Moore Co., Inc., Ashford, New York, 1995-1999.
- *Assistant Environmental Scientist*, Dames & Moore Group, West Valley, New York, 1990-1995.
- *Heavy Equipment Operator*, Accent Strip Inc., Orchard Park, New York, 1989-1990.
- *Research Assistant*, SUNY Environmental Resources Center, Fredonia, New York, 1988-1989.

PROFESSIONAL AFFILIATIONS:

- *The Wildlife Society,* National Northeastern US & NY State Chapters.
- *The Wildlife Society*, Wildlife Damage Control Management Group
- *Society of Wetland Scientists*, National and Mid-Atlantic States Chapters
- *US Department of Energy,* Emergency Management Issues – Special Interest Group (EMI-SIG)
- *New York State Wetlands Forum*
- *Beta Beta Beta National Biological Honor Society.*

PRESENTATIONS/PUBLICATIONS:

Winter, J.D., R.B. Gillespie, S.E. Monteleone, W.A.Trembath and, T.A. Storch. 1989. *Report on characterizing the biomass and species composition of macrophytes, fish spawning and nursery areas. And sediments in Chautauqua Lake, New York in 1988 and 1989.* Final Report to the Chautauqua County Department of Planning and Development.

Storch, T.A., J.D. Winter, R.B. Gillespie, W.A. Trembath, and M.P. Wilson. 1990. *Investigation of lake chemistry, biology and basic hydraulics related to inflow and nutrient loading.* Final project report to the Town of Orchard Park, New York.

PROFESSIONAL EXPERIENCE:

Miscellaneous Wetland Delineations, New York State - Conducted field delineation of wetlands and waters of the U.S. for numerous private, commercial, and industrial clients throughout New York State as per the *U.S. Army Corps of Engineers 1987 Wetlands Delineation Manual*. Some of these projects include the 26,500+-acre Flat Rock Wind Power Project site in Lewis County, NY, a 4.6-mile, 34.5 kV electrical transmission line right-of-way between the Shoemaker and Washington Heights substations in Orange County, NY, and at the Chemical Waste Management, Inc. property in Niagara County, NY.

Miscellaneous Phase I Environmental Site Assessments, New York State - Conducted Phase I Environmental Site Assessments for numerous private, municipal and commercial clients throughout Western and Central New York in general accordance with the American Society for Testing and Materials (ASTM) Standard E 1527-93. Some of these assessments were conducted for the Mirbeau Inn & Spa in the Town of Skaneateles, Ontario County, NY, the 26,500+-acre Flat Rock Wind Power Project site in Lewis County, NY, the 12 square mile Bishop Wind Power Project in Livingston County, NY, the Bloomfield Central School District in the Town of East Bloomfield, Ontario County, NY, and the 145-acre Madison Wind Power Project in Madison County, NY.

Wetland Mitigation Monitoring, New York State - Conducted compensatory wetland mitigation area monitoring and preparation of monitoring status reports for numerous clients in accordance with criteria and special conditions outlined in Army Corps of Engineers wetland disturbance permits. Some of the monitoring projects were conducted for the Starpoint Central School District, and Chemical Waste Management, Inc. property, both located in Niagara County, NY.

Blenheim-Gilboa Wetland Monitoring - Installed groundwater monitoring wells and co-conducted a wetland shrub survival study as part of compensatory wetland mitigation area monitoring for the NY Power Authority's Blenheim-Gilboa Slide Area Remediation Project in The Town of Blenheim, Schoharie County, NY.

Ecological Habitat Study, Athens Power Project - Co-conducted a wetland shrub survival and ecological habitat study as part of compensatory wetland mitigation area monitoring for the Athens Generating Co., L.P. (an affiliate of PG&E Generating) in the Town of Athens, Greene County, NY.

Wetland Delineation, Corbett's Glen - Conducted field delineation of wetlands and Waters of the U.S. for the Corbett's Glen Nature Park in Monroe County, NY. In addition, performed endangered/protected plant surveys at the nature park, in which extensive field identification, mapping, and cataloging of plants were performed.

Huckleberry Swamp Biological Study - Undertook a biological control study to release and monitor a population of two purple loosestrife-specific leaf-eating beetles (*Galerucella calmariensis* and *Galerucella pusilla*) at the 79-acre Huckleberry Swamp in the Town of Rose, Wayne County, NY.

Muir Woods Aquatic and Terrestrial Study - Performed an aquatic and terrestrial ecological characterization and endangered/protected amphibian (salamander) survey at the Muir Woods project site in the Town of Amherst, Erie County, NY.

Wegmans Wetland and Ecological Assessment - Performed wetland and ecological habitat assessments for numerous properties owned throughout Western and Central New York by Wegmans Food Market, Inc. Made property maintenance recommendations to eliminate unwanted impacts to site natural resources during site maintenance activities.

Miscellaneous Wetlands Permitting - Prepared numerous joint Army Corps/NYSDEC Applications for Permit for municipal and private clients in Western New York. Some of these projects include

the Irondequoit Creek Trail Improvement Project in the Town of Penfield, Monroe County, the Rivers Run Senior Housing project development in the Town of Henrietta, Monroe County, and the Sylvan Beach Welcome Center and Pedestrian Improvement Project in the Town of Sylvan Beach, Oneida County, NY.

Natural Resources Documentation, NYSDEC - Co-authored the natural resources inventory, current land use, management issues and policy, and proposed management actions sections of the draft Lake George Wild Forest Area and the Wilcox Lake Wild Forest Area Unit Management Plans for the New York State Department of Environmental Conservation.

Work With Previous Firms

Coordinated field and laboratory efforts of an aquatic ecology survey at the West Valley Demonstration Project (WVDP) in Cattaraugus County, NY. Technical contributions included field supervision of sampling and identification of fishes, aquatic vegetation, planktonic and macro-benthic organisms, and conducting physical and chemical analyses on designated sample locations.

Conducted endangered/protected plant surveys at the WVDP in 1995, 1999, 2000 and 2001. Extensive field identification, mapping, collection, keying, and cataloging of plants was performed.

Performed an ecological characterization of the Ramco Steel Co. superfund property in Lackawanna, NY. Technical contributions included field identification, mapping and cataloging of terrestrial and aquatic vegetation, birds, and mammals.

Conducted field delineation and mapping of wetlands at the WVDP in 1992, 1997, 1999, and 2000 as per the U.S. Army Corps of Engineers 1987 Wetlands Delineation Manual. Utilized the Munsell soil index for categorization of hydric soils, and conducted an extensive terrestrial vegetation follow-up study.

Performed field delineation and mapping of wetlands at the Li Tungsten Superfund site in the City of Glen Cove, Long Island NY (2001). Technical contributions included wetland delineation report, disturbance permit application, and preparation of a mitigation plan for the facility.

Conducted a rare and endangered species (Indiana bat) habitat assessment and wetland assessment for the proposed siting of a high-tension power line in Northeastern Ohio.

Supervised a team of seasonal interns conducting an amphibian, small mammal, and reptile threatened & endangered species survey and inventory at the WVDP.

Conducted a water quality study on the impacts of nitrite in wastewater effluents. The study includes an overview of the environmental fate, the ecotoxicity, and alternative treatment methods associated with the cold weather treatment of wastewater for the eradication of nitrogen during cold weather months.

Extensive involvement in many aspects of the effluent monitoring and environmental monitoring program at the West Valley Demonstration Project (WVDP). Technical contributions included collection and testing of environmental samples in accordance with federal and state regulations and permits.

Project Scientist responsible for meteorological data acquisition at the WVDP. Primarily responsibilities included calibration, maintenance, and troubleshooting of digital and analog data acquisition systems, strip chart recorders, and sensory systems.

As an active member of The Wildlife Society and as a New York State licensed Nuisance Wildlife Control Operator, had primary response and supervision responsibilities in the wildlife control

program at the WVDP. This program included the field supervision and hands-on humane capture, handling, disposal and/or release of wildlife that was deemed a nuisance or presented a health & safety risk.

Conducted a small mammal and nuisance pigeon removal project for the WVDP; developed the management plan as the primary author, and implemented as the head field supervisor, a multi-phased whitetail deer removal program plan at the WVDP. The deer management program plan received a Westinghouse Corporate Management Award for its overall success and safe implementation.

Developed, co-authored and edited numerous NEPA and SEQRA documents including environmental assessments, environmental checklists, and an Environmental Impact Statement Implementation Plan at the WVDP.

Primary environmental regulatory compliance analyst for day-to-day review of all proposed work at the WVDP (1997-2000).

Developed an environmental impacts analysis of the Buffalo & Pittsburgh Railroad's Ashford - Buffalo Rail Line proposed abandonment's effect upon the WVDP.

Co-authored a report on information relative to environmental justice issues for the WVDP. The study focused upon natural resource utilization and cultural resources of potentially affected populations within a fifty- (50) mile radius of the WVDP.

Research Assistant, SUNY Environmental Resources Center, Fredonia, NY

Supervised a group of ten scientists who performed a two-year field investigation and mapping exercise of aquatic vegetation, fish spawning and nursery areas, and sediments for an EIS on aquatic herbicide application and mechanical vegetation control on Chautauqua Lake, NY.

Conducted a water quality, nutrient loading, aquatic vegetation, and fishery age structure study on Green Lake in Orchard Park, NY. Primary chemist responsible for the examination of year-round variations of limnological parameters. Gave an oral presentation of findings to the Orchard Park, NY town-planning board.

Studied the effects of chemical lampricides on the population of adult sea lamprey and stream ecosystem structure in the Lake Erie tributaries: Cattaraugus Creek and Canadaway Creek, NY.

REQUEST FOR PART 182 DETERMINATION

By: Daigler Engineering, P.C.

June 2011

Request for Part 182 Determination
Endangered and Threatened Species

CARROLL LANDFILL EXPANSION
CARROLL, NEW YORK

Prepared on behalf of:

Sealand Waste, LLC
85 High Tech Drive
Rush, New York 14543

Prepared by:

DAIGLER ENGINEERING P.C.
1711 Grand Island Blvd.
Grand Island, New York 14072-2131

June 2011

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REQUEST FOR PART 182 DETERMINATION
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Sealand Waste, LLC

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1 INTRODUCTION

1.1 PROPOSED PROJECT

Mr. Daniel J. Bree, sole owner and president of Sealand Waste, LLC (Sealand), a private enterprise headquartered in Rush, New York, is proposing to purchase the 54.1-acre parcel of land containing the existing Carroll Landfill, a Construction and Demolition (C&D) Debris landfill in the Town of Carroll, Chautauqua County, New York from Donald J. Jones and Carol L. Jones. Sealand intends to continue the C&D landfill activity beyond the three acre limit allowed by the New York State Department of Environmental Conservation (NYSDEC) Permit (#9-0624-00025/00002-0 expired October 31, 2007) and add demolition debris recycling and yard waste composting to the operation.

Sealand's main office is located at 85 High Tech Drive, Rush, New York 14543. The corporation documents for Sealand were filed with the New York State Department of State on August 23, 2004. Sealand is a subsidiary company of the privately held Sealand Waste Corp., also with headquarter offices at 85 High Tech Drive in Rush. Mr. Daniel J. Bree is also the sole founder and is President of Sealand Waste Corp. Mr. Bree is a former part owner of Seneca Meadows, Inc. (SMI), a 6NYCRR Part 360 Municipal Solid Waste (MSW) landfill in the Town of Seneca Falls, Seneca County, New York.

The Carroll landfill is situated on a parcel of property with a total area of 54.1 acres. The property was originally the site of a small surface mine; however, on depleting the saleable mineral resources, permits were issued by the NYSDEC and the Town of Carroll Town Board for development of the construction and demolition debris landfill. At this time, the existing three-acre landfill has been capped with a soil barrier layer and topsoil layer. The topsoil layer supports a vigorous growth of a mixture of fescue, clover, and rye. This landfill is estimated to contain approximately 100,000 cubic yards of waste. Currently, no landfilling, recycling, or other operations are occurring at the site.

Sealand proposes to remove the existing waste from the three-acre footprint, and place the material inside the proposed single composite liner system for the expanded approximate 38-acre landfill footprint in accordance with the applicable local, state and federal requirements. An approximate additional 8.5 acres of the 54.1 acre parcel will be developed with ancillary and

support facilities to include a scale house, office building, access roadways, leachate storage facility, maintenance building and stormwater management basins and structures. The remaining 7.6 acres of the site are expected to be undeveloped forested and meadow or brush land. Daigler Engineering, P.C. (DE) has been retained by Sealand to complete applicable permit applications for the Carroll Landfill Expansion Project.

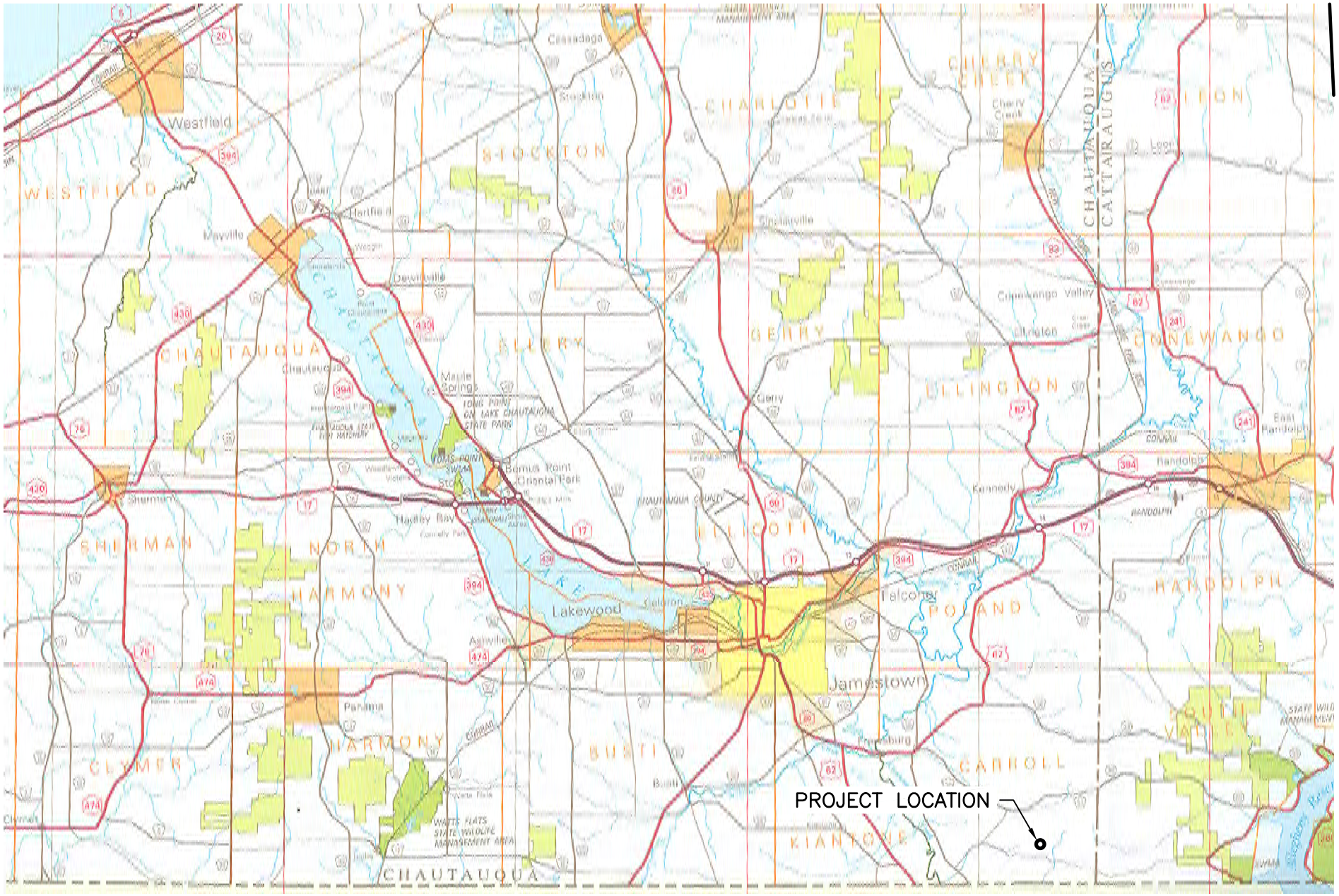
1.2 PROJECT LOCATION

The project site is located in the Town of Carroll, Chautauqua County, New York. The southeast corner of the property is approximately 2,000 feet northwest of the intersection of Dodge Road and Sandberg Road in the southeastern corner of the Town of Carroll, approximately one mile north of the New York/Pennsylvania border, as shown on Figure 1. The subject property and lands in the area surrounding the site are zoned AR-1, Agricultural/Residential District 1. In the vicinity of the site, the land is characteristic of a rural setting consisting of wooded lands, agricultural fields, and residences. The topographic map is also provided as Figure 2, with the subject property outlined.

1.2.1 Surface Water

Several drainage ways in the western area of the property come together to form a tributary to Storehouse Run, a perennial trout stream outside the eastern property boundary. Storehouse Run, Waters Index Number Pa 59 and its tributaries are assigned a Water Quality Class of C, and Standards of C(T) by 6 NYCRR Part 800.6 Table III, Item #2. Discharge standards for Class C(T) surface water bodies are established by the water quality regulations. The project area is located within the Conewango Creek Watershed.

On September 1, 2004, under the request of Mr. Kenneth Taft, Deputy Permit Administrator of the NYSDEC Division of Permits, personnel from the NYSDEC Division of Fish, Wildlife and Marine Resources, Region 9, conducted a fish survey of Storehouse Run by electrofishing at two sites in Storehouse Run. The first site was about 400 feet downstream of the upper crossing of Dodge Road, and the second site was about 0.5 miles upstream of the Pennsylvania state line. Both sites included the following fish species, mottled sculpin, blacknose dace, creek chub, and brown trout. All brown trout were of wild origin. Based on the results of their survey, the NYSDEC noted that the proper classification for Storehouse Run from its source to where it

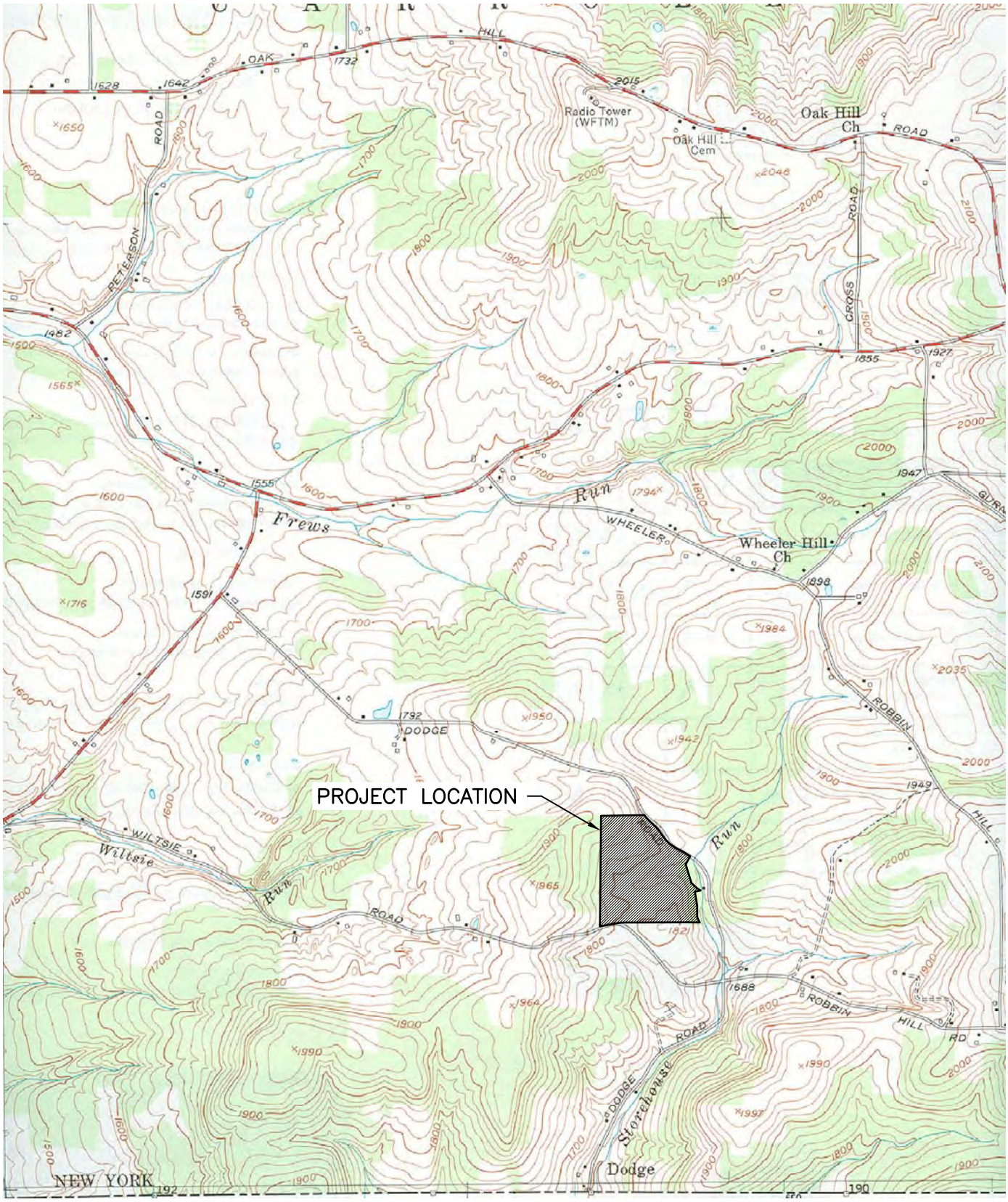


Environmental Solutions

28 Dock Street Shelburne, Nova Scotia

SEALAND WASTE, L.L.C.			REGIONAL MAP		FIGURE 1
DES. BY:	DRW. BY:	CHK. BY:	CARROLL LANDFILL EXPANSION PROJECT		
SEPTEMBER 2010			TOWN OF CARROLL	CHAUTAUQUA COUNTY	NEW YORK

Q:\Sealand\02-0104 Carroll Landfill\Site Investigation\acad\FIG 1-REGIONAL MAP.dwg 9/24/2010 8:34 AM



Environmental Solutions

28 Dock Street Shelburne, Nova Scotia

PROJECT NO:		TITLE: CARROLL LANDFILL VICINITY MAP	
DWG. FILE: FIG 2-CARROLL LANDFILL VICINITY MAP.dwg			
SCALE: N.T.S.		PROJECT: CARROLL LANDFILL EXPANSION PROJECT	FIGURE 2
DES. BY:	DRW. BY: CHK. BY:	PREPARED FOR: SEALAND WASTE, L.L.C.	
DATE: September 2010		TOWN OF CARROLL / CHAUTAUQUA COUNTY / STATE OF NEW YORK	

Q:\Sealand\02-0104 Carroll Landfill\Site Investigation\acad\FIG 2-CARROLL LANDFILL VICINITY MAP.dwg 9/24/2010 8:35 AM

enters Pennsylvania should be C(TS), not C(T). The difference between the two classifications is C(T) designates trout supporting waters, while C(TS) designates water suitable for trout spawning, which raises the value of Storehouse Run's fishery resource. In the case of the T designation, the dissolved oxygen specification for trout waters shall apply; and for TS the dissolved oxygen specification for trout spawning waters shall apply. A copy of a letter describing the fish survey is included as Attachment 2.

Because of these designations and classifications, stormwater discharges will be managed to meet the discharge standards for Class C(TS) streams, as established by 6 NYCRR Part 700 through Part 706, administered by the NYSDEC. Notable among the standards for Class C(TS) is that any surface water discharge to the stream shall not exceed a temperature of 70º F, raise or lower the temperature of the stream by more than 2º F between June and September, or raise the temperature of the stream more than 5º F or cause an exceedance of 50º F maximum (whichever is less) between October and May.

1.3 WETLANDS

DE retained Earth Dimensions Inc. (EDI) to complete a wetland delineation study for which the U.S. Army Corps of Engineers and NYSDEC to determine their jurisdictional authority over the investigation area, pursuant to Section 404 of the Clean Water Act and Article 24 (Freshwater Wetlands) of the New York State Environmental Conservation Law. The wetland delineation inspection was performed on November 2 and 3rd, 2010. EDI performed the delineation in accordance with the Corps of Engineers Wetlands Delineation Manual (January 1987) and Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (October 2009).

EDI confirmed the presence of five (5) wetland areas totaling 6.09 ± acres in the property. General information is provided for the identified wetlands. The USACE inspected the site on November 19th 2010 but have not yet issued their jurisdictional determination. The wetland delineation map provided by EDI is shown in Figure 3. General information acquired from the wetland delineation report by EDI is presented in Table 1.

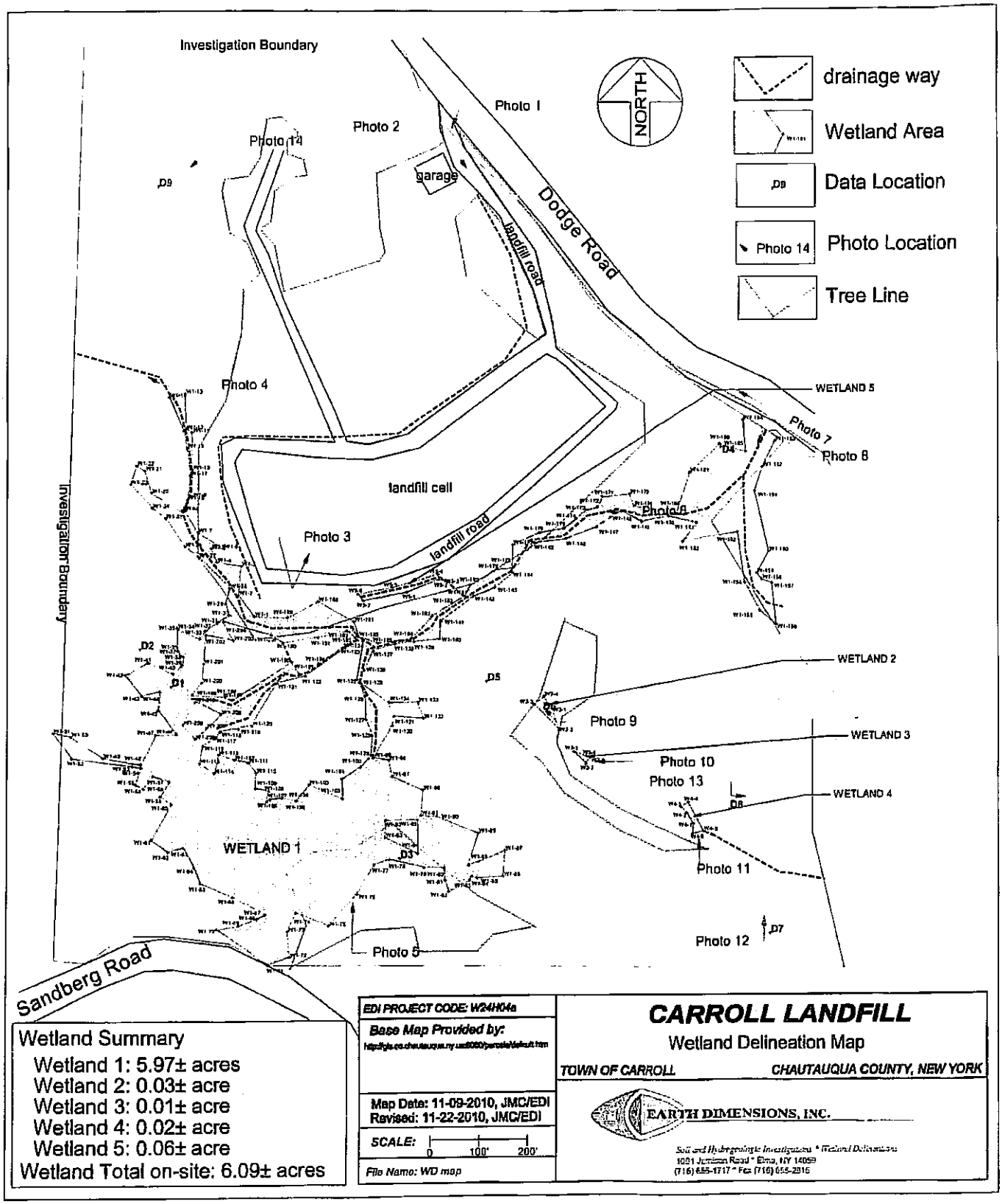


Figure 3: EDI Wetland Delineation

Table 1: EDI Identified Wetlands

Wetland Identification Number	Total Acreage Mapped	Reschke's Classifications
Wetland 1	5.97 ±	Shrub Swamp, Forested Wetland, Shallow Emergent Wetland Complex
Wetland 2	0.03 ±	Shrub Swamp
Wetland 3	0.01 ±	Shrub Swamp
Wetland 4	0.02 ±	Shrup Swamp/Seepage Wetland
Wetland 5	0.6 ±	Shallow Emergent

1.4 ECOLOGICAL AND BIOLOGICAL COMMUNITIES

Environmental Design and Research, P.C.(EDR) was retained by Daigler Engineering to conduct a reconnaissance level Vegetation and Wildlife Survey in July, 2004. The purpose of the Vegetation and Wildlife Survey was to establish an understanding of the flora, fauna, and ecological communities on the site, as well as to determine the potential effects of project-related impacts. The report describing the results of the survey is presented in Attachment 1 of the Vegetation and Wildlife Survey (EDR 2004).

1.4.1 Wildlife Species

EDR's study resulted in the direct observation of eight mammal species, and the inclusion of over 35 species that would likely be found onsite based on range and site conditions (see Table 2). No unusual or rare mammals were documented, and there is little possibility they would be found there based on the conditions at the site (EDR 2004).

Three reptiles and amphibians were identified during the onsite survey which included surveying the wetlands and drainage ways onsite. The New York State (NYS) Amphibian and Reptile (Herp) Atlas was consulted and it was determined that at least 25 species of reptiles and amphibians could occur on the project site (EDR 2004). None of the species documented by the

NYS Herp Atlas are currently listed as endangered or threatened by the NYSDEC or the United States Fish and Wildlife Services (USFWS)[1].

The nearest classified stream to the site, Storehouse Run is not physically located within the property boundary, but will possibly receive stormwater runoff from the site. Storehouse Run eventually drains into the Conewango Creek, which than empties into the Allegheny River. EDR did not complete any netting or collecting activities on Storehouse Run, but their observations revealed the presence of unidentified species of minnows. In 2004, the NYSDEC completed a stream survey of two sections of Storehouse Run, along Dodge Road. These surveys revealed the presence of mottled sculpin, blacknose dace, creek chub, and brown trout (Cornett, NYSDEC 2004). Table 2 presents the identified and probable species as identified by EDR (2004), whether through direct observation or consulting appropriate references (NYS Herp Atlas) or other appropriate references as identified by EDR in the original report.

Additionally, the project site provides habitat for resident and migratory birds, primarily those associated with successional shrub-dominated cover types and forest edges (EDR 2004). An inventory of bird species was completed by direct observation (visual and auditory) and by consulting the NYS Breeding Bird Atlas (BBA), Edition 1, released in 1988. The full species list reflects species confirmed by direct observation and probable species ascertained from the listings in the BBA record for the area. The most common species onsite include American robin, gray catbird, hairy woodpecker, common crow, and song sparrow. A second edition of the BBA was released in 2008 for data collected between 2000 and 2005. This has resulted in some changes, specifically regarding the species likely to be in the general area of the project. Of the 25 species confirmed by direct observation, none were on any federal, state or local endangered or threatened list. However, two are listed as special concern by the NYSDEC[2]. The whip-poor-will bird was a direct observation and the red shoulder hawk is listed in the BBA (2008). Table 3 presents the identified and probable bird species list (with a comparison between BBA editions), where direct observations by EDR are noted.

[1]Referenced April 19,2011.
[2] List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State. Accessed on April19, 2011 from http://www.dec.ny.gov/animals/7494.html.

1.4.2 Ecological Habitats

The project site includes a variety of ecological communities as determined by EDR, through the use of aerial photography and confirmed with field verification and surveying. These communities include deciduous and mixed forest, successional, shrubland, successional old field, conifer plantation, wetlands, intermittent streams, ditches, and disturbed/developed areas. Each of these communities has distinctive plant and wildlife features which are briefly discussed below.

Deciduous/Mixed Forest

The deciduous forest is the most dominant ecological community on site (EDR 2004) and is prominently found in the western portion of the site. It is characterized by relatively young-even aged, second growth forest. Common trees include maples and white ash. The mixed forest areas are limited to small sections in the northeastern portion of the site. Here, there is a mix of mature deciduous and coniferous overstory, and a diverse understory and ground plain vegetation (EDR 2004). Mature forests, although not abundant on the site, they can provide several important habitat elements; the mature oaks, rough barked trees and deadwood. The mature oaks provide acorns for several mammal species and the rough barked trees are foraging and food storage sites for birds. Deadwood, whether still standing or fallen, is essential for many species; it can offer cover, food storage, foraging site, and a home for many small species. EDR highlights that the mature forest habitats can be associated with diversity and complexity, but in this location they are severely inhibited by their small size.

Successional Shrubland

These areas are located primarily in the southeastern portion of the project site. They are mostly comprised of shrubs and tree saplings (EDR 2004). Shrubland provide several benefits to animal populations, including cover, nesting areas for birds, and food sources for several different species.

Successional Old Field

These areas are made up of grasses and forbs, and less than 50% of the vegetation is shrubs and tree saplings (EDR 2004). The largest continuous area of the old field habitat is the closed,

capped portion of the existing C&D landfill. Old fields on site are used as hunting areas by raptors, signing grounds for breeding birds, and as foraging areas for aerial insectivores, including bats. The lack of overstory vegetation allows for dense herbaceous ground cover, which support abundant insect populations (EDR 2004). The vegetation and insect population provide food sources for nesting songbirds, sparrows, and small mammals like the woodchuck and cottontail rabbit, which then act as a prey base for predators, like the hawk, fox, and coyote (EDR 2004).

Conifer Plantation

There are several small areas of conifer plantations on the eastern side of the site. These areas can be highly preferred by bird species and red squirrels, because they offer food, cover, and escape. However, they lack understory vegetation, and as a result this limits the wildlife habitat value (EDR 2004).

Disturbed/Developed Areas

There are several developed and disturbed areas onsite concentrated in the north-central portion. These areas include roads, buildings, inactive surface mines, man-made debris, and material storage areas. Ecologically speaking, they lightly resemble old field habitats. EDR indicates that the value of these habitats is limited due to the lack of cover, and more importantly, the disturbances caused from human activity.

Although there is a variety of vegetation on the site, its ability to be an area of high ecological integrity is hindered by several factors, including the sites relatively small size and fragmented communities. The mature forest habitat on site may have the necessary characteristics of a mature forest, but its small and scattered size make it insufficient to support and provide the ecological benefits of a similar, but larger sized habitat.

2 NEW YORK STATE ENDANGERED AND THREATENED SPECIES

A review of Subpart 182.5 Endangered species, threatened species and species of special concern listings was completed to determine the probability of these particular species dwelling within the project area. The following section presents general information including the location, range, and preferred habitats of several of endangered, threatened, and special concern species to determine potential project related impacts on specific species.

2.1 ENDANGERED SPECIES

The native species that merit listing as endangered under Part 182 include molluscs, insects, amphibians, birds, and mammals. Of the listed endangered species the following species are being considered with respect to this project, the clubshell and the rayed bean. All other endangered species are not within the range of the project and were not considered in this report.

The clubshell (Pleurobema clava) species is listed both federally and nationally to be endangered. It is expected to be located in both Chautauqua and Cattaraugus County. A five-year review of this species was completed in 2008 by the USFWS. A copy of this review is presented in Attachment 3. The clubshell is most often observed in clean, stable, coarse sand and gravel runs, in medium to small rivers and streams (USFWS 2008). The clubshell has been found living in the Allegheny River in multiple sites, including the Navigation Pools 7, 8, and 9 near Armstrong County, Pa., downstream of the site and located within the Lower Allegheny Watershed. Two clubshells were documented in Cassadaga Creek in New York in 2005, but the extent of additional populations or current statuses are not known at this time. Stream bed disturbances, including sand and gravel dredging, gravel bar removal, bridge construction, and impoundments continue to threaten clubshell populations (USFWS 2008). Clubshell species can be affected by human made disturbances to hydrography and water quality. The proposed project would in fact alter the existing runoff patterns onsite, but with the installation of segregated non-contact and contact stormwater management systems and the batch discharging requirements to meet the special needs of Storehouse Run, minimal changes are expected to occur within Storehouse Run. Additionally, there are other water quality requirements and permits required that are in conjunction with a permit for a solid waste management facility under Part 360. It is expected that the impacts to integrity of Storehouse Run will be minimized by the design of

stormwater management control system. More importantly, impacts to the clubshell species will be minimal, if at all, because of the water quality requirements of Storehouse Run and the already possible non-existence of the species in this area.

The rayed bean (Villosa fabilis) is currently listed as a NYS endangered species, and is also a candidate for federal endangered listing by the USFWS. Efforts were made to determine this species locale and existence in New York State. The preferred habitat for the rayed bean is in smaller, headwater creeks, but sometimes in larger rivers. Adult rayed beans can spend their whole life buried in substrate, however excessive sedimentation can suffocate the rayed bean and continues to be a threat to their survival (USFWS Rayed Bean Fact Sheet). The USFWS recently completed a review of this species and proposed to have the rayed bean classfified as endangered throughout its range. The USFWS indicates that the rayed bean is currently in Lake Erie and in the Allegheny River (USFWS November 2010), this document is included as Attachment 4. The USFWS also compiled a current listing of the rayed bean status at historical locations. Of these historical locations the closest to the site, the Conewango Creek, a tributary of Storehouse Run, is listed. However, the last observed rayed bean species here was in 1908, and it is currently listed as extirpated from the creek (USFWS November 2010). Similar to the clubshell, they are impacted by human made disturbances such as dams and changes in stream flow. The rayed bean can also be affected by changing water temperatures (USFWS Rayed Bean Fact Sheet). As previously stated, the special discharge requirements of Storehouse Run have the possibility of enveloping protection for additional species, not just the trout present. It is expected that because of the discharge requirements for Storehouse Run and the low probability of the rayed bean being present near the project, the impacts are expected to be minimal to none.

2.2 THREATENED SPECIES

The native that merit listing as threatened under Part 182 include molluscs, insects, amphibians, birds, and mammals. Of the listed threatened species, the bald eagle (Haliaeetus leucocephalus) is being considered for this project. According to USFWS, the Bald Eagle is not probable to be located in Chautauqua County[3]. The bald eagle review was completed to help address

[3] USFWS Species by County Report
http://ecos.fws.gov/tess_public/countySearch!speciesByCountyReport.action?fips=36013 Accessed April 19,2011.

community concerns about the protection and management of this species. The other listed endangered species were not within range of the project and not considered in this report.

There have been major efforts throughout the entire bald eagle range to promote propagation and protection of this species. Bald eagles are wholly North American, and currently are found in every state except Hawaii, as well as throughout Canada. Eagles prefer undisturbed areas near large lakes and reservoirs, marshes and swamps, or stretches along rivers where they can find open water and their primary food, fish. A bald eagle nest is a large structure, usually located high in a tall, live white pine tree near water.

On or near the project site, there are no large open bodies of water which would be a suitable habitat for a nesting pair. In the greater region, there are two large bodies of water, including Chautauqua Lake to the west, and the Allegheny River to the east that would be and are suitable for bald eagle habitat. Additionally, according to NYSDEC, Chautauqua County is not part of their wintering, or breeding range, as displayed in Figure 4. Within the project boundaries, or in the general area of the project, the lands are not necessarily suitable for the species to fulfill their essential behaviors, including, breeding, feeding, nesting, migration, and overwintering.

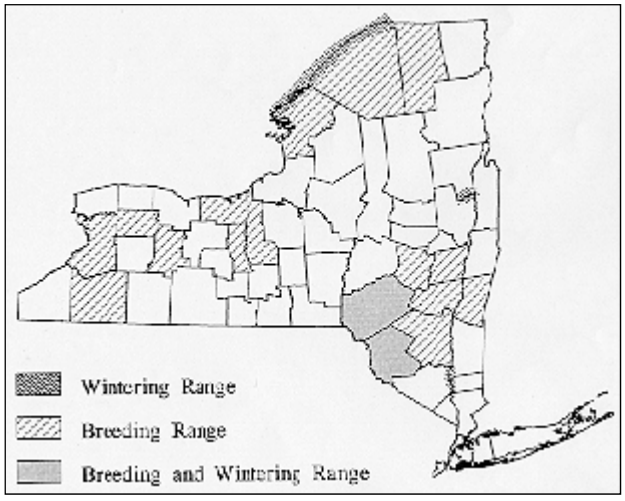


Figure 4: Bald Eagle Distribution Map[4]

[4] NYSDEC Bald Eagle Fact Sheet. Accessed May 14, 2011 from: http://www.dec.ny.gov/animals/9383.html

Table 2: Identified and Probable Species List

Mammals		
Opossum	Striped Skunk	White-footed Mouse
Smoky Shrew	Coyote*	Meadow Vole*
Masked Shrew	Red Fox	Norway Rat
Shorttail Shrew	Gray Fox	House Mouse
Least Shrew	Woodchuck*	Meadow Jumping Mouse
Eastern Mole	Eastern Chipmunk	Woodland Jumping Mouse
Starnose Mole	Eastern Gray Squirrel	Porcupine*
Hairytale Mole	Red Squirrel*	Eastern Cottontail*
Eastern Pipistrel	Southern Flying Squirrel	Whitetail Deer*
Big Brown Bat	Deer Mouse	Shorttail Weasel
Hoary Bat	Black Bear	Longtail Weasel
Red Bat	Raccoon*	Mink
Little Brown Myotis	Silver-haired Bat	
Reptile and Amphibian		
Northern Water Snake	Northern Ringneck Snake	Northern Two-lined Salamander*
Northern Brown Snake	Northern Black Racer	Slimy Salamander
Eastern Garter Snake	Spotted Salamander	Northern Dusky Salamander
Shorthead Garter Snake	Red-spotted Newt	Allegheny Dusky Salamander
Northern Red-bellied Snake	Red-backed Salamander*	Northern Spring Salamander
Eastern Milk Snake	*Blue-spotted Salamander*	American Toad*
Smooth Green Snake	*Jefferson's Salamander*	Spring Peeper
Gray Treefrog	Pickeral Frog	Green Frog*
Wood Frog	Northern Leopard Frog	Bull Frog*
Fish		
Mottled Sculpin	Creek Chub	
Slimy Sculpin	Blacknose Dace	Brown Trout

*Indicates direct observation

-Italics indicate species that are potentially no longer in Chautauqua County based on 2007 Herp Atlas Interim Report Mapping, http://www.dec.ny.gov/animals/7485.html

Table 3: Identified and Probable Bird Species List

2008 BBA	2000 BBA		
Great Blue Heron	Great Blue Heron	Cliff Swallow	Cape May Warbler
Turkey Vulture	Green Heron	American Crow	Kentucky Warbler
Red-tailed Hawk*	Turkey Vulture	Fish Crow	Cerulean Warbler
Red-Shouldered Hawk	Sharp-shinned Hawk	Common Raven	House Sparrow*
Ruffed Grouse*	Cooper's Hawk	Black-capped Chickadee	Red Winged Blackbird
Ring-necked Pheasant	Red-tailed Hawk*	Tufted Titmouse	Baltimore Oriole
Wild Turkey*	American Kestrel	White-breasted Nuthatch	Common Grackle*
Ruby-throated Hummingbird	Red-Shouldered Hawk	Red-breasted Nuthatch	Brown-headed Cowbird*
Northern Flicker*	Broad-winged Hawk	Brown Creeper	Scarlet Tanager
Eastern Kingbird	Ruffed Grouse*	Carolina Wren	Northern Cardinal*
Eastern Phoebe*	Ring-necked Pheasant	House Wren	Rose-breasted Grosbreak
Tree Swallow	Wild Turkey*	Winter Wren	Indigo Bunting*
Barn Swallow	Killdeer	Northern Mockingbird	House Finch
Cliff Swallow	Spotted Sandpiper	Gray Catbird*	Purple Finch
Blue Jay*	American Woodcock	Brown Thasher	American Goldfinch
American Crow*	Herring Gull	American Robin*	Pine Siskin
White-breasted Nuthatch	Ring-billed Gull	Wood Thrush*	Rufous-sided Towhee*
Gray Catbird*	Rock Dove	Veery	Dark-eyed Junco
American Robin*	Mourning Dove	Hermit Thrush	Snow Bunting
Wood Thrush*	Yellow-billed Cuckoo	Eastern Bluebird	Chipping Sparrow
Veery	Black-billed Cuckoo	Blue-gray Gnatcatcher	Field Sparrow*
Baltimore Oriole	Eastern Screech Owl	Golden-crowned Kinglet	Swamp Sparrow
Eastern Bluebird	Great Horned Owl	Ruby-Crowned Kinglet	Song Sparrow*
Cedar Waxing*	Barred Owl	Cedar Waxing*	White-throated sparrow
European Starling*	Common Nighthawk	European Starling*	
Blue-winged Warbler	Whip-poor-will*	Solitary Vireo	
Chestnut-sided Warbler	Chimney Swift	Red-eyed Vireo	
Ovenbird	Ruby-throated Hummingbird	Yellow-throated Vireo	
Common Yellowthroat	Belted Kingfisher	Warbling Vireo	
House Sparrow*	Northern Flicker*	Philadelphia Vireo	
American Goldfinch	Pileated Woodpecker	White-eyed Vireo	
Dark-eyed Junco	Red-headed Woodpecker	Black and White Warbler	
Chipping Sparrow	Yellow-bellied Sapsucker	Blue-winged Warbler	
Field Sparrow*	Eastern Kingbird	Yellow Warbler	
Song Sparrow*	Great Crested Flycatcher	Magnolia Warbler	
Common Grackle*	Eastern Phoebe*	Black-throated Blue Warbler	
Brown-headed Cowbird*	Willow Flycatcher	Chestnut-sided Warbler	
Northern Cardinal*	Least Fylcatcher	Black-throated Green Warbler	
Rose-breasted Grosbreak	Alder Flycatcher	Ovenbird	
Indigo Bunting*	Eastern Wood-Pewee	Northern Waterthrush	
Rufous-sided Towhee*	Yellow-bellied Flycatcher	Lousiania Waterthrush	
Savannah Sparrow**	Purple Martin	Common Yellowthroat	
Bobolink**	Tree Swallow	Canada Warbler	
Red-winged Blackbird**	Barn Swallow	Yellow-breasted Chat	
Canada Goose**	Northern Rough-winged Swallow	American Redstart	
Mallard**	Blue Jay*	White-crowned Sparrow	

* Indicates EDR direct observation during July 22-23, 2004 Field Survey

**Indicates new addition to the BBA

Prior use of this land includes a mining operation, landfilling, and general land disturbances associated with those major activities, dating as far back as 1989. Because of the history of this property, and in context with the local land and water features, it is anticipated that no additional changes in habitat, population, and survivability of the bald eagle species would occur within the area of the project. Furthermore, it seems that this area would not be a destination for the species with or without the realization of the project.

2.3 SPECIES OF SPECIAL CONCERN

Those species of special concern that merit listing as such under Part 182 include molluscs, insects, amphibians, birds, and mammals. Of the listed special concern species, the following species are being considered with respect to this project, the Red-shouldered hawk, and the whip-poor-will. The other listed species of special concern were not within the range of the project and are not considered in this report.

The Red-shouldered hawk (Buteo lineatus) is listed in the 2008 BBA as a potential species of the area. Red-shouldered hawks inhabit wooded swamps, river bottoms, and lowlands, although the project site includes small areas of forested wetland along intermittent streams, it lacks the mature floodplain forest habitat preferred by this species (EDR 2004). Disturbances from humans in the form of off-road vehicles, hunters, horseback riders and suburbanites in general have pushed red-shouldered hawks into the deepest, wildest areas left. Although some members of this species seem to be unaffected by humans, most are secretive and avoid inhabited areas[5]

The whip-poor-will (Caprimulgus vociferous) was a direct observation (visual or auditory) by EDR during the field survey. However, it is not listed in the most current BBA record for the area. Although rarely seen, the whip-poor-will is a locally common breeder in parts of New York that are not heavily forested, especially in Long Island and the St. Lawrence Valley regions of New York State. The species has disappeared from many parts of New York which it has previously inhabited[6]. Because whip-poor-wills are nocturnal, there is trouble in identifying and locating this species. However, it is anticipated that given the history of the species, there appears to be no additional impacts that would disserve this species.

[5] Red-shouldered hawk fact sheet. Accessed on April 19, 2011 from: http://www.dec.ny.gov/animals/7082.html.
[6]Whip-poor-will fact sheet. Accessed on April 19, 2011 from http://www.dec.ny.gov/animals/59604.html

3 CONCLUSIONS

This request for Part 182 determination was completed in part to answer community concerns, and to ensure project compliance in support of wildlife management and preservation activities throughout New York State. This particular property has been the subject of various intensive land uses. Although onsite there are currently habitable wildlife areas, the habitat value of the site is limited by several factors. The young age and small size of blocks of forested habitat on site limits its value for forest interior wildlife species. Other forest habitat features such as standing and fallen deadwood, den trees, and mast-producing species which are essential for certain species are lacking or scarcely scattered throughout the site. Most importantly, the habitat disturbance caused by human activity on and adjacent to the site including, landfilling, cultivation, logging, agricultural activities have already precluded this area as potential habitats for essential behaviors for many species (EDR 2004). It is anticipated that the project will have little to no impact on any endangered, threatened, or special concern species.

4 REFERENCES

1. New York State Department of Environmental Conservation. Bald Eagle Fact Sheet. Accessed May 14, 2011 from: http://www.dec.ny.gov/animals/9383.html

2. New York State Department of Environmental Conservation. List of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State. Accessed on April 19, 2011 from: http://www.dec.ny.gov/animals/7494.html.

3. New York State Department of Environmental Conservation. Red-shouldered hawk fact sheet. Accessed on April 19, 2011 from: http://www.dec.ny.gov/animals/7082.html.

4. New York State Department of Environmental Conservation. Whip-poor-will fact sheet. Accessed on April 19, 2011 from http://www.dec.ny.gov/animals/59604.html

5. United States Fish and Wildlife Services. Species by County Report. Accessed April 19, 2011 from: http://ecos.fws.gov/tess_public/countySearch!speciesByCountyReport.action?fips=36013 .

ATTACHMENT 1

Vegetation and Wildlife Survey

By: Environmental Design & Research, P.C.
January 2005

*

First document of this Appendix; survey not repeated here.

ATTACHMENT 2

Communication of Storehouse Run

Letter from: Scott Cornett

To: File

Regarding: Survey of Storehouse Run (Dodge Creek)

Dated: September 7, 2004

Included in Appendix A of the Vegetation and Wildlife Survey: not repeated here.

ATTACHMENT 3

Clubshell 5-Year Review

Clubshell
(Pleurobema clava)

5-Year Review:
Summary and Evaluation

Fall 2008

U.S. Fish and Wildlife Service
Pennsylvania Field Office
315 South Allen Street, Suite 322
State College, Pennsylvania 16801-4850

5-YEAR REVIEW

Species reviewed: Clubshell (*Pleurobema clava*)

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Field Office: Pennsylvania Field Office, Robert Anderson 814-234-4090, Robert_M_Anderson@fws.gov

Lead Regional Office: Region 5, Mary Parkin, 617-417-3331, Mary_Parkin@fws.gov

Cooperating Field Offices:

West Virginia Field Office, Barbara Douglas, 304-636-6586, Barbara_Douglas@fws.gov
Ohio Field Office, Angela Zimmerman, 614-469-6923, Angela_Zimmerman@fws.gov
Michigan Field Office, Barbara Hosler, 517-351-6326, Barbara_Hosler@fws.gov
Kentucky Field Office, Leroy Koch, 502-695-0468, Leroy_Koch@fws.gov

Cooperating Regional Offices:

Region 3, Carlita Payne, 612-713-5339, Carlita_Payne@fws.gov
Region 4, Kelly Bibb, 404-679-7132, Kelly_Bibb@fws.gov

1.2 Methods Used to Complete the Review

The clubshell 5-year review was conducted as an individual effort by the lead recovery biologist for this species. U.S. Fish and Wildlife Service (Service) field office and State natural resource agency personnel responsible for the recovery of the clubshell were contacted for current information on occurrences, threats, and recovery activities in Indiana, Kentucky, Michigan, Ohio, Pennsylvania, and West Virginia. U.S. Geological Survey (USGS) biologists and academicians conducting research on the clubshell were also contacted, as were Service fisheries biologists and others involved with holding captive clubshell. The current recovery plan was finalized in 1994 and is out of date; therefore, the information that was provided by the State and Service biologists, and included in the Natural Heritage Database, reports and other gray literature, forms the principal basis for this status review.

1.3 Background

1.3.1 Federal Register notice announcing initiation of this review

71 FR 20178 (April 21, 2006) – Notice of Endangered and Threatened Wildlife and Plants; Initiation of a 5-Year Review of Nine Listed Species: the Purple Bean (*Villosa perpurpurea*), Clubshell (*Pleurobema clava*), Northern Red-bellied Cooter (*Pseudemys rubriventris bangsi*), Roanoke Logperch (*Percina rex*), Swamp Pink (*Helonias bullata*), Northern Riffleshell (*Epioblasma torulosa rangiana*), Flat-spired Three-toothed Land Snail (*Triodopsis platysayoides*), Puritan Tiger Beetle (*Cicindela puritana*), and Dwarf Wedgemussel (*Alasmidonta heterodon*)

1.3.2 Listing history

Federal Register notice (FR): 58 FR 5638-5642
Date listed: January 22, 1993
Entity listed: Species
Classification: Endangered, Entire Range; except where listed as Experimental Populations

1.3.3 Associated rulemakings

66 FR 32250-32264 (June 14, 2001) – Establishment of Nonessential Experimental Population Status for 16 Freshwater Mussels and 1 Freshwater Snail (Anthony's Riversnail) in the Free-Flowing Reach of the Tennessee River below the Wilson Dam, Colbert and Lauderdale Counties, Alabama.

1.3.4 Review history

Since the time of Federal listing of the clubshell in 1993, no status review or 5-year review has been conducted for this species.

1.3.5 Species' Recovery Priority Number at start of 5-year review

Recovery Priority Number: 5 (indicating that the clubshell is taxonomically categorized as a species, has a high degree of threat, and low recovery potential)

1.3.6 Recovery plan

Name of plan: Clubshell (*Pleurobema clava*) and Northern Riffleshell (*Epioblasma torulosa rangiana*) Recovery Plan
Date issued: September 21, 1994
Dates of previous revisions: None

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment policy

2.1.1 Is the species under review a vertebrate? The species is an invertebrate that is listed in its entire range; therefore, the distinct population segment policy is not applicable to this listing.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? Yes, however, see section 2.2.3.

2.2.2 Adequacy of recovery criteria

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat? No.

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? No.

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.

1994 Recovery Plan Criteria

In order to ***reclassify*** the clubshell as threatened from endangered, the following criterion must be met:

1. Viable populations must be documented in 10 separate drainages for this species. A viable population consists of sufficient numbers of reproducing individuals to maintain a stable or increasing population. These populations should include as many subpopulations as possible to maintain whatever fraction of the original genetic variability that remains.

   The following drainages are identified as necessary to achieve recovery: Tippecanoe River (Indiana), East Fork West Branch St. Joseph River (Michigan/Ohio), Fish Creek (Indiana/Ohio), Green River (Kentucky), Little Darby Creek (Ohio), Elk River (West Virginia), French Creek (Pennsylvania), Allegheny River (Pennsylvania), and two additional drainages.

   This criterion is partially met. Apparently reproducing populations occur in 7 of the 10 listed waterways: Tippecanoe River (Indiana), East Fork West Branch St. Joseph River (Michigan/Ohio), Green River (Kentucky), Little Darby Creek (Ohio), Elk

River (West Virginia), French Creek (Pennsylvania), and the Allegheny River (Pennsylvania). Reproduction has also been documented in the Shenango River (Pennsylvania). Living clubshells are still occasionally found in several other streams, but recent reproduction has not always been documented (see section 2.3.1.2). The viability of remaining populations, including those showing some evidence of reproduction, is unknown. Viability is a function not only of population characteristics (*e.g.*, size, structure, fecundity, distribution), but also of threats, some of which do not appear to be fully understood or controlled.

In order to ***remove*** the clubshell from the Federal list of threatened and endangered species, the following additional criteria must be met:

2. Each of the 10 populations in Criterion 1 must be large enough to survive a single adverse ecological event. Most populations at this time are localized and susceptible to such impacts. Therefore, the extent of most populations must be increased, either naturally or through translocation.

3. The populations and their drainages from Criteria 1 and 2 must be permanently protected from all foreseeable and controllable threats, both natural and anthropogenic.

The recovery criteria have not been met; furthermore, they are vague in that: (1) Population viability is not defined, (2) the separation distance (between sub-populations) necessary to ameliorate catastrophic events is not identified, (3) population protection is not well-defined, and (4) habitat protection is not well-defined. Several recovery tasks are intended to address habitat and population protection, but the needs of this species, including its environmental tolerances, are not well understood (see section 4.0).

2.3 Updated Information and Current Species Status

2.3.1 Biology and habitat

The clubshell has been found in a variety of stream and river conditions, but it is most often observed in clean, stable, coarse sand and gravel runs, often just downstream of riffle areas, in medium to small rivers and streams (Stansbery *et al.* 1982). It typically burrows completely beneath the substrate to a depth of 2 to 4 inches, relying on water to percolate between the sediment particles (Watters 1990). More than 70 percent of a population may be hidden below the substrate surface (Smith *et al.* 2001). As a fluvial organism, the clubshell can tolerate a range of water velocities, and although often considered to be intolerant of permanently slack water conditions (USFWS 1994), it has been found living and reproducing in Navigation Pools 7, 8, and 9 in the Allegheny River at depths of 10 to 15 feet.

2.3.1.1 New information on the species' biology and life history:

Clubshell glochidia are obligate parasites on fish gills, a possible adaptation for upstream dispersal of a relatively immobile organism living in flowing water, and which would otherwise be flushed from the river system over time. Not all fish species are suitable hosts. The striped shiner (*Notropis chrysocephalus*), central stoneroller (*Campostoma anomalum*), blackside darter (*Percina maculata*), and logperch (*Percina caprodes*) have been capable of serving as hosts for the clubshell under laboratory conditions (Watters and O'Dee 1997, O'Dee and Watters 2000). It is likely that additional untested fish species can be used by clubshell glochidia in the wild.

The clubshell likely reaches sexual maturity between 3 and 5 years, as does the closely related Tennessee clubshell, *Pleurobema oviforme* (Weaver *et al.* 1991). Clubshells are relatively long-lived with life spans of 20 years or more. Males of the genus *Pleurobema* release sperm into the water in April, May, and June, and downstream females uptake the sperm with incoming water (Weaver *et al.* 1991). The clubshell is long-lived and has low annual juvenile survival rates.

2.3.1.2 Abundance, population trends, demographic features, and/or demographic trends:

Clubshells are cryptic, with perhaps 70 percent of a population occurring below the substrate surface; therefore, qualitative population estimates must take into account undetected individuals. Further, where clubshells are found at low population densities, population estimates may have large margins of error due to undetected mussels. In addition, sparsely distributed juveniles used to document successful reproduction are likely even more difficult to detect. Documenting reproductive success is further complicated because clubshells are relatively long-lived. Adults, which may be less sensitive to environmental disturbance than juveniles, could persist for decades before the population shows significant evidence of decline.

Reproducing clubshell populations are often hard to detect when densities are very low or surveys are single-day, catch-per-unit efforts. Few intensive, statistically valid surveys have been conducted on clubshell populations outside of French Creek and the Allegheny River. Populations in the southern and western portions of the species range, particularly where population densities may be near or below the detection rate, may not be practically assessed with quantitative techniques. The difficulty in detecting clubshells results in poorly defined distribution and abundance information, even within the streams where the species is known to occur.

All streams with known clubshell populations are listed below by major watershed. The underlined streams and locations are listed in the recovery plan as areas where viable populations of clubshell are necessary to achieve recovery:

Wabash River System

- Clubshells occur in several locations in the Tippecanoe River in Indiana, with larger concentrations in the headwaters below Lake Tippecanoe and in the lower reaches below Lake Shaffer and Lake Freeman. The species shows evidence of a variety of year classes, which is indicative of reproduction (B. Fisher, Indiana Department of Natural Resources, 2007 pers. comm.). Although the recovery plan identified the population in the Tippecanoe River as the largest, recent surveys indicate that the population in the Allegheny River (Pennsylvania, see below) occurs over more miles of river and is larger in size.

- In 1998, a live clubshell was collected in the Middle Branch North Fork Vermilion River in Illinois. The small size of the specimen (4.5 cm) suggests that species has successfully reproduced in the Middle Branch in the last decade (Szafoni *et al.* 2000).

Maumee River System

- In 2004 and 2005, 6 living clubshells were found in an extensive qualitative and quantitative survey of 26 miles of Fish Creek in Indiana, albeit with no evidence of recent reproduction (Brady *et al.* 2004, Brady *et al.* 2005).

- A clubshell population occurs in East Branch of the West Fork St. Joseph River in Michigan, where the species can be found with relative frequency but appears to be skewed toward larger individuals and may no longer be reproducing (Badra 2000, Badra 2004).

Green River System

- Since 2000, living clubshells have been reported from the Green River in Kentucky from about 6 to 25 miles downstream of the Green River Reservoir (J. Layzer, Tennessee Technological University, pers. comm. 2007). This population shows evidence of periodic success in reproduction, apparently related to discharge rates from Green River Reservoir and hatchery produced juveniles were released back to this population in 2007 (J. Layzer, pers. comm. 2007).

Scioto River System

- Living clubshells can be found in a 13 mile stretch of Little Darby Creek in Ohio, where the species is reproducing and appears to represent a significant population (Tetzloff 2000; G.T. Watters, The Ohio State University, pers. comm. 2007).

- In 2006, a single, 5-year-old clubshell was reported from Big Darby Creek in Ohio, which may represent a recent range extension from Little Darby Creek following the removal of a low-head dam (M. Hoggarth, Otterbein College, pers. comm. 2007).

Kanawha River System

- Clubshell still occurs in localized areas of the Elk River in West Virginia, between Sutton Dam to within about 42 miles of the confluence with the Kanawha River (a distance of approximately 52 stream miles), where the species still appears to be successfully reproducing (B. Douglas, USFWS, pers. comm. 2007; J. Clayton, West Virginia Department of Natural Resources, pers. comm. 2007).

Allegheny River System

- In the Allegheny River in Pennsylvania, clubshells have been documented to occur in abundance at several locations, but the species' distribution is discontinuous (*i.e.*, localized to areas of suitable habitat). The condition of these populations ranges from those exhibiting successful reproduction to those with apparently depressed vigor and a predominance of older adults (USGS 2004). Clubshell populations are known from scattered locations in the middle Allegheny River (*e.g.*, near the towns of Kennerdell, Foxburg, Oil City, Parker and East Brady), downstream to river mile 58, which includes the two upper Navigation Pools (Pools 8 and 9). In many of these locations, mussel population data are based solely on qualitative surveys, and the clubshell appears to be relatively less abundant than the other more common species with which it co-occurs in the Allegheny River, such as muckets (*Actinonaias ligamentina*) and spikes (*Elliptio dilatata*).

  Quantitative sampling has occurred at a few locations on the Allegheny River. For example, approximately 3025 clubshells were estimated to occur in 100-meter wide river sections located 200 and 300 meters downstream of the existing West Hickory Bridge (USGS 2000). The total population of clubshells in the upper 52 km of the Allegheny River sampled by USGS may exceed 1,100,000 individuals (Villella 2007).

- The clubshell population is discontinuously distributed in the upper approximately 15 miles of French Creek in Pennsylvania, from near the confluence with LeBoeuf Creek, downstream to the vicinity of the State Route 6 Bridge at Mill Village. Within this reach, clubshells range from relatively common, to rare or absent at sites that have otherwise diverse mussel communities. Of 31 sites investigated along the length of French Creek in 2003, clubshells were documented alive at only 3 sites. The size distribution ranged from 17 mm to 81 mm, indicating that successful reproduction is occurring. In 2004, population estimates at these sites ranged from less than 10 to over 800 individuals per site (Smith and Crabtree 2005). In the

French Creek watershed, the clubshell populations have a relatively small range that has little overlap with that of the federally listed, endangered northern riffleshell.

Clubshells have also been found in the reaches of four French Creek tributaries: Conneaut Outlet, Conneauttee Creek, and Muddy Creek in Crawford County and LeBoeuf Creek in Erie County, Pennsylvania. Documentation of these tributary populations is often based on small numbers of individuals in highly restricted reaches of these streams. The population in Conneaut Outlet is isolated, does not appear to be reproducing, and is restricted to less than a mile of stream immediately below a wastewater treatment plant.

- Two clubshells were documented in Cassadaga Creek in New York in 2005. The extent of this population beyond the single known site and its reproductive status are not known at this time (Smith and Horn 2006).

Monongahela River System

- A small and apparently non-reproducing population of clubshell exists in Hackers Creek in West Virginia (B. Douglas, pers. comm. 2007). This population appears to be in severe decline and may soon be lost (J. Clayton, pers. comm. 2007).

Beaver River System

- Twenty-four living clubshells were found in quantitative sampling at one site related to a bridge replacement project on the Shenango River in Mercer County, Pennsylvania (EnviroScience 2002). This study provided a population density estimate of 0.33 clubshell per square meter, and a population estimate of 41 to 155 individuals in the 13,191 m^2 sampling area. The size range of clubshells at this site ranged from 37 mm to more than 60 mm, indicating the population is successfully reproducing. The full extent of the Shenango River population is unknown due to a lack of sampling, but potential habitat extends from at least Pymatuning Reservoir to Shenango Reservoir and perhaps below into Lawrence County.

- An apparently small, non-reproducing population of clubshells occurs in Pymatuning Creek, Ohio (G.T. Watters, pers. comm. 2007). In 2006, only a single, large adult clubshell was found in Pymatuning Creek, along with several deeply buried, dead shells (M. Hoggarth, Otterbein College, pers. comm. 2007).

Muskingum River System

- In 1987, a single, freshly-dead clubshell (with adductor muscle tissue still attached) was reported from the Walhonding River in Ohio (M. Hoggarth, pers. comm. 2007).

No other fresh or recently dead clubshell specimens have been reported from this stream, but no comprehensive survey has been completed.

Other Ohio River Tributaries

- A few scattered individual clubshells have been documented during spot surveys in Meathouse Fork of Middle Island Creek, West Virginia; however, because no systematic surveys have been completed, the status and range of clubshells in Meathouse fork is unknown (B. Douglas, pers. comm. 2007).

- Clubshells have been found in the South Fork of the Hughes River, a tributary of the Little Kanawha River, in West Virginia. Mussel survey data from this river are scant, so the status and extent of any clubshell population is unknown (B. Douglas, pers. comm. 2007).

In summary, clubshells appear to be restricted to 13 populations in the Ohio River and Lake Erie Basins (Appendix 1). Portions of 21 streams support or might still support the species. Evidence of recent successful recruitment has been reported in nine streams, including the Allegheny River, French Creek, LeBoeuf Creek, Muddy Creek, Tippecanoe River, Middle Branch of the North Fork Vermilion River, Green River, Elk River, Little Darby Creek, and Shenango River. In seven streams, clubshell populations appear to be comprised of only older adults, and the populations are in decline: East Fork of the West Branch St. Joseph River, Fish Creek, Hackers Creek, Walhonding River, Cassadaga Creek, Pymatuning Creek, Conneaut Outlet, and Conneauttee Creek. Finally, based on a single specimen, the clubshell could be exhibiting a range extension as a result of habitat management in Big Darby Creek, Ohio.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation:

Tim King and Cheryl Morrison (U.S. Geological Survey, Leetown, WV) have been investigating the genetic structure of the clubshell with a focus on determining the genetic relatedness of the remaining populations. The data indicate that the clubshell populations in the Allegheny River, French Creek, and the St. Joseph River system are genetically diverse and have not undergone a bottleneck event (sometimes evident after population recovery from a highly reduced abundance). Individual clubshells from these streams can be identified to the source population in the majority of cases. This suggests that these populations are genetically distinct and mixing should be avoided. Few genetic samples have been included from populations in the southern portion of the range of the clubshell, including the Tennessee and Cumberland River systems. Some populations of Tennessee clubshell (*Pleurobema oviforme*), identified based on shell morphology, may actually be *Pleurobema clava*.

2.3.1.4 Taxonomic classification or changes in nomenclature:

The genetic relationship between *Pleurobema oviforme* and *Pleurobema clava* in the Tennessee and Cumberland Rivers is unclear, and some populations may not be correctly identified as Tennessee clubshell based on shell morphology and geography. The existing genetic analysis is based, however, on a small sample size, and is therefore incomplete and inconclusive.

2.3.1.5 Spatial distribution, trends in spatial distribution, and/or changes from historical range:

Although population numbers are relatively high in a few localized areas, the remaining clubshell populations are now sparsely distributed across the range of the species. Of 100 streams once known to be occupied by *P. clava*, the species is now limited to 13 extant populations occupying 21 streams. Seven populations show signs of successful recruitment. Impoundments and degraded habitat separate most populations from each other, eliminating the potential for natural recolonization if a catastrophic event temporarily degrades habitat (*e.g.*, toxic spill event, flood).

2.3.1.6 Habitat or ecosystem conditions:

The extant clubshell populations occur in relatively small streams to medium-sized rivers. Many of the clubshell populations in smaller streams appear to be limited in extent (*e.g.*, a single stream reach, a small number of individuals) and show no evidence of recent recruitment (including Fish Creek, Pymatuning Creek, Conneaut Outlet, Hackers Creek, Cassadaga Creek). Because up to 70 percent of a clubshell population can be distributed below the substrate surface (Smith *et al.* 2001), this species is presumed to be highly dependent on interstitial flow through the substrate for oxygen and food and, therefore, is highly susceptible to siltation that fills interstitial voids. The reduced hydraulic energy typical of smaller streams may make this habitat type more susceptible to siltation. Smaller streams are also less likely to be able to ameliorate localized disturbance that increases silt or contaminant loads.

All clubshell populations in medium-sized rivers (*i.e.*, Allegheny River, French Creek, Green River, Tippecanoe River, and Elk River) occur downstream of reservoirs or natural lakes. Although these lentic systems tend to remove fine silts, potentially protecting downstream clubshells from upstream erosion, they also limit the range of the species, which is not tolerant of predominantly lentic conditions. Regulated river flows can also limit the range of the clubshell; for example, in the Allegheny River clubshells become more abundant several kilometers downstream of Kinzua Dam.

2.3.2 Five-Factor Analysis

The 1994 recovery plan identified four primary factors responsible for the decline of clubshell populations: siltation, impoundments, in-stream sand and gravel mining, and pollutants (USFWS 1994). These threats have been organized to align with the five listing factors, as follows.

2.3.2.1 Present or threatened destruction, modification, or curtailment of its habitat or range:

Ongoing threats to the clubshell include water quality degradation from point and non-point sources, particularly in small tributaries that have limited capability to dilute and assimilate sewage, agricultural runoff, and other pollutants. In addition, the species is affected by hydrologic and water quality alterations resulting from the operation of impoundments such as Union City Reservoir on French Creek, Green River Reservoir on the Green River, Pymatuning Reservoir on the Shenango River, Kinzua Dam on the Allegheny River, and Sutton Dam on the Elk River. The presence of impoundments may have ameliorated the effects of downstream siltation on clubshell, but these structures also control river discharges (and the many environmental parameters influenced by discharge), which may profoundly affect the ability of these populations to occupy or successfully reproduce in downstream habitats.

A variety of instream activities continues to threaten clubshell populations, including sand and gravel dredging, gravel bar removal, bridge construction, and pipeline construction. Protecting clubshell populations from the direct physical disturbance of these activities depends on accurately identifying the location of the populations, which is difficult with a cryptic species such as clubshell. The indirect effects of altering the streambed configuration following in-stream disturbance can result in long-lasting alteration of streamflow patterns that may result in head-cutting and channel reconfiguration, thereby eliminating previously suitable habitat some distance from the disturbance.

Coal, oil, and natural gas resources are present in a number of the watersheds that are known to support clubshell, including the Allegheny River, Hackers Creek, Meathouse Fork, and the Elk River. Exploration and extraction of these energy resources can result in increased siltation, a changed hydrograph, and altered water quality even at a distance from the mine or well field. Clubshell populations in smaller streams are more vulnerable to these resource extraction activities, which can account for a much larger percentage of a small watershed. However, clubshell habitat in larger streams can also be threatened by the cumulative effects of a large number of mines and well fields.

Land-based development near streams of occurrence, including residential development and agriculture, often results in loss of riparian habitat, increased storm water runoff due

to increased impervious surfaces, increased sedimentation due to loss of streamside vegetation, and subsequent degradation of streambanks. Because clubshells often live below the gravel surface, this species may be exceptionally sensitive to the increased siltation that these activities generate. The clubshell in Little Darby Creek on the western side of the City of Columbus is an example of a population threatened by development, while Hackers Creek, Pymatuning Creek, and Meathouse Fork appear to be strongly influenced by agriculture.

Development has also resulted in an increased number of sewage treatment plants in drainages that support clubshell as well as an increase in the amount of sewage discharged from existing plants. Mounting evidence indicates that freshwater mussels are more sensitive to several components of treated sewage effluent (*e.g.,* ammonia, chlorine and copper) than are the typical organisms used to establish criteria protective of aquatic life. Small streams, such as Conneaut Outlet, are particularly vulnerable to sewage effluent, which can comprise a significant portion of the total stream flow.

This species, like many mussels, is susceptible to permanent, temporary, and intermittent forms of environmental degradation. Reduced populations may take several decades to recover, even if no further degradation occurs.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

Collection is not known to present a significant threat at this time. The clubshell is not a commercially valuable species. Nonetheless, the small number of remaining populations increases its vulnerability to over-zealous scientific collecting or educational programs that sample mussels and may increase the value for illegal trade by shell collectors.

2.3.2.3 Disease or predation:

Several animals prey on this species, including muskrats, raccoons, otters, molluscivous fish, and some invertebrates. This effect may be negligible in larger populations such as the Allegheny River but could represent a significant threat to the small isolated clubshell populations.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Coal, oil, and gas resources are present in a number of the basins where clubshell occur, and extraction of these resources has increased dramatically in recent years, particularly in Pennsylvania and West Virginia. Although oil and gas extraction generally occurs away from the river, extensive road networks are required to construct and maintain wells. These road networks frequently cross or occur near tributaries, contributing sediment to the receiving waterway. In addition, the construction and operation of wells

may result in the discharge of brine. Point source discharges are typically regulated; however, nonpoint inputs such as silt and other contaminants may not be sufficiently regulated, particularly those originating some distance from a waterway. In 2006, more than 3700 permits were issued for oil and gas wells by the Pennsylvania Department of Environmental Protection, which also issued 98 citations for permit violations at 54 wells (Hopey 2007).

Even regulated point sources may adversely affect clubshells. Freshwater mussels appear to be more sensitive to some pollutants than the organisms typically used in toxicity testing. As a result, some of the water quality criteria established by the U.S. Environmental Protection Agency (EPA) to protect aquatic life may not be protective of mussels. For example, Augspurger *et al.* (2003) found that the current EPA numeric criteria for ammonia may not protect mussels. Consequently, even those sewage treatment plants that comply with their ammonia effluent limits at all times may still be discharging water that is toxic to unionids. Few substances have been tested for their toxicity to mussels, let alone the endangered clubshell, so "safe" concentrations for this species are not yet known. In addition, some States allow mixing zones, or zones in which numeric water quality criteria can be exceeded. Conneaut Outlet in Crawford County, Pennsylvania, is an example of a clubshell population that has been adversely affected by a regulated discharge. In this case, clubshells were eliminated from over 1000 feet of suitable habitat immediately downstream of a municipal sewage treatment plant, probably due to lethal levels of chlorine and ammonia.

Agriculture, suburban, and urban land uses continue to expand in many watersheds in the existing range of clubshell. These land use changes alter runoff patterns and flow in clubshell habitat, with unknown consequences to these remaining populations. Few regulatory mechanisms exist to address land use changes that may indirectly affect stream habitat that is remote from the disturbance.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Zebra mussels (*Dreissena polymorpha*) have been documented in headwater lakes and reservoirs of a number of streams supporting clubshell populations. These lakes and reservoirs supply a source for zebra mussel veligers (larvae) to colonize downstream reaches. The presence of zebra mussel populations may also cause increased use of molluscides to treat zebra mussel infestations in the watershed. Nearly all remaining reproducing clubshell populations are downstream of lakes or reservoirs that support, or could support, zebra mussels.

The isolated nature of remaining clubshell populations combined with life history traits means that natural recolonization is unlikely in the event of a natural or manmade catastrophic event. Many of the remaining population appear to be limited to relatively short stream reaches or single sites. These small isolated populations are particularly

vulnerable extirpation due to losses resulting from events such as droughts, floods, toxicant spills, or other stochastic events.

2.4 Synthesis

The clubshell was listed as endangered, without critical habitat, in 1993. Historically, the clubshell was once abundant and appears to have been a highly successful species occupying a range of riverine habitats throughout the Ohio River basin and tributaries of western Lake Erie (Stansbery *et al.* 1982). The clubshell often shares habitat with the northern riffleshell in Pennsylvania but is extant in more streams, particularly those of smaller drainages, than typically used by northern riffleshell. The species has been documented in over 100 streams throughout its range, although it now appears to be limited to 13 populations distributed in 21 streams.

Few extant clubshell populations occupy habitats that are protected from the threats affecting this species. Riverine habitat adjacent to extant populations is not easily protected, other than by State shoreline protection regulations or local land use regulations. Development of adjacent uplands continues to be a significant and pervasive threat to remaining populations.

Only seven clubshell populations show evidence of recent reproductive success. For unknown reasons, many of the remaining clubshell populations do not appear to be reproducing in locations were many other species of freshwater mussels show evidence of recent recruitment. Large clubshell populations persist in a few streams where the Endangered Species Act (ESA) and other regulatory mechanisms have been important to maintaining these populations. However, the species continues to decline in half of the streams where it was present when listed as endangered in 1993. In some of these streams, such as Fish Creek, Hackers Creek, Pymatuning Creek, and Conneaut Outlet, the species appears to be nearly extirpated.

In sum, the more extensive but geographically-limited populations found in the Allegheny River do not compensate for the declining populations and lost habitat elsewhere in the clubshell's range. These concerns are paired with the fact that the recovery criteria for downlisting have not been met, although the downlisting criterion of 10 viable populations may be achievable. Without significant recovery activities targeted at understanding those life history traits of the clubshell that make it susceptible to land use changes, as well as a concerted effort to address ongoing threats, it is unlikely the species can be downlisted in the near future, since there is a real possibility of further range contraction. There is increased interest and understanding of methods to augmentation and reintroduction clubshell populations; however, while promising, these efforts maybe limited by an incomplete understanding of the factors that appear to be limiting natural population recovery in most of the extant populations.

Our current understanding of the clubshell's status leads us to conclude this species continues to face a probability of extinction throughout all its range, thereby meeting the definition of endangered under the ESA.

3.0 RESULTS

3.1 Recommended Classification: No change is needed. Retain as endangered.

Brief Rationale: Despite an apparently healthy population in the Allegheny River system (including its tributary, French Creek), and evidence of reproduction in six other rivers, the listing as endangered appears to be appropriate because the criteria to downlist the species have not been achieved. An endangered classification is also appropriate because of the species' continued decline and apparent lack of reproduction, in at least three of the 13 extant populations due to undefined causes. Additionally, more than half of the remaining populations that show evidence of recruitment appear to be limited to single stream reaches and likely very small populations that are highly susceptible to catastrophic events. These factors contribute to the conclusion that clubshell remains susceptible to significant, but largely undefined, continuing threats.

3.2 New Recovery Priority Number: No change recommended. Retain as 5.

Brief Rationale: Recovery Priority Number of 5 indicates that the clubshell is taxonomically categorized as a species, has a high degree of threat, and low recovery potential. Although there are reliable techniques in place for managing mussel populations, strategies and techniques for abating threats to the species are less tractable.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

Recommendation: Revise recovery plan.

The recovery plan for the clubshell is more than 10 years old. A significant amount of information is available regarding threats to the essential recovery streams identified in the plan. A revised plan will assist local and State entities in planning watershed and ecosystem actions to recover habitat for eventual relocation. The recovery criteria also need to be updated to specifically address each of the relevant listing factors.

Recommendations for specific recovery actions:

The following recovery actions should be made a priority:

1) Identify and map both actual and potential threats at existing sites, and identify activities or practices that may affect the clubshell.

2) Assess the effects of stream regulation on the existing populations, and develop recommendations for dam operators to protect and enhance downstream clubshell habitat.

3) Determine contaminant sensitivity for each life stage, particularly silt concentrations.

4) Implement a quantitative monitoring program at sites within the reproducing populations to assess the reproductive condition of these populations.

5) Continue genetic analysis to define the ranges of clubshell (*Pleurobema clava*) and Tennessee clubshell (*Pleurobema oviforme*) in the Cumberland and Tennessee Rivers.

6) Captive and *in situ* holding of clubshell may provide additional options for the species' recovery and re-establishment into historic habitat through augmentation or reintroduction of relocated animals or captive propagation. Husbandry methods should be developed, and an assessment of historic habitat completed to identify sites where clubshell augmentation and re-establishment can be achieved.

5.0 REFERENCES

Augspurger, T.J., Keller, A.E., Black, M.C., Cope, W.G., and Dwyer, F.J. 2003. Water quality guidance for protection of freshwater mussels (Unionidae) from ammonia exposure. Environmental Toxicology and Chemistry 22(11):2569-2575.

Badra, P.J. 2000. Surveys for the Clubshell (*Pleurobema clava*) and other rare clams in Michigan: Year Two Progress Report - 1999. Report to U.S. Fish and Wildlife Service, Twin Cities, Minnesota. 32 pp.

Badra, P.J. 2004. Monitoring Clubshell (*Pleurobema clava*) Populations and Surveys for the Northern Riffleshell (*Epioblasma torulosa Rangiana*) in Michigan. Report to U.S. Fish and Wildlife Service, Michigan Field Office, Lansing, Michigan. 11 pp.

Brady, T., Gordon, R., and Tosick, M. 2004. Qualitative Survey of the Freshwater Mussels of Fish Creek in Ohio and Indiana. Fish Creek Counsel/Bloomington Field Office, Bloomington IN. 5 pp. plus appendices.

Brady, T., Gordon, R., and Tosick, M. 2005. Quantitative Survey of the Freshwater Mussels of Fish Creek in Ohio and Indiana. Fish Creek Counsel/Bloomington Field Office, Bloomington Indiana. 12 pp.

EnviroScience, Inc. 2002. Porter Road Bridge Replacement Freshwater Mussel Population Survey. Shenango River, Mercer County, Pennsylvania, December 17, 2002. Report prepared for the Pennsylvania Department of Transportation, Engineering District 1-0. 22 pp. plus figures and appendices.

Hopey, D. 2007. "Oil, gas drilling called out of control, conservationists say Allegheny National Forest is being hurt." *Pittsburgh Post-Gazette,* January 26.

O'Dee, S. H. and Watters, G. T. 2000. New or confirmed host fish identifications for 10 freshwater mussels. Proceeding of the Conservation, Captive Care and Propagation of Freshwater mussels Symposium, 1998, pp. 77-82, Ohio Biological Survey, Columbus, Ohio.

O'Dee, S. H. and Watters, G. T. 2000. New or confirmed host fish identifications for 10 freshwater mussels. Proceeding of the Conservation, Captive Care and Propagation of Freshwater mussels

Symposium, 1998, pp. 77-82, Ohio Biological Survey, Columbus, Ohio.

Smith, D.R., Villella, R.F., and Lemarié, D.P. 2001. Survey protocol for assessment of endangered freshwater mussel in the Allegheny River, Pennsylvania. Journal of the North American Benthological Society 20:118-132.

Smith, T. and Crabtree, D. July 30, 2005. Final Report. Freshwater Mussel (Unionidae) and Fish Assemblage Habitat Use and Spatial Distributions in the French Creek Watershed: Reference for Western Pennsylvania Unionid Protection and Restoration. Western Pennsylvania Conservancy, Pittsburgh, Pennsylvania. 180 pp. plus Appendices.

Smith, T. and Horn, Z. 2006. Freshwater Mussel (Unionidae) Spatial Distribution in the New York Portion of the Allegheny River Watershed. Report to The Nature Conservancy. 26 pp. plus appendices.

Stansbery, D.H., Borror, K.G., and Newman, K.E. 1982. Biological abstracts of selected species of Unionid mollusks recovered from Ohio. Unpublished report prepared for the Ohio Heritage Foundation. Ohio Department of Natural Resources.

Szafoni, R.E., Cummings, K.S., and Mayer, C.A. 2000. Freshwater Mussels (Mollusca: Unionidae) of the Middle Branch, North Fork Vermilion River, Illinois/Indiana. Transactions of the Illinois State Academy of Science. 93: 229-237.

Tetzloff, John. 2000. 2000 Survey of the Freshwater Mussels of the Lower Big Darby Creek. Ohio Department of Natural Resources. Report to Division of Wildlife. Columbus, Ohio. 52 pp.

U.S. Fish and Wildlife Service. 1994. Clubshell mussel (*Pleurobema clava*) and northern riffleshell (*Epioblasma torulosa rangiana*) recovery plan. Hadley, Massachusetts. 68 pp.

U.S. Geological Survey. 2000. A Survey of Freshwater Mussel Populations at West Hickory Bridge Alternate 2 and 3 on the Allegheny River, M.P. 158.9, S.R. 0127, Section B00, Forest County, Pennsylvania. U.S. Geological Survey, Kearneysville, WV. 26 pp.

U.S. Geological Survey. 2004. Mussel survey of the upper Allegheny River from Warren to Tionesta, Phase one and two sampling, Two year annual report. Submitted to the Pennsylvania Department of Transportation. U.S. Geological Survey, Kearneysville, WV. 17 pp. plus appendices.

Villella, R. 2007. A reassessment of freshwater mussels in the Allegheny River: some surprising results. (abs). Freshwater Conservation Society Symposium, 2007. Little Rock, Arkansas.Watters, G.T. 1990. 1990 survey of the unionids of the Big Darby Creek System. Final Report to The Nature Conservancy. 229 pp.

Watters, G.T. 1990. 1990 survey of the unionids of the Big Darby Creek System. Final Report to The Nature Conservancy. 229 pp.

Watters, G.T. and O'Dee, S.H. 1997. Identification of potential hosts: *Elliptio fisheriana* (Lea 1838), Fusconaia masoni (Conrad 1834), *Fusconaia flava* (Rafinesque 1820), and *Pleurobema clava* (Lamarck 1819). Triennial Unionid Report, Report No. 13, November 1997, pp. 38-39.

Weaver, L.R., Pardue, G.B., and Neves, R.J. 1991. Reproductive biology and fish hosts of the Tennessee clubshell *Pleurobema oviforme* (Mollusca: Unionidae) in Virginia. The American Midland Naturalist 126:82-89.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Clubshell (*Pleurobema clava*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__✓__ No change needed

Review Conducted By: Robert Anderson, Pennsylvania Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 8-15-07

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve _____ Date 9/11/09
Acting Regional Director

INTER-REGIONAL CONCURRENCE:

Cooperating Regional Director, Fish and Wildlife Service, Region 3

Signature See other signature page Date_____

Cooperating Regional Director, Fish and Wildlife Service, Region 4

Signature _____ Date 11/27/07
acting Assistant Regional Director
Ecological Services

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Clubshell (*Pleurobema clava*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__✓__ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: Robert Anderson, Pennsylvania Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 8-15-07

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve See other signature page Date _____

Cooperating Assistant Regional Director, Ecological Services
Fish and Wildlife Service, Midwest Region

__X__ Concur ____ Do Not Concur

Signature Lynn M. Lewis Date 4/7/09

Appendix 1.

Clubshell populations are presently known to occur (or appear to be extant) in the following streams.

Basin	Population	Stream	Approximate Range	Status[1]
Lake Erie (St. Lawrence River system)	St. Joseph River	East Brnch of the West Fork St. Joseph River	scattered over ~10 mile reach	No recruitment documented; status unknown
		Fish Creek (isolated from other populations)	7-mile reach	A few scattered individuals reported; no recruitment documented;; declining
Ohio River	Wabash River	Tippecanoe River	scattered over ~ 150 miles	Recruitment documented; stable
	Green River	Middle Branch, North Fork Vermilion River	1 site	1 live young individual found in 1998
	Green River Scioto River	Green River	scattered over ~20 miles	Recruitment documented; stable
		Little Darby Creek	12-mile reach	Recruitment documented; declining
	Shenango River Shenango River	Big Darby Creek	1 site	1 live young individual found in 2006
		Shenango River	1 site	Recent recruitment; status unknown
	Muskingum River	Pymatuning Creek (isolated from the Shenango River)	4 sites	No recruitment documented; declining

Ohio River (continued)	Allegheny River	Allegheny River	scattered over 66 miles	Successful recruitment at multiple sites; stable
		Cassadaga Creek (isolated from the Allegheny River)	1 site	2 live individuals found in 2005; no recruitment documented; status unknown
	French Creek	French Creek	Scattered over 15 miles --Erie, Venango & Crawford Co.	Successful recruitment at multiple sites; stable
		Conneauttee Creek	1 site	No recruitment documented; declining
		LeBoeuf Creek	3-mile reach	Recruitment documented; stable
		Muddy Creek	1 site	Recruitment documented; status unknown
		Conneaut Outlet (isolated from the French Creek)	500-foot reach	No recruitment documented; declining
	Kanawha River	Elk River	Scattered over 42 miles -- Braxton and Clay Counties	Successful recruitment at multiple sites; stable
	Monongahela River	Hackers Creek	100-yard reach	No recruitment documented; declining
	Little Kanawha River	South Fork Hughes River	not reported	A few scattered individuals reported; no recruitment documented; status unknown
	Middle Island Creek	Meathouse Fork of Middle Island Creek	not reported	A few scattered individuals reported; no recruitment documented; status unknown
TOTALS	13 populations	21 streams		8 populations in 9 streams recruiting

ATTACHMENT 4

Rayed Bean Review

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R3–ES–2010–0019; MO 92210–0–0008–B2]

RIN 1018–AV96

Endangered and Threatened Wildlife and Plants; Listing the Rayed Bean and Snuffbox as Endangered

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposed rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), propose to list the rayed bean (*Villosa fabalis*) and snuffbox (*Epioblasma triquetra*) as endangered throughout their ranges, under Endangered Species Act of 1973, as amended (Act). This proposed rule, if made final, would extend the Act's protection to the rayed bean and the snuffbox. We have determined that designating critical habitat for these species is prudent, but not determinable at this time. The Service seeks data and comments from the public on this proposed listing rule.

DATES: We will consider comments we receive on or before January 3, 2011. We must receive requests for public hearings, in writing, at the address shown in the **FOR FURTHER INFORMATION CONTACT** section on or before December 17, 2010.

ADDRESSES: You may submit comments by one of the following methods:

- *Federal eRulemaking Portal: http://www.regulations.gov.* Follow the instructions for submitting comments on Docket No. FWS–R3–2010–0019.
- *U.S. mail or hand-delivery:* Public Comments Processing, Attn: FWS–R3–2010–0019; Division of Policy and Directives Management; U.S. Fish and Wildlife Service; 4401 N. Fairfax Drive, Suite 222; Arlington, VA 22203.

We will post all comments on *http://www.regulations.gov.* This generally means that we will post any personal information you provide us (*see* the Public Comments section below for more information).

FOR FURTHER INFORMATION CONTACT: Angela Boyer at the U.S. Fish and Wildlife Service, Ohio Ecological Services Field Office, 4625 Morse Road, Suite 104, Columbus, OH 43230; telephone 614–416–8993, ext. 22.

SUPPLEMENTARY INFORMATION:

Public Comments

Our intent is to use the best available commercial and scientific data as the foundation for all endangered and threatened species listing determinations. We therefore request comments or suggestions from other concerned governmental agencies, the scientific community, industry, or any other interested party concerning this proposed rule to list the rayed bean and snuffbox as endangered. We particularly seek comments concerning:

(1) Survey results for the rayed bean or snuffbox, as well as any studies that may show distribution, status, population size, or population trends, including indications of recruitment;

(2) Pertinent aspects of life history, ecology, and habitat use of the rayed bean or snuffbox;

(3) Current and foreseeable threats faced by the rayed bean or snuffbox, or both species, in relation to the five factors (as defiued in section 4(a)(1) of the Act (16 U.S.C. 1531 *et seq.*));

(4) The specific physical and biological features to consider, and specific areas that may meet the definition of critical habitat and that should or should not be considered for a proposed critical habitat designation as provided by section 4 of the Act; and

(5) The data and studies to which this proposal refers.

You may submit your comments and materials concerning this proposed rule by one of the methods listed in the **ADDRESSES** section. We will not accept comments sent by e-mail or fax or to an address not listed in the **ADDRESSES** section. Comments must be submitted to *http://www.regulations.gov* before midnight (Eastern Time) on the date specified in the **DATES** section. Finally, we will not consider hand-delivered comments that we do not receive, or mailed comments that are not postmarked, by the date specified in the **DATES** section.

We will post your entire comment —including your personal identifying information—on *http://www.regulations.gov.* If you provide us personal identifying information such as your street address, phoue number, or e-mail address, you may request at the top of your document that we withhold this information from public review. However, we cannot guarantee that we will be able to do so.

Comments and materials we receive, as well as supporting documentation we used in preparing this proposed rule, will be available for public inspection on *http://www.regulations.gov,* or by appointment, during normal business hours at the Ohio Ecological Services Field Office (*see* **FOR FURTHER INFORMATION CONTACT**).

Public Hearing

The Act provides for one or more public hearings on this proposal, if requested. We must receive requests by the date listed in the **DATES** section above. Such requests must be made in writing and addressed to the Field Supervisor of the Ohio Ecological Services Field Office (*see* **FOR FURTHER INFORMATION CONTACT**).

Background

Species Descriptions

The rayed bean is a small mussel usually less than 1.5 inches (in) (3.8 centimeters (cm)) in length (Cummings and Mayer 1992, p. 142; Parmalee and Bogan 1998, p. 244; West *et al.* 2000, p. 248). The shell outline is elongate or ovate in males and elliptical in females, and moderately inflated in both sexes, but more so in females (Parmalee and Bogan 1998, p. 244). The valves are thick and solid. The anterior end is rounded in females and bluntly pointed in males (Cummings and Mayer 1992, p. 142). Females are generally smaller than males (Parmalee and Bogan 1998, p. 244). Dorsally, the shell margin is straight, while the veutral margin is straight to slightly curved (Cummings and Mayer 1992, p. 142). The beaks are slightly elevated ahove the hingeline (West *et al.* 2000, p. 248), with sculpture consisting of double loops with some nodules (Parmalee and Bogan 1998, p. 244). No posterior ridge is evident. Surface texture is smooth and sub-shiny, and green, yellowish-green, or brown in color, with numerous wavy, dark-green rays of various widths (sometimes obscure in older, blackened specimens) (Cummings and Mayer 1992, p. 142; West *et al.* 2000, p. 248). Internally, the left valve has two pseudocardinal teeth (tooth-like structures along the hinge line of the internal portion of the shell) that are triangular, relatively heavy, and large, and two short, heavy lateral teeth (Cummings and Mayer 1992, p. 142). The right valve has a low, triangular pseudocardinal tooth, with possibly smaller secondary teeth anteriorly and posteriorly, and a short, heavy, and somewhat elevated lateral tooth (Parmalee and Bogan 1998, p. 244). The color of the nacre (mother-of-pearl) is silvery white or bluish and iridescent posteriorly. Key characters useful for distinguishing the rayed bean from other mussels is its small size, thick valves, unusually heavy teeth for a small mussel, and color pattern (Cummings and Mayer 1992, p. 142).

The snuffbox is a small- to medium-sized mussel with males reaching up to 2.8 in. (7.0 cm) in length (Cummings

and Mayer 1992, p. 162; Parmalee and Bogan 1998, p. 108). The maximum length of females is about 1.8 in (4.5 cm) (Parmalee and Bogan 1998, p. 108). The shape of the shell is somewhat triangular (females), oblong, or ovate (males) with the valves solid, thick, and very inflated. The beaks are located somewhat anterior of the middle, swollen, turned forward and inward, and extended above the hingeline (Cummings and Mayer 1992, p. 162). Beak sculpture consists of three or four faint, double-looped bars (Cummings and Mayer 1992, p. 162; Parmalee and Bogan 1998, p. 108). The anterior end of the shell is rounded, and the posterior end is truncated, highly so in females. The posterior ridge is prominent, being high and rounded, while the posterior slope is widely flattened. The posterior ridge and slope in females is covered with fine ridges and grooves, and the posterioventral shell edge is finely toothed (Cummings and Mayer 1992, p. 162). When females are viewed from a dorsal or ventral perspective, the convergence of the two valves on the posterior slope is nearly straight due to being highly inflated. This gives the female snuffbox a unique broadly lanceolate or cordate perspective when viewed at the substrate and water column interface (Ortmann 1919, p. 329; van der Schalie 1932, p. 104). The ventral margin is slightly rounded in males and nearly straight in females. Females have recurved denticles on the posterior shell margin that aid in holding host fish (Barnhart 2008, p. 1). The periostracum (external shell surface) is generally smooth and yellowish or yellowish-green in young individuals, becoming darker with age. Green squarish, triangular, or chevron-shaped marks cover the umbone (the inflated area of the shell along the dorsal margin) but become poorly delineated stripes with age. Internally, the left valve has two high, thin, triangular, emarginate pseudocardinal teeth (the front tooth being thinner than the back tooth) and two short, strong, slightly curved, and finely striated lateral teeth. The right valve has a high, triangular pseudocardinal tooth with a single short, erect, and heavy lateral tooth. The interdentum (a flattened area between the pseudocardinal and lateral teeth) is absent, and the beak cavity is wide and deep. The color of the nacre is white, often with a silvery luster, and a gray-blue or gray-green tinge in the beak cavity. The soft anatomy was described by Oesch (1984, pp. 233–234), and Williams *et al.* (2008, p. 282). Key characters useful for distinguishing the snuffbox from other species include its unique color pattern, shape (especially in females), and high degree of inflation.

Taxonomy

The rayed bean is a member of the freshwater mussel family Unionidae and was originally described as *Unio fabalis* by Lea in 1831. The type locality is the Ohio River (Parmalee and Bogan 1998, p. 244), probably in the vicinity of Cincinnati, Ohio. Over the years, the rayed bean has been placed in the genera *Unio, Margarita, Margaron, Eurynia, Micromya,* and *Lemiox.* It was ultimately placed in the genus *Villosa* by Stein (1963, p. 19), where it remains today (Turgeon *et al.* 1998, p. 33). We recognize *Unio capillus, U. lapillus,* and *U. donacapsis* as synonyms of *Villosa fabalis.*

The snuffbox is a member of the freshwater mussel family Unionidae and was described as *Truncilla triqueter* (Rafinesque 1820, p. 300). The species name was later changed to *triquetra* (Simpson 1900, p. 517), from the Latin *triquetrous* meaning "having three acute angles," a reference to the general shape of the female. The type locality is the Falls of the Ohio (Ohio River, Louisville, Kentucky) (Parmalee and Bogan 1998, p. 108). The synonymy of the snuffbox was summarized by Johnson (1978, pp. 248–249), Parmalee and Bogan (1998, p. 108), and Roe (no date, p. 3). This species has also been considered a member of the genera *Unio, Dysnomia, Plagiola, Mya, Margarita, Margaron,* and *Epioblasma* at various times since its description. The monotypic subgenus *Truncillopsis* was created for this species (Ortmann and Walker 1922, p. 65). The genus *Epioblasma* was not in common usage until the 1970s (Stansbery 1973, p. 22; Stansbery 1976, p. 48; *contra* Johnson 1978, p. 248), where it currently remains (Turgeon *et al.* 1998, p. 34). *Unio triqueter, U. triangularis, U. triangularis longisculus, U. triangularis pergibosus, U. cuneatus,* and *U. formosus* are recognized as synonyms of *E. triquetra.* Tricorn pearly mussel is another common name for this species (Clarke 1981a, p. 354).

Life History

The general biology of the rayed bean and the snuffbox are similar to other bivalved mollusks belonging to the family Unionidae. Adults are suspension-feeders, spending their entire lives partially or completely buried within the substrate (Murray and Leonard 1962, p. 27). Adults feed on algae, bacteria, detritus, microscopic animals, and dissolved organic material (Silverman *et al.* 1997, p. 1859; Nichols and Garling 2000, p. 873; Christian *et al.* 2004, pp. 108–109; Strayer *et al.* 2004, pp. 430–431). Recent evidence suggests that adult mussels may also deposit-feed on particles in the sediment (Raikow and Hamilton 2001, p. 520). For their first several months, juvenile mussels employ foot (pedal) feeding, consuming settled algae and detritus (Yeager *et al.* 1994, p. 221). Unionids have an unusual mode of reproduction. Their life cycle includes a brief, obligatory parasitic stage on fish. Eggs develop into microscopic larvae called glochidia within special gill chambers of the female. The female expels the mature glochidia, which must attach to the gills or the fins of an appropriate fish host to complete development. Host fish specificity varies among unionids. Some species appear to use a single host, while others can transform on several host species. Following successful infestation, glochidia encyst (enclose in a cyst-like structure) and drop off as newly transformed juveniles. For further information on freshwater mussels, see Gordon and Layzer (1989, pp. 1–17).

Mussel biologists know relatively little about the specific life-history requirements of the rayed bean and the snuffbox. Most mussels, including the rayed bean and snuffbox, have separate sexes. The age at sexual maturity, which is unknown for the rayed bean and snuffbox, is highly variable among and within species (0–9 years) (Haag and Staton 2003, pp. 2122–2123), and may be sex dependent (Smith 1979, p. 382). Both species are thought to be long-term brooders; rayed bean females brood glochidia from May through October (Parmalee and Bogan 1998, p. 108; Ecological Specialists, Inc. (ESI) 2000, p. 5; Woolnough 2002, p. 23), and snuffbox brood glochidia from September to May (Ortmann 1912, p. 355; 1919, p. 327). The only published research identifies the Tippecanoe darter (*Etheostoma tippecanoe*) as a host fish for the rayed bean (White *et al.* 1996, p. 191). Other rayed bean hosts are thought to include the greenside darter (*E. blennioides*), rainbow darter (*E. caeruleum*), mottled sculpin (*Cottus bairdi*), and largemouth bass (*Micropterus salmoides*) (Woolnough 2002, p. 51). Based on inference of closely related species, additional hosts may be suitable, including other darter and sculpin species (Jones 2002, pers. comm.). Juvenile snuffbox have successfully transformed on logperch (*Percina caprodes*), blackside darter (*P. maculata*), rainbow darter, Iowa darter (*E. exile*), blackspotted topminnow (*Fundulus olivaceous*), mottled sculpin, banded sculpin (*C. carolinae*), Ozark sculpin (*C. hypselurus*), largemouth

bass, and brook stickleback (*Culaea inconstans*) in laboratory tests (Sherman 1994, p. 17; Yeager and Saylor 1995, p. 3; Hillegass and Hove 1997, p. 25; Barnhart *et al.* 1998, p. 34; Hove *et al.* 2000, p. 30; Sherman Mulcrone 2004, pp. 100–103).

Habitot Characteristics

The rayed bean is generally known from smaller, headwater creeks, but occurrence records exist from larger rivers (Cummings and Mayer 1992, p. 142; Parmalee and Bogan 1998, pp. 244). They are usually found in or near shoal or riffle areas, and in the shallow, wave-washed areas of glacial lakes, including Lake Erie (West *et al.* 2000, p. 253). In Lake Erie, the species is generally associated with islands in the western portion of the lake. Preferred substrates typically include gravel and sand. The rayed bean is oftentimes found among vegetation (water willow (*Justicio americano*) and water milfoil (Myriophyllum *sp.*)) in and adjacent to riffles and shoals (Watters 1988b, p. 15; West *et al.* 2000, p. 253). Specimens are typically buried among the roots of the vegetation (Parmalee and Bogan 1998, pp. 245). Adults and juveniles appear to produce byssal threads (thin, protein-based fibers) (Woolnough 2002, pp. 99–100), apparently to attach themselves to substrate particles.

The snuffbox is found in small to medium-sized creeks to larger rivers and in lakes (Cummings and Mayer 1992, p. 162; Parmalee and Bogan 1998, p. 108). The species occurs in swift currents of riffles and shoals and wave-washed shores of lakes over gravel and sand with occasional cobble and boulders. Individuals generally burrow deep into the substrate except when spawning or attempting to attract a host (Parmalee and Bogan 1998, p. 108).

Strayer (1999a, pp. 471–472) demonstrated in field trials that mussels in streams occur chiefly in flow refuges, or relatively stable areas that displayed little movement of particles during flood events. Flow refuges conceivably allow relatively immobile mussels to remain in the same general location throughout their entire lives. He thought that features commonly used in the past to explain the spatial patchiness of mussels (water depth, current speed, sediment grain size) were poor predictors of where mussels actually occur in streams.

Rayed Bean Historical Distribution

The rayed bean historically occurred in 112 streams, lakes, and some human-made canals in 10 States: Illinois, Indiana, Kentucky, Michigan, New York, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia; and Ontario, Canada. The mussel occurred in parts of the upper (Lake Michigan drainage) and lower Great Lakes systems, and throughout most of the Ohio and Tennessee River systems. During historical times, the rayed bean was fairly widespread and locally common in many Ohio River system streams based on collections made over a several-decade period. The species was once fairly common in the Belle, South Branch Thames, Detroit, Scioto, Wabash, and Duck Rivers; several tributaries in the Scioto system (Olentangy River, and Big Darby and Alum Creeks); and Tippecanoe Lake based on literature and museum records (Call 1900; Watters 1994, p. 105; West *et al.* 2000, p. 251; Badra 2002, pers. comm.). The rayed bean was last reported from some streams several decades ago (North Branch Clinton, Auglaize, Ohio, West Fork, Beaver, Shenango, Mahoning, Mohican, Scioto, Green, Barren, Salamonie, White, Big Blue, Tennessee, Holston, South Fork Holston, Nolichucky, Clinch, North Fork Clinch, and Powell Rivers; Wolf, Conewango, Oil, Crooked, Pymatuning, Mill, Alum, Whetstone, Deer, Lick, and Richland Creeks; and Buckeye, Tippecanoe, Winona, and Pike Lakes). The rayed bean population in Lake Erie was once considerable (Ohio State University Museum of Biological Diversity (OSUM) collections), but has been eliminated by the zebra mussel.

Rayed Bean Current Distribution

Extant populations of the rayed bean are known from 28 streams and 1 lake in six States and one Canadian province: Indiana (St. Joseph River (stream) (Fish Creek (tributary)), Tippecanoe River (Lake Maxinkuckee, Sugar Creek)), Michigan (Black River (Mill Creek), Pine River, Belle River, Clinton River), New York (Allegheny River (Olean Creek, Cassadaga Creek, French Creek)), Ohio (Swan Creek, Fish Creek, Blanchard River, Tymochtee Creek, Walhonding River, Mill Creek, Big Darby Creek, Scioto Brush Creek), (Great Miami River, Little Miami River (East Fork Little Miami River), Stillwater River), Pennsylvania (Allegheny River (French Creek (Cussewago Creek))), and West Virginia (Elk River); and Ontario, Canada (Sydenham River, Thames River).

Rayed Bean Population Estimates and Status

Based on historical and current data, the rayed bean has declined significantly rangewide and is now known from only 28 streams and 1 lake (down from 112), a 74 percent decline (Table 1). This species has also been eliminated from long reaches of former habitat in hundreds of miles of the Maumee, Ohio, Wabash, and Tennessee Rivers and from numerous stream reaches and their tributaries. In addition, this species is no longer known from the States of Illinois, Kentucky, Tennessee, and Virginia. The rayed bean was also extirpated in West Virginia until the 2006 reintroduction into the Elk River (Clayton 2007, pers. comm.).

In this proposed rule, mussel shell collection records have been classified according to the condition of shell material. Fresh dead (FD) shells still have flesh attached to the valves, they may or may not retain a luster to their nacre, and their periostracum is non-peeling, all indicating relatively recent death (generally less than 1 year) (Buchanan 1980, p. 4). Relic (R) shells have lost the luster to their nacre, have peeling or absent periostracum, may be brittle or worn, and likely have been dead more than a year (Buchanan 1980, pp. 4–5; Zanatta *et al.* 2002, p. 482). Generally, FD shells indicate the continued presence of the species at a site (Metcalf 1980, p. 4). The presence of R shells only, along with repeated failure to find live (L) animals or FD shells, likely signifies that a population is extirpated (Watters and Dunn 1993–94, pp. 253–254). Shells labeled R may originally have been reported by collectors as either weathered dead (or weathered dry) or subfossil. If no details on shell condition were provided for a record, the shell is simply referred to as dead. In this document, a population is considered viable if it is reproducing and has enough individuals to sustain the population at its current level for the foreseeable future.

TABLE 1—RAYED BEAN STATUS AT HISTORICAL LOCATIONS

River basin	Stream	Last observed (R = relic)	Current status	Comments
Upper Great Lakes Sub-basin.	Pigeon River	1996 (R)	Extirpated	
Lower Great Lakes Sub-basin.	Black River	2001	Unknown	Small and of questionable viability.
	Mill Creek	2002	Unknown	Unknown.
	Pine River	2002	Declining	Recruiting.
	Belle River	2003	Unknown	
	Clinton River	1992	Unknown	Recruiting.
	North Fork Clinton River	1933	Extirpated	
	Sydenham River (Canada)	2003	Stable	Recruiting.
	Thames River	2008	Unknown	Unknown.
	Detroit River	1983	Extirpated	
	Rouge River	<1914	Extirpated.	
	Huron River	1931–32	Extirpated.	
	Raisin River	1941	Extirpated.	
	Macon Creek	1976–78 (R)	Extirpated.	
	Maumee River	1913	Extirpated.	
	Swan Creek	2009	Stable	Recruiting.
	St. Joseph River	1998	Declining	Probably not recruiting.
	West Branch St. Joseph River	1997 (R)	Extirpated.	
	Fish Creek	2009	Declining	Unknown.
	Cedar Creek	1985	Extirpated.	
	Feeder Canal to St. Joseph River	1988 (R)	Extirpated.	
	Auglaize River	1964	Extirpated.	
	Ottawa River	1998 (R)	Extirpated.	
	Blanchard River	2009	Unknown	Recruiting.
	Sandusky River	1978	Extirpated.	
	Tymochtee Creek	1996	Unknown	Unknown.
	Wolf Creek	1971 (R)	Extirpated.	
	Lake Erie	1977–87	Extirpated.	
Ohio River system	Ohio River mainstem	<1960	Extirpated.	
	Allegheny River	2007	Stable	Recruiting.
	Chautauqua Lake outlet	<1919	Extirpated.	
	Chautauqua Lake	<1919	Extirpated.	
	Olean Creek	2000	Unknown	Recruiting.
	Cassadaga Creek	1994	Unknown	Recruiting.
	Conewango Creek	~1908	Extirpated.	
	Oil Creek	<1970	Extirpated.	
	French Creek	2005	Stable	Recruiting.
	Cussewago Creek	1991	Unknown.	
	Crooked Creek	~1908	Extirpated.	
	West Fork River	<1913	Extirpated.	
	Beaver River	~1910	Extirpated.	
	Shenango River	~1908	Extirpated.	
	Pymatuning Creek	~1908	Extirpated.	
	Mahoning River	<1921	Extirpated.	
	Middle Island Creek	1980 (R)	Extirpated.	
	Muskingum River	1980 (R)	Extirpated.	
	Tuscarawas River	?	Extirpated.	
	Walhonding River	1991–95	Declining	Probably not recruiting.
	Mohican River	1969	Extirpated.	
	Elk River	2008	Reintroduced in 2006.	
	Scioto River	1964	Extirpated.	
	Mill Creek	2007	Unknown.	
	Alum Creek	1970	Extirpated.	
	Blacklick Creek	?	Extirpated.	
	Olentangy River	1962	Extirpated.	
	Whetstone Creek	1961	Extirpated.	
	Big Walnut Creek	1961	Extirpated.	
	Walnut Creek	1994 (R)	Extirpated.	
	Big Darby Creek	2008	Declining	Unknown.
	Little Darby Creek	1990 (R) or 1986 (R)	Extirpated.	
	Deer Creek	1981	Extirpated.	
	Sugar Creek	<1900	Extirpated.	
	Scioto Brush Creek	1987	Unknown	Probably not recruiting.
	Cedar Creek	?	Extirpated.	
	Buckeye Lake	?	Extirpated.	
	Ohio and Erie Canal	?	Extirpated	
	Great Miami River	2009	Unknown	Unknown.
	Little Miami River	1990–91	Unknown	Probably not recruiting.
	East Fork Little Miami River	1990–91	Unknown.	

TABLE 1—RAYED BEAN STATUS AT HISTORICAL LOCATIONS—Continued

River basin	Stream	Last observed (R = relic)	Current status	Comments
	Stillwater River	1987	Unknown	Probably not recruiting.
	South Fork Licking River	1982 (R)	Extirpated.	
	North Fork Elkhorn Creek	1982 (R)	Extirpated.	
	Eagle Creek	1981 (R)	Extirpated.	
	Brashears Creek	1983 (R)	Extirpated.	
	Green River	1964	Extirpated.	
	Nolin River	1983 (R)	Extirpated.	
	Barren River	<1900, ?	Extirpated.	
	Wabash River	1962 (R)	Extirpated.	
	Salamonie River	1971	Extirpated.	
	Mississinewa River	1994 (R)	Extirpated.	
	Tippecanoe River	1995	Declining	Possibly recruiting.
	Tippecanoe Lake	<1920	Extirpated.	
	Winona Lake	1934	Extirpated.	
	Pike Lake	1906	Extirpated.	
	Lake Maxinkuckee	1997	Declining	Unknown.
	Vermilion River	1999 (R)	Extirpated.	
	Salt Fork Vermilion River	1956–57	Extirpated.	
	Middle Fork Vermilion River	1991	Extirpated.	
	North Fork Vermilion River	1995 (R)	Extirpated.	
	Embarras River	1956	Extirpated.	
	Sugar Creek	1998	Unknown	Unknown.
	White River	<1903	Extirpated.	
	West Fork White River	1989–91 (R)	Extirpated.	
	East Fork White River	?	Extirpated.	
	Big Blue River	1944	Extirpated.	
	Walnut Creek	1992 (R)	Extirpated.	
	Mill Creek	1992 (R)	Extirpated.	
	Fall Creek	?	Extirpated.	
	Sugar Creek	1950	Extirpated.	
Tennessee River system.	Tennessee River mainstem	<1939	Extirpated.	
	Holston River	1914–15	Extirpated.	
	North Fork Holston River	1913	Extirpated.	
	South Fork Holston River	1914	Extirpated.	
	Nolichucky River	1968	Extirpated.	
	Lick Creek	1967 (R)	Extirpated.	
	First Creek	?	Extirpated.	
	Clinch River	1965	Extirpated.	
	North Fork Clinch River	<1921	Extirpated.	
	Powell River	1913–15	Extirpated.	
	Elk River	1965	Extirpated.	
	Richland Creek	1892	Extirpated.	
	Duck River	1982	Extirpated.	

Upper Great Lakes Sub-Basin

The rayed bean was not known from the upper Great Lakes sub-basin until 1996, when relic specimens were documented from a tributary to the St. Joseph River, a tributary to Lake Michigan. No extant populations of the rayed bean are currently known from this system.

Lower Great Lakes Sub-Basin

Of the 112 water bodies from which the rayed bean was historically recorded, 27 are in the lower Great Lakes system. The species is thought to be extant in 12 streams, which are discussed below, but historically significant populations have been eliminated from Lake Erie and the Detroit River.

Black River—A tributary of the St. Clair River, linking Lakes Huron and St. Clair, the Black River is located in southeastern Michigan. Hoeh and Trdan (1985, p. 115) surveyed 17 sites in the Black River system, including 12 mainstem sites, but failed to find the rayed bean. The rayed bean was not discovered there until the summer of 2001 when a single live (L) individual was found in the lower river in the Port Huron State Game Area (PHSGA) (Badra 2002, pers. comm.). A survey in 2003 failed to find any rayed bean, and two surveys in 2005 found only two valves (Badra 2008, pers. comm.). An additional survey was performed in 2005 at six sites, but no rayed bean were found (Badra 2008, pers. comm.). The status of this population cannot be accurately assessed at this time, but would appear to be small and of questionable viability (Butler 2002, p. 8).

Mill Creek—Mill Creek is a tributary of the Black River, St. Clair County, in southeastern Michigan. The rayed bean was discovered in Mill Creek in August 2002. Five dead specimens were found approximately 0.5 miles (mi) (0.8 kilometers (km)) above its confluence with the Black River in the PHSGA (Badra 2002, pers. comm.). A Mill Creek site 0.25 mi (0.4 km) from the confluence of the Black River was surveyed in 2003 and 2004 with one rayed bean shell found during each survey (Badra 2008, pers. comm.). Similar to the population in the Black River, the status of this newly discovered population cannot be accurately assessed at this time.

Pine River—Another tributary of the St. Clair River, the Pine River is located in southeastern Michigan. The rayed bean was apparently not collected in the Pine River until 1982 when specimens were found at three sites (Hoeh and Trdan 1985, p. 116). These collections included 5 L individuals and 23 FD specimens (Badra 2002, pers. comm.). Hoeh and Trdan (1985, p. 116) considered it to be "rare," semi-quantitatively defined as occurring at a rate of less than one specimen per person-hour sampling effort. In 1997, two L individuals were found. The last survey in the Pine River occurred in 2002 (Badra 2008, pers. comm.), and one L rayed bean was documented (Badra and Goforth 2003, p. 6). The species may have declined significantly since the 1980s, but is probably still viable in the Pine River.

Belle River—The Belle River is a third tributary of the St. Clair River harboring an extant population of the rayed bean. This species was first collected from the Belle River in 1965, when 17 FD specimens were collected (OSUM 1965:0106). The same site was revisited in 1978, but only one FD shell is represented in OSUM 1978:0013. Since that time, L individuals or FD specimens have been found in 1983 and 1992, while only R shells were found in 1994 (Badra 2008, pers. comm.). During summer 2002 sampling, single L specimens were found at two new sites, with an additional four and two FD specimens, respectively, also found from these sites (Badra 2008, pers. comm.). The status of the population is still not well known, but appears to be small.

Clinton River—The rayed bean was first recorded from the Clinton River in 1933 (Badra 2008, pers. comm.). The mussel fauna in the entire mainstem of the Clinton River downstream of Pontiac, Michigan, was apparently wiped out by pollution between 1933 and 1977 (Strayer 1980, p. 147). In 1992, Trdan and Hoeh (1993, p. 102) found 26 L individuals using a suction dredge from a bridge site slated for widening where Strayer (1980, p. 146) found only R shells. The rayed bean represented 1.2 percent relative abundance of the 10 species collected at the site. The population is probably viable but currently restricted to about 3 mi (4.8 km) of stream in the western suburbs of Pontiac. Its long-term status appears to be highly precarious.

Sydenham River—The rayed bean in the Sydenham River represents one of the largest rayed bean populations remaining. West *et al.* (2000, pp. 252–253) presented a highly detailed collection history of the rayed bean in the Sydenham River. The rayed bean is currently thought to exist in an approximately 75-mi (120-km) reach of the middle Sydenham, from the general vicinity of Napier, Outario, downstream to Dawn Mills. The species appears to be most abundant in the lower half of this river reach. Although the range has remained relatively consistent over time, abundance data at repeatedly sampled sites from the 1960s to the late 1990s indicate a general decline of the rayed bean. Based on the range of sizes and roughly equal number of specimens in various size classes of the L and FD material they gathered, West *et al.* (2000, p. 256) considered the population to be "healthy" and "reproducing" (recruiting). Data from sampling in 2001 shows evidence of recruitment and variable size classes for both sexes from most of the sites (Woolnough 2002, p. 50). Based on this data, the rayed bean population in the Sydenham River is doing considerably better than West *et al.* (2000, pp. 252–253) suggested. Woolnough and Morris (2009, p. 19) estimates that there are 1.5 million mature rayed bean in the Sydenham River living in the 38-mile (61-km) stretch between Napier Road near Alvinston, Ontario, and Dawn Mills, Ontario.

Thames River—The Thames River flows west through southwestern Ontario. The rayed bean was historically known from only the south branch until 2008, when it was discovered in the north branch. In July 2008, six gravid (full of eggs) females were collected at two north branch sites (Woolnough 2008, pers. comm.). In September 2008, four L females and two L males were collected at two different north branch sites (Woolnough 2008, pers. comm.). All of these individuals were collected within a 4.5-mi (7.2-km) reach of the river (Woolnough 2008, pers. comm.). Woolnough and Morris (2009, p. 19) estimates that there are 4,300 mature rayed bean in the Thames River.

Maumee River System—The Maumee River system, which flows into the western end of Lake Erie, was once a major center of distribution of the rayed bean. The species was historically known from eight streams in the system in addition to the mainstem Maumee. Further, an additional population was discovered in the system in 2005 in Swan Creek.

Swan Creek—Swan Creek is a tributary of the lower Maumee River in northwestern Ohio. This population was discovered in 2005. Surveys conducted in 2006 and 2007 found that the Swan Creek population is limited to about 3 river mi (5 river km) between river mile (RM) 18.3 and 15.3 (Grabarkiewicz 2008, p. 11). The rayed bean was the fourth most abundant unionid present within the 2006–2008 sample area, reaching densities of eight individuals per square meter in some areas and comprising about 14.1 percent of the total mussel community (Grabarkiewicz 2008, p. 10). The rayed bean population in Swan Creek is viable and, although limited to a short reach, may be one of the most robust remaining populations.

St. Joseph River—The St. Joseph River is one of the two major headwater tributaries to the Maumee, with a drainage area in southeastern Michigan, northwestern Ohio, aud northeastern Indiana. The mainstem flows in a southwesterly direction to its confluence with the St. Mary's River to form the Maumee in Ft. Wayne, Indiana. The rayed bean was historically known from numerous sites on the river, but now apparently persists only at a couple of sites in the lower St. Joseph River iu Allen and DeKalb Counties, Indiana (Watters 1988b, p. 15; 1998, Appendix C); a few FD specimens were found in both studies, but no live individuals were found. Grabarkiewicz and Crail (2008, p. 13) surveyed six sites on the West Branch St. Joseph River in 2007, but did not encounter any rayed bean.

Fish Creek—A tributary of the St. Joseph River that begins in Ohio, Fish Creek flows west then south through Indiana, then eventually east into Ohio before joining the St. Joseph River at Edgerton. The rayed bean persists in Williams County, Ohio, and possibly DeKalb County, Indiana. Based on the appearance of 2 L individuals and FD shells, it inhabits the lower 10 mi (16.1 km) or less of the stream (Watters 1988b, p. 18; Grabarkiewicz 2009, pers. comm.). Watters (1988b, p. ii) considered Fish Creek to be "the most pristine tributary of the St. Joseph system." A major diesel fuel spill from a ruptured pipeline in DeKalb County in 1993 resulted in a mussel kill in the lower portion of the stream (Sparks *et al.* 1999, p. 12). It is not known if the rayed bean was affected by the spill. Surveys in 2004 (at 64 qualitative sites) aud 2005 (at 11 quantitative sites) failed to detect the species (Brady *et al.* 2004, p. 2; 2005, p. 3). However, Grabarkiewicz (2009, pers. comm.) reported finding two L and three FD rayed bean in 2005 at the County Road 3 bridge in Ohio. In 2009, two FD rayed bean were found in lower Fish Creek iu Ohio (personal observation). The viability and status of this population is uncertain (Fisher 2008, pers. comm.).

Blanchard River—The Blanchard River is a tributary of the Auglaize River in the Maumee River system, in northwestern Ohio. First discovered in

1946, this population is one of the largest of the rayed bean rangewide. The rayed bean in the Blanchard River is restricted to 25–30 river mi (40–48 river km) in the upper portion of the stream in Hardin and Hancock Counties upstream of Findley (Hoggarth *et al.* 2000, p. 22). Hoggarth *et al.* (2000, p. 23) reported the rayed bean to be the fourth most common species in the drainage. The population is considered to be viable.

Tymochtee Creek—Tymochtee Creek is a tributary to the upper Sandusky River in north-central Ohio, which flows into the southwestern portion of Lake Erie. The rayed bean is known from three sites in a reach of stream in Wyandot County and was first collected in 1970. All collections of the rayed bean have been small, with not more than five FD shells found in any one collection effort. The last record is for 1996, when a pair and three unpaired valves were collected. The condition of at least one of the valves indicated that the rayed bean is probably still extant in the stream, although no L individuals were observed (Athearn 2002, pers. comm.). The rayed bean status in Tymochtee Creek is therefore currently unknown.

Ohio River System

The rayed bean was historically known from the Ohio River in the vicinity of Cincinnati, Ohio, downstream to the Illinois portion of the river. It undoubtedly occurred elsewhere in the upper mainstem. Few historical records are known (mostly circa 1900), and no recent collections have been made, indicating that it became extirpated there decades ago. It was historically known from 71 streams, canals, and lakes in the system, representing roughly two-thirds of its total range. Ortmann (1925, p. 354) considered the rayed bean to be "abundant in small streams" in the Ohio River system. Currently, only 16 streams and a lake are thought to have extant rayed bean populations in the system.

Allegheny River System—Nine streams and Chautauqua Lake historically harbored rayed bean populations in the Allegheny River system. Currently, the rayed bean is found in half of these water bodies, but in good uumbers in two streams (Allegheny River and French Creek) in this drainage.

Allegheny River—The Allegheny River drains northwestern Pennsylvania and western New York joining the Monongahela River at Pittsburgh, Pennsylvania, to form the Ohio River. Ortmann (1909a, p. 179; 1919, p. 262) was the first to report the rayed bean from the Allegheny. The population once stretched from Cataraugus County, New York, to Armstrong County, Pennsylvania. Based on historical collections, it appears that the rayed hean is more abundant now than it was historically in the Allegheny River. This may indicate that the rayed bean population in the Allegheny has expanded in the past 100 years. Many streams in western Pennsylvania have improved water quality since Ortmann's time, when he reported on the wholesale destruction of mussels in several streams (Ortmann 1909b, pp. 11–12). It currently occurs in Pennsylvania downstream of Allegheny (Kinzua) Reservoir in Warren County to the pool of Lock and Dam 8 in northern Armstrong County, a distance of over 100 river mi (161 river km) (Villella Bumgardner 2008, pers. comm.). The Allegheny population is viable and one of the most important remaining rangewide today.

Olean Creek—Olean Creek is a tributary of the Allegheny River in western New York. A small population of the rayed hean is known from the lower portions of the stream. Strayer *et al.* (1991, p. 67) reported the rayed bean from three sites during 1987–90 sampling, although just one L individual was located with R shells from the other two sites. Only R shells were found in Olean Creek in 1994, but three L individuals were found in 2000, at the proposed construction site of the City of Olean Water Treatment Plant (ESI 2000, p. 8). Collected only during their quantitative sampling effort, the rayed bean represented a relative abundance of 11.5 percent of the seven L species sampled. The rayed bean age distribution of these specimens also indicates recent recruitment into the population (ESI 2000, p. 9). Relic specimens are now known from an 8-mi (13-km) reach of stream, with L individuals known from less than 1.5 mi (2.4 km) of the lower creek. The Olean Creek population appears viable, but is small and tenuous (Butler 2008, pers. comm.)

Cassadaga Creek—Cassadaga Creek is a tributary of Conewango Creek in the Allegheny River system, in western New York. A small population of the rayed bean is known from a single riffle (Ross Mills) in the lower creek north of Jamestown. Four L specimens were found in 1994 (Strayer 1995). Muskrat middens collected during the winter of 2002 produced 38 FD specimens with a size range of 0.8–1.7 in (2.0–4.3 cm) (Clapsadl 2002, pers. comm.). Although the rayed bean is not known from other sites in the stream, it appears to be viable at this site. The highly restricted extent of the population combined with its proximity to roads and retail development, including a gas station close to the flood zone upstream, makes it extremely susceptible to a stochastic event (such as a toxic chemical spill).

French Creek—French Creek is a major tributary of the middle Allegheny River, in western New York and northwestern Pennsylvania. One of the largest rayed bean populations known is found in much of the lower portions of the stream in four Pennsylvania counties (the species is not known from the New York portion of stream). Ortmann (1909a, p. 188; 1919, p. 264) reported the species from two counties, Crawford and Vanango. Not until circa 1970 did the population become more thoroughly known, with museum lot sizes indicating sizable populations at several sites, particularly in the lower reaches of the stream. Recent collections indicate that population levels remain high with the rayed bean occurring throughout the mainstem (Villella Bumgardner 2002, pers. comm.; Smith and Crabtree 2005, pp. 15–17; Enviroscience 2006, p. 5).

Cussewago Creek—Cussewago Creek is a tributary of lower French Creek, with its confluence at Meadville, Crawford County, Pennsylvania. A small population was reported in 1991 from Cussewago Creek (Proch 2001, pers. comm.). The rayed bean is thought to persist in the stream, but its current status is unknown.

Walhonding River—The Walhonding River is a tributary of the upper Muskiugum River system, in central Ohio, forming the latter River at its confluence with the Tuscarawas River at Coschocton. Small numbers of rayed bean shells are represented in OSUM collections from the 1960s and 1970s. During 1991–93, Hoggarth (1995–96, p. 161) discovered one L individual and one FD specimen at one site, while four R specimens were found at three other sites. A small rayed bean population is thought to remain in the Walhonding River; its status is unknown, but is deemed highly tenuous given the small population size. The population is probably nearing extirpation (Hoggarth 2008a, pers. comm.).

Elk River—The Elk River is a major 181-river-mi (291-river-km) tributary in the lower Kanawha River system draining central West Virginia and flowing west to the Kanawaha River at Charleston. The rayed bean was extirpated in the Elk River sometime in the 1990s. In 2006 and 2007, approximately 600 adults were reintroduced into the Elk River above Clendenin. In 2008, an effort was made to monitor the reintroduction. A 30-

minute search yielded two L individuals, but efforts were discontinued due to high water and excessive habitat disturbance caused by the search effort (Clayton 2008, pers. comm.). The translocated adults are thought to persist in the stream, but it is unknown if this new population is reproducing.

Scioto River system—The Scioto River system, in central and south-central Ohio, is a major northern tributary of the Ohio River. A historically large meta-population of the rayed bean occupied at least 11 streams, the Ohio and Erie Canal, and Buckeye Lake. Sizable populations were noted in at least the Olentangy River, and Alum and Big Darby Creeks, based on OSUM collections primarily from the 1960s. A series of system reservoirs mostly north of Columbus reduced habitat and contributed to the elimination of some populations in several streams (Alum, Big Walnut, and Deer Creeks; Olentangy and Scioto Rivers). The location of the Columbus Metropolitan Area in the heart of the watershed has also taken a major toll on the species. The historical Scioto rayed bean meta-population has since been decimated by anthropogenic factors. Currently, remnant populations are known only from Mill Creek, Big Darby Creek, and Scioto Brush Creek.

Mill Creek—Mill Creek is a tributary of the Scioto River in central Ohio that joins the Scioto River at the O'Shaughnessy Reservoir northwest of the City of Columbus. In 2004, seven FD specimens were found during a survey in the City of Marysville (Hoggarth 2005, p. 7). In 2007, Hoggarth (2007a, pp. 5–6) found two L rayed bean at the same site and one L individual at au additional site. No other information is available on the status of this population.

Big Darby Creek—Big Darby Creek is one of the major tributaries draining the northwestern portion of the Scioto River system in central Ohio. A sizable rayed bean population was noted in Big Darby Creek from OSUM collections primarily from the 1960s. Watters (1994, p. 105) reported finding a few FD specimens in 1986, but none in 1990, and indicated that the rayed bean was probably extirpated from Big Darby Creek. In 2006, one L individual was found at the U.S. Highway 42 bridge replacement project site (Hoggarth 2006, p. 6). This individual was relocated to a site upstream out of the impact zone of the bridge project, and nine additional L individuals were subsequently found at the relocation site (Hoggarth 2006, p. 6). In 2007, three L rayed bean were found at the relocation site (Hoggarth 2007b, p. 9). Hoggarth (2008b, pers. comm.) visited the same relocation site in 2008, and reported finding "numerous living specimens" of the rayed bean. The status of this population cannot be accurately assessed at this time, but would appear to be small and of questionable viability.

Scioto Brush Creek— Scioto Brush Creek is a small western tributary of the lower Scioto River in Scioto County, south-central Ohio. Watters (1988a, p. 45) discovered the rayed bean in this stream in 1987, reporting two FD and two R specimens from a site, and a R specimen from a second site among the 20 sites he collected. This population's current status is uncertain.

Great Miami River—The Great Miami River is a major northern tributary of the Ohio River in southwestern Ohio that originates from Indian Lake in west-central Ohio and flows into the Ohio River west of Cincinnati. The occurrence of the rayed bean in the Great Miami River was discovered in August 2009, during a mussel survey for a bridge project in Logan County, Ohio. Only one individual was documented, a male approximately 7 to 8 years of age (Hoggarth 2009, pers. comm.). The status of this newly discovered population is not known.

Little Miami River—The Little Miami River is a northern tributary of the Ohio River in southwestern Ohio, flowing into the latter at the eastern fringe of the Cincinnati metropolitan area. Hoggarth (1992, p. 248) surveyed over 100 sites in the entire system. He found one L individual at a site in Warren County and possibly a subfossil shell at another site, although there is contradictory data in his paper (Butler 2002, p. 17). The latter site may have been the same as that reported for a pre-1863 record (Hoggarth 1992, p. 265). The rayed bean appears to be very rare in the Little Miami, having been found extant at only 1 of 46 mainstem sites. Hoggarth (1992, p. 267) highlighted the "fragile nature" of the extant mussel community in the system, while noting that localized reaches of the Little Miami were "severely impacted." The species status in the river is uncertain, but apparently very tenuous and probably headed toward extirpation (Butler 2002, p. 17).

East Fork Little Miami River—The East Fork Little Miami River is an eastern tributary of the lower Little Miami River, with its confluence at the eastern fringe of the Cincinnati metropolitan area. According to OSUM records, eight FD specimens were reported from a site in eastern Clermont County in 1973. Hoggarth (1992, p. 265) reported one L, three FD, and one R rayed bean from three sites in a 7-river-mi (11-river-km) stretch of the stream in western Clermont and adjacent Brown County (including the 1973 site). Harsha Reservoir on the East Fork destroyed several miles of potential stream habitat for the rayed bean a few miles downstream of the extant population. The status of the rayed bean in the river is uncertain but probably of doubtful persistence (Butler 2002, p. 17).

Stillwater River—The Stillwater River is a western tributary of the middle Great Miami River in southwestern Ohio. The rayed bean is known from two specimens, one FD and one R, collected in 1987 at two sites spanning the Miami–Montgomery County line (OSUM records). Both sites occur in the footprint of Englewood Reservoir (constructed circa 1920), which serves as a retarding basin (a constructed empty lake used to absorb and contain flooding in periods of high rain) that is normally a free-flowing river except in times of flood, therefore continuing to provide riverine habitat that is normally destroyed by permanently impounded reservoirs. The rayed bean in the Stillwater River may be extant, but its status is currently unknown and considered highly imperiled.

Tippecanoe River—The Tippecanoe River is a large northern tributary of the middle Wabash River in north-central Indiana. The first records for the rayed bean date to circa 1900 (Daniels 1903, p. 646). Historically, this species was known from numerous sites in six counties in the Tippecanoe River. A total of 12 FD specimens from 5 of 30 sites were found when sampled in 1992. The rayed bean "is apparently on the decline" in the river (ESI 1993, p. 87). The Tippecanoe rayed bean population was thought to be recruiting by Fisher (2008, pers. comm.), but appears tenuous and its long-term viability is questionable.

Lake Maxinkuckee—Lake Maxinkuckee is a glacial lake in the headwaters of the Tippecanoe River in north-central Indiana. The rayed bean has been known from the lake for more than a century (Blatchley 1901). A 1997 OSUM record included seven FD specimens collected at its outlet to the Tippecanoe River. Fisher (2002, pers. comm.), who made the 1997 OSUM collection, noted that many native mussels had zebra mussels attached to their valves and were apparently contributing to their mortality. The status of the rayed bean in Lake Maxinkuckee is therefore highly tenuous, and its long-term persistence questionable.

Sugar Creek—Sugar Creek is a tributary of the East Fork White River, in the lower Wabash River system in south-central Indiana. A rayed bean population was first reported there in

1930. Harmon (1992, p. 33) sampled 27 mainstem and 16 tributary sites finding FD specimens at 3 mainstem sites and R specimens from 2 other sites. The sites with FD material were found in the lowermost 6 mi (9.7 km) of stream. The status and viability of this tenuous population is uncertain (Fisher 2008, pers. comm.).

Tennessee River System

Historically, the rayed bean was known from the Tennessee River and 12 of its tributary streams. Ortmann (1924, p. 55) reported that the rayed bean had a "rather irregular distribution"; however, museum lots show that it was fairly common in some streams (North Fork Clinch, Duck Rivers). The last L rayed bean records from the system, with the exception of the Duck River, were from the 1960s or earlier. The species held on in the Duck until the early 1980s. Recent intensive sampling in the Duck watershed has failed to locate even a R shell of the rayed bean (Ahlstedt *et al.* 2004, p. 29). Tributaries in this system have been extensively sampled over the past 25 years. It is highly probable that this species is extirpated from the entire Tennessee River system.

A project was initiated in 2008 to reintroduce rayed bean into the Duck River by translocating over 1,000 adults from the Allegheny River system. Although the rayed bean was extirpated from the Duck River about 25 years ago, major improvements in water quality and physical habitat conditions have occurred in the past 15 years. In response to these improvements, recruitment of nearly all extant mussel species has been documented and suggests that reintroduction of the rayed bean might be successful (Anderson 2008, pers. comm.). The reintroduction has not yet occurred.

The information presented in this document indicates that the rayed bean has experienced a significant reduction in range and most of its populations are disjunct, isolated, and with few exceptions, appear to be declining (West *et al.* 2000, p. 251). The extirpation of this species from over 80 streams and other water bodies within its historical range indicates that substantial population losses have occurred. Relatively few streams are thought to harbor sizable viable populations (Sydenham, Swan, Blanchard, and Allegheny Rivers, and French Creek). Small population size and restricted stream reaches of current occurrence are a real threat to the rayed bean due to the negative genetic aspects associated with small, geographically isolated populations. This can be especially true for a species, like rayed bean, that was historically widespread and had population connectivity among mainstem rivers and multiple tributaries. The current distribution, abundance, and trend information illustrates that the rayed bean is imperiled.

Snuffbox Historical Distribution

The snuffbox historically occurred in 208 streams and lakes in 18 States and 1 Canadian province: Alabama, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Mississippi, Missouri, New York, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin; and Ontario. The major watersheds of historical streams and lakes of occurrence include the upper Great Lakes sub-basin (Lake Michigan drainage), lower Great Lakes sub-basin (Lakes Huron, Erie, and Ontario drainages), upper Mississippi River sub-basin, lower Missouri River system, Ohio River system, Cumberland River system, Tennessee River system, lower Mississippi River sub-basin, and White River system.

Snuffbox Current Distribution

Extant populations of the snuffbox are known from 74 streams in 14 States and 1 Canadian province: Alabama (Tennessee River, Paint Rock River, and Elk River), Arkansas (Buffalo River, Spring River, and Strawberry River), Illinois (Kankakee River and Embarras River), Indiana (Pigeon River, Salamonie River, Tippecanoe River, Sugar Creek, Buck Creek, Muscatatuck River, and Graham Creek), Kentucky (Tygarts Creek, Kinniconick Creek, Licking River, Slate Creek, Middle Fork Kentucky River, Red Bird River, Red River, Rolling Fork Salt River, Green River, and Buck Creek), Michigan (Grand River, Maple River, Pine River, Belle River, Clinton River, Huron River, Davis Creek, South Ore Creek, and Portage River), Minnesota (St. Croix River), Missouri (Meramec River, Bourbeuse River, St. Francis River, and Black River), Ohio (Grand River, Ohio River, Muskingum River, Walhonding River, Killbuck Creek, Olentangy River, Big Darby Creek, Little Darby Creek, Salt Creek, Scioto Brush Creek, South Fork Scioto Brush Creek, Little Miami River, and Stillwater River), Pennsylvania (Allegheny River, French Creek, West Branch French Creek, Le Boeuf Creek, Muddy Creek, Conneaut Outlet, Little Mahoning Creek, Dunkard Creek, Shenango River, and Little Shenango River), Tennessee (Clinch River, Powell River, Elk River, and Duck River), Virginia (Clinch River and Powell River), West Virginia (Ohio River, Dunkard Creek, Middle Island Creek, North Fork Hughes River, and Elk River), Wisconsin (St. Croix River, Wolf River, Embarrass River, Little Wolf River, and Willow Creek), and Ontario (Ausable River and Sydenham River). It is probable that the species persists in some of the 134 streams or lakes where it is now considered extirpated (Butler 2007, p. 16); however, if extant, these populations are likely to be small and not viable.

Snuffbox Population Estimates and Status

Based on historical and current data, the snuffbox has declined significantly rangewide and is now known from only 74 streams (down from 208 historically), representing a 65 percent decline in occupied streams (Table 2). Since multiple streams may comprise a single snuffbox population (French Creek system), the actual number of extant populations is less than 74. Extant populations, with few exceptions, are highly fragmented and restricted to short reaches. Available records indicate that 24 of 74, or 33 percent, of streams considered to harbor extant populations of the snuffbox are represented by only one or two recent L or FD individuals (Embarrass, Little Wolf, Maple, Pigeon, Kankakee, Meramec, Ohio, Muskingum, Olentangy, Stillwater, Green, Powell, Duck, and Black Rivers; and Little Mahoning, Middle Island, Big Darby, Little Darby, Salt, South Fork Scioto Brush, Slate, and Buck (Indiana), Graham, Buck (Kentucky) Creeks.

Butler (2007, pp. 70–71) categorized the extant populations into three groups based on population size, general distribution, evidence of recent recruitment, and assessment of current viability. Stronghold populations were described as having sizable populations generally distributed over a significant and more or less contiguous length of stream (30 or more river mi (48 or more river km)), with ample evidence of recent recruitment, and currently considered viable. Significant populations were defined as small, generally restricted populations with limited recent recruitment and viability. Many significant populations are susceptible to extirpation, but this category has a broad range of quality. The third category, marginal populations, are defined as those which are very small and highly restricted with no evidence of recent recruitment, of questionable viability, and that may be on the verge of extirpation in the immediate future. Following this criteria, there are 6 stronghold populations, 23 significant populations,

and 45 marginal populations of snuffbox.

A population is considered extant if L individuals or FD specimens have been located since approximately 1985. A population is considered to be recruiting if there was recent (within approximately 10 years) evidence of subadults (generally, individuals less than or equal to 1.5 in (3.8 cm) long or less than or equal to 4 years).

TABLE 2—SNUFFBOX EXTANT STREAM POPULATION SUMMARY BY STREAM OF OCCURRENCE

Stream (state)	Last observed	Recruiting	Potential viability	Population size	Population trend	Status category
Wolf River (WI)	2006	Yes	High	Large	Declining	Stronghold.
Embarrass River (WI).	1995	?	?	Small	?	Marginal.
Little Wolf River (WI).	1999	?	?	Small	?	Marginal.
Willow Creek (WI)	2001	?	?	Small	?	Marginal.
Grand River (MI)	2002	Yes	High	Medium	?	Significant.
Maple River (MI)	2001	?	?	Small	?	Marginal.
Pine River (MI)	2002	?	Low	Small	Stable	Marginal.
Belle River (MI)	2002	Yes	High	Small	?	Significant.
Clinton River (MI)	2003	Yes	High	Large	Declining	Significant.
Huron River (MI)	2001	?	Low	Medium	?	Significant.
Davis Creek (MI)	2005	Yes	High	Medium	?	Significant.
South Ore Creek (MI).	1999	Yes	High	Small	?	Significant.
Portage River (MI)	1998	Yes	High	Medium	?	Significant.
Grand River (OH)	2006	Yes	High	Medium	?	Significant.
St. Croix River (MN and WI).	2004	Yes	High	Large	Declining	Significant.
Kankakee River (IL)	1991	?	?	Small	?	Marginal.
Meramec River (MO).	1997	?	?	Small	Declining	Marginal.
Bourbeuse River (MO).	2006	Yes	High	Large	Improving	Stronghold.
Ohio River (OH)	2001	?	Low	Small	?	Marginal.
Muskingum River (OH).	2005	?	?	Small	?	Marginal.
Walhonding River (OH).	1991	?	?	Small	Declining	Significant.
Killbuck Creek (OH)	2009	?	?	Small	Declining	Marginal.
Olentangy River (OH).	1989	?	?	Small	Declining	Marginal.
Big Darby Creek (OH).	2008	?	?	Small	Declining	Marginal.
Little Darby Creek (OH).	1999	?	?	Small	Declining	Marginal.
Salt Creek (OH)	1987	?	?	Small	?	Marginal.
Scioto Brush Creek (OH).	1987	?	?	Small	?	Marginal.
South Fork Scioto Brush Creek (OH).	1987	?	?	Small	?	Marginal.
Little Miami River (OH).	1991	?	?	Small	?	Marginal.
Stillwater River (OH).	1987	?	?	Small	?	Marginal.
Pigeon River (IN)	1998	?	?	Small	?	Marginal.
Salamonie River (IN).	2004	Yes	Low	Small	?	Significant.
Tippecanoe River (IN).	2003	?	?	Small	Declining	Marginal.
Embarras River (IL)	2008	Yes	Low	Small	Declining	Significant.
Sugar Creek (IN)	1990	?	?	Small	Declining	Marginal.
Buck Creek (IN)	1990	?	?	Small	?	Marginal.
Muscatatuck River (IN).	1988	?	?	Small	?	Marginal.
Graham Creek (IN)	1990	?	?	Small	Declining	Marginal.
St. Francis River (MO).	2006	Yes	High	Medium	Stable	Significant.
Black River (MO)	2002	Yes	Low	Small	?	Significant.
Tygarts Creek (KY)	1995	?	?	Small	Declining	Marginal.
Kinniconick Creek (KY).	2005	?	Low	Small	Declining	Marginal.
Licking River (KY)	2006	?	Low	Small	?	Marginal.
Slate Creek (KY)	1992	?	?	Small	Declining	Marginal.
Middle Fork Kentucky River (KY).	1997	?	?	Small	?	Marginal.

TABLE 2—SNUFFBOX EXTANT STREAM POPULATION SUMMARY BY STREAM OF OCCURRENCE—Continued

Stream (state)	Last observed	Recruiting	Potential viability	Population size	Population trend	Status category
Red Bird River (KY)	1995	?	?	Small	?	Marginal.
Red River (KY)	~2002	?	?	Small	?	Significant.
Rolling Fork Salt River (KY).	~2005	?	?	Small	?	Marginal.
Green River (KY)	1989	?	?	Small	Declining	Marginal.
Buck Creek (KY)	1987–90	?	?	Small	Declining	Marginal.
Clinch River (TN and VA).	2006	Yes	High	Large	Stable or Declining	Stronghold.
Powell River (TN and VA).	2008	?	?	Small	Declining	Marginal.
Tennessee River (AL).	2006	?	?	Small	?	Marginal.
Paint Rock River (AL).	2008	Yes	High	Large	Improving	Stronghold.
Elk River (TN and AL).	2007	Yes	Low	Small	Stable	Significant.
Duck River (TN)	2001	?	?	Small	?	Marginal.
Buffalo River (AR)	2006	?	?	Small	?	Marginal.
Spring River (AR)	2005	?	Low	Medium	?	Significant.
Strawberry River (AR).	1997	?	?	Small	?	Marginal.
Allegheny River (PA).	2001	?	?	Small	?	Marginal.
French Creek (PA)	2008	Yes	High	Large	Stable	Stronghold.
West Branch French Creek (PA).	2008	?	?	Small	?	Marginal.
Le Boeuf Creek (PA).	2006	Yes	Low	Small	?	Marginal.
Muddy Creek (PA)	2008	Yes	Low	Medium	?	Significant.
Conneaut Outlet (PA).	1997	?	?	Small	?	Marginal.
Little Mahoning Creek (PA).	1991	?	?	Small	?	Marginal.
Dunkard Creek (PA and WV).	2009	?	?	Small	Declining	Significant.
Shenango River (PA).	2002	?	?	Small	?	Marginal.
Little Shenango River (PA).	2002	?	?	Small	?	Significant.
Middle Island Creek (WV).	2001	?	?	Small	Declining	Marginal.
North Fork Hughes River (WV).	2001	?	Low	Small	Declining	Significant.
Elk River (WV)	2004	?	Low	Medium	Improving	Significant.
Ausable River (ON)	2006	Yes	High	Medium	Declining	Significant.
Sydenham River (ON).	2002	Yes	High	Large	?	Stronghold.

Upper Great Lakes Sub-Basin

The snuffbox was formerly known from 15 streams and lakes in the upper Great Lakes sub-basin. The Fox River system in Wisconsin, particularly its major tributary the Wolf River (and its tributaries), had a widespread and locally abundant population. The species is thought to be extant in seven sub-basin streams; however, all but the Wolf and Grand Rivers have populations that are considered marginal.

Wolf River—The Wolf River is the major tributary of the Fox River draining a large portion of northeastern Wisconsin and flowing southward to join the Fox River at Lake Butte Des Morts, near Oshkosh. Snuffbox records are known from Shawano, Waupaca, and Outagamie Counties. The snuffbox is known from a 30-river-mi (48-river-km) reach of the Wolf River (Butler 2007, p. 21). It is one of the few stronghold populations, but appears to exhibit a low level of recruitment. Only 4 of 257 individuals collected in the mid-1990s were less than 6 years old (Butler 2007, p. 21). A bridge replacement project on the south side of Shawano, scheduled to begin in 2010, may adversely impact the large snuffbox bed located just downstream (ESI 2006, p. 10). The zebra mussel occurs in this river, with a 0.7 percent infestation rate on unionids sampled in 2006 (ESI 2006, p. 6). This large population continues to be viable but appears to be in decline (Butler 2008, pers. comm.).

Embarrass River—A western tributary of the lower Wolf River, the Embarrass River parallels the western bank of the Wolf River before joining it at New London, Wisconsin. A population of the snuffbox is located in the headwaters below a small dam at Pella, Wisconsin. Records exist for three L individuals and two dead specimens during 1987–1988 and a single D specimen in 1995 (Butler 2007, p. 22). Its current status is unknown.

Little Wolf River—The Little Wolf River is a western tributary of the lower

Wolf River in Waupaca County, Wisconsin. The snuffbox is known from a single L individual collected in 1988 at RM 14 below the Mill Pond dam at Manawa (Butler 2007, p. 22). Five D specimens were found during 1999 at RM 2, where shells were abundant in a muskrat midden (Butler 2007, p. 22). Nothing else is known regarding this population.

Willow Creek—Willow Creek flows eastward into Lake Poygan, a large flow-through lake of the Wolf River system, in Waushara County, Wisconsin. The snuffbox is known from a single observation of two L females in 2001 (Butler 2007, p. 22). No other information is available on the status of this population.

Grand River—The Grand River, a major Lake Michigan tributary, represeuts the largest lotic (moving water) watershed in Michigan and is located in the southwestern portion of the State. The snuffbox is sporadically distributed in approximately 25 river mi (40 river km) of the middle Grand River, approximately between the confluences of the Flat and Maple Rivers. The medium-sized population appears to have a low level of viability, with recruitment noted in 1999 (Badra 2008, pers. comm.).

Maple River—The Maple River is a northeastern tributary of the Grand River draining south-central Michigan. A single snuffbox record (one L individual) is known from 2001 in southern Gratiot County, approximately 20 river mi (32 river km) upstream of the Grand River (Badra 2008, pers. comm.). Portions of the Maple River and several tributaries have been channelized, but the suitability of these channelized areas for the snuffbox is unknown (Badra 2010, pers. comm.). The current status of this small population is unknown.

Pigeon River—The Pigeon River is a headwater tributary of the St. Joseph River system of Lake Michigan, flowing westward across northern-most Indiana, crossing the State border to its confluence in southwestern Michigan. One very large FD specimen was fouud in 1998, among thousands of shells in LaGrange County, Indiana (Butler 2007, p. 24). The same site was sampled in 1996 without evidence of this species, and R shells were found at three of nine sites sampled in 2004 (Butler 2007, p. 24). The snuffbox occupied reach historically covered more than 10 river mi (16.1 river km) in north-central LaGrange County. The species is very rare in this river, and its viability is unknown.

Lower Great Lakes Sub-Basin

Of all the water bodies from which the snuffbox was historically recorded, 32 are in the lower Great Lakes sub-basin, including several chains-of-lakes, springs, and channels in some systems (Clinton, Huron Rivers). Historically sizable populations occurred in some streams (Lake Erie; Belle, Clinton, Huron, Portage, and Niagara Rivers), but the species had become "characteristically uncommon" by the 1970s (Strayer 1980, p. 147). A pre-zebra mussel decline of unionids in Lake Erie was noted (Mackie *et al.* 1980, p. 101), and the snuffbox appeared extirpated there by the late 1960s. The Lake St. Clair population of snuffbox persisted until around 1983 (Nalepa and Gauvin 1988, p. 414; Nalepa 1994, p. 2231; Nalepa *et al.* 1996, p. 361), which was the year the zebra mussel is thought to have invaded (Schloesser *et al.* 1998, p. 70). Observations of L and FD snuffbox from the Detroit River were made until 1994, but the mussel fauna has since been devastated by zebra mussels, and the snuffbox is now considered to be extirpated (Schloesser *et al.* 1998 p. 69; Butler 2007, p. 25). Other snuffbox populations in the sub-basin may also have suffered from zebra mussel invasions, but not those in the Ausable and Sydenham Rivers in Ontario. The lack of impounded area on these streams has likely prevented the introduction or the establishment of zebra mussels (Ausable River Recovery Team 2005, p. 12; Dextrase *et al.* 2000, p. 10). The snuffbox is considered extant in 10 streams of the lower Great Lakes sub-basin, including a stronghold population in the Sydenham River and sizable but reach-limited populations in the Clinton River and Davis Creek. A single FD valve was reported in 1998 from among 24 sites sampled in the Thames River, but no evidence of the snuffbox was found at 16 Thames sites in 2004 (McGoldrick 2005, pers. comm.). Currently, the species is considered extant in Canada only in the Ausable and Sydenham Rivers (Morris and Burridge 2006, p. 9). Both of these populations are viable.

Ausable River—The Ausable River is a southeastern tributary of Lake Huron, draining southwestern Ontario, Canada. A survey conducted in 2006 found that a sizable population of snuffbox occurs in the lower portion of the stream in over 23 river mi (37 river km) (McGoldrick 2007, pers. comm.). The size range of individuals found in the 2006 survey indicates recent recruitment in the viable population (McGoldrick 2007, pers. comm.; Staton 2007, pers. comm.).

Pine River—A tributary of the St. Clair River, the Pine River flows south and is located in St. Clair County, in southeastern Michigan. Although apparently stable, the snuffbox population is small, very restricted in range, and has a low potential for viability (Badra 2002, pers. comm.; Badra and Goforth 2003, p. 23).

Belle River—The Belle River is another tributary of the St. Clair River in St. Clair County, flowing in a southeasterly direction. Records for the snuffbox date to the early 1960s, but all L and FD records over the past 40 years have been from the same lower mainstem site. Historically, a sizable population was found in the Belle (65 specimens, 1965). The Belle is located in a primarily agricultural watershed (Hoeh and Trdan 1985, p. 115), and is impacted by sedimentation and runoff. The population has declined to the point of being small, but shows evidence of recruitment and viability (Badra 2002, pers. comm.; Badra and Goforth 2003, p. 24; Sherman 2005, pers. comm.).

Clinton River—The Clinton River is an eastward flowing chain-of-lakes tributary of Lake St. Clair in southeastern Michigan. The snuffbox population in the Clinton River is limited to around 10 river mi (16.2 river km) and lakeshore in the western suburbs of Pontiac primarily between Cass and Loon Lakes. This population appears to be recruiting (Sherman Mulcrone 2004, p. 64) and viable, although apparently in decline since the early 1990s (Badra 2002, pers. comm.; Butler 2007, p. 27).

Sydenham River—The Sydenham River is a large, southeasterly flowing, eastern tributary of Lake St. Clair in extreme southwestern Ontario. The snuffbox was reported in the mid-1960s and early 1970s but was overlooked during surveys in 1985 (except D shells) and 1991 (Butler 2007, p. 28). During the 1997–99 sampling, a total of 10 L and FD individuals were found from 4 of 12 sites, including the 3 1960s sites (Metcalfe-Smith *et al.* 2003, p. 41). The suuffbox was recorded at a rate of 0.22 per hour of effort during 1997–98 (Metcalfe-Smith *et al.* 2000, p. 728). More recent sampling found 57 L and FD individuals from 21 collection events (some individuals may have been counted multiple times) at six sites during 2000–02. The increase in numbers relative to historical collections may be attributed to more intensive sampling methods rather than to improving population size (Metcalfe-Smith *et al.* 2003, p. 46), thus making population trend assessments difficult (Morris and Burridge 2006, p. 12). This

stronghold population is recruiting (Butler 2007, p. 28), viable, and is currently known from approximately 30 river miles (48 km) of the middle Sydenham.

Huron River—The Huron River is a major tributary of western Lake Erie draining a significant portion of southeastern Michigan. It is a complex system of flow-through chains-of-lakes and tributaries. The snuffbox is considered extant in two disjunct upper mainstem reaches. Individuals in the middle Huron River reach and in Davis Creek are considered a single population segment (Marangelo 2005a, pers. comm.).

Zebra mussels invaded the Huron River system in the early 1990s. Zebra mussel densities on individual mussels increased from less than 1 in spring 1995 to 245 in winter 1998 (Nichols *et al.* 2000, p. 72). Despite the increasing presence of zebra mussels, the Huron population is probably recruiting and viable (Butler 2007, p. 29).

Davis Creek—Davis Creek is a chain-of-lakes in the upper Huron River system, primarily in southeastern Livingston County, Michigan. The snuffbox appears to be limited to the lower 3 river mi (4.8 river km), comprising a single population with one of the extant Huron River population segments in this area. This viable population appears to be sizable and is experiencing recent recruitment (Marangelo 2005a, pers. comm.; Zanatta 2005, pers. comm.).

South Ore Creek—South Ore Creek is a northern tributary of the Huron River, forming a southward flowing chain-of-lakes draining southeastern Livingston County, Michigan. The snuffbox was discovered in 1999, just upstream of Ore Lake, which is near the Huron River confluence (Butler 2007, p. 31). Three subadult snuffbox (two age 2, one age 3–4) were recorded. Despite the lack of additional information, the small population appears to be viable based on recent recruitment.

Portage River—The Portage River is a chain-of-lakes in the northwestern portion of the Huron River system. Two University of Michigan Museum of Zoology (UMMZ) records suggest historical abundance (Badra 2002, pers. comm.). The species was reported as "rare" in the lower river during 1976–78 (Strayer 1979, p. 94). At least 22 L, young (age 4 and younger) individuals were identified in 1998 at one of three sites upstream of Little Portage Lake and Portage Lake (Butler 2007, p. 31). The localized population appears to be medium-sized and viable.

Grand River—The Grand River is a 99-river-mi (159-river-km) tributary of Lake Erie, flowing north then west to its confluence northeast of Cleveland, Ohio. Several museum snuffbox records date back to the 1800s. Dozens of FD snuffbox were found washed up ou the banks in the vicinity of the Interstate 90 crossing in Lake County, Ohio, following a major flood in 2006 (Butler 2007, p. 32). The species is known from approximately 12 river mi (19.3 river km) downstream of Harpersfield Dam (Huehner *et al.* 2005, p. 59; Zimmerman 2008a, pers. comm.). The sizable population was considered recruiting based on the 1995 Huehner *et al.* (2005, p. 59) survey.

Upper Mississippi River Sub-basin

The snuffbox was historically known from 17 streams in the upper Mississippi River sub-basin. Records exist for Mississippi River Pools (MRPs) 3–4, 5a–6, and 14–16 (Kelner no date, p. 6), with early surveys summarized by van der Schalie and van der Schalie (1950, p. 456). The species was reported L in the upper river in the 1920s (Grier 1922, p. 15; Grier 1926, p. 119) but not from subsequent surveys (254 sites upstream of the Ohio River during 1930–1931 (UMMZ, Ellis 1931, pp. 1–10), MRPs 5–7 and 9 in 1965 (Finke 1966, Table 2; Thiel 1981, p. 16), MRPs 3–11 during 1977–79 (Thiel 1981, p. 16)) and is now extirpated from the mainstem of the Mississippi River (Havlik and Sauer 2000, p. 4). Only 4 of 17 historical populations remain, but they include two of the largest rangewide (St. Croix and Bourbeuse Rivers). Three populations, including the St. Croix, appear to be declining.

St. Croix River—The St. Croix River is a major south-flowing tributary of the upper Mississippi River and forms the border between southeastern Minnesota and northwestern Wisconsin. Densities of juvenile snuffbox declined at eight sites between 1992 and 2002 (Hornbach *et al.* 2003, p. 344). Snuffbox density at Interstate Park declined significantly between 1988 and 2004 (WIDNR 2004). A flood in 2001 may have contributed to these declines in mussel density, but post-flood recruitment was also surprisingly low (WIDNR 2004). The St. Croix snuffbox population occurs from the Northern States Power Dam (NSPD) at RM 54.2 to RM 36.8 (Heath 2005, pers. comm.), represents the species' northernmost occurrence, and despite recent observed declines, remains one of the six stronghold populations rangewide.

Kankakee River—The Kankakee River is a major, westward-flowing, upper Illinois River tributary with its headwaters in northwest Indiana and northeast Illinois. The snuffbox was reported over a century ago (Baker 1906, p. 63), but surveys in 1911 (43 sites; Wilson and Clark 1913, pp. 41–50), 1978 (13 sites; Suloway 1981, p. 236), 1975–2000 (18 samples from an unknown number of Will County, Illinois, sites; Sietmau *et al.* 2001, p. 279), and 1999 (4 sites, Stinson *et al.* 2000, Appendix C) failed to find it. It was considered extirpated from the Kankakee by Cummings *et al.* (1988, p. 16), but single FD specimens in Illinois (Will County in 1988, Kankakee County in 1991) were subsequently found. Only R shells have been found since 1991. The Kankakee River population, if extant, appears small, localized, aud of doubtful viability.

Meramec River—The Meramec River is a 236-mi (380-km) tributary that flows northeasterly into the Mississippi River downstream of St. Louis and drains the northeastern slope of the Ozark Plateaus in east-central Missouri. Early species lists failed to report the snuffbox (Grier 1916, p. 518; Utterback 1917, p. 28). Buchanan (1980, p. 63) found FD specimens at three sites and R shells at two other sites sampled in 1977–78. Roberts and Bruenderman (2000, p. 85) sampled 42 sites in 1997, including 26 of Buchanan's (1980, p. 5) sites, and found FD specimens at RM 33.5, 48.8, and 59.8; and one L individual at RM 39.8. The L individual (2.4 in (6.1 cm), approximately 6 years old) was reported from a reach where a die-off, perhaps attributable to disease, was reported in 1978 (Buchanan 1986, p. 44). There was an obvious decline of mussels in the system based on catch-per-unit-effort data over the 20-year period (Roberts and Bruenderman 2000, p. 8). The Meramec snuffbox population is rare, sporadically distributed over approximately 26 river mi (41.8 river km), and of unknown viability.

Bourbeuse River—The Bourbeuse River is a 149-mi (240-km), northeasterly flowing, northern tributary of the Meramec River, joining it at RM 68. The snuffbox is currently distributed over about 60 river mi (96.6 river km) upstream of RM 16, plus a disjunct site at the mouth of the river. Although it was considered to have "greatly declined" by the late 1990s (Roberts and Bruenderman 2000, p. 15), post-2000 sampling indicates that the population is recruiting, viable, and improving (McMurray 2006, pers. comm.). The Bourbeuse, one of the few stronghold snuffbox populations rangewide, has been augmented with laboratory propagated juveniles since 2002 (McMurray 2006, pers. comm.).

Lower Missouri River System

The snuffbox was historically known from four streams in this system. The highly disjunct occurrences suggest that it was more widespread historically. All populations in the system are considered extirpated (Butler 2007, p. 36).

Ohio River System

Half of the water body occurrences for the snuffbox rangewide are known from the Ohio River system, which collectively represented the largest block of available habitat for this species. Sizable populations historically occurred in at least a dozen streams in the system. Today, only French Creek is considered to have a stronghold population, although nine others are also significant. Currently, the species is known from 40 of the 107 streams of historical occurrence.

Ohio River—The Ohio River is the largest eastern tributary of the Mississippi, with its confluence marking the divide between the upper and lower portions of the latter system. Numerous historical records are known from throughout the River. Recently, single FD and L specimens have been reported from just below Belleville Lock and Dam, Ohio and West Virginia, in 1995 and 2001, respectively (ESI 2002, p. 27). Having persisted in this highly modified river may indicate that the small population exhibits a low level of viability.

Allegheny River—The 325-mi (523-km) Allegheny River drains northwestern Pennsylvania and a small portion of adjacent New York flowing south before joining the Monongahela River at Pittsburgh to form the Ohio River. Snuffbox collections are sporadically known since around 1900 in Pennsylvania from Forest County downstream to Armstrong County. The snuffbox is currently known from three disjunct sites over a 42-river-mi (67.6-river-km) reach centered in Venango County (Butler 2007, p. 37). Its occurrence in the lower Allegheny River and lower French Creek could be considered a single population segment. The viability status of the small population is unknown.

French Creek—French Creek is a major tributary of the middle Allegheny River with its headwaters in western New York and flowing south into northwestern Pennsylvania. The snuffbox is known from the length of the stream in Pennsylvania in Erie, Crawford, Mercer, and Venango Counties. Most records date since approximately 1970 (Dennis 1971, p. 97). Snuffbox collections made during 2002–2004 were summarized by Smith (2005, pp. 3–9). Live and FD specimens were found at 19 sites throughout the stream. The size of the L individuals indicated that multiple year classes were represented, including subadults. The species stretches for approximately 80 river mi (128.7 river km) from around RM 10, upstream. The population encompasses several of its tributary population segments as well, making it relatively more secure when compared to most of the other stronghold populations that are linearly distributed and, thus, more susceptible to stochastic events (Sydenham, Bourbeuse, and Clinch Rivers). The French Creek snuffbox population is considered large and viable (Evans 2003a, pers. comm.; Zimmerman 2008c, pers. comm.), appears stable, and may represent the best stronghold population rangewide.

West Branch French Creek—West Branch of French Creek follows a southerly course to its parent stream in Erie County, Pennsylvania. The only record for the snuffbox dates from 1993, but the number of specimens and shell condition are unknown (Evans 2003b, pers. comm.). Union City Lake isolates the upper French Creek and West Branch French Creek population segment from the main French Creek population. The snuffbox was not found at three sites sampled in 2006 (Smith 2006, pers. comm.). Zimmerman (2008c, pers. comm.) documented 38 L individuals at a site near Wattsburg, Pennsylvania. This population appears to be small and of unknown viability.

Le Boeuf Creek—Le Boeuf Creek is a small western tributary of upper French Creek flowing in a southerly direction just west of West Branch French Creek in Erie County. The first snuffbox collections in this creek were made 100 years ago (Ortmann 1909a, p. 188). Two FD and 6 R shells were reported in 1988 (Evans 2003b, pers. comm.), and 1 L, 16 FD, and 8 R specimens were found in 1991 (Butler 2007, p. 40). Three L individuals were found at a site in 2006 (Smith 2006, pers. comm.). The snuffbox population has recently recruited and exhibits some level of viability, but appears to be very limited in extent.

Muddy Creek—Muddy Creek is an eastern tributary of upper French Creek in Crawford County, Pennsylvania. The snuffbox was not discovered until the summer of 2003. Forty-two L individuals were reported from 11 of 20 lower river sites (Morrison 2005, pers. comm.). Low numbers were found at most sites, but 18 L individuals were collected from a site near the mouth. This occurrence is considered to be part of the more extensive French Creek snuffbox population. Zimmerman (2008c, pers. comm.) documented one L female in 2008. The population is medium-sized, occurs along 8 river mi (12.9 river km) of the lower mainstem, and is recruiting, as recent juveniles were recorded (Morrison 2005, pers. comm.).

Conneaut Outlet—This stream forms the outlet to Conneaut Lake, flowing in a southeasterly direction until its confluence with middle French Creek, Crawford County. The snuffbox was first reported by Ortmann (1909a, p. 188), and was rediscovered L in 1997, but without collection details (Butler 2007, p. 40). No specimens were found at a site sampled in 2006 (Smith 2006, pers. comm.). The snuffbox is considered rare in this stream and its viability is unknown.

Little Mahoning Creek—Little Mahoning Creek is a tributary of Mahoning Creek, a lower eastern tributary of the Allegheny River northeast of Pittsburgh. The snuffbox was discovered in 1991, when sampling produced two FD and one R specimen at 1 of 12 sites in the system (Butler 2007, p. 41). The lower 10 miles of Little Mahoning Creek is subject to periodic inundation by a reservoir on Mahoning Creek (Butler 2010, pers. comm.). However, the impact of this periodic flooding on the snuffbox is not known. Viability is unknown.

Dunkard Creek—Dunkard Creek is an easterly flowing, western tributary of the middle Monongahela River, straddling the Pennsylvania and West Virginia State lines. Snuffbox records occur in both States from several museum collections from 1969–74. Small numbers of specimens, of undocumented condition, were found at four sites during 1993–94 sampling in Pennsylvania (Bogan 1993, p. 8; Evans 2003b, pers. comm.). Eight specimens, of undocumented condition, were collected at a West Virginia site in 1997. On September 1, 2009, a fish kill was reported in Dunkard Creek due to an unknown cause (Clayton 2009, pers. comm.). The Upper Monongahela River Association (2009) reported that 161 aquatic species including fish, mussels, and plants died along Dunkard Creek due to this toxic event. According to Clayton (2009, pers. comm.), the event may have killed 100 percent of the mussel fauna in the entire stream. The status of this population is not known at this time, but the snuffbox may now be extirpated from Dunkard Creek.

Shenango River—The Shenango River is a large tributary in the Beaver River system, a northern tributary of the upper Ohio River in west-central Pennsylvania. The snuffbox was

reported from four sites on the Shenango in 1908 (Ortmann 1919, p. 328). Six L individuals were collected from three sites sampled in 2001–02 between Jamestown and New Hamburg (about 25 river mi (40.2 river km)). The upper reach is considered the best habitat in the Shenango River. The population is small and has declined, although some recent reproduction is evident (Zimmerman 2008b, pers. comm.).

Little Shenango River—The Little Shenango River is a small tributary of the upper Shenango River, Mercer County, Pennsylvania. This population was not located during limited surveys (Dennis 1971, p. 97; Bursey 1987, p. 42), but a single FD museum record from 1991 exists. The species was reported to be relatively abundant and reproducing in the lower portion in 2002 (Zimmerman 2008b, pers. comm.). Viability of the small population is unknown.

Middle Island Creek—Middle Island Creek is a small tributary of the Ohio River in northwestern West Virginia. The first snuffbox records were made at six sites in 1969, when the species was locally common in Doddridge, Tyler, and Pleasants Counties (Taylor and Spurlock 1981, p. 157). The snuffbox was later found at two sites in Tyler County in 1980, and the overall mussel population was considered to be "thriving" (Taylor and Spurlock 1981, p. 157). The most recent record was for a single L individual collected in Tyler County in 2001 (Zimmerman 2008b, pers. comm.). This snuffbox population has declined, is currently rare, and its viability is questionable (Zimmerman 2008b, pers. comm.).

Muskingum River—The Muskingum River is a large, southerly flowing, northern tributary of the upper Ohio River draiuing a significant portion of east-central Ohio. The snuffbox, which has a long collection history dating to the early 1800s, occurred along the entire mainstem and was locally abundant. Two L individuals and two FD shells were found in 1979, but no L or FD snuffbox were found in surveys conducted in 1979–81 (Stansbery and King 1983) and in 1992–93 (Watters and Dunn 1993–94, p. 241). A single L specimen was located during sampling for a construction project iu 2005 near Dresden (Taylor 2006, pers. comm.). Viability of this population is unknown.

Walhonding River—The Walhonding River is a short (23.3 river mi (37.5 river km)), east flowing tributary of the Muskingum River in central Ohio, forming the latter river at its confluence with the Tuscarawas River, and formed by the confluence of the Mohican and Kokosing Rivers. The snuffbox historically occurred throughout the river. The extant snuffbox reach (RM 1.8–6.8) is downstream from Killbuck Creek. The population had apparently declined in range and size by the early 1990s and possibly further since. A once productive site about 0.25 mi (0.40 km) downstream of the Killbuck Creek confluence yielded only a few mussels of very common species in 2006, but no snuffbox (Butler 2007, p. 44). The Walhonding River population is considered small and of unknown viability.

Killbuck Creek—Killbuck Creek is a large tributary of the lower Walhonding River, flowing south from southern Medina County to Coshocton County and entering the latter at approximately RM 7. Live and FD snuffbox were found by Hoggarth (1997, p. 33) at eight sites from RM 15 to the mouth. Its occurrence has become more sporadic in the last 10 years. In spring 2006, 4 L adults were found at 2 sites approximately 3 river mi (4.8 river km) apart, while 9 large L individuals and a single FD specimen were collected near RM 13 during fall 2006 (Ahlstedt 2007, pers. comm.; Butler 2007, p. 45). A shrinking distribution, declining population size, and lack of evidence of recent recruitment suggest that the population may be losing viability and trending towards extirpation.

North Fork Hughes River—The North Fork Hughes River is a westerly flowing tributary of the Hughes River in the lower Little Kanawha River system in northwestern West Virginia. The snuffbox was found at one of six North Fork sites sampled during a 1981–82 survey of the Little Kanawha River system (Schmidt *et al.* 1983). A total of 41 L adult individuals (23 reported as gravid) were reported at 5 sites located over a 1.5-mi (2.4-km) reach in North Fork State Park, Richie County, in 1993 (Butler 2007, p. 46). At least 10 L individuals were found at a site in the park in 1997 (Butler 2007, p. 46), and a single FD specimen was collected at an additional site downstream in 2001 (Butler 2007, p. 46). This small snuffbox population is declining and currently restricted to less than 4 river mi (6.4 river km), but may be viable.

Elk River—The Elk River is a major, 181-mi (291-km) tributary in the lower Kanawha River system draining central West Virginia flowing west to the Kanawha at Charleston. The snuffbox went undetected in a 1920s survey (Butler 2007, p. 46). Ten L individuals were collected during 1991–1995, the smallest being about 5 years old (Butler 2007, pp. 46–47). Collectively, 16 L individuals were identified at 8 sites in a 13-river-mi (20.9-river-km) reach in Kanawha County in 2002, and 4 L individuals were found at 4 sites in 2004 over a 16.8-river-mi (27-river-km) reach further upstream (Douglas 2005, pers. comm.). This medium-sized population extends over 30 river mi (48.3 river km), is viable, and may have improved since the 1970s.

Tygarts Creek—Tygarts Creek is a small, north-flowing, southern tributary of the Ohio River in northeastern Kentucky. Thirteen snuffbox were reported from one of five sites sampled in 1977 (Taylor 1980, p. 90). FD specimens are also known from 1981 and 1987 (Cicerello 2003, pers. comm.). Nine L (Butler 2007, p. 47) and 36 FD specimens were found at 2 sites, respectively, in 1988, while 1 L and 2 FD were reported from at least 2 sites in 1995 (Cicerello 2003, pers. comm.). The overall mussel population appeared "healthy" in 1977 (Taylor 1980), but the small snuffbox population has recently declined, and its viability is unknown.

Scioto River System—The Scioto River system in central and south-central Ohio is a major northern tributary of the upper Ohio River. The system was one of the most routinely sampled watersheds for mussels (mostly OSUM records), and historically harbored a large and thoroughly dispersed snuffbox population in the mainstem and 16 tributaries. The system was either exceptional for its snuffbox population, or it provided a general historical perspective of what researchers may have found if other systems had been as thoroughly sampled. Sizable populations were noted in at least the Olentangy River, Big Darby Creek, and Big Walnut Creek. Development associated with the Columbus metropolitan area has taken a major toll on the aquatic fauna. Pollutants from the 1800s included wastes from sawmills, breweries, and slaughterhouses (Butler 2007, p. 48). Only a few fish species were found in the Scioto River 100 years ago (Trautman 1981, p. 33). Currently, 90 to 95 percent of the normal summer-fall flow in the river consists of wastewater treatment plant (WWTP) discharges (Yoder *et al.* 2005, p. 410). Museum records indicate that the snuffbox had completely disappeared from the mainstem by the 1970s. A series of reservoirs around Columbus fragmented habitat and eliminated or reduced populations (Olentangy and Scioto Rivers; Alum, Big Walnut and Deer Creeks). Currently, remnant populations remain in six streams, making the snuffbox precariously close to extirpation throughout this once rich system.

Olentangy River—The Olentangy River is a major headwater tributary of the Scioto River, draining central Ohio and flowing south to its confluence in Franklin County. OSUM snuffbox records date to the 1870s, although most are from the 1950s and 1960s. The snuffbox was reported from 15 of 31 mainstem sites collected during a 1960–61 survey, when it appeared "fairly common" in the lower river (Stein 1963, p. 138). A single L individual in southern Delaware County and two FD specimens in eastern Marion County were found among 30 sites in 1989, with R shells at 7 other sites (Hoggarth 1990, pp. 20–27). The small population has declined (Hoggarth 1990, p. 14), and viability is unknown.

Big Darby Creek—Big Darby Creek is one of the major tributaries draining the northwestern portion of the Scioto River system in central Ohio. Dozens of large OSUM lots of snuffbox date to the late 1950s; six Pickaway County collections in 1962 alone had 250 L and FD specimens. Watters (1990, p. 4; 1994, p. 100) surveyed 42 mainstem sites in 1986 and 49 sites in 1990. Combining the data from both years, 80 L and FD snuffbox were collected at 22 sites (Watters 1994, p. 101). The population in 1990 occurred in a reach from approximately RM 11.5 to RM 42.5. The snuffbox was recruiting (Watters 1994, p. 101); four individuals during both 1986 and 1990 were 2 to 5 years of age. The overall population trend over the past 40 years has been downward. Between 1986 and 1990, the number of L and FD specimeus was reduced from 54 to 16 and its distribution declined from 17 to 8 sites. Two FD specimens were found at sites in Franklin (1996) and Pickaway (2000) Counties, and three other sites produced only R specimens (OSUM records). This historically large snuffbox population has declined to marginal status and its viability is questionable.

Little Darby Creek—Little Darby Creek is the major tributary in the Big Darby Creek system, flowing in a southeasterly direction to its confluence in southwestern Franklin County, Ohio. The 25 OSUM lots for this species are small (fewer than five specimens per lot), date to the early 1960s, and represent lower mainstem sites in Madison County. Single FD and R specimens were collected in 1999 from a Union County site (OSUM 66740), where L individuals were collected in 1964 (Stein 1966, p. 23). This site yielded only R specimens in 1990 (Watters 1990, Appendix A.11; 1994, p. 102). Overall, the snuffbox was historically known from 35 river mi (56 river km). The well documented OSUM collection history illustrates the steady decline of a snuffbox population nearing extirpation.

Salt Creek—Salt Creek is an eastern tributary in the Scioto River system, south-central Ohio. All records (OSUM) were collected in the lower mainstem (Ross County) beginning in 1958. A single L individual from 1987 represents the last known record. The mussels in this system "have been heavily impacted, apparently by the towns of Adelphi and Laurelville" (Watters 1992, p. 78). The current status of this snuffbox population is unknown.

Scioto Brush Creek—Scioto Bush Creek is a small, western tributary of the lower Scioto River in Scioto County, south-central Ohio. The snuffbox was discovered here in the 1960s (Watters 1988a, p. 45). Three L and FD specimens from 2 sites and R shells from 2 other sites were collected during a 1987 survey covering 11 sites (Watters 1988a, pp. 210–220). The snuffbox population, collectively known from five fragmented sites along the lower two-thirds of stream, is small, and its viability is unknown.

South Fork Scioto Brush Creek—South Fork Scioto Brush Creek is a small tributary of Scioto Brush Creek, in the lower Scioto River system. A single snuffbox was found during a survey of five sites in 1987 (Watters 1988a, pp. 210–220). The South Fork and Scioto Brush Creek populations can be considered a single population unit, the viability of this unit is uncertain.

Kinniconick Creek—Kinniconick Creek is a small, southern tributary of the Ohio River in northeastern Kentucky. Snuffbox was reported L from 4 of 15 sites sampled in 1982 with R shells from an additional 2 sites (Warren *et al.* 1984, pp. 48–49). Single FD and L snuffbox were collected in 2001 and 2004, respectively, from sampling efforts at several sites (Butler 2007, p. 51), and a single FD specimen was found while resurveying four sites in 2005 (Butler 2007, p. 51). The snuffbox declined in the past few decades, is considered rare, and its viability is uncertain.

Little Miami River—The Little Miami River is a northern tributary of the Ohio River in southwestern Ohio, flowing south into the latter at the eastern fringe of the Cincinnati metropolitan area. Snuffbox records from the Little Miami date to the mid-1800s, but most collections are from the past several decades. Seven FD specimens were found at 4 of 46 mainstem sites surveyed during 1990–91, with 10 R shells at 6 other sites (Hoggarth 1992, p. 265). The FD specimens were found in approximately 20 river mi (32.2 river km), mostly in Warren County. Current viability of this small population is unknown.

Licking River—The Licking River is a southern tributary of the Ohio River in northeastern Kentucky, flowing in a northwesterly direction to its confluence across from Cincinnati. The snuffbox occurred at 13 of 60 historical mainstem sites below Cave Run Reservoir (Laudermilk 1993, p. 45) and a preimpoundment site in the reservoir footprint (Clinger 1974, p. 52). The population extended approximately 50 river mi (80.5 river km). All collections of snuffbox are small in number (Butler 2007, p. 52). A single L individual and a FD specimen were found at 2 sites and R shells were reported from 7 other sites among 49 sites sampled in 1991 (Laudermilk 1993, p. 45). Single L and FD snuffbox were collected in 1999 (Cicerello 2003, pers. comm.), and a single L individual was found in 2006 (Butler 2007, p. 53). The snuffbox has become very rare, sporadic in occurrence, and its viability is questionable.

Slate Creek—Slate Creek is a southern tributary of the Licking River below Cave Run Dam in east-central Kentucky. Historically, the snuffbox was considered "extremely abundant throughout the stream" (Taylor and Spurlock 1983) and collectively known from six sites (Laudermilk 1993, p. 45). Seventeen D specimens were recorded from a site in 1987 (Cicerello 2003, pers. comm.). A single FD and seven R specimens were found at three sites sampled in 1991 (Butler 2007, p. 53), when it was considered "occasional" in distribution (Laudermilk 1993, p. 45). Twelve L individuals were found in 1992 (Cicerello 2003, pers. comm.). Subsequent sampling has produced no additional snuffbox; two sites and four sites yielded only R specimens in 2001 and 2002, respectively (Cicerello 2005, pers. comm.). If extant, the population is marginal at best, with unlikely viability.

Stillwater River—The Stillwater River is a 67-mi (108-km), western tributary of the Great Miami River draining southwestern Ohio. The species was collectively known from eight sites throughout the River (Watters 1988a, pp. 59–71; OSUM records). One FD specimen below Englewood Dam in Montgomery County was found among 18 sites surveyed in 1987, with R shells from 5 other sites (Watters 1988a, pp. 59–71). No other information on the small population is available, and its viability is unknown.

Middle Fork Kentucky River—The Middle Fork is one of three headwater

tributaries (with the North and South Forks) forming the Kentucky River, flowing in a northerly then westerly direction and draining a portion of southeastern Kentucky. The snuffbox was first reported in 1966. Three L individuals and a R shell were found at three sites in 1996, and a single L individual was collected from another site in 1997 (Cicerello 2003, pers. comm.). All sites occur within a 10-river-mi (16-river-km) reach above Buckhorn Reservoir in Leslie County. This small population has uuknown viability.

Red Bird River—The Red Bird River is a north-flowing headwater tributary of the South Fork Kentucky River in Clay County, southeastern Kentucky, forming the latter at its confluence with Goose Creek. Ten FD specimens were recorded from two sites in 1988, and three L and one FD snuffbox were collected from four sites in 1995 (Cicerello 2003, pers. comm.). This small population occurs sporadically in the lower 20 river mi (32 river km), and viability is unknown (Cicerello 2003, pers. comm.; 2006, pers. comm.).

Red River—The Red (or North Fork Red) River is a westerly flowing tributary of the upper Kentucky River in eastern Kentucky. No L snuffbox were found in surveys of the 9-river-mi (15-river-km) reach of the Wild River section during surveys of 1980, 1986, and 1991 (Houp 1980, p. 56; 1993, p. 96), but two FD and one L snuffbox were found at three sites in 1988, while five L individuals were found in 1996 (Cicerello 2006, pers. comm.). Mostly males have been found since 2002, and they are being held in captivity for future culture efforts (Butler 2007, p. 55). A small population persists over a 10-river-mi (16-river-km) reach in the lower section of the Red River Gorge Geological Area of the Daniel Boone National Forest in Menifee, Wolfe, and Powell Counties (Cicerello 2006, pers. comm.). Viability of this population is unknown.

Rolling Fork Salt River—The Rolling Fork is a major southern tributary of the Salt River in central Kentucky, flowing in a northwesterly direction to join the Salt near its mouth. The snuffbox was first reported in 1958 (Rosewater 1959, p. 62). Seven FD specimens and a single L subadult were collected in 1988 from four sites in Larue, Marion, and Nelson Counties (Cicerello 2003, pers. comm.; Haag 2006, pers. comm.). A survey of 12 mainstem and 30 tributary sites in the Rolling Fork system in 1998–99 yielded no evidence of the snuffbox, prompting an investigator to consider it extirpated (Akers 2000, p. 13), but occasional specimens may still be fouud (Butler 2007, p. 55). The species is sporadically distributed over 40 river miles of the upper river (Cicerello 2006, pers. comm.). If it is still extant, the viability of this small population is unknown.

Green River—A major southern tributary of the lower Ohio River, the Green River flows in a westerly direction and drains west-central Kentucky. Ortmann (1926, p. 182) considered the snuffbox to be well distributed over the system, but not abundant. Large museum collections of snuffbox were taken from Munfordville during 1961–66, but only six R shells were reported there in 1967. The snuffbox has been rare since. Five L and FD snuffbox were collected at 4 of 42 sites during 1987–89 sampling iu Mammoth Cave Natioual Park (Cicerello and Hannan 1990, pp. 16–17). Three L and six FD snuffbox were reported in the upper Green River from 1984–90 (Cicerello 2003, pers. comm.). A single L individual was collected in Taylor County in 1989 (Layzer 2009, pers. comm.), but no evidence of the snuffbox was reported at numerous other sites in 1999, 2000, 2001, and 2003 (Cicerello 2006, pers. comm.). Once abundant and occurring over 200 river mi (322 river km), the species has become exceediugly rare since the 1960s. Current snuffbox viability is unknown, and it may be nearing extirpation from the entire Green River system, where it was formerly known from eight tributaries.

Wabash River System—The Wabash River is the second largest sub-basin within the Ohio River system, the watershed of the 350-mi (563-km) river encompassing much of Indiana, west-central Ohio, and southeastern Illinois. The mainstem and at least 27 streams had one of the largest snuffbox populatiou clusters. The species persists today as seven small populations in the system; the viability of these populations is unknown (Butler 2007, p. 57).

Salamonie River—The Salamonie River is a southern tributary of the upper Wabash River, flowing in a northwesterly direction and drainiug east-central Indiana. Two historical museum records were found. Nine sites were surveyed during 1993–94 without finding any evidence of the snuffbox (ESI 1995, p. 19). The snuffbox was rediscovered in 2004 above Salamonie Reservoir, where two L individuals at one site and FD shells, including a very small juvenile, were found at another site 2 mi (3 km) away (Fisher 2005, pers. comm.). The small population is considered to be recruiting and viable at some level.

Tippecanoe River—The largest tributary of the upper Wabash River system, the Tippecanoe River drains north-central Indiana and flows westerly then southerly before joining the Wabash near Lafayette. Nearly all records of the snuffbox were made in the past 20 years. Two weathered shells were found in the lower mainstem among 16 sites sampled in 1987 (Cummings *et al.* 1987, p. 25; Cummings and Berlocher 1990, p. 93) and 30 sites in 1991–92 (ESI 1993, p. 68). One L individual and over 32 FD specimens were found at a site at the upper end of Freeman Reservoir during a 1993 drawdown that may have contributed to their demise (Fisher 2003, pers. comm.). A single FD specimen was found below Shafer Reservoir among 13 sites sampled in 2003 (ESI 2003, p. 9). The viability of this declining population is unknown, but it appears close to extirpation (Fisher 2003, pers. comm.).

Embarras River—The Embarras River is a southerly flowing, western tributary of the lower Wabash River in southeastern Illinois. Museum lots represent collections datiug to 1956 and contain snuffbox from nine mainstem and two tributary sites. A total of 9 L and 15 FD specimens were collected at four sites in 1986 in Coles and Douglas Counties (Cummings *et al.* 1988, p. 8). Although overall mussel abundance at the 21 sites sampled in both 1956 and 1986 dropped 86 percent, the snuffbox was one of only five species that showed relatively stable population size over the 30-year period (Cummings *et al.* 1988, p. 9). Additional L and FD snuffbox from museum collections were recorded from single sites in 1988. Three L and eight FD snuffbox were found at two sites in 1992, and oue L and three FD were found at three of six sites surveyed during 2001–2002. Since 1986, the small snuffbox population has occurred sporadically at six sites over 50 river mi (80 river km) of the upper river. The species was reported as significant and viable by Butler (2007 pers. comm.), but has declined to some extent. Recent surveys, however, documented ouly one L individual in 2005 and one L and one FD in 2008, indicating that the Embarras River population may be closer to a marginal population than a significant one (Tiemann 2009, pers. comm.).

Sugar Creek—Sugar Creek is a tributary in the upper East Fork White River system, draining central Indiana east and south of Indianapolis. A single L individual from one site, FD specimens from seven sites, and R shells from an additional eight sites were reported in 1990 (Harmon 1992, pp. 40–41 1998). The snuffbox population

occurred sporadically over 35 river mi (56 km) to near the mouth. Only R shells were found while resampling some historical sites in 1995, 1998, and 2001 (Butler 2007, p.59). It is questionable whether the population remains extant.

Buck Creek—Buck Creek is a southerly flowing, western tributary of Sugar Creek in the upper East Fork White River system east of Indianapolis. A FD snuffbox was found near the mouth and R specimens at an upstream site in 1990 (Harmon 1992, p. 41. Similar to the parent stream population in Sugar Creek, the snuffbox may already be extirpated iu Buck Creek (Fisher 2003, pers. comm.).

Muscatatuck River—The Muscatatuck River is a large, westerly flowing tributary of the upper East Fork White River in southeastern Indiana. The snuffbox was first reported from the stream by Daniels (1903, p. 646). FD specimens (unknown number) were recorded at a site downstream from Graham Creek that was sampled in 1988 (Harmon 1989, p. 118). Status and viability of snuffbox in the Muscatatuck River are unknown.

Graham Creek—Graham Creek flows southwesterly to join Big Creek in forming the Muscatatuck River in the East Fork White River system in southeastern Indiana. The species was found FD (numbers unknown) at six sites over 10 river mi (16 river km) of the lower stream in Jennings County in 1988 (Harmon 1989, p. 117), and a single FD specimen was found in 1990 (Harmon 1998). Viability of these small population is unknown.

Cumberland River System—Snuffbox populations are known from the mainstem Cumberland River and 6 of its tributaries. With few exceptions, most mainstem records were made prior to the 1920s when the species was locally common (Wilson and Clark 1914, p. 45). The snuffbox is considered extirpated from the mainstem. Currently, a single tributary population may be extant, but is considered not viable. The species is likely to become extirpated from the entire river system in the foreseeable future.

Buck Creek—Buck Creek is a southerly flowing, northern tributary of the upper Cumberland River below Cumberland Falls in southeastern Kentucky. One D valve was found at a site in 1981 (Clarke 1981b, Appendix), and two L and one FD snuffbox were reported from three sites during 1983–84 (Schuster *et al.* 1989, p. 82). The species was also reported L from a lower mainstem site among seven sites sampled from 1987–90 (Layzer and Anderson 1992, p. 16). A recent survey found only R shells at 3 of 23 sites (Hagman 2000, p. 21). If extant, the declining snuffbox population in Buck Creek is likely to become extirpated in the foreseeable future.

Tennessee River System

The Tennessee River is the largest tributary of the Ohio River, draining seven southeastern States and joining the Ohio near its month in western Kentucky. The snuffbox originally was known from throughout all but the lower section of river and 17 of its tributaries. Hundreds of miles of large river habitat on the mainstem have been lost under nine reservoirs, with additional dams on several tributaries (Clinch, Holston, and Elk Rivers) (Tennessee Valley Authority (TVA) 1971, p. 4). The loss of mussel resources has been substantial (Watters 2000, p. 262). Muscle Shoals, the 53-river-mi (85-river-km) reach in northwestern Alabama, historically harbored 69 mussel species, the most diverse mussel fauna ever known (Garner and McGregor 2001, p. 155). The construction of three dams (Wilson in 1925, Wheeler in 1930, and Pickwick Landing in 1940) inundated most of the mussel beds. No L snuffbox have been reported at Muscle Shoals for around 100 years (Garner and McGregor 2001, p. 162). The snuffbox may persist in the mainstem at a very low density and in only five tributaries. The Clinch River maintains a stronghold population, but highly restricted populations persist in the other streams.

Clinch River—The 350-mi (563-km) Clinch River is a major tributary of the upper Tennessee River originating in southwestern Virginia, and flowing in a southwesterly direction to its confluence near Knoxville in northeastern Tennessee. No other river in North America has extant populations of more federally endangered (15) and candidate (4) species of mussels than does the upper Clinch River above Norris Reservoir. The snuffbox was reported from nine sites by Ortmann (1918, pp. 601–606). Museum records from Hancock County, Tennessee, during 1965–71 documented a very large population of snuffbox. The snuffbox is generally distributed from RM 170 to RM 195 in Hancock County, but is sporadic in Virginia (RM 213–235), where it has recently declined (Butler 2007, p. 62). The snuffbox population is recruiting, viable, and currently stable, although decreased in size and range from 40 years ago. The Clinch River ranks among the six stronghold snuffbox populations rangewide.

Powell River—The Powell River is the major tributary of the upper Clinch River flowing in a southwesterly direction parallel to and northwest of the Clinch River in southwestern Virginia and northeastern Tennessee. The snuffbox was reported at three sites by Ortmann (1918, pp. 597–598), five sites during 1973–78 by Dennis (1981, p. 3), four sites from 1975–78 by Ahlstedt and Brown (1979, p. 42), and four Virginia sites in 1988–89 by Wolcott and Neves (1994, p. 7). Large collections attest to its former abundance. The species was found L and FD in the Powell River, Tennessee, during 1989–90 (Hubbs *et al.* 1991, Appendix A). Johnson (2008) collected two L individuals at RM 95. The population has declined, viability is questionable, and its extirpation may be imminent (Butler 2007, p. 63).

Tennessee River—The snuffbox originally was known from all but the lower section of the river. Butler (2007, p. 61) reported the snuffbox as "believed to be extirpated from the entire Tennesssee River." However, Yokley (2002, p. 1) collected a single FD male in 2002 at the U.S. 231 Bridge, Madison and Morgan Counties. In 2006, one L female was found at the same location, though it was the only snuffbox out of 8,978 mussels collected at the site (Yokley 2006, p. 1). Nothing further is known about the status of the snuffbox in the Tennessee River mainstem.

Paint Rock River—The Paint Rock River is a southerly flowing, northern tributary of the southern bend of the Tennessee River in northeastern Alabama and adjacent Tennessee. The snuffbox was first reported from one of six mainstem sites by Ortmann (1925, p. 359). No evidence of snuffbox was found in two surveys during 1965–67 (Isom and Yokley 1973, p. 444) and a 1980 survey (Butler 2007, p. 64). Twelve L and FD snuffbox were found at four sites between RMs 13 and 21 (Ahlstedt 1995–96, p. 70). The species was again absent from 10 upper mainstem sites surveyed in 2002 (Godwin 2002, p. 9). Four FD specimens of varying sizes were found at lower river sites in 2002 (Fraley 2003, pers. comm.; Smith 2005, pers. comm.) and 2003–2006 (Freeman 2006, pers. comm.). One L and 11 FD specimens were found at RM 21 in 2005, and 2 L and 16 FD were collected at RM 31 in 2007 (Gangloff 2007, pers. comm.). In July 2008, Freeman (2008, pers. comm.) observed multiple age classes (sizes) of FD snuffbox in middens between RM 34.7 and 32.5. Fobian *et al.* (2008, p. 14) collected 21 L snuffbox at 7 sites and FD specimens at 8 sites between RM 46.7 and 13.1. The stronghold snuffbox population exists between RMs 13 and 44, and is

recruiting, viable, and has clearly improved since 1980.

Elk River—The Elk River is a large, northern tributary flowing 200 river mi (322 river km) in a southwesterly direction in the southern bend of the Tennessee River in south-central Tennessee and north-central Alabama. Snuffbox collections have been sporadic. The species was found at 2 sites in the mid-1960s (Isom *et al.* 1973, p. 440), and a single L individual was found among 108 sites sampled in 1980 (Ahlstedt 1983, p. 47). Single specimens were also reported from 4 sites sampled in the lower river in 1997 (Madison and Layzer 1998, Table 6) and 16 sites sampled in 1999 (Service 1999, p. 3). A very large FD specimen was found at RM 51 among 4 sites sampled in 2001 (Hubbs 2002, p. 5; Butler 2007, p. 65). A single L and a FD snuffbox were found at a site in Giles County during qualitative sampling events at five sites in 2005 (Ahlstedt *et al.* 2006). Ford (2008, pers. comm.) reported collecting FD specimens at Stairstep Shoals in Giles County, Tennessee, in July 2007. The small snuffbox population has recently recruited, exhibits some level of viability, and its numbers appear relatively stable in recent history.

Duck River—The Duck River is the downstream-most large tributary of the Tennessee River draining south-central Tennessee and flowing 285 river miles (459 river km) west to its confluence near the head of Kentucky Reservoir. The snuffbox historically occurred throughout the Duck River and, based on museum records, was locally common 40 to 50 years ago, but was absent in surveys from RM 180 downstream in the mid-1970s (Ahlstedt 1981, p. 62; Dennis 1984, p. 38). Two L individuals were collected from 2 of 99 sites surveyed in 1979 (Butler 2007, p. 66). A single L individual was discovered in Maury County among 72 sites sampled during 2000–03 (Ahlstedt *et al.* 2004, p. 119), but none were found at 11 lower sites surveyed in 2000 (Schilling and Williams 2002, p. 409). The snuffbox is very rare, and its viability is uncertain.

Lower Mississippi River Sub-Basin

The Lower Mississippi River Sub-basin includes 954 miles of the Mississippi River from its confluence with the Ohio River at Cairo, Illinois, to its mouth in the Gulf of Mexico. The snuffbox is known from a single stream in this sub-basin, outside of the White River system.

St. Francis River—The St. Francis River is a major tributary of the lower Mississippi with its headwaters in southeastern Missouri, and flowing south into northeastern Arkansas. The only Arkansas records available for this 450-mi (724-km) river are from 1964, located approximately 1 mi southwest of Parkin in Cross County (Bates and Dennis 1983, p. 63; Harris *et al.* 2007, p. 10). Snuffbox records exist for Butler, Wayne, and Stoddard Counties, Missouri, where it was considered "locally abundant" (Oesch 1984, p. 235). The species is known from above Wappapello Reservoir, but was absent from Missouri surveys conducted below Wappapello Dam in 1983 (Bates and Dennis 1983, p. 63) and 1986 (Ahlstedt and Jenkinson 1991, p. 240). Twelve L snuffbox were sampled at sites in 2002 (Hutson and Barnhart 2004, pp. 84–85). Live individuals were found during collections at RM 172.1 in 2005 and 2006 (Butler 2007, p. 67). The snuffbox is restricted to a 10-mi (16-km) reach (RM 172.1–182.0) on the northeastern edge of the Ozark Plateaus in the vicinity of Sam A. Baker State Park, Wayne County (Hutson and Barnhart 2004, p. 85). This medium-sized snuffbox population appears to be stable and viable, but restricted in distribution.

White River System—The 690-mi (1,110-km) White River is a large tributary system of the western bank of the Mississippi River. A snuffbox population once occurred in the mainstem and six of its larger tributaries. The last record from the mainstem in Arkansas is pre-1921 (Harris *et al.* 2007, p. 10). Highly restricted populations persist in four streams.

Buffalo River—The Buffalo River is a large, eastward-flowing tributary of the middle White River in north-central Arkansas. The snuffbox was not found during surveys in 1910 (26 sites; Meek and Clark 1912, p. 13) and 1995 (40 sites; Harris 1996, p. 9), but two L individuals were found at a single site among 60 sites surveyed in 2006 (Matthews 2007, pers. comm.). The small population occurs in the lower river in Marion County, and its viability is unknown.

Black River—The Black River is the largest tributary in the White River system, draining much of southeastern Missouri and northeastern Arkansas before flowing in a southerly direction into the White River near Newport, Arkansas. A long but sporadic collection history for the snuffbox appears in the 300-mi (483-km) Black River. A single, approximately 4-year-old L male was collected at RM 65.5, Wayne County, among 51 Missouri sites sampled in 2002 (Hutson and Barnhart 2004, p. 154). The species has become extirpated from the lower river on the Mississippi Embayment, including Arkansas. The snuffbox appears rare but viable at some level.

Spring River—The Spring River is a large tributary of the Black River that drains the eastern Ozark Plateaus in south-central Missouri and northeastern Arkansas. Based on pre-1986 records, the snuffbox was known in low numbers from at least four sites in approximately 20 river mi (34 river km) of the lowermost mainstem in Arkansas (Harris and Gordon 1987, p. 53). A single L adult male was found in Lawrence County in 2005, and represents the first L specimen found in Arkansas in more than 20 years (Butler 2007, p. 69). Further, 53 FD snuffbox were collected in four large muskrat middens (Harris *et al.* 2007, p. 15). The extent of the population is not known, but it is probably limited to relatively few miles in the lower mainstem in Lawrence and Randolph Counties. This population appears small, and its status and viability are unknown.

Strawberry River—The Strawberry River is a western tributary of the Black River draining a portion of the southeastern Ozark Plateaus in northeastern Arkansas. The only snuffbox records were from around 1983 and 1997 in the middle mainstem in Sharp County (Butler 2007, p. 69). No other details on these collections or the status of the population are known. Considering the dearth of records, the snuffbox appears to be very rare in the Strawberry River, and of unknown viability.

Summary of Snuffbox Population Estimates and Status

The snuffbox has declined rangewide and appears to be extant in 74 of 208 streams and lakes of historical occurrence, a 65 percent decline in occupied streams. Realistically, much more than 65 percent of the habitat historically available for this species no longer supports its populations. Habitat losses measured in the thousands of miles have occurred rangewide. Since multiple streams may comprise single snuffbox population segments (for example, the French Creek system), the actual number of extant populations is somewhat less. Extant populations, with few exceptions, are highly fragmented and restricted to short reaches. The elimination of this species from scores of streams and thousands of miles of stream reaches indicates catastrophic population losses and a precipitous decline in overall abundance. It is reasonable to estimate that total range reduction and overall population losses for the snuffbox each approximate, if not exceed, 90 percent.

Previous Federal Action

We identified the rayed bean as a Category 2 species in a notice of review published in the **Federal Register** on May 22, 1984 (49 FR 21664). The rayed bean remained a Category 2 species in subsequent notices including January 6, 1989 (54 FR 554), November 21, 1991 (56 FR 58804), and November 15, 1994 (59 FR 58982). Prior to 1996, a Category 2 species was one that we were considering for possible addition to the Federal List of Endangered and Threatened Wildlife but for which conclusive data on biological vulnerability and threats were not available to support a proposed rule. We stopped designating Category 2 species in the February 28, 1996, Notice of Review (61 FR 7596). We now define a candidate species as a species for which we have on file sufficient information to propose it for protection under the Act. We designated the rayed bean as a candidate species on May 4, 2004 (69 FR 24876).

We identified the snuffbox as a Category 2 species in the notice of review published in the **Federal Register** on November 21, 1991 (56 FR 58804). The snuffbox remained a Category 2 in the subsequent notice on November 15, 1994 (59 FR 58982) but was dropped from the list in the February 28, 1996, Notice of Review (61 FR 7596), when we stopped designating Category 2 species. The snuffbox is not currently listed as a candidate species for listing.

Summary of Information Pertaining to the Five Factors

Section 4 of the Act (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, set forth the procedures for adding species to the Federal lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, we may determine a species to be endangered or threatened due to one or more of the following five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination. Each of these factors is discussed below.

A. The Present or Threatened Destruction, Modification, or Curtailment of Their Habitat or Range.

Both species have experienced significant curtailment of their occupied habitats (*see* Background, above). The rayed bean has been eliminated from about 74 percent of the streams it historically occurred in. This species has also been eliminated from long reaches of former habitat in hundreds of miles of the Maumee, Ohio, Wabash, and Tennessee Rivers and from numerous stream reaches in their tributaries. The snuffbox has been eliminated from about 65 percent of the streams in which it historically occurred. Furthermore, extant populations, with few exceptions, are highly fragmented and restricted to short reaches. Available records indicate that 33 percent of streams considered to harbor extant populations of the snuffbox are represented by only one or two recent L or FD individuals. The primary cause of range curtailment for both species has been modification and destruction of river and stream habitats, primarily by the construction of impoundments.

Impoundment—Impoundments result in the dramatic modification of riffle and shoal habitats and a resulting loss of mussel resources, especially in larger rivers. Neves *et al.* (1997, pp. 63–64) and Watters (2000, pp. 261–262) reviewed the specific effects of impoundments on freshwater mollusks. Dams interrupt a river's ecological processes by modifying flood pulses; controlling impounded water elevations; altering water flow, sediments, nutrients, and energy inputs and outputs; increasing depth; decreasing habitat heterogeneity; decreasing stability due to subsequent sedimentation; blocking host fish passage; and isolating mussel populations from fish hosts. Even small, low-head dams can have some of these effects on mussels.

The reproductive process of riverine mussels is generally disrupted by impoundments, making the rayed bean and snuffbox unable to successfully reproduce and recruit under reservoir conditions. Population losses due to impoundments have likely contributed more to the decline and imperilment of the rayed bean and snuffbox than has any other single factor. Neither species occurs in reservoirs lacking riverine characteristics, and only the snuffbox persists in large rivers with dams (Ohio River), and then only in sections retaining riverine characteristics (generally tailwaters). Both species, however, historically occurred in the wave-washed shallows of several glacial lakes, an environment very different from that found in impoundments.

Stream habitat throughout major portions of the range of both species has been impounded. The majority of the Tennessee and Cumberland River mainstems and many of their largest tributaries are now impounded. There are 36 major dams located in the Tennessee River system, and about 90 percent of the Cumberland River downstream of Cumberland Falls is either directly impounded by U.S. Army Corps of Engineers (Corps) structures or otherwise impacted by cold tailwater released from dams. Watters (2000, pp. 262–263) summarizes the tremendous loss of mussel species from various portions of the Tennessee and Cumberland River systems. The rayed bean has been eliminated from the Tennessee River system and the snuffbox, once widespread throughout both systems, now persists in only five Tennessee River tributaries and one Cumberland River tributary.

This impoundment scenario is similar in many other parts of the range of the rayed bean and snuffbox, and includes uumerous navigational locks and dams (Ohio, Allegheny, Muskingum and Green Rivers), major dams (Shenango, Elk, Walhonding, Scioto, Little Miami, Green, Nolin, Barren, Tippecanoe, Wabash, Mississinewa, Salamonie, and Duck Rivers), and low-head dams (Pine, Belle, Clinton, Huron, Maumee, Auglaize, Sandusky, Mahoning, Tuscarawas, Walhonding, Scioto, Olentangy, Wabash, Mississinewa, East Fork White, West Fork White, and Duck Rivers; and Middle Island, Big Walnut, Alum, Big Darby, Little Darby, Sugar, and Richland Creeks) that have contributed to the loss of the species' habitat. Sediment accumulations behind dams of all sizes generally preclude the occurrence of the rayed bean and snuffbox.

Dredging and Channelization—Dredging and channelization activities have profoundly altered riverine habitats nationwide. Hartfield (1993, pp. 131–141), Neves *et al.* (1997, pp. 71–72), and Watters (2000, pp. 268–269) reviewed the specific effects of channelization on freshwater mollusks. Channelization impacts a stream's physical (accelerated erosion, reduced depth, decreased habitat diversity, geomorphic instability, and riparian canopy loss) and biological (decreased fish and mussel diversity, changed species composition and abundance, decreased biomass, and reduced growth rates) characteristics (Hartfield 1993, p. 131; Hubbard *et al.* 1993, pp. 136–145). Channel construction for navigation has

been shown to increase flood heights (Belt 1975, p. 189). This is partially attributed to a decrease in stream length and increase in gradient (Hubbard *et al.* 1993, p. 137). Flood events may thus be exacerbated, conveying into streams large quantities of sediment, potentially with adsorbed contaminants. Channel maintenance may result in profound impacts downstream (Stansbery 1970, p. 10), such as increases in turbidity and sedimentation, which may smother benthic (bottom-dwelling) organisms such as the rayed bean and snuffbox.

The only known rayed bean populations that remain in navigation channels are in the upper two navigation pools of the Allegheny River. Activities associated with navigation channels may have contributed to the elimination of the rayed bean from the Ohio, lower Allegheny, and Muskingum Rivers, and potentially others. Channel maintenance operations for barge navigation have impacted habitat for the snuffbox in several large rivers. Impacts associated with barge traffic, which include construction of fleeting areas, mooring cells, docking facilities, and propeller wash, also disrupt habitat. Navigation maintenance activities may continue to adversely affect this species in the upper Ohio River. Hundreds of miles of rayed bean (Olentangy, Salamonie, Mississinewa, Vermilion, North Fork Vermilion, Embarras Rivers) and snuffbox (Grand, Kankakee, Sangamon, Kaskaskia, Olentangy, Salamonie, Mississinewa, Eel, Vermilion, and North Fork Vermilion, Embarras, Paint Rock, and St. Francis Rivers; and Tonawanda, Killbuck, Chickamauga, and Bear Creeks) streams were dredged and channelized decades ago, and some populations have been eliminated from these streams. The entire length of the Kankakee River in Indiana was channelized by 1917. In addition, hundreds of drains (formed from ditching low-gradient creeks and swales) were created around 100 years ago in Illinois, Michigan, and other midwestern States. Stream channelizations were attempts to reduce flooding, draiu low-lying areas, and "improve" storm flow runoff.

Chemical Cantaminants—Chemical contaminants are ubiquitous throughout the environment and are considered a major threat in the decline of freshwater mussel species (Cope *et al.* 2008, p. 451; Richter *et al.* 1997, p. 1081; Strayer *et al.* 2004, p. 436; Wang *et al.* 2007, p. 2029). Chemicals enter the environmeut through both point and nonpoint discharges, including spills, industrial sources, municipal effluents, and agricultural runoff. These sources contribute organic compounds, heavy metals, pesticides, and a wide variety of newly emerging contaminants to the aquatic environment. As a result, water and sediment quality can be degraded to the extent that mussel populations are adversely impacted.

Chemical spills can be especially devastating to mussels because they may result in exposure of a relatively immobile species to extremely elevated concentrations that far exceed toxic levels and any water quality standards that might be in effect. Some notable spills that released large quantities of highly concentrated chemicals resulting in mortality to mussels include: massive mussel kills on the Clinch River at Carbo, Virginia, occurred from a power plant alkaline fly ash pond spill in 1967 and a sulfuric acid spill in 1970 (Crossman *et al.* 1973, p. 6); approximately 18,000 mussels of several species including 750 individuals from three endangered mussel species were eliminated from the upper Clinch River near Cedar Bluff, Virginia, in 1998, when an overturned tanker truck released 1,600 gallons (6,056 liters) of a chemical used in rubber manufacturing (Jones *et al.* 2001, p. 20; Schmerfeld 2006, p. 12); and an ongoing release of sodium dimethyl dithiocarbamate, a chemical used to reduce and precipitate hexachrome, starting in 1999 impacted approximately 10 river miles (16 km) of the Ohio River and resulted in an estimated loss of one million mussels, including individuals from two federally listed species (DeVault 2009, pers. comm.; Clayton 2008, pers. comm.). These are not the only instances where chemical spills have resulted in the loss of high numbers of mussels (Brown *et al.* 2005, p. 1457; Neves 1991, p. 252; Jones *et al.* 2001, p. 20; Schmerfeld 2006, pp. 12–13), but are provided as examples of the serious threat chemical spills pose to mussel species. The rayed bean and snuffbox are especially threatened by chemical spills because these spills can occur anywhere there are highways with tanker trucks, industries, or mines and where these overlap with rayed bean and snuffbox distribution.

Exposure of mussels to lower concentrations of contaminauts more likely to be found in aquatic environments can also adversely affect mussels and result in the decline of freshwater mussel species. Such concentrations may not be immediately lethal, but over time, can result in mortality, reduced filtration efficiency, reduced growth, decreased reproduction, changes in enzyme activity, and behavioral changes to all mussel life stages. Frequently, procedures which evaluate the "safe" concentration of an environmental contaminant (for example, national water quality criteria) do not have data for freshwater mussel species or exclude data that is available for freshwater mussels (March *et al.* 2007, pp. 2066–2067, 2073).

Current research is now starting to focus on the contaminant sensitivity of freshwater mussel glochidia and newly-released juvenile mussels (Goudreau *et al.* 1993, pp. 219–222; Jacobson *et al.* 1997, p. 2390; Wang, 2007a, pp. 2041–2046; Valenti 2005, pp. 1244–1245; Valenti 2006, pp. 2514–2517; March 2007, pp. 2068–2073) and juveniles (Bartsch *et al.* 2003, p. 2561; Augspurger *et al.* 2003, p. 2569; Mummert *et al.* 2003, p. 2549, Wang, 2007b, pp. 2053–2055, Wang, 2007a, pp. 2041–2046, Valenti 2005, pp. 1244–1245; Valenti 2006, pp. 2514–2517; March 2007, pp. 2068–2073) to such contaminants as ammonia, metals, chlorine, and pesticides. The toxicity information presented in this section focuses on recent water-only laboratory acute (sudden and severe exposure) and chronic (prolonged or repeated exposure) toxicity tests with early life stages of freshwater mussels using the standard testing methodology published by the American Society for Testing and Materials (ASTM) (American Society for Testing and Materials 2008, pp. 1442–1493). Use of this standard testing method generates consistent, reliable toxicity data with acceptable precision and accuracy (Wang *et al.* 2007a, p. 2035) aud was used for toxicity tests on ammonia, copper, chlorine, and select pesticides (Augspurger *et al.* 2007, p. 2025; Bringolf *et al.* 2007a, p. 2087; Bringolf *et al.* 2007c, p. 2101; Wang *et al.* 2007a, p. 2029; Wang *et al.* 2007b, p. 2036; Wang *et al.* 2007c, p. 2048). Use of these tests has documented that while mussels are sensitive to some contaminants, they are not universally sensitive to all contaminants (Augspurger *et al.* 2007, pp. 2025–2026).

One chemical that is particularly toxic to early life stages of mussels is ammonia. Sources of ammonia include agricultural sources (animal feedlots and nitrogenous fertilizers), municipal wastewater treatment plants, and industrial waste (Augspurger *et al.* 2007, p. 2026), as well as precipitation and natural processes (decomposition of organic nitrogen) (Goudreau *et al.* 1993, p. 212; Hickey and Martin 1999, p. 44; Augspurger *et al.* 2003, p. 2569; Newton 2003, p. 1243). Therefore, ammonia is considered a limiting factor for survival and recovery of some mussel species due to its ubiquity in aquatic environments, high level of toxicity, and because the highest concentrations

typically occur in mussel microhabitats (Augspurger *et al.* 2003, p. 2574). In addition, studies have shown that ammonia concentrations increase with increasing temperature and low-flow conditions (Cherry *et al.* 2005, p. 378; Cooper *et al.* 2005, p. 381), which may be exacerbated by the effects of climate change, and may cause ammonia to become more problematic for juvenile mussels. The Environmental Protection Agency's established ammonia water quality criteria (EPA 1985, p. 94–99) may not be protective of mussels (Augspurger *et al.* 2003, p. 2572; Sharpe 2005, p. 28) under current and future climate conditions.

Mussels are also affected by metals (Keller and Zam 1991, p. 543), such as cadmium, chromium, copper, mercury, and zinc, which can negatively affect biological processes such as growth, filtration efficiency, enzyme activity, valve closure, and behavior (Naimo 1995, pp. 351–355; Keller and Zam 1991, p. 543; Jacobson *et al.* 1997, p. 2390; Valenti *et al.* 2005, p. 1244). Metals occur in industrial and wastewater effluents and are often a result of atmospheric deposition from industrial processes and incinerators. Glochidia and juvenile freshwater mussels have recently been studied to determine the acute and chronic toxicity of copper to these life stages (Wang 2007a, pp. 2036–2047; Wang 2007b, pp. 2048–2056). The chronic values determined for copper ranged from 8.5 to 9.8 micrograms per liter (ug/L) for survival and from 4.6 to 8.5 ug/L for growth of juveniles. These chronic values are below the EPA's 1996 chronic water quality criterion of 15 ug/L (hardness 170 mg/L) for copper (Wang 2007b, pp. 2052–2055). March (2007, pp. 2066, 2073) identifies that copper water quality criteria and modified State water quality standards may not be protective of mussels.

Mercury is another heavy metal that has the potential to negatively affect mussel populations, and it is receiving attention due to its widespread distribution and potential to adversely impact the environment. Mercury has been detected throughout aquatic environments as a product of municipal and industrial waste and atmospheric deposition from coal burning plants. One recent study evaluated the sensitivity of early life stages of mussels to mercury (Valenti 2005, p. 1242). This study determined that, for the mussel species used (rainbow mussel, *Villosa iris*), glochidia were more sensitive to mercury thau were juvenile mussels, with the median lethal concentration value of 14 ug/L compared to 114 ug/L for the juvenile life stage. The chronic toxicity tests conducted determined that juveniles exposed to mercury greater than or equal to 8 ug/L exhibited reduced growth. These observed toxicity values are greater than EPA's Criteria Continuous Concentration and Criteria Maximum Concentration, which are 0.77 ug/L and 1.4 ug/L, respectively. Based on these data we believe that EPA's water quality standards for mercury should be protective of juvenile mussels and glochidia, except iu cases of illegal dumping, permit violations, or spills. However, impacts to mussels from mercury toxicity may be occurring in some streams. According to the National Summary Data reported by States to the EPA, 3,770 monitored waters do not meet EPA standards for mercury in the United States (*http://iaspub.epa.gov/waters10/attains_nation_cy.control?p_report_type=T*, accessed 6/28/2010). Acute mercury toxicity was determined to be the cause of extirpation of a diverse mussel fauna for a 70-mile (112-km) portion of the North Fork Holston River (Brown *et al.* 2005, pp. 1455–1457).

In addition to ammonia, agricultural sources of chemical contaminants include two broad categories that have the potential to adversely impact mussel species: Nutrients and pesticides. Nutrients (such as nitrogen and phosphorus) can impact streams when their concentrations reach levels that cannot be assimilated, a condition known as over-enrichment. Nutrient over-enrichment is primarily a result of runoff from livestock farms, feedlots, and heavily fertilized row crops (Peterjohn and Correll 1984, p. 1471). Over-enriched conditions are exacerbated by low-flow conditions, such as those experienced during typical summer-season flows and that might occur with greater frequency and magnitude as a result of climate change. Bauer (1988, p. 244) found that excessive nitrogen concentrations can be detrimental to the adult freshwater pearl mussel (*Margaritifera margaritifera*), as was evident by the positive linear relationship between mortality and nitrate concentration. Also, a study of mussel life span and size (Bauer 1992, p. 425) showed a negative correlation between growth rate and eutrophication, aud longevity was reduced, as the concentration of nitrates increased. Nutrient over-enrichment can result in an increase in primary productivity, and the subsequent respiration depletes dissolved oxygen levels. This may be particularly detrimental to juvenile mussels that inhabit the interstitial spaces in the substrate where lower dissolved oxygen concentrations are more likely than on the sediment surface where adults tend to live (Sparks and Strayer 1998, pp. 132–133).

Elevated concentrations of pesticide frequently occur in streams due to pesticide runoff, overspray application to row crops, and lack of adequate riparian buffers. Agricultural pesticide applications often coincide with the reproductive and early life stages of mussels, and thus impacts to mussels due to pesticides may be increased (Bringolf *et al.* 2007a, p. 2094). Little is known regarding the impact of currently used pesticides to freshwater mussels even though some pesticides, such as glyphosate (Roundup), are used globally. Recent studies tested the toxicity of glyphosate, its formulations, and a surfactant (MON 0818) used in several glyphosate formulations, to early life stages of the fatmucket (*Lampsilis siliquoidea*), a native freshwater mussel (Bringolf *et al.* 2007a, p. 2094). Studies conducted with juvenile mussels and glochidia determined that the surfactaut (MON 0818) was the most toxic of the compounds tested and that *L. siliquoidea* glochidia were the most sensitive organism tested to date (Bringolf *et al.* 2007a, p. 2094). Roundup, technical grade glyphosate isopropylamine salt, and isopropylamine were also acutely toxic to juveniles and glochidia (Bringolf *et al.* 2007a, p. 2097). The impacts of other pesticides including atrazine, chlorpyrifos, and permethrin on glochidia and juvenile life stages have also recently been studied (Bringolf *et al.* 2007b, p. 2101). This study determined that chlorpyrifos was toxic to both *L. siliquoidea* glochidia and juveniles (Bringolf *et al.* 2007b, p. 2104). The above results indicate the potential toxicity of commonly applied pesticides and the threat to mussel species as a result of the widespread use of these pesticides. All of these pesticides are commonly used throughout the range of the rayed bean and snuffbox.

A potential, but undocumented, threat to freshwater mussel species, including rayed bean and snuffbox, are contaminants referred to as "emerging contaminants" that are being detected in aquatic ecosystems at an increasing rate. Pharmaceuticals, hormones, and other organic contaminants have been detected downstream from urban areas and livestock production (Kolpin *et al.* 2002, p. 1202). A large potential source of these emerging contaminauts is wastewater being discharged through both permitted (National Pollutant Discharge Elimination System (NPDES)) and nou-permitted sites throughout the country. Permitted discharge sites are

ubiquitous in watersheds with rayed bean and snuffbox populations, providing ample opportunities for contaminants to impact the species (for example, there are more than 250 NPDES sites in the Meramec River, Missouri system, which harbors a declining population of snuffbox; Roberts and Bruenderman 2000, p. 78).

The information presented in this section represents some of the threats from chemical contaminants that have been documented both in the laboratory and field and demonstrates that chemical contaminants pose a substantial threat to the rayed bean and snuffbox. This information indicates the potential for contaminauts to contribute to declining rayed bean and snuffbox populations—from spills that are immediately lethal to species to chronic contaminant exposure, which results in death, reduced growth, or reduced reproduction of rayed bean and snuffbox.

Mining—The low pH commonly associated with coal mine runoff can reduce glochidial encystment rates, thus impacting mussel recruitment (Huebner and Pynuönen 1992, p. 2350). Additionally, adverse impacts from heavy metal-rich drainage from coal mining and associated sedimentation has been documeuted in portions of historical rayed bean and snuffbox habitat in the upper Ohio River system in western Pennsylvania (Ortmann 1909c, p. 97), West Virginia, and southeastern Ohio. Likewise, coal mining has impacted rayed bean habitat in the upper Tennessee River system, Virginia (Kitchel *et al.* 1981, p. 21), and snuffbox habitat in eastern Kentucky (lower Ohio and Mississippi River systems in southeastern Illinois and western Kentucky; upper Cumberlaud River system in southeastern Kentucky and northeastern Tennessee; and upper Tennessee River system in southwestern Virginia) (Ortmann 1909c, p. 103; Neel and Allen 1964, pp. 428–430; Kitchel *et al.* 1981, p. 21; Anderson *et al.* 1991, pp. 6–7; Gordon 1991, p. 2; Bogan and Davis 1992, p. 2; Layzer and Anderson 1992, pp. 91–94; Ahlstedt and Tuberville 1997, p. 75; Milam *et al.* 2000, p. 53; Warren and Haag 2005, p. 1394). Acid mine drainage was implicated in the mussel die-off in the Little South Fork Cumberland River, Kentucky (Anderson *et al.* 1991, pp. 6–7; Layzer and Anderson, 1992, p. 94; Ahlstedt and Saylor 1995–96, pp. 92–93; Warren and Haag 2005, p. 1394). Tailings pond failures have also impacted aquatic resources (Powell River, Virginia; Butler 2007, p. 83). A decline of the suuffbox and other imperiled mussels in the Powell River was blamed ou coal mining impacts (Ahlstedt and Tuberville 1997, p. 75). Increased mining activities in the upper Clinch River system is resulting in "blackwater" events (Jones and Neves 2004, p. 2). Anecdotal evidence suggests that coal fines are increasing in the Clinch River reach that harbors a stronghold snuffbox population (Butler 2007, p. 84). A coal-fired power plant planned for the upper Clinch River in Virginia would further increase mining in the Clinch and Powell watersheds.

Currently, coal mining activities occur only in the Elk River in West Virginia (Douglas 2010, pers. comm.). However, if coal mining activities are reinitiated in western Pennsylvania, they could become a threat to populations of both species in the lower French Creek and the Allegheny River.

Instream and alluvial (clay, silt, sand, or other material deposited by running water) gravel mining has been implicated in the destruction of several mussel populations (Hartfield 1993, pp. 135–136; Brown and Curole 1997, pp. 239–240). Negative impacts associated with gravel mining include stream channel modifications (altered habitat, disrupted flow patterns, sediment transport), water quality modifications (increased turbidity, reduced light penetration, increased temperature), macroinvertebrate population changes (elimination, habitat disruption, increased sedimentation), and changes in fish populations (impacts to spawning and nursery habitat, food web disruptions) (Kanehl and Lyons 1992, pp. 26–27; Roell 1999, p. 5). Gravel mining may continue to be a localized threat to rayed bean and snuffbox populations (Kankakee, Bourbeuse, Walhonding, Elk (Tennessee), and Strawberry Rivers; Big Darby and Buck (Kentucky) Creeks).

Other mining activities that impact snuffbox populations include miuing for metals (lead, cadmium, zinc) in Missouri. Mining has been implicated in the decline of mussels from the upper St. Francis River (Hutson and Barnhart 2004, pp. 86–87). Lead and barite mining is commou in the Big River, a Meramec River tributary. A tailiugs-pond blowout discharged 81,000 cubic yards of mine tailings in 1977 that impacted approximately 80 river mi (129 river km) (Buchanan 1980, p. 9; Roberts and Bruenderman 2000, p. 24). As of 2000, high levels of heavy metals were still detected in the system (Roberts and Bruenderman 2000, p. 24) and may continue to hinder stream recovery. Forty-five tailings ponds and numerous tailings piles remain in the watershed (Roberts and Bruenderman 2000, p. 24).

Oil and gas production may have contributed to the decline of the rayed bean and snuffbox in certain drainages (Sangamon River in the upper Mississippi River system; Slippery Rock and Connoquenessing Creeks in the upper Ohio River system; Green, Kentucky, Salamonie, and Mississinewa Rivers in the lower Ohio River system) (Ortmann 1909c, p.104; Schanzle and Cummings 1991, p. 1; ESI 1995, p. 39; Cicerello 1999, p. 11). Pollutants include brines, high levels of potassium, and numerous organic compounds (Imlay 1971, p. 39). An increasing demand for domestic energy resources is expected to accelerate oil and gas exploratiou iu certain rayed bean and snuffbox streams in the foreseeable future.

Siltation—Excessive sedimentation affects an estimated 46 percent of all U.S. streams (Judy *et al.* 1984), including the majority of the streams with extant rayed bean and snuffbox populations. Sedimentation has been implicated in the decline of mussel populations natiouwide, aud is a threat to rayed bean and snuffbox (Kunz 1898, p. 328; Ellis 1936, pp. 39–40; Marking and Bills 1979, p. 204; Vannote and Minshall 1982, pp. 4105–4106; Dennis 1984, p. 212; Wolcott and Neves 1990, pp. 74–75; Brim Box 1999, p. 79; Fraley and Ahlstedt 2000, p. 194; Poole and Downing 2004, pp. 119–120). Specific biological impacts include reduced feeding and respiratory efficiency from clogged gills, disrupted metabolic processes, reduced growth rates, limited burrowiug activity, aud physical smothering (Ellis 1936, pp. 39–40; Stausbery 1971, p. 6; Imlay 1972, p. 76; Marking and Bills 1979, p. 210; Vannote and Minshall 1982, p. 4105; Waters 1995, p. 7).

Studies indicate that excessive sediment level impacts are sublethal, with detrimental effects not immediately apparent (Brim Box and Mossa 1999, p. 101). Physical habitat effects include altered suspended and bed material loads, and bed sediment composition associated with increased sediment production and run-off; clogged interstitial habitats and reduced interstitial flow rates and dissolved oxygen levels; changed channels in form, position, and degree of stability; altered depth or width-depth ratio that affects light penetration and flow regime; aggraded (filling) or degraded (scouring) channels; and changed channel positions that dewater mussel beds (Vannote and Minshall 1982, p. 4105; Gordon *et al.* 1992, pp. 296–297; Kanehl and Lyons 1992, pp. 26–27; Brim Box and Mossa 1999, p. 102).

Interstitial spaces in the substrate provide essential habitat for juvenile mussels. When clogged, interstitial flow rates and spaces may become reduced (Brim Box and Mossa 1999, p. 100), thus reducing juvenile habitat availability. The rayed bean burrows deep into interstitial substrates, making it particularly susceptible to degradation of this habitat. Sediment may act as a vector for delivering contaminants such as nutrients and pesticides to streams. Juveniles can readily ingest contaminants adsorbed to silt particles during normal feeding activities. These factors may explain, in part, why so many mussel populations, including those of the rayed bean and snuffbox, appear to be experiencing recruitment failures.

Agricultural activities produce the most significant amount of sediment that enters streams (Waters 1995, pp. 17–18). Neves *et al.* (1997, p. 65) stated that agriculture (including both sediment and chemical run-off) affects 72 percent of the impaired river miles in the country. Unrestricted access by livestock is a significant threat to many streams and their mussel populations (Fraley and Ahlstedt 2000, p. 193). Soil compaction for intensive grazing may reduce infiltration rates and increase run-off, and trampling of riparian vegetation increases the probability of erosion (Armour *et al.* 1991, pp. 8–10; Trimble and Mendel 1995, pp. 238–239; Brim Box and Mossa 1999, p. 103).

The majority of extant rayed bean and snuffbox populations are threatened by some form of agricultural runoff (e.g., nutrients, pesticides, sediment). The Maumee River system, for example, has a drainage area that contains approximately 89 percent agricultural land (Sanders 2002, p. 10.1). The decline of rayed bean and snuffbox in this system may be largely attributed to stream habitat impacts resulting from intensive farming and associated runoff. The rayed bean and snuffbox once occurred in the Maumee River mainstem, as well as in up to nine of its tributaries. Currently, the snuffbox is extirpated from the Maumee River system and the rayed bean is only found in distinct but small reaches of the St. Joseph River, Fish Creek, Swan Creek, and Blanchard River. All of these remaining populations (which comprise about 20 percent of all remaining rayed bean populations rangewide) are currently threatened by ongoing agricultural activities. This scenario is echoed across the remaining extant range of the rayed bean and snuffbox.

Other Activities Affecting Rayed Bean and Snuffbox Habitat—Activities associated with urbanization can be detrimental to stream habitats (Couch and Hamilton 2002, p. 1) and were summarized by Feminella and Walsh (2005, pp. 585–587). Developmental activities may impact streams and their mussel fauna where adequate streamside buffers are not maintained and erosion of impacted land is allowed to enter streams (Brainwood *et al.* 2006, p. 511). Types of development may include highway coustruction, parking lots, building construction, general infrastructure (utilities, sewer systems), and recreation facilities. Factors impacting rayed bean and snuffbox populations in urban and suburban areas include lawn care chemicals (Conners and Black 2004, pp. 366–367), sedimentation, toxic effluents, domestic sewage, road salts, and general runoff.

Impervious surfaces are detrimental to mussel habitat by altering various hydrological factors, including: Increased volumes of flow, annual flow rates, peak flows and duration, and temperature; decreased base flow; and changes in sediment loadings (Galli 1991, p. 28; EPA 1997, p. 4; DeWalle *et al.* 2000, p. 2655; Myers-Kinzie *et al.* 2002, p. 822). These factors result in flooding, erosion, channel widening, altered streambeds, channel instability, riparian and instream habitat loss, and loss of fish populations (EPA 1997, p. 4). As little as 10 percent of a watershed being impervious can cause channel instability and a host of other stream habitat effects (Booth 1991, p. 98; Booth and Reinelt 1993, p. 549). Impervious surfaces may reduce sediment input into streams but result in channel instability by accelerating stormwater runoff, which increases bank erosion and bed scouring (Brim Box and Mossa 1999, p. 103). Stream channels become highly unstable as they respond to increased flows by eroding a groove in the bottom of the channel (incising), whicb increases the force of the water against the channel (shear stress) and bed mobilization (Doyle *et al.* 2000, p. 156). Hydrological variability influences the distribution of mussels in streams, with distinct communities associated with hydrologically flashy and hydrologically stable streams (Di Maio and Corkum 1995, p. 669). High shear stress, peak flows, and substrate movement limits mussel communities, reduces abundance (particularly for juveniles), and increasingly dislodges mussels and moves them downstream (Layzer and Madison 1995, p. 337; Myers-Kinzie *et al.* 2002, p. 822; Gangloff and Feminella 2006, p. 70). Recruitment is also significantly reduced in high discharge years (Howard and Cuffey 2006, p. 688). Most rayed bean and snuffbox streams have been impacted by general developmental activities and increased impervious surface levels (Butler 2007, p. 88; Butler 2002, p. 25).

All rayed bean or snuffbox streams are crossed by bridges and roads. Effects from these structures were reviewed by Wheeler *et al.* (2005). Categories of impacts include primary effects (construction), secondary effects (post-construction), and indirect effects (development associated with highway presence) (Angermeier *et al.* 2004, pp. 21–24). Culverts act as barriers to fish passage (Wheeler *et al.* 2005, p. 149), particularly by increasiug flow velocity (Warren and Pardew 1998, p. 637). Stream channels become destabilized when culverted or improperly bridged by interrupting the transport of woody debris, substrate, and water (Wheeler *et al.* 2005, p. 152).

Anthropogenic activities can lower water tables, making rayed bean, snuffbox, and other mussel populations susceptible to depressed flow levels. Water withdrawals for irrigation, municipal, and industrial water supplies are an increasing concern. U.S. water consumption doubled from 1960 to 2000 and is likely to increase further (Naiman and Turner 2000, p. 960). Therefore, we anticipate water withdrawals and potential stream dewatering to be a threat to rayed bean and snuffbox in the foreseeable future.

We have identified a number of threats to the habitat of the rayed bean and snuffbox which have operated in the past, are impacting the species now, and will continue to impact the species in the foreseeable future. On the basis of this analysis, we find that the present and threatened destruction, modification, or curtailment of the species' habitats is a threat to the rayed bean and snuffbox throughout all of their range. Based on our analysis of the best available information, we have no reason to believe that the present or threatened destruction, modification, or curtailment of rayed bean or snuffbox habitat will change in the foreseeable future. The decline of the freshwater mussels in the eastern United States is primarily the result the long-lasting effects of habitat alterations such as impoundments, channelization, chemical contaminants, mining, and sedimentation. Although efforts have been made to restore habitat in some areas, the long-term effects of large-scale and wide-ranging habitat modification, destruction, and curtailment will last far into the foreseeable future.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The rayed bean and snuffbox are not commercially valuable species. Rare species like the rayed bean and snuffbox may increasingly be sought by lay and experienced collectors. Most stream reaches inhabited by these species are restricted, and their populations are generally small. Although scientific collecting is not thought to represent a significant threat, localized populations could become impacted and possibly extirpated by over-collecting, particularly if this activity is unregulated. Native Americans were known to harvest the rayed bean for food, but because of its size, utilization rates were very low (Bogan 1990, p. 134). Localized declines of snuffbox from use as bait by fishermen has been noted (Cumberland River; Wilson and Clark 1914, p. 45), although it is unlikely that exploitation activities have eliminated any snuffbox populations.

On the basis of this analysis, we find that overutilization for commercial, recreational, scientific, or educational purposes is not now a threat to the rayed bean or snuffbox in any portion of their range or likely to become a significant threat in the foreseeable future.

C. Disease or Predation

Little is known about diseases in freshwater mussels (Grizzle and Brunner 2007). However, mussel die-offs have been documented in rayed bean and snuffbox streams (Neves 1986, p. 9), and some researchers believe that disease may be a factor contributing to the die-offs (Buchanan 1986, p. 53; Neves 1986, p. 11). Mussel parasites include water mites, trematodes, oligochaetes, leeches, copepods, bacteria, and protozoa (Grizzle and Brunner 2007). Generally, parasites are not suspected of being a major limiting factor (Oesch 1984, p. 16), but a recent study provides contrary evidence. Reproductive output and physiological condition were negatively correlated with mite and trematode abundance, respectively (Gangloff and Feminella 2004). Stressors that reduce fitness may make mussels more susceptible to parasites (Butler 2007, p. 90). Furthermore, nonnative mussels may carry diseases and parasites that are potentially devastating to native mussel fauna, including rayed bean and snuffbox (Strayer 1999b, p.88).

The muskrat (*Ondatra zibethicus*) is cited as the most prevalent mussel predator (Kunz 1898, p. 328; Hanson *et al.* 1989, p. 15). Muskrat predation may limit the recovery potential of endangered mussels or contribute to local extirpations of previously stressed populations, according to Neves and Odom (1989, p. 940), but they consider it primarily a seasonal or localized threat. The snuffbox ranked fourth among 12 species in a St. Croix River muskrat midden, being nearly four times more abundant than in quantitative surveys (Tyrrell and Hornbach 1998, p. 304). Numbers were too low to determine selectivity indices or statistics.

Muskrats were not thought to be a threat to the rayed bean by West *et al.* (2000, pp. 255–256), due to their general selection of mussels larger than 1.4–1.6 in (3.6–4.1 cm) long (Convey *et al.* 1989, p. 656; Hanson *et al.* 1989, p. 24). Neves and Odom (1989, pp. 938–939) also noted that muskrats did not select for small mussels. Nevertheless, some muskrat predation on the rayed bean has recently been documented in Cassadaga Creek, New York, but is generally considered insignificant.

Other mammals (raccoon (*Procyon lotor*), mink (*Mustela vison*), river otter (*Lutra Canadensis*), striped skunk (*Mephitis mephitis*), hog (*Sus scrofa*), rat (*Rattus spp.*)), amphibians (hellbender (*Cryptobranchus alleganiensis*)), turtles, aquatic birds, and fishes (freshwater drum (*Aplodinotus grunniens*), redear sunfish (*Lepomis microlophus*)) feed on mussels (Kunz 1898, p. 328; Meek and Clark 1912, p. 6; Neck 1986, p. 64; Tyrrell and Hornbach 1998, p. 301). Hydra, non-biting midge larvae, dragonfly larvae, crayfish, and especially flatworms are invertebrate predators on newly metamorphosed juveniles (Zimmerman and Neves 2003, p. 28; Klocker and Strayer 2004, p. 174). The overall threat posed by these predators ou the rayed bean and snuffbox is not considered significant.

Studies indicate that in some localized areas, disease and predation may have a negative impact on mussel populations. However, based on our analysis of the best available information, we do not believe that disease or predation is a significant threat to the overall status of rayed bean or snuffbox, nor do we believe that it is likely to become a significant threat in the foreseeable future.

D. The Inadequacy of Existing Regulatory Mechanisms

Most States with extant rayed bean and snuffbox populations prohibit collection of mussels without a State collecting permit. However, enforcement of this permit requirement is difficult.

Sources of nonpoint source pollution include timber clearcutting, clearing of riparian vegetation, urbanization, road construction, and other practices that allow bare earth to enter streams (The Nature Conservancy 2004, p. 13). Current laws do not adequately protect rayed bean and snuffbox habitat from nonpoint source pollution, as the laws to prevent sediment entering waterways are poorly enforced. Best management practices for sediment and erosion control are often recommended or required by local ordinances for construction projects; however, compliance, monitoring, and enforcement of these recommendations are often poorly implemented. Furthermore, there are currently no requirements within the scope of Federal environmental laws to specifically consider the rayed bean or snuffbox during Federal activities, or to ensure that Federal projects will not jeopardize their continued existence.

Point source discharges within the range of the rayed bean and snuffbox have been reduced since the inception of the Clean Water Act (33 U.S.C. 1251 *et seq.*), but this may not provide adequate protection for filter-feeding organisms that can be impacted by extremely low levels of contaminants (*see* Chemical Contaminants discussion under Factor A). There is no specific information on the sensitivity of the rayed bean and snuffbox to common industrial and municipal pollutants, and very little information on other freshwater mussels. Therefore, it appears that a lack of adequate research and data prevents existing regulations, such as the Clean Water Act (administered by the EPA and the U.S. Army Corps of Engineers), from being fully used or effective.

Despite these existing regulatory mechanisms, the rayed bean and snuffbox continue to decline due to the effects of habitat destruction, poor water quality, contaminants, and other factors. We find that these regulatory measures have been insufficient to significantly reduce or remove the threats to the rayed bean and snuffbox and, therefore, that the inadequacy of existing regulatory mechanisms is a threat to these species throughout all of their range.

Based on our analysis of the best available information, we have no reason to believe that the aforementioned regulations, which currently do not offer adequate protection to the rayed bean and snuffbox, will be improved in the foreseeable future.

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Other factors have played a role in the decline of rayed bean and snuffbox populations. Reduced uumbers of host fish have an indirect impact by contributing to reduced recruitment (Watters 1996, p. 83; Khym and Layzer 2000, p. 183). Factors associated with climate change likely to affect regional mussel populations include changes in stream temperature regimes and precipitation levels that may indirectly result in redнced habitat and declines in host fish stocks (Hastie *et al.* 2003, p. 44). Remedial (such as flood control structures) and preventative (for example, more renewable energy from hydroelectric facilities to reduce greenhouse gas emissions) measures to address climate change issues (Hastie *et al.* 2003, p. 45) may impact rayed bean and snuffbox populations in the future.

Population Fragmentation and Isolation—The majority of the remaining populations of the rayed bean and snuffbox are generally small and geographically isolated. The patchy distributional pattern of populations in short river reaches makes them much more susceptible to extirpation from single catastrophic events, such as toxic chemical spills (Watters and Dunn 1993–94, p. 257). Furthermore, this level of isolation makes natural repopulation of any extirpated population unlikely without human intervention. Population isolation prohibits the natural interchange of genetic material between populations, and small population size reduces the reservoir of genetic diversity within populations, which can lead to inbreeding depression (Avise and Hambrick 1996, p. 461).

The Scioto River system provides a good example of the impacts of population fragmentation and isolation. Historically, the rayed bean and snuffbox were widespread and locally abundant in the mainstem and numerous tributaries. The Scioto River became highly contaminated over a century ago (Trautman 1981, p. 33; Yoder *et al.* 2005, p. 410), and these species eventually died out in the mainstem and most tributaries. The population segments that persist have become increasingly isolated due to impoundments and other factors; all are very small, highly fragmented, and appear to be on a trend towards extirpation.

Many rayed bean and snuffbox populations are potentially below the effective population size (EPS) required to maintain genetic heterogeneity and population viability (Soulé 1980, p. 162). Isolated populations eventually die out when population size drops below the EPS or threshold level of sustainability. Recruitment reduction or failure is a potential problem for many small rayed bean and snuffbox populations rangewide, a condition likely exacerbated by their reduced range and increasingly isolated populations. Evidence of recruitment has not been documented in many populations, indicating that recruitment reduction or outright failure is possible. Many populations of both species may be experiencing the bottleneck effect of not attaining EPS. Small, isolated, below EPS-threshold populations of short-lived species (most host fishes) theoretically die out within a decade or so, while below-threshold populations of long-lived species (like the rayed bean and snuffbox) might take decades to die out even given years of total recruitment failure.

We find that fragmentation and isolation of small remaining populations of the rayed bean and snuffbox are current and ongoing threats to both species throughout all of their range that will continue into the foreseeable future.

Exotic Species—Various exotic or nonnative species of aquatic organisms are firmly established in the range of the rayed bean and snuffbox. The exotic species that poses the most significant threat to the rayed bean and snuffbox is the zebra mussel (*Dreissena polymorpha*). The invasion of the zebra mussel poses a threat to the mussel fauna in many regions, and species extinctions are expected as a result of its continued spread in the eastern United States (Ricciardi *et al.* 1998, p. 616). Strayer (1999b, pp. 77–80) reviewed in detail the mechanisms by which zebra mussels impact native mussels. The primary means of impact is direct fouling of the shells of live native mussels. Zebra mussels attach in large numbers to the shells of live native mussels and are implicated in the loss of entire native mussel beds. Fouling impacts include impeding locomotion (both laterally and vertically), interfering with normal valve movements, deforming valve margins, and locally depleting food resources and increasing waste products. Heavy infestations of zebra mussels on native mussels may overly stress the animals by reducing their energy stores. They may also reduce food concentrations to levels too low to support reproduction, or even survival in extreme cases.

Another way zebra mussels may impact native mussels is through filtering their sperm and possibly glochidia from the water column, thus reducing reproductive potential. Habitat for native mussels may also be degraded by large deposits of zebra mussel pseudofeces (undigested waste material passed out of the incurrent siphon) (Vaughan 1997, p. 11). Additionally, an indirect impact is the proliferation of aquatic plants from increased water clarity in lakes, which in turn has prompted managers to increase the use of herbicides that may threaten mussels via food reduction (Marangelo 2005b, pers. comm.).

Zebra mussels are thoroughly established in the Great Lakes drainages and much of the Ohio River system, overlapping much of the current range of the rayed bean and snuffbox. Zebra mussels have eliminated populations of the rayed bean in Lakes Erie and Tippecanoe and the Detroit River. The greatest current potential for zebra mussels to impact the rayed bean and snuffbox are in the Lake St. Clair drainages, Allegheny River, Tippecanoe River, French Creek, and Lake Maxinkuckee. In addition, there is long-term potential for zebra mussel invasions into other systems that currently harbor rayed bean and snuffbox populations. However, zebra mussels are not always a serious threat to rayed bean and snuffbox (Tippecanoe River, Fisher 2005, pers. comm.; Clinton River, Butler 2007, p. 94; French Creek, Butler 2007, p. 94). Significant but highly fluctuating zebra mussel populations remain largely restricted to navigational waterways, although smaller streams have also had their mussel fauna virtually eliminated by them (Martel *et al.* 2001, p. 2188). At least two of the stronghold snuffbox populations (Wolf River and French Creek) presently have low numbers of zebra mussels.

The Asian clam (*Corbicula fluminea*) has spread throughout the range of the rayed bean and snuffbox since its introduction in the mid-1900s. Asian clams compete with native mussels, especially juveniles, for food, nutrients, and space (Neves and Widlak 1987, p. 6; Leff *et al.* 1990, p. 415) and may ingest sperm, glochidia, and newly metamorphosed juveniles of native mussels (Strayer 1999b, p. 82; Yeager *et al.* 2001, p. 257). Dense Asian clam populations actively disturb sediments that may reduce habitat for juvenile mussels (Strayer 1999b, p. 82).

Asian clam densities vary widely in the absence of native mussels or in patches with sparse mussel concentrations, but clam density is never high in dense mussel beds, indicating that the clam is unable to successfully invade small-scale habitat patches with high unionid biomass

(Vaughn and Spooner 2006, p. 335). The invading clam therefore appears to preferentially invade sites where mussels are already in decline (Strayer 1999b, p. 82; Vaughn and Spooner 2006, p. 332) and does not appear be a causative factor in the decline of mussels in dense beds. However, an Asian clam population that thrives in previously stressed, sparse mussel populations can exacerbate unionid imperilment through competition and impeding mussel population expansion (Vaughn and Spooner 2006, p. 335).

The round goby (*Neogobius melanostomus*) is another exotic fish species released into the Great Lakes that is well established and likely to spread through the Mississippi River system (Strayer 1999b, pp. 87–88). This species is an aggressive competitor of similar sized benthic fish (sculpins, darters) as well as a voracious carnivore despite its size (less than 10 in. (25.4 cm) in length), preying on a variety of foods, including small mussels and fishes that could serve as glochidial hosts (Strayer 1999b, p. 88; Janssen and Jude 2001, p. 325). Round gobies may therefore have indirect effects on the rayed bean and snuffbox through negative impacts to their host fishes.

Additional exotic species will invariably become established in the foreseeable future (Strayer 1999b, pp. 88–89). These include *Limnoperna fortunei,* a biofouling mussel (an animal that undesirably accumulates on wetted surfaces) from southeast Asia that has already spread to Japan and South America, and "probably will have strong effects" on native mussels (Strayer 1999b, p. 89). Exotic species could carry diseases and parasites that may be devastating to the native biota. Because of our ignorance of mollusk diseases and parasites, "it is imprudent to conclude that alien diseases and parasites are unimportant" (Strayer 1999b, p. 88).

Exotic species, such as those described above, are an ongoing threat to the rayed bean and snuffbox—a threat that is likely to increase as these exotic species expand their occupancy within the range of the rayed bean and snuffbox.

Summary of Threats

The decline of the rayed bean and snuffbox (described by Butler 2002, 2007) is primarily the result of habitat loss and degradation (Neves 1991, p. 252). These losses have been well documented since the mid-19th century (Higgins 1858, p. 551). Chief among the causes of decline are impoundments, channelization, chemical contaminants, mining, and sedimentation (Neves 1991, pp. 260–261; 1993, p. 4–5; Williams *et al.* 1993, p. 7; Neves *et al.* 1997, pp. 60–72; Watters 2000, p. 269). These stressors have had profound impacts on rayed bean and snuffbox populations and their habitat.

The majority of the remaining populations of the rayed bean and snuffbox are generally small and geographically isolated (Butler 2002, 2007). The patchy distributional pattern of populations in short river reaches makes those populations much more susceptible to extirpation from single catastrophic events, such as toxic chemical spills (Watters and Dunn 1993–94, p. 257). Furthermore, this level of isolation makes natural repopulation of any extirpated population virtually impossible without human intervention. Various nonnative species of aquatic organisms are firmly established in the range of the rayed bean and snuffbox; however, the exotic species that poses the most significant threat to the rayed bean and snuffbox is the zebra mussel (*Dreissena polymorpha*) (Butler 2002, p. 27; 2007, p. 93).

Proposed Determination

Section 3 of the Act defines an endangered species as any species that is "in danger of extinction throughout all or a significant portion of its range" and a threatened species as any species that "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." We find that the rayed bean and snuffbox are presently in danger of extinction throughout their entire range, based on the immediacy, severity, and scope of the threats described above. Although there are ongoing attempts to alleviate some threats, there appear to be no populations without current significant threats and many threats are without obvious or readily available solutions. Therefore, on the basis of the best available scientific and commercial information, we propose listing the rayed bean and snuffbox as endangered in accordance with sections 3(6) and 4(a)(1) of the Act.

Under the Act and our implementing regulations, a species may warrant listing if it is endangered or threatened throughout all or a significant portion of its range. Threats to the rayed bean and snuffbox occur throughout their range. Therefore, we assessed the status of the species throughout their entire range. The threats to the survival of the species occur throughout the species' ranges and are not restricted to any particular significant portion of those ranges. Accordingly, our assessment and proposed determination applies to the species throughout their entire range.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness and conservation by Federal, State, Tribal, and local agencies, private organizations, and individuals. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed species. The protection required by Federal agencies and the prohibitions against certain activities are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed, preparation of a draft and final recovery plan, and revisions to the plan as significant new information becomes available. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. The recovery plan identifies site-specific management actions that will achieve recovery of the species, measurable criteria that determine when a species may be downlisted or delisted, and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (comprised of species experts, Federal and State agencies, non-government organizations, and stakeholders) are often established to develop recovery plans. When completed, the recovery outline, draft recovery plan, and the

final recovery plan will be available on our Web site (*http://www.fws.gov/endangered*), or from our Ohio Ecological Services Field Office (*see* **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, Tribal, non-governmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (*e.g.,* restoration of native vegetation), research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on private, State, and Tribal lands.

If this species is listed, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost share grants for non-Federal landowners, the academic community, and nongovernmental organizations. Additionally, under section 6 of the Act, we would be able to grant funds to the States of Illinois, Indiana, Kentucky, Michigan, New York, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia for management actions promoting the conservation of the rayed bean and to the States of Alabama, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Mississippi, Missouri, New York, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin for the conservation of the snuffbox. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants.*

Although the rayed bean and snuffbox are only proposed for listing under the Act at this time, please let us know if you are interested in participating in recovery efforts for these species. Additionally, we invite you to submit any new information on these species whenever it becomes available and any information you may have for recovery planning purposes; if you submit information after the date listed in the **DATES** section above, you will need to send it to the street address provided in the **FOR FURTHER INFORMATION CONTACT** section.

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and with respect to its critical habitat, if any is being designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(4) requires Federal agencies to confer informally with us on any action that is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of such a species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with us.

Federal agency actions that may require conference or consultation as described in the preceding paragraph include the issuance of permits for reservoir construction, stream alterations, wastewater facility development, water withdrawal projects, pesticide registration, agricultural assistance programs, mining, road and bridge construction, and Federal loan programs. Activities will trigger consultation under section 7 of the Act if tbey may affect the rayed bean or snuffbox, or both species, addressed in this proposed rule.

Jeopardy Standard

Prior to and following listing and designation of critical habitat, if prudent and determinable, the Service applies an analytical framework for jeopardy analyses that relies heavily on the importance of core area populations to the survival and recovery of the species. The section 7(a)(2) analysis is focused not only on these populations but also on the habitat conditions necessary to support them.

The jeopardy analysis usually expresses the survival and recovery needs of the species in a qualitative fashion without making distinctions between what is necessary for survival and what is necessary for recovery. Generally, if a proposed Federal action is incompatible with the viability of the affected core area populations(s), inclusive of associated habitat conditions, a jeopardy finding is considered to be warranted, because of the relationship of each core area population to the survival and recovery of the species as a whole.

Section 9 Take

The Act and implementing regulations set forth a series of general prohibitions and exceptions that apply to all endangered and threatened wildlife. If we finalize listing of the rayed bean and snuffbox, these prohibitions would be applicable to the rayed bean and snuffbox. The prohibitions of section 9(a)(2) of the Act, codified at 50 CFR 17.21 for endangered wildlife, in part, make it illegal for any person subject to the jurisdiction of the United States to take (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt any of these), import or export, deliver, receive, carry, transport, or ship in interstate or foreign commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any listed species. It also is illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Further, it is illegal for any person to attempt to commit, to solicit another person to commit, or to cause to be committed, any of these acts. Certain exceptions apply to our agents and State conservation agencies.

We may issue permits to carry out otherwise prohibited activities involving endangered wildlife under certain circumstances. We codified the regulations governing permits for endangered species at 50 CFR 17.22. Such permits are available for scientific purposes, to enhance the propagation or survival of the species, or for incidental take in the course of otherwise lawful activities.

It is our policy, published in the **Federal Register** on July 1, 1994 (59 FR 34272), to identify, to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act and associated regulations at 50 CFR 17.21. The intent of this policy is to increase public awareness of the effect of this proposed listing on proposed and ongoing activities within a species' range. We believe, based on the best available information, that the following actions will not result in a violation of the provisions of section 9 of the Act, provided these actions are carried out in accordance with existing regulations and permit requirements:

(1) Activities authorized, funded, or carried out by Federal agencies (*e.g.,* bridge and highway construction, pipeline construction, hydropower licensing, *etc.*), when such activities are conducted in accordance with the consultation and planning requirements for listed species under section 7 of the Act.

(2) Any action carried out for scientific research or to enhance the propagation or survival of the rayed bean or snuffbox that is conducted in

accordance with the conditions of a 50 CFR 17.22 permit.

(3) Any incidental take of rayed bean or snuffbox resulting from an otherwise lawful activity conducted in accordance with the conditions of an incidental take permit issued under 50 CFR 17.22. Non-Federal applicants may design a habitat conservation plan (HCP) for the species and apply for an incidental take permit. HCPs may be developed for listed species and are designed to minimize and mitigate impacts to the species to the greatest extent practicable.

We believe the following activities would be likely to result in a violation of section 9 of the Act; however, possible violations are not limited to these actions alone:

(1) Unauthorized killing, collecting, handling, or harassing of individual rayed bean or snuffbox, or both species, at any life stage.

(2) Sale or offer for sale of rayed bean or snuffbox in addition to delivering, receiving, carrying, transporting, or shipping in interstate or foreign commerce any rayed bean or snuffbox.

(3) Unauthorized destruction or alteration of the species' habitat (instream dredging, channelization, impoundment, streambank clearing, discharge of fill material) that actually kills or injures individual rayed bean or snuffbox by significantly impairing their essential behavioral patterns, including breeding, feeding, or sheltering.

(4) Violation of any discharge or water withdrawal permit within these species' occupied ranges that results in the death or injury of individual rayed bean or snuffbox by significantly impairing their essential behavioral patterns, including breeding, feeding, or sheltering.

(5) Discharge or dumping of toxic chemicals or other pollutants into waters supporting the species that actually kills or injures individual rayed bean or snuffbox by significantly impairing their essential behavioral patterns, including breeding, feeding, or sheltering.

We will review other activities not identified above on a case-by-case basis to determine whether they may be likely to result in a violation of section 9 of the Act. We do not consider these lists to be exhaustive, and provide them as information to the public.

You should direct questions regarding whether specific activities may constitute a future violation of section 9 of the Act to the Field Supervisor of the Service's Ohio Ecological Services Field Office (*see* **FOR FURTHER INFORMATION CONTACT** section). Requests for copies of regulations regarding listed species and inquiries about prohibitions and permits should be addressed to the U.S. Fish and Wildlife Service, Ecological Services Division, Henry Whipple Federal Building, 1 Federal Drive, Fort Snelling, MN 55111 (Phone 612–713–5350; Fax 612–713–5292).

Critical Habitat

Background

Critical habitat is defined in section 3 of the Act as:

(i) The specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features

(I) Essential to the conservation of the species and

(II) That may require special management considerations or protection; and

(ii) Specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.

"Conservation" is defined in section 3 of the Act as meaning the use of all methods and procedures needed to bring the species to the point at which listing under the Act is no longer necessary.

Critical habitat receives protection under section 7 of the Act through the prohibition against Federal agencies carrying out, funding, or autborizing the destruction or adverse modification of critical habitat. Section 7(a)(2) requires consultation on Federal actions that may affect critical habitat. The designation of critical habitat does not affect land ownership or establish a refuge, wilderness, reserve, preserve, or other conservation area. Such designatiou does not allow the government or public to access private lands. Such designation does not require implementation of restoration, recovery, or enhancement measures by non-Federal landowners. Where a landowner seeks or requests Federal agency funding or authorization for an action that may affect a listed species or critical habitat, the consultation requirements of section 7(a)(2) of the Act would apply, but even in the event of a destruction or adverse modification finding, Federal action agency's and the applicant's obligation is not to restore or recover the species, but to implement reasonable and prudent alternatives to avoid destruction or adverse modification of critical habitat.

For inclusion in a critical habitat designation, the habitat within the geographical area occupied by the species at the time it was listed must contain the physical and biological features essential to the conservation of the species, and be included only if those features may require special management considerations or protection. Critical habitat designations identify, to the extent known using the best scientific and commercial data available, habitat areas that provide essential life cycle needs of the species (areas on which are found the physical and biological features (PBFs) laid out in the appropriate quantity and spatial arrangement for the conservation of the species). Under the Act and regulations at 50 CFR 424.12, we can designate critical habitat in areas outside the geographical area occupied by the species at the time it is listed only when we determine that those areas are essential for the conservation of the species and that designation limited to those areas occupied at the time of listing would be inadequate to ensure the conservation of the species.

Section 4 of the Act requires that we designate critical habitat on the basis of the best scientific and commercial data available. Further, our Policy on Information Standards Under the Endangered Species Act (published in the **Federal Register** on July 1, 1994 (59 FR 34271)), the Information Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Pub. L. 106–554; H.R. 5658)), and our associated Information Quality Guidelines, provide criteria, establish procedures, and provide guidance to ensure that our decisions are based on the best scientific data available. They require our biologists, to the extent consistent with the Act and with the use of the best scientific data available, to use primary and original sources of information as the basis for recommendations to designate critical habitat.

When we are determining which areas should be designated as critical habitat, our primary source of information is generally the information developed during the listing process for the species. Additional information sources may include the recovery plan for the species, articles in peer-reviewed journals, conservation plans developed by States and counties, scientific status surveys and studies, biological assessments, or other unpublished materials and expert opinion or personal knowledge.

Habitat is often dynamic, and species may move from one area to another over time. Furthermore, we recognize that critical habitat designated at a particular point in time may not include all of the habitat areas that we may later determine are necessary for the recovery of the species. For these reasons, a

critical habitat designation does not signal that habitat outside the designated area is unimportant or may not be required for recovery of the species.

Areas that are important to the conservation of the species, but are outside the critical habitat designation, will continue to be subject to conservation actions we implement under section 7(a)(1) of the Act. Areas that support populations are also subject to the regulatory protections afforded by the section 7(a)(2) jeopardy standard, as determined on the basis of the best available scientific information at the time of the agency action. Federally funded or permitted projects affecting listed species outside their designated critical habitat areas may still result in jeopardy findings in some cases. Similarly, critical habitat designations made on the basis of the best available information at the time of designation will not control the direction and substance of future recovery plans, habitat conservation plans (HCPs), or other species conservation planning efforts if new information available at the time of these planning efforts calls for a different outcome.

Prudency Determination

Section 4(a)(3) of the Act, as amended, and implementing regulations (50 CFR 424.12), require that, to the maximum extent prudent and determinable, we designate critical habitat at the time we determine that a species is endangered or threatened. Our regulations (50 CFR 424.12(a)(1)) state that the designation of critical habitat is not prudent when one or both of the following situations exist: (1) The species is threatened by takiug or other human activity, and identification of critical habitat can be expected to increase the degree of threat to the species, or (2) such designation of critical habitat would not be beneficial to the species.

There is currently no imminent threat of take attributed to collection or vandalism under Factor B (overutilization for commercial, recreational, scientific, or educational purposes) for the rayed bean or snuffbox, and identification of critical habitat is not expected to initiate such a threat. In the absence of finding that the designation of critical habitat would increase threats to a species, if there are any benefits to a critical habitat designation, then a prudent finding is warranted. The potential benefits include: (1) Triggering consultation under section 7(a)(2) of the Act, in new areas for actions in which there may be a Federal nexus where it would not otherwise occur because the species may not be present; (2) focusing conservation activities on the most essential habitat features and areas; (3) increasing awareness of important habitat areas among State or county governments, or private entities; and (4) preventing inadvertent harm to the species.

Critical habitat designation includes the identification of the physical and biological features of the habitat essential to the conservation of each species that may require special management and protection. As such, these designations will provide useful information to individuals, local and State governments, and other entities engaged in activities or long-range planning that may affect areas essential to the conservation of the species. Conservation of the rayed bean and snuffbox and essential features of their habitats will require habitat management, protection, and restoration, which will be facilitated by disseminating information on the locations and the key physical and biological features of those habitats. In the case of the rayed bean and snuffbox, these aspects of critical habitat designation would potentially benefit the conservation of the species. Therefore, since we have determined that the designation of critical habitat will not likely increase the degree of threat to these species and may provide some measure of benefit, we find that designation of critical habitat is prudent for the rayed bean and snuffbox.

Critical Habitat Determinability

As stated above, section 4(a)(3) of the Act requires the designation of critical habitat concurrently with the species' listing "to the maximum extent prudent and determinable." Our regulations at 50 CFR 424.12(a)(2) state that critical habitat is not determinable when one or both of the following situations exist:

(i) Information sufficient to perform required analyses of the impacts of the designation is lacking, or

(ii) The biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat.

When critical habitat is not determinable, the Act provides for an additional year to publish a critical habitat designation (16 U.S.C. 1533(b)(6)(C)(ii)).

In accordance with sections 3(5)(A)(i) and 4(b)(1)(A) of the Act and regulations at 50 CFR 424.12, in determining which areas to propose as critical habitat, we must consider those physical and biological features essential to the conservation of the species. These include, but are not limited to:

(1) Space for individual and population growth and for normal behavior;

(2) Food, water, air, light, minerals, or other nutritional or physiological requirements;

(3) Cover or shelter;

(4) Sites for breeding, reproduction, and rearing (or development) of offspring; and

(5) Habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distribution of a species.

We are currently unable to identify the physical and biological features essential for the conservation of the rayed bean and snuffbox because information on those features for these species is not known at this time. The apparent poor viability of the species' occurrences observed in recent years indicates that current conditions are not sufficient to meet the basic biological requirements of these species in many rivers. Since the rayed bean and snuffbox have not been observed for decades in many of their historical locations, and much of the habitat in which they still persist has been drastically altered, the optimal conditions that would provide the biological or ecological requisites of these species are not known. Although we can surmise that habitat degradation from a variety of factors has contributed to the decline of these species, we do not know specifically what essential physical or biological features of that habitat are currently lacking for the rayed bean and snuffbox.

Key features of the basic life history, ecology, reproductive biology, and habitat requirements of most mussels, including the rayed bean and snuffbox, are unknown. Species-specific ecological requirements have not been determined (for example, minimum water flow and effects of particular pollutants). Population dynamics, such as species' interactions and community structure, population trends, and population size aud age class structure necessary to maintain long-term viability, have not been determined for these species. Of particular concern to both species is that many of the remaining rayed bean and snuffbox populations consist of very low densities, which limit our ability to investigate their population dynamics. Basics of reproductive biology for these species are unknown, such as age and size at earliest maturity, reproductive longevity, and the level of recruitment needed for species' survival and long-term viability. As we are unable to

identify many physical and biological features essential to the conservation of the rayed bean and snuffbox, we are unable to identify areas that contain these features. Therefore, although we have determined that the designation of critical habitat is prudent for the rayed bean and snuffbox, because the biological and physical requirements of these species are not sufficiently known, we find that critical habitat for the rayed bean and snuffbox is not determinable at this time.

Peer Review

In accordance with our policy, "Notice of Interagency Cooperative Policy for Peer Review in Endangered Species Act Activities," that was published on July 1, 1994 (59 FR 34270), we will seek the expert opinion of at least three appropriate independent specialists regarding this proposed rule. The purpose of such review is to ensure listing decisions are based on scientifically sound data, assumptions, and analysis. We will send copies of this proposed rule to the peer reviewers immediately following publication in the **Federal Register**. We will invite these peer reviewers to comment, during the public comment period, on the specific assumptions and the data that are the basis for our conclusions regarding the proposal to list rayed bean and snuffbox as endangered and our proposal regarding critical habitat for this species.

We will consider all comments and information we receive during the comment period on this proposed rule during preparation of a final rulemaking. Accordingly, our final decision may differ from this proposal.

Public Hearings

The Act provides for one or more public hearings on this proposal, if requested. Requests must be received within 45 days after the date of publication of this proposal in the **Federal Register** (*see* **DATES**). Such requests must be sent to the address shown in the **FOR FURTHER INFORMATION CONTACT** section. We will schedule public hearings on this proposal, if any are requested, and announce the dates, times, and places of those hearings, as well as how to obtain reasonable accommodation, in the **Federal Register** and local newspapers at least 15 days before the hearing.

Persons needing reasonable accommodation to attend and participate in a pnblic hearing should contact the Ohio Ecological Services Field Office at 614–416–8993, ext. 22, as soon as possible. To allow sufficient time to process requests, please call no later than one week before the hearing date. Information regarding this proposed rule is available in alternative formats upon request.

Required Determinations

Clarity of Rule

We are required by Executive Orders 12866 and 12988 and by the Presidential Memorandum of June 1, 1998, to write all rules in plain language. This means that each rule we publish must:

(a) Be logically organized;

(b) Use the active voice to address readers directly;

(c) Use clear language rather than jargon;

(d) Be divided into short sections and sentences; and

(e) Use lists and tables wherever possible.

If you feel that we have not met these requirements, send us comments by one of the methods listed in the **ADDRESSES** section. To better help us revise the rule, your comments should be as specific as possible. For example, you should tell us the names of the sections or paragraphs that are unclearly written, which sections or sentences are too long, the sections where you feel lists or tables would be useful, etc.

Paperwork Reduction Act (44 U.S.C. 3501, et seq.)

This proposed rule does not contain any new collections of information that require approval by the Office of Management and Budget (OMB) under the Paperwork Reduction Act. This rule will not impose new recordkeeping or reporting requirements on State or local governments, individuals, businesses, or organizations. We may not conduct or sponsor and you are not required to respond to a collection of information unless it displays a currently valid OMB control number.

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

We have determined that we do not need to prepare an environmental assessment, as defined under the authority of the National Environmental Policy Act of 1969, in connection with regulations adopted under section 4(a) of the Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

References Cited

A complete list of all references cited in this proposed rule is available on the Internet at *http://www.regulations.gov* or upon request from the Field Supervisor, Ohio Ecological Services Field Office (*see* **FOR FURTHER INFORMATION CONTACT** section).

Author

The primary author of this proposed rule is Angela Boyer of the Ohio Ecological Services Field Office (*see* **FOR FURTHER INFORMATION CONTACT** section).

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Proposed Regulation Promulgation

Accordingly, we propose to amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as follows:

PART 17—[AMENDED]

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500; unless otherwise noted.

2. Amend § 17.11(h) by adding new entries for "Mussel, rayed bean" and "Mussel, snuffbox" in alphabetical order under CLAMS to the List of Endangered and Threatened Wildlife as follows:

§ 17.11 Endangered and threatened wildlife.

* * * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
*	*	*	*	*	*	*	

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
CLAMS							
*	*	* *		*	*	*	
Mussel, rayed bean	*Villosa fabalis*	U.S.A. (IL, IN, KY, MI, NY, OH, PA, TN, VA, WV, WI).	NA	E	.....	NA	NA
*	*	* *		*	*	*	
Mussel, snuffbox	*Epioblasma triquetra* ...	U.S.A. (AL, AR, IL, IN, IA, KS, KY, MI, MN, MS, MO, NY, OH, PA, TN, VA, WV, WI).	NA	E	.....	NA	NA
*	*	* *		*	*	*	

* * * * *

Dated: October 15, 2010.

Gary D. Frazer,

Acting Director, U.S. Fish and Wildlife Service.

[FR Doc. 2010–27413 Filed 11–1–10; 8:45 am]

BILLING CODE 4310–55–P

Letter from: David Denk, New York State Department
of Environmental Conservation
To: Tracy Kindlon, Daigler Engineering, P.C.

Letter of No Jurisdiction for Endangered and Threatened Species

July 25, 2011

New York State Department of Environmental Conservation
Division of Environmental Permits, Region 9
270 Michigan Avenue, Buffalo, New York, 14203-2915
Phone: (716) 851-7165 · **Fax:** (716) 851-7168
Website: www.dec.ny.gov

Joe Martens
Commissioner

July 25, 2011

Ms. Tracy Kindlon
Daigler Engineering, P.C.
1711 Grand Island Boulevard
Grand Island, New York 14072

Letter of No Jurisdiction for
Endangered and Threatened Species
Proposed Sealand C&D Landfill
Town of Carroll, Chautauqua County
DEC No. 9-0624-00025/00002

Dear Ms. Kindlon:

This office received your Request for Determination pursuant to 6 NYCRR Part 182 for the proposed Sealand Waste, LLC C&D Landfill in the Town of Carroll. The New York State Department of Environmental Conservation (the Department) has determined that this proposal is not likely to result in the take of threatened or endangered species. This determination is based on the information in your request received on June 23, 2011 and information in the Department's Natural Heritage Program database. Accordingly, no permit is required at this time pursuant to the implementing regulations (6NYCRR Part 182) of the New York State Endangered and Threatened Species Law (Article 11-0535).

Be advised that any changes in location, expansion of the footprint of the project, modifications of the scope, or changes in the timing of proposed action that are not identified in the submission referenced above may trigger Department jurisdiction. Please reinitiate contact with this office if such activities are contemplated.

Please note that this letter does not relieve you of the responsibility of obtaining all other necessary permits or approvals from other agencies or local municipalities.

Sincerely,

David S. Denk
Regional Permit Administrator

ec: Mr. Mark Kandel, NYSDEC DFWMR
Mr. Charles Cranston, NYSDEC DEP

Letter from: United States Department of the Interior
Fish and Wildlife Service
To: Daigler Engineering, P.C.

List of Threatened and Endangered Species

January 29, 2014

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New York Ecological Services Field Office
3817 LUKER ROAD
CORTLAND, NY 13045
PHONE: (607)753-9334 FAX: (607)753-9699
URL: www.fws.gov/northeast/nyfo/es/section7.htm

Consultation Tracking Number: 05E1NY00-2014-SLI-0327 January 29, 2014
Project Name: Carroll Landfill Expansion

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project.

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). This list can also be used to determine whether listed species may be present for projects without federal agency involvement. New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list.

Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the ESA, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC site at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list. If listed, proposed, or candidate species were identified as potentially occurring in the project area, coordination with our office is encouraged. Information on the steps involved with assessing potential impacts from projects can be found at: http://www.fws.gov/northeast/nyfo/es/section7.htm

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects

should follow the Services wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the ESA. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment

United States Department of Interior
Fish and Wildlife Service

Project name: Carroll Landfill Expansion

Official Species List

Provided by:

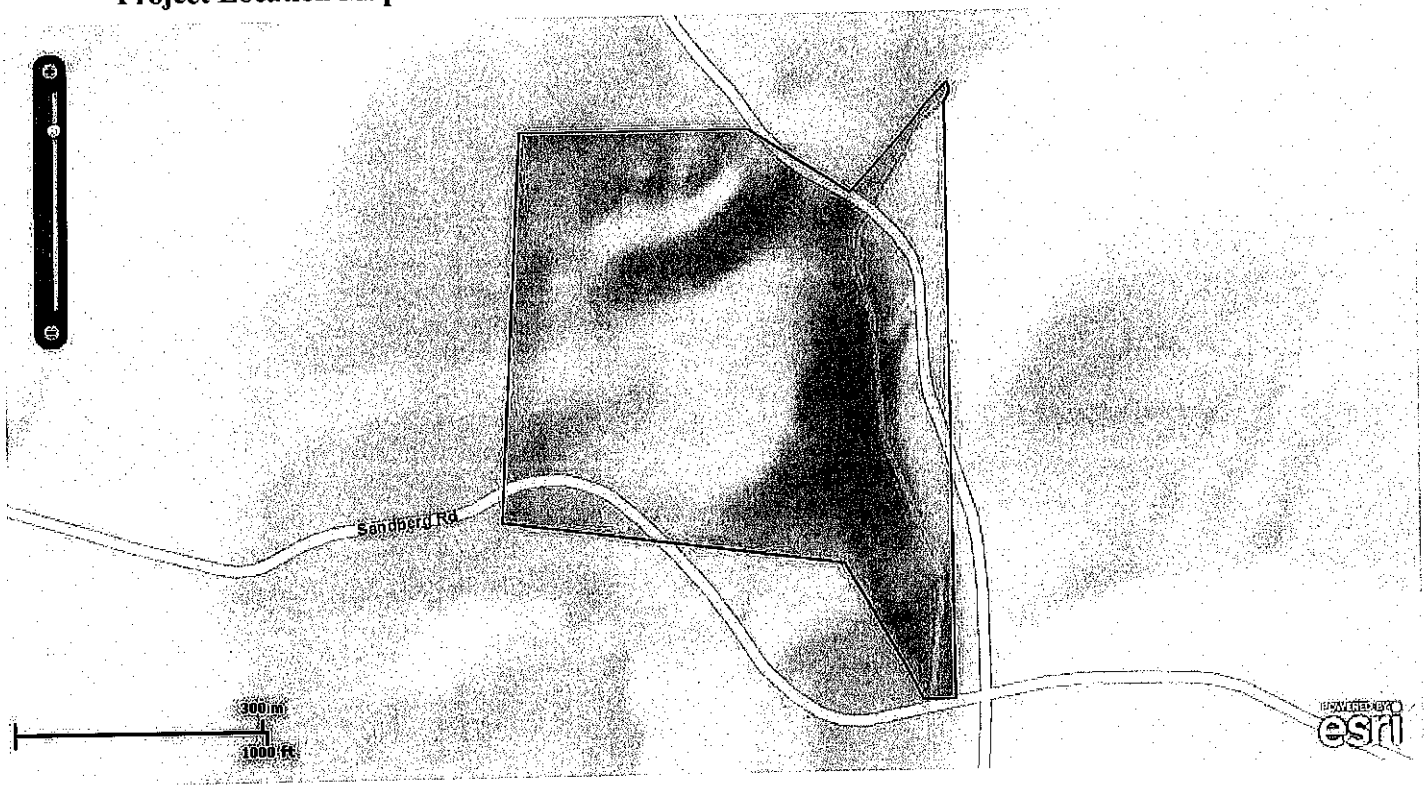
New York Ecological Services Field Office
3817 LUKER ROAD
CORTLAND, NY 13045
(607) 753-9334
http://www.fws.gov/northeast/nyfo/es/section7.htm

Consultation Tracking Number: 05E1NY00-2014-SLI-0327
Project Type: Landfill
Project Description: Project is located approximately at the dodge rd, sandberg rd intersection northeast of Frewsburg NY in the Town of Carroll. Site is approximately 53 acres.

United States Department of Interior
Fish and Wildlife Service

Project name: Carroll Landfill Expansion

Project Location Map:



Project Coordinates: MULTIPOLYGON (((-79.0837102 42.0153906, -79.0836695 42.015295, -79.0837553 42.0151674, -79.0836695 42.0087264, -79.0841394 42.0087264, -79.0853024 42.0102044, -79.0903192 42.0107034, -79.0900188 42.0149124, -79.0866735 42.0149124, -79.0851693 42.0142109, -79.0837102 42.0153906)))

Project Counties: Chautauqua, NY

United States Department of Interior
Fish and Wildlife Service

Project name: Carroll Landfill Expansion

Endangered Species Act Species List

There are a total of 3 threatened, endangered, or candidate species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Critical habitats listed on the **Has Critical Habitat** lines may or may not lie within your project area. See the **Critical habitats within your project area** section further below for critical habitat that lies within your project. Please contact the designated FWS office if you have questions.

clubshell *(Pleurobema clava)*

Population: Entire Range; Except where listed as Experimental Populations

Listing Status: Endangered

northern long-eared Bat *(Myotis septentrionalis)*

Listing Status: Proposed Endangered

Rayed Bean *(Villosa fabalis)*

Listing Status: Endangered

United States Department of Interior
Fish and Wildlife Service

Project name: Carroll Landfill Expansion

Critical habitats that lie within your project area

There are no critical habitats within your project area.

Letter from: Andrea Chaloux, New York State Department
of Environmental Conservation
New York Natural Heritage Program
To: David Lenox, Daigler Engineering, P.C.

New York Natural Heritage Program Database Review

November 14, 2016

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Division of Fish, Wildlife & Marine Resources
New York Natural Heritage Program
625 Broadway, 5th Floor, Albany, New York 12233-4757
Phone: (518) 402-8935 • **Fax:** (518) 402-8925
Website: www.dec.ny.gov

November 14, 2016

David Lenox
Daigler Engineering, P.C.
2620 Grand Island Blvd.
Grand Island, NY 14072

Re: Carroll Landfill Expansion
Town/City: Carroll. County: Chautauqua.

Dear David Lenox:

In response to your recent request, we have reviewed the New York Natural Heritage Program database with respect to the above project.

We have no records of rare or state-listed animals or plants, or significant natural communities at your site or in its immediate vicinity.

The absence of data does not necessarily mean that rare or state-listed species, significant natural communities, or other significant habitats do not exist on or adjacent to the proposed site. Rather, our files currently do not contain information that indicates their presence. For most sites, comprehensive field surveys have not been conducted. We cannot provide a definitive statement on the presence or absence of all rare or state-listed species or significant natural communities. Depending on the nature of the project and the conditions at the project site, further information from on-site surveys or other resources may be required to fully assess impacts on biological resources.

This response applies only to known occurrences of rare or state-listed animals and plants, significan natural communities, and other significant habitats maintained in the Natural Heritage database. Your project may require additional review or permits; for information regarding other permits that may be required under state law for regulated areas or activities (e.g., regulated wetlands), please contact the appropriate NYS DEC Regional Office, Division of Environmental Permits, as listed at www.dec.ny.gov/about/39381.html.

Sincerely,

Andrea Chaloux

Andrea Chaloux
Environmental Review Specialist
New York Natural Heritage Program

1417

Letter from: United States Fish and Wildlife Service

To: Attention: Mr. Joseph Rowley, David Stilwell

United States Army Corps of Engineers

US Fish and Wildlife Service Comment Letter
Re: Section 404 Wetland Permit
Public Notice

August 29, 2014

Emailed 08/29/2014

United States Department of the Interior

2014 SEP -8 AM 10:4

FISH AND WILDLIFE SERVICE
3817 Luker Road
Cortland, NY 13045

August 29, 2014

Lt. Colonel Karl D. Jansen
District Engineer, Buffalo District
United States Army Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207

Attention: Mr. Joseph Rowley, Regulatory Branch

Dear Colonel Jansen:

The U.S. Fish and Wildlife Service (Service) has reviewed the U.S. Army Corps of Engineers (Corps) Public Notice (PN) 2005-00198 for the Sealand Waste, LLC, Carroll Landfill expansion, a construction and demolition debris landfill. The total parcel is 54.1 acres and is located near the intersections of Dodge and Sandberg Roads in the Town of Carroll, Chautauqua County, New York. The proposed project involves expanding the landfill beyond the three-acre limit allowed by the New York Department of Environmental Conservation (NYSDEC) and the addition of demolition debris recycling and yard waste composting operations.

Project Description

The project involves removal of existing waste from the three-acre footprint, and placement of material inside the proposed single composite liner system for an expanded approximately 38-acre landfill footprint. An additional 8.5 acres are proposed to be developed for ancillary and support facilities to include a scale house, office building, access roadways, leachate storage facility, maintenance building, and stormwater management basins and structures. Approximately 7.6 acres will remain undeveloped. The project will be developed in phases as market conditions warrant and will have a site life of approximately 11.5 years.

Approximately 6.06 acres of wetland are on-site. The preferred alternative would result in approximately 5.8 acres of wetland impact. Sealand Waste, LLC, is proposing 12.7 acres of wetland (2.2:1 ratio) and 11, 905 linear feet of drainageway (4:1 ratio) to mitigate wetland and stream impacts. No project plans have been submitted for our review. Please provide a copy to our office when the plans become available.

The Service is providing the following comments pursuant to the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*), the Bald and Golden Eagle Protection Act (BGEPA) (16 U.S.C. 668-668d), the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703-712; Ch. 128; July 13, 1918; 40 Stat. 755), and the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq.*).

Endangered Species Act

Listed species

There are two federally-listed species known to occur in Chautauqua County – the clubshell mussel (*Pleurobema clava*; Endangered) and the rayed bean mussel (*Villosa fabalis*; Endangered). Clubshell mussel habitat consists of clean, loose sand and gravel in medium to small rivers and streams, while rayed bean mussels are generally found in small headwater creeks with gravel or sand substrates. The proposed project is located on a property that abuts Storehouse Run, a tributary to Conewango Creek, where the Service's species distribution models predict a probability for suitable habitat for these species to occur in the area.

Because the project site is adjacent to a tributary where suitable habitat may occur, we recommend that a qualified surveyor conduct a habitat assessment of Storehouse Run to determine whether suitable habitat exists for either of these species. Pursuant to Section 7 of the ESA, the Corps should then make a determination as to whether this project may affect either of these species.

Proposed species

The northern long-eared bat (*Myotis septentrionalis*) (NLEB) is currently proposed for listing under the ESA. The final listing decision for the NLEB is expected in April 2015. At this time no critical habitat has been proposed for the NLEB. The entire state of New York is within the range of the NLEB; this species can occur above 900-feet elevation, unlike Indiana bats. During the summer, the NLEB typically roosts singly or in colonies in cavities, underneath bark, crevices, or hollows of both live and dead trees and/or snags (typically $\geq$ 3 inches dbh). Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat seems opportunistic in selecting roosts, using tree species based on presence of cavities or crevices, or the presence of peeling bark. It has also been occasionally found roosting in structures like barns and sheds, particularly when suitable tree roosts are unavailable. They forage for insects in upland and lowland woodlots and tree-lined corridors. During the winter, the NLEB predominately hibernates in caves and abandoned mine portals. Additional habitat types may be identified as new information is obtained.

Species proposed for listing are not afforded protection under the ESA; however, as soon as a listing becomes effective, the prohibition against jeopardizing its continued existence and "take"[1] applies regardless of an action's stage of completion. If federal involvement (in this case, the

[1] Take is defined in Section 3 of the ESA as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

Corps) retains any discretionary involvement over actions that may affect the species after listing, Section 7 consultation procedures apply.

The nearest known occurrence for NLEB is approximately 10 miles to the northeast. Although no known occurrences are within or adjacent to the proposed project, suitable habitat for foraging and roosting may potentially be present. If the final decision is to list NLEB as endangered and if the project construction is anticipated to continue beyond April 2, 2015, then we recommend tree clearing be conducted in the winter months (October 31 to March 31) when bats are in hibernation. We understand that approximately 31 acres of tree removal is needed for this project. Furthermore, the Service recommends incorporating the following conservation measures into construction plans to further avoid and minimize potential impacts to the NLEB, especially if project plans continue into 2015:

- Bright orange construction fencing or flagging be used to clearly demarcate trees to be protected compared with those to be cut prior to the initiation of any construction activities at the site. This will help ensure that contractors do not accidentally remove more trees than anticipated;

- No artificial dyes, coloring, insecticide, algaecide, and/or herbicide will be used on the ground for long-term maintenance of the property; and

- Limiting the number of lights (i.e., on buildings, parking lots), including motion sensors or timers, directing the lights toward the ground and buildings, and including shields to direct the light downward.

Should project plans change, or if additional information on listed or proposed species or critical habitat becomes available, this determination may be reconsidered. The most recent compilation of federally-listed and proposed endangered and threatened species in New York is available for your information. Until the proposed project is complete, we recommend that you check our website every 90 days from the date of this letter to ensure that listed species presence/absence information for the proposed project is current.*

Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act

The bald eagle (*Haliaeetus leucocephalus*) is also found in the county. Eagles have been delisted pursuant to the ESA, but remain protected under the BGEPA, MBTA, and by the state of New York (State). There is a bald eagle nest to the northwest approximately 4.6 miles. Due to the distance involved, we do not anticipate any impacts to bald eagles as a result of this project. However, if eagles are found within or near the project area, the Service recommends that you follow the Bald Eagle Management Guidelines found on the Service's website at: http://www.fws.gov/migratorybirds/baldandgoldeneaglemanagement.htm.

The above-listed species are also listed by the State. Any additional information regarding the proposed project and its potential to impact listed species should be coordinated with both this office and with the New York State Department of Environmental Conservation's Region 9 Allegany Office.

Fish and Wildlife Coordination Act

Wetlands provide important habitat for many species of fish and wildlife, as well as recreational opportunities for consumptive and non-consumptive users. Further, wetlands maintain water quality by trapping and filtering pollution and sediments from adjacent developments. During storm events, wetlands store and slowly release excess runoff, and prevent flood damage. For these reasons and others, wetlands are important to society from an ecological and economic standpoint.

The Service has the following comments related to the "Request for Part 182 Determination for Endangered and Threatened Species" prepared by Daigler Engineering, P.C., dated June 2011:

- Page 1-3, second paragraph, states that, "stormwater discharges will be managed to meet the discharge standards for Class C(TS) streams." Please provide information as to where the discharges will occur on the proposed project site.

The following are comments related to the "Alternatives Analysis" prepared by Daigler Engineering, P.C., document dated January 16, 2014:

- It is stated on page 1-3 that "Sealand Waste, LLC, evaluated on-site and off-site alternatives that would avoid or minimize disturbance to the existing wetland," yet the alternative chosen has the largest capacity (5,375,100 cubic yards), the largest footprint (approximately 35.6 acres), and the most wetland impact (approximately 5.8 acres). We recommend reconsidering alternatives and choosing one that is the "least damaging practicable alternative," to completely avoid and/or minimize impacts.

- Maps submitted to date indicate the current landfill configuration. Please send plans and maps that indicate the future construction and where wetland impacts will occur.

- Lastly, we understand that the Draft Enviroumental Impact Statement is being updated (per April 17, 2014, letter from Mr. David Lenox, Daigler Engineering, P.C., to Mr. Joseph Rowley). Please provide a copy when completed for our review. We also request copies of the April 19, 2013, off-site alternative analysis that was completed (Section 4.2, page 4-2), as well as a copy of the wetland mitigation plan as noted on page 5-5 (Section 5.3).

Thank you for the opportunity to comment on this proposed project. Please contact Noelle Rayman at 607-753-9334 if there are any questions regarding this letter and reference file number 14-TA-0265.

Sincerely,

Sandra L Doran

for David A. Stilwell
Field Supervisor

*Additional information referred to above may be found on our website at: http://www.fws.gov/northeast/nyfo/es/section7.htm

cc: NYSDEC, Region 9, Allegany, NY (A. Rothrock)
NYSDEC, Region 9, Buffalo, NY (Env. Permits)
NYSDEC, Albany, NY (Wildlife Diversity)
COE, Buffalo, NY (J. Rowley)

Freshwater Mussel Survey and Habitat Assessment

By: EcoLogic, LLC

August 20, 2015

A FRESHWATER MUSSEL SURVEY AND HABITAT ASSESSMENT OF STOREHOUSE RUN IN THE VICINITY OF THE CARROLL LANDFILL, TOWN OF CARROLL, CHAUTAUQUA COUNTY, NEW YORK

Prepared for

DAIGLER ENGINEERING, P.C.
2620 Grand Island Boulevard
Grand Island, NY 14072

Prepared by

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August 20, 2015

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I. INTRODUCTION

EcoLogic, LLC (EcoLogic) was hired by Daigler Engineering, P.C. to conduct an endangered mussel species survey and habitat assessment in Storehouse Run and two tributaries in the vicinity of the Carroll Landfill in the Town of Carroll, Chautauqua County, NY. The mussel survey and habitat assessment were necessary to determine if proposed expansion of the Carroll Landfill could impact populations or habitat of two federally-listed endangered mussel species, the clubshell (*Pleurobema clava*) and rayed bean (*Villosa fabalis*). This report presents the results of the mussel survey and habitat assessment conducted by EcoLogic on July 23, 2015.

II. METHODS

The target area for the mussel survey and habitat assessment was Storehouse Run extending from 200 ft upstream and downstream of proposed stormwater discharges associated with the expanded landfill, encompassing approximately 1,160 ft of stream length (Figure 1). Also included were sections of two unnamed intermittent streams that flow through a portion of the landfill property and join Storehouse Run within the assessment area. For ease of discussion, these streams will be referred to as the main tributary and the sub-tributary (Figure 1). Only a small portion of the reach of Storehouse Run within the assessment area lies within the Carroll Landfill property boundary, and attempts by EcoLogic to obtain landowner permission to access the area of the stream on adjacent private property were unsuccessful. Consequently, access to Storehouse Run in the assessment area was limited to a small reach at the upstream end of the assessment area and another somewhat larger area in the downstream quarter of the assessment area (Figure 1).

The U.S. Fish and Wildlife Service (USFWS) was consulted for guidance on how to proceed without permission from landowners to access portions of the stream on private property (personal communication between K. Jirka, EcoLogic, and S. Doran, USFWS, June 24, 2015). The USFWS indicated that an acceptable approach would be to conduct the mussel survey and habitat assessment on those portions of the assessment area that were accessible without trespassing on private property (e.g., areas associated with the Carroll Landfill property and

nearby road crossings) and gather other existing information that could be used to assess the suitability of habitat for clubshell and rayed bean within portions of the target area that were inaccessible. This included assessing the presence/absence of mussels and quality of available habitat in accessible areas of Storehouse Run upstream and downstream of the assessment area, contacting staff of the Region 9 office of the New York State Department of Environmental Conservation (NYSDEC) and Darran Crabtree of The Nature Conservancy, who conducted recent mussel surveys in the area in the past.

Prior to conducting the field assessment, a review of existing information on the habitat preferences of clubshell and rayed bean was conducted. This information was used as a basis for evaluating the suitability of the habitat within the assessment reach for supporting these two species. The accessible reaches of the Storehouse Run mussel survey and habitat assessment area and portions of the intermittent tributaries within the Carroll Landfill property boundary were visited, searched for mussels, and evaluated based on the potential for the habitat to support clubshells and rayed beans. Stream banks adjacent to the assessment reach also were searched for shells that may have been discarded by predators or deposited during high flow events.

The small size of the streams made it possible to easily view the entire stream bottom from the shoreline or while walking in the stream. Accessible areas with water depth <0.4 ft were searched visually with the unaided eye. Accessible areas where water depth was >0.4 ft were searched with the aid of an underwater viewing bucket. Areas were searched for live mussels and shells of dead mussels. Habitat was assessed on the basis of substrate composition, water depth, current velocity, and riparian condition. Areas of the stream that could not be directly accessed were viewed from a distance, sometimes with binoculars, to gather information on habitat conditions. General habitat conditions and specific habitat features were photo-documented.

III. RESULTS

A. Clubshell and Rayed Bean Habitat Preferences

The clubshell is most often found in gravelly riffles or clean, stable, coarse sand and gravel runs, often just downstream of riffle areas, in medium to small rivers and streams (Strayer and Jirka 1997, Stansbery *et al.* 1982). Clubshells show a propensity for being distributed below the substrate surface and may live burrowed several inches into the substrate (Smith *et al.* 2001, Watters *et al*. 2009). This behavior suggests that this species is highly dependent on interstitial flow through the substrate for oxygen and food and, therefore, is highly susceptible to siltation that fills interstitial voids (USFWS 2008). The clubshell can tolerate a range of water velocities, but generally is considered to be intolerant of permanently slack water conditions. Although this species appears to prefer riffle and run habitat, it also has been found in pool habitat up to 15 ft deep in the Allegheny River (USFWS 2008).

The rayed bean typically occurs in shallow riffle or run habitat in high-quality creeks and small rivers (Ortmann 1919, Watters *et al.* 2009, K. Jirka, personal observation). It prefers substrates of sand and gravel and is often associated with root systems of aquatic macrophytes (Ortmann 1919, Watters *et al.* 2009, K. Jirka, personal observation). Although the rayed bean is typically found in streams and small rivers, it can also occur in medium to large rivers and in wave-washed areas of natural lakes (West *et al.* 2000).

B. Habitat Conditions in Storehouse Run

The field survey and assessment of mussel habitat in Storehouse Run was conducted on July 23, 2015 when stream discharge was at typical summer low-flow conditions. The water was clear (bottom visible throughout the assessment area), and water temperature was 61 °F at 1130 hours. The reach of Storehouse Run in the assessment area was a relatively high-gradient (approximately 30 ft drop in elevation) stream comprised of shallow riffle and run habitat with occasional shallow pools (Photos 1-4; see Figure 2 for photo locations). The substrate was primarily a mix of unconsolidated cobble, gravel, and sand in riffles and cobble, gravel, and sand

coated with silt in runs and pools (Photos 5 and 6). Boulders generally occurred sporadically, but were prevalent in some areas of higher gradient (Photo 4, 7). Similarly, exposed bedrock was found in some areas and overlain with shallow layers of cobble and gravel in others (Photos 8 and 9). Silt was not a dominant component of the substrate but typically coated rock and sand substrate wherever the current was not fast enough to keep silt in suspension (Photos 1, 2, 10, and 11).

The stream banks of Storehouse Run through much of the assessment area showed signs of active erosion and instability. Portions of the stream ran through maintained lawns and lacked any woody riparian cover (Photos 7 and 12). The channel in these areas was deeply incised and the stream banks were generally unstable. There also was evidence of stream bank erosion in the wooded riparian zone where bank undercutting and sloughing were observed (Photos 13 and 14). Water depth throughout Storehouse Run in the assessment area was extremely shallow, generally <0.5 ft and often <0.3 ft. Current velocity was generally low, typically well below 1 ft/s except in areas of high gradient. No aquatic macrophytes were observed growing in the stream channel.

Storehouse Run was visited at locations outside of the assessment area to gain supplemental information on mussel presence/absence and habitat suitability. The stream was viewed where it crosses under Dodge Road approximately 100 ft upstream of the assessment area and from approximately 300 ft upstream of Sandberg Road to approximately 100 ft downstream of Sandberg Road (approximately 550-1,000 ft downstream of the assessment area). Storehouse Run upstream of the assessment area was a narrow, high-gradient stream with cobble/gravel substrate except immediately downstream of the culvert under Dodge Road where there was a scour hole with silt-covered cobble, gravel, and sand (Photos 15 and 16). The reach of Storehouse Run immediately upstream of Sandberg Road was a relatively high-gradient stream composed primarily of shallow riffle with unconsolidated cobble and gravel substrate (Photos 17 and 18). Immediately downstream of Sandberg Road was a large pool with silt-covered substrate and then a series of shallow riffles and runs (Photos 19 and 20). The stream bed in this reach was hard clay overlain with a relatively thin layer of unconsolidated cobble and gravel (Photo 21).

C. Habitat Conditions in the Storehouse Run Main Tributary and Sub-tributary

The field survey and assessment of mussel habitat in the streams tributary to Storehouse Run also was conducted on July 23, 2015 when stream discharge was at typical summer low-flow conditions. The streams were clear (bottom visible throughout the assessment area), and water temperature in the sub-tributary was 60 °F at 1200 hours. The main tributary contained considerably more flow than the sub-tributary, and appeared similar in size to Storehouse Run at their confluence. The main tributary was of relatively high gradient and was comprised of very shallow riffle and run habitat except for a shallow pool at its confluence with the sub-tributary (Photos 22-25). The substrate was primarily a mix of unconsolidated cobble, gravel, and sand in riffles and cobble, gravel, and sand coated with silt in runs and pools. Boulders occurred sporadically, and bedrock was not observed. Silt was not a dominant component of the substrate but typically coated rock and sand substrate wherever the current slowed, even within shallow riffles (Photo 26). Water depth throughout the main tributary in the assessment area was extremely shallow, generally <0.4 ft and often <0.2 ft. Current velocity was generally low, typically well below 1 ft/s except in areas of high gradient. No aquatic macrophytes were observed growing in the stream channel. Bank and channel degradation were evident at one location where an all-terrain vehicle trail crossed the stream (Photo 27). Mud ruts were worn into the edge of the bank, and the stream bed was wider and shallower in this areas than in areas immediately adjacent upstream and downstream.

The sub-tributary was a narrow, intermittent stream (Photos 28-30). Stream channel width varied from about 1.5 ft to 5.0 ft, but the wider the channel the higher the percentage of the width that was dewatered. Water depth was always <0.5 ft and typically <0.2 ft. Current velocity was very low due to the low discharge, despite the relatively high gradient of the stream. The substrate generally consisted on unconsolidated cobble and gravel in high-gradient zones and gravel, gravel and cobble, or gravel, cobble, and sand, all coated with silt, in areas of lower gradient (Photos 31-32). Boulders occurred sporadically, and bedrock was not observed. No aquatic macrophytes were observed growing in the stream channel.

D. Additional Information on Mussels and Mussel Habitat in Storehouse Run

Efforts to gather existing information on mussels and mussel habitat in Storehouse Run proved unproductive. Staff of the Region 9 office of the NYSDEC had no records of mussels or information on suitability of habitat in Storehouse Run (email from M. Clancy, Fisheries Manager, NYSDEC Region 9 to K. Jirka, EcoLogic, July 30, 2015). Similarly, The Nature Conservancy (TNC) had no information regarding mussels or their habitat for Storehouse Run in New York or Pennsylvania (email from D. Crabtree, TNC, to K. Jirka, EcoLogic, August 5, 2015). Given the results of the mussel survey and habitat assessment field effort and the lack of information available from the two most likely sources of mussel occurrence data, no additional information was sought on the potential for Storehouse Run in the assessment area to support clubshells, rayed beans, or their habitat.

E. Mussel Occurrence and Suitability of Habitat

No live mussels (clubshells, rayed beans, or other species), shells of dead mussels, or any other evidence of the presence of mussels were found in Storehouse Run, the main tributary, or the sub-tributary within the assessment area. Although only about 10-15% of Storehouse Run within the assessment area was actually searched for mussels, it was possible to view the habitat from a distance at several locations and assess its quality from the perspective of supporting clubshells and rayed beans. The quality and characteristics of the habitat within Storehouse Run appeared consistent throughout the length of the assessment area and well downstream. No habitat was found within Storehouse Run, the main tributary, or the sub-tributary within the assessment area and up to 1,000 ft downstream that approximated the type of habitat which clubshells or rayed beans typically use.

Both clubshells and rayed beans prefer sand and/or fine gravel relatively free of silt in riffle/run habitat. The only areas in which silt did not coat the substrate were high-gradient riffles with unconsolidated cobble substrate. Unconsolidated cobble is unsuitable substrate for clubshells, rayed beans, and other mussels because of its tendency to shift or become mobile during high-flow events. Anywhere preferred consolidated sand and fine gravel deposits were found

contained a significant accumulation of silt on top of the mineral substrate, a condition unsuitable for clubshells and rayed beans. The presence of underlying and sometimes exposed bedrock within Storehouse Run further reduced the suitability of habitat within the assessment area for both clubshells and rayed beans, which often burrow up to several inches into the substrate. The hard clay base to the stream bed downstream of Sandberg Road was similarly unsuitable for either species.

The relatively degraded physical condition of the riparian zone of Storehouse Run within the assessment area also diminished the quality of the habitat for clubshells and rayed beans. The actively eroding and sloughing banks result in relatively high bed load and sedimentation, conditions of which clubshells and rayed beans are intolerant. The intermittent nature of the sub-tributary eliminates any likelihood that this stream could support clubshells or rayed beans. Although apparently permanent flowing streams, discharge in Storehouse Run and the main tributary within the assessment area during dry years likely becomes so low as to render much of the stream bed uninhabitable to mussels in general and especially so to sensitive species like clubshell and rayed bean.

Based on the findings of the field survey and habitat assessment and the lack of any evidence of the presence of mussels of any species in Storehouse Run downstream of the assessment area, it can be concluded that Storehouse Run, the main tributary, and the sub-tributary within the assessment area do not support clubshells or rayed beans, and the habitat within these reaches of stream is not suitable to do so.

V. LITERATURE CITED

Ortmann, A. E. 1919. A monograph of the naiads of Pennsylvania. Part III. Systematic account of the genera and species. Memoirs of the Carnegie museum 8:1-384.

Smith, D.R., R. F. Villella, and D. P. Lemarie. 2001. Survey protocol for assessment of endangered freshwater mussel in the Allegheny River, Pennsylvania. Journal of the North American Benthological Society 20:118-132.

Stansbery, D. H., K. G. Borror, and K. E. Newman. 1982. Biological abstracts of selected species of unionid mollusks recovered from Ohio. Unpublished report prepared for the Ohio Heritage Foundation. Ohio Department of Natural Resources.

Strayer, D. L. and K. J. Jirka. 1997. The pearly mussels of New York State. New York State Museum Memoir 26. Albany, NY. 113 pp. + 27 pl.

United States Fish and Wildlife Service (USFWS). 2008. Clubshell (Pleurobema clava) 5-year review: summary and evaluation. Pennsylvania Field Office, State College, PA. 22 pp.

Watters, G., M. Hoggarth, and D. Stansbery. 2009. The freshwater mussels of Ohio. The Ohio State Press, Columbus. 421 pp.

West, E. L., J. L. Metcalfe-Smith, and S. K. Staton. 2000. Status of the rayed bean, *Villosa fabalis* (Bivalvia: Unionidae), in Ontario and Canada. The Canadian Field-Naturalist 114:248-258.

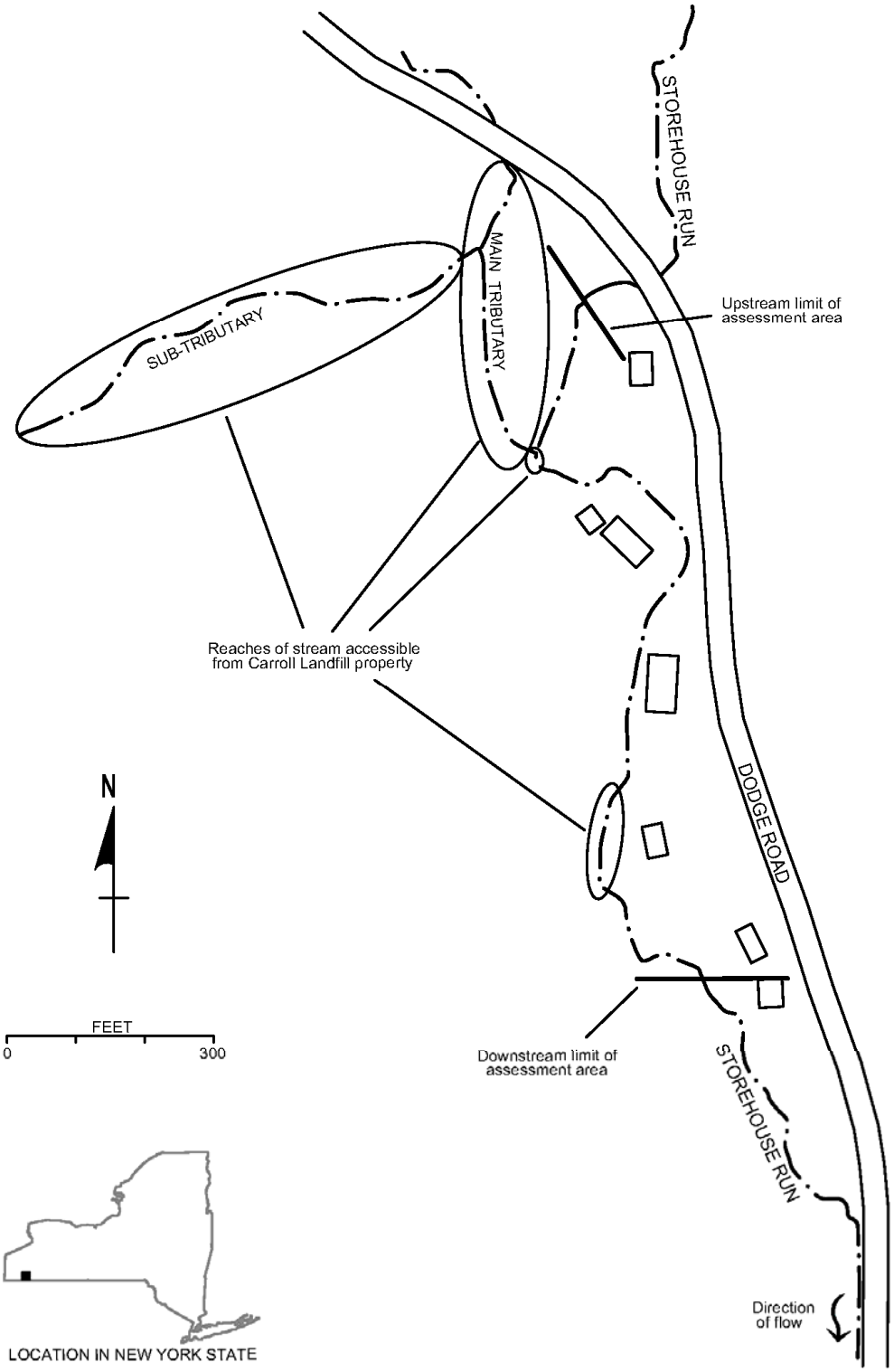


Figure 1. The mussel survey and habitat assessment area in Storehouse Run, its main tributary, and its sub-tributary in the vicinity of the Carroll Landfill, Town of Carroll, Chautauqua County, NY.

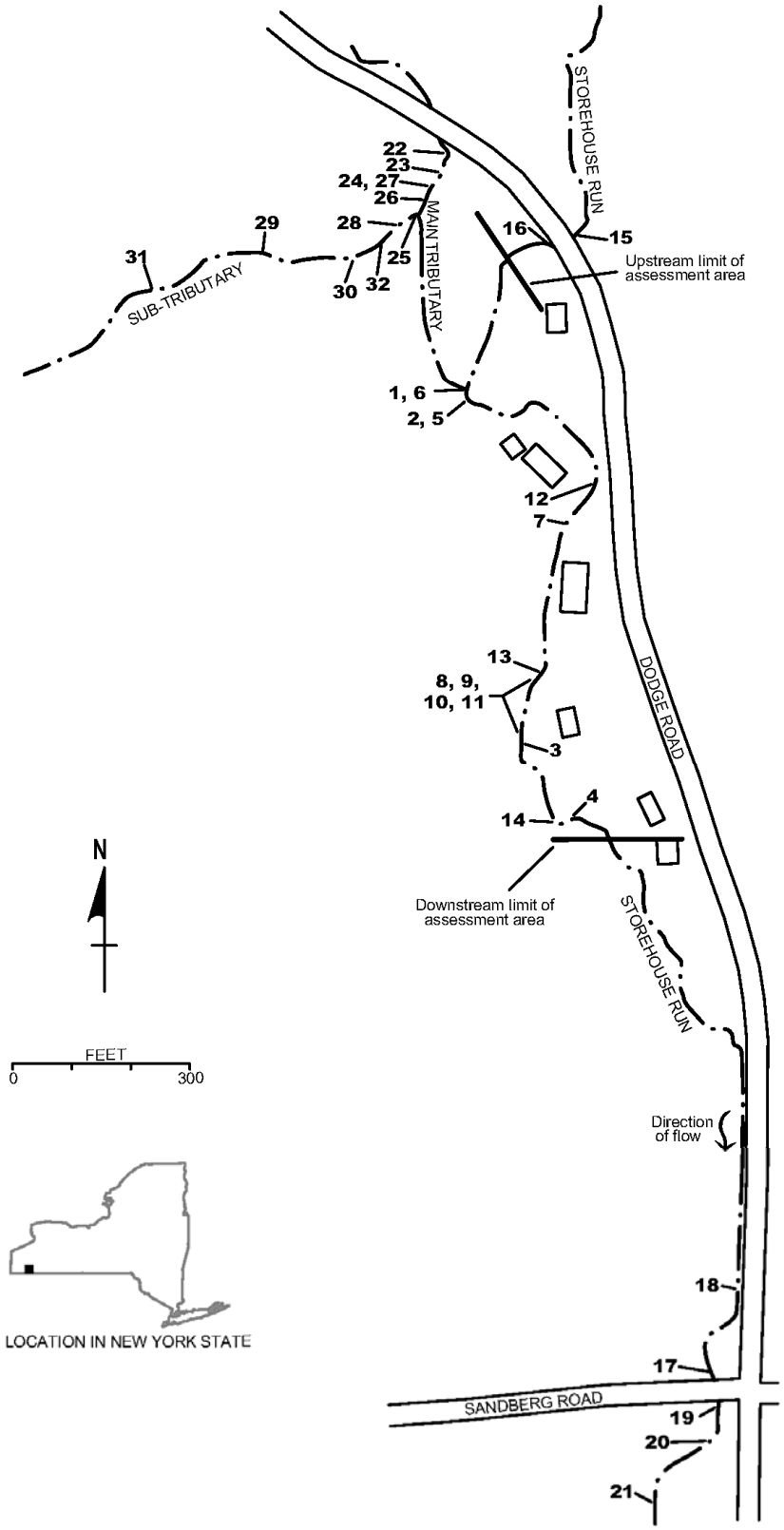


Figure 2. Locations at which photographs presented in this report were taken in the vicinity of Storehouse Run, its main tributary, and its sub-tributary in the vicinity of the Carroll Landfill, Town of Carroll, Chautauqua County, NY.

Photo 1. Riffle/run habitat near the upstream end of the assessment area of Storehouse Run and its confluence with the main tributary, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 2. High-gradient riffle habitat near the upstream end of the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 3. Shallow pool, riffle, and run habitat near the downstream end of the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 4. Riffle habitat near the downstream end of the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 5. Cobble, gravel, and sand substrate in riffle habitat in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 6. Silt-coated cobble, gravel, and sand substrate typical of run and pool habitat in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 7. Boulder substrate near mid-point of the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 8. Bedrock substrate in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 9. Bedrock substrate in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 10. Silt coating gravel, cobble, and sand substrate in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 11. Silt coating bedrock substrate in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 12. Mowed lawn abutting the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 13. Bank erosion in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 14. Bank sloughing in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 15. High-gradient riffle habitat in Storehouse Run immediately upstream of Dodge Road, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 16. Silt-coated pool habitat in Storehouse Run immediately downstream of Dodge Road, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 17. High-gradient riffle with unconsolidated cobble substrate in Storehouse Run immediately upstream of Sandberg Road, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 18. High-gradient riffle with unconsolidated cobble substrate in Storehouse Run upstream of Sandberg Road, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 19. Silt-coated pool habitat in Storehouse Run immediately downstream of Sandberg Road, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 20. Shallow riffle and run habitat in Storehouse Run immediately downstream of Sandberg Road, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 21. Predominantly hard clay substrate with scattered rock in Storehouse Run downstream of Sandberg Road, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 22. Riffle habitat at the upstream end of the main tributary in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 23. Riffle/run habitat near the upstream end of the main tributary in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 24. Riffle/run habitat in the main tributary in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 25. Pool habitat at confluence of the main tributary and sub-tributary in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 26. Silt coating pockets of gravel in a shallow riffle of the main tributary in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 27. All-terrain vehicle track crossing of the main tributary in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo. 28 Partially exposed channel at downstream end of the sub-tributary in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 29. Mostly dry channel near mid-reach of the sub-tributary in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 30. Narrow (approximately 1.5 ft wide) channel in the lower reach of the sub-tributary in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo 31. Cobble and cobble/gravel substrate in higher gradient area of the sub-tributary in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

Photo. 32 Silt-coated substrate in low-gradient area of the sub-tributary in the assessment area of Storehouse Run, Town of Carroll, Chautauqua County, NY, July 23, 2015.

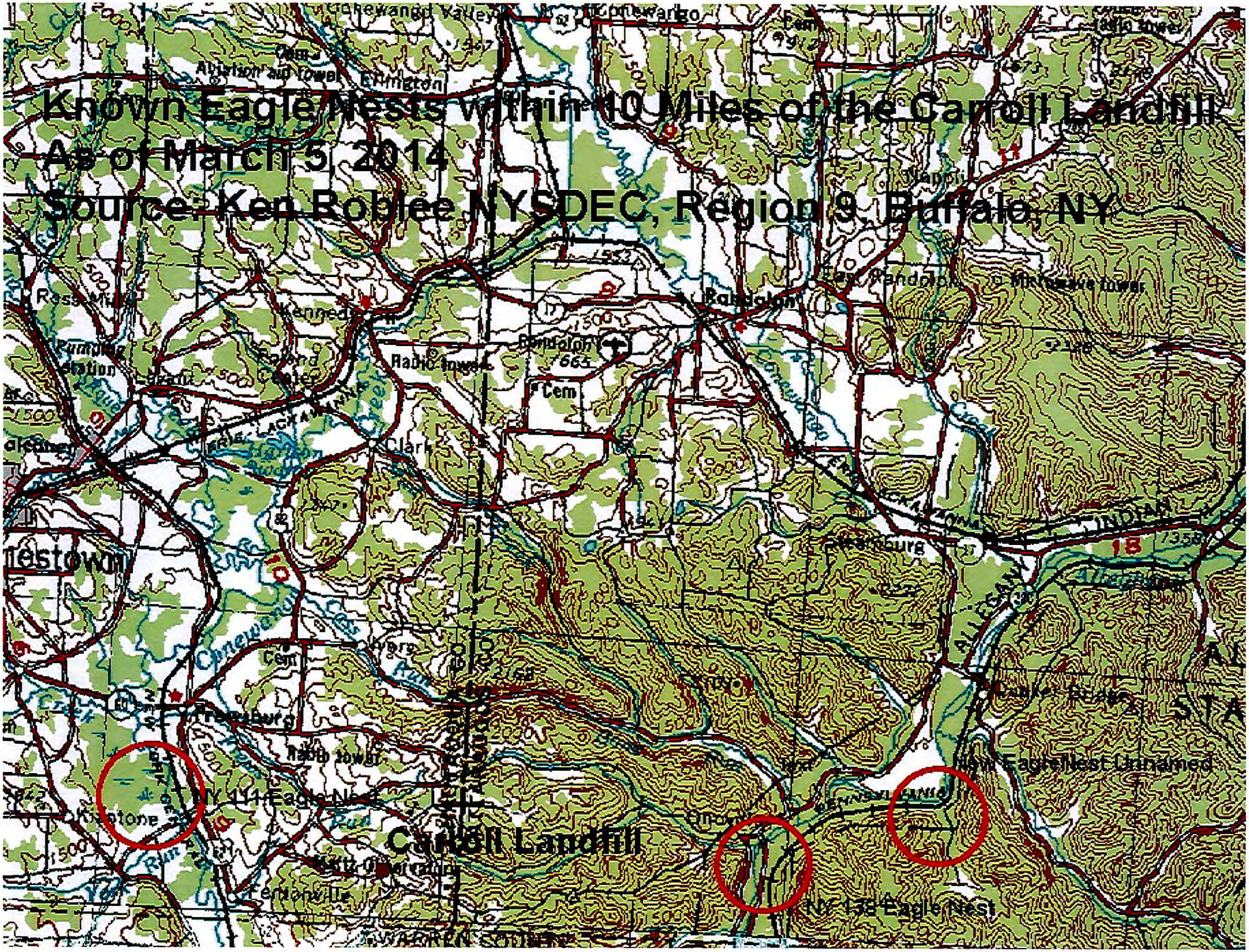
NYSDEC Bald Eagle Nest Location Map

Received - March 5, 2014
Last Confirmed (Anne Rothrock) - February 2, 2017

Pennsylvania Bald Eagle Nest Location Map

Accessed – January 6, 2017

Known Eagle Nests within 10 Miles of the Carroll Landfill
As of March 5, 2014
Source: Ken Roblee NYSDEC, Region 9, Buffalo, NY



U.S. FISH AND WILDLIFE SERVICE PENNSYLVANIA FIELD OFFICE

BALD EAGLE MAPPING TOOL

ACCESSED ON JANUARY 6, 2017