Complete Report

Erie National Wildlife Refuge - All - 2012

Report produced: Dec 03, 2020 08:47 PM MST

CAP Information (Contaminants Assessment Process)

A Contaminant Assessment Process (CAP) has been conducted for this refuge. A CAP is an information gathering process and initial assessment of a U.S. Fish & Wildlife Service National Wildlife Refuge in relation to environmental contaminants. You will find information in this report on particular contaminants of concern to fish and wildlife resources on the refuge and areas of the refuge of particular interest with regard to these contaminants.

Primary Investigator Information

Analysis started: Oct 24, 2012
Analysis completed: Nov 29, 2012

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Notes on Primary Investigator:
No notes have been entered

Background Information

The following section presents the known background information for a contaminant site, including literature references, secondary contacts, and any meeting information.

Literature References

This section lists references in citation form with links to further information on the contaminant sources, contaminant categories and summary information.

Notes on Reference Inputs:

No comments entered

Literature References Entered in CAP Database for Erie National Wildlife Refuge

1. Mohler, J.W., Morrison, P, & Haas, J. (2006) The mussels of Muddy Creek on Erie National Wildlife Refuge. Northeastern Naturaliast, 13(4), 569-582.

   Relevance:

   Biological inventory of freshwater mussels and host fish species relevant to the risks from contamination of surface waters.

2. .USFWS Pennsylvania Field Office

Description:

Tissue analysis for samples collected in or near surface waters within the refuge.

Categories:

- Other Inorganics
- Other Pesticides
- Heavy Metals
- Other Organics
- Organochlorines

3. .USFWS Pennsylvania Field Office

Relevance:

Evaluation of the risks to surface water associated with the use of natural gas brine waste on roads.

Sources:

- Petroleum exploration/production
- Runoff - urban/hiway/airport

Categories:

- Dissolved Solids
- Other Inorganics
- Chloride

4. USFWS. 2007. Erie NWR Draft Habitat Management Plan.

Relevance:

The document briefly outlines potential contaminant sources and at-risk resources.

Description:

Source for all of the natural resources information for the refuge including species lists, habitat types, and watershed hydrology.

Sources:

- Petroleum exploration/production
- Accident - spills
- Mining - other
- Runoff - urban/hiway/airport
- Agricultural - drainwater
- Agricultural - aerial spray

Categories:

- Petroleum Products
- Water Temperature
- BOD
- Synthetic Pyrethroids
- Organophosphates
- Nutrients - other than sewage

- Salts
- Oil and Grease
- Turbidity
- Other Pesticides
- Heavy Metals
- Total Solids
- Carbamates
- Sediments

5. NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. Vegetation Alliances and Associations of Erie National Wildlife Refuge. NatureServe Central Databases. Arlington, VA. Data current as of 27 February 2007

   Relevance:

   Biological classifiction data for Pennsylvania

6. James M. Haynes and Scott M. Wells. 2006. Fishes in Muddy Creek, Erie National Wildlife RefugeSeneca Division, with Emphasis on Host Species for Federal and State-Listed Freshwater Mussels and State-Listed Fishes. Department of Environmental Science and Biology, State University of New York College at Brockport, Brockport, NY. 20pp.

   Relevance:

   Protection of mussel and fish species diversity is a priority in the French Creek watershed. Knowledge of host fish species and their sensitivity to contaminants is critical to ensuring mussel recruitment and recovery.

   Description:

   Documents the fish community in the Seneca Division of the refuge. Identifies host fish species critical to T&E and state-listed mussel populations.

7. WPC. 2002. French Creek Watershed Conservation Plan. Western Pennsylvania Conservancy and French Creek Project. Pittsburgh, PA 290 pp.

   Relevance:

   The stressors identified for the French Creek watershed are relevant to the refuge, particularly contaminants that are air- or water-borne.

   Description:

   Detailed description of the abiotic and biotic resources of the watershed and discussion of the stressors that could adversely affect the unique biodiversity.

   Sources:

   - Petroleum exploration/production
   - Air pollution - other
   - Agricultural - livestock
   - Municipal wastewater
   - Agricultural - drainwater

   Categories:

   - Petroleum Products

- Urea and other Organic Nitrogen Compounds
- Water Temperature
- BOD
- Ammonia
- Nutrients - other than sewage
- Thermal Inputs
- Salts
- Airborne Particulates
- Nitrate
- Free Chlorine
- Sewage
- Heavy Metals
- Chloride
- Total Nitrogen

Contacts

Notes on Contacts:

1. **Lelaina Marin**

   USFWS Erie National Wildlife Refuge
   11296 Wood Duck Lane
   Guys Mills, Pennsylvania 16327
   Phone: 814-789-3585, ext. 223
   Fax: 814-789-3585
   Email: lelaina_marin@fws.gov

   Description:
   No description provided

   Comments:
   As the refuge biologist, Lelaina is knowledgeable about the refuge, its ecology, and stressors.

2. **KATHLEEN A PATNODE**

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   Description:
   Kathleen has been an environmental contaminants specialist with the Pennsylvania Field Office for eight years. Her expertise is in environmental toxicology and wildlife ecology.

   Comments:
   Kathleen was responsible for reviewing all of the contaminants data for this CAP.

Meetings

Notes on Meetings:

NWR and PAFO conference call
Date: 08-27-2012
Description: Internal conference calls between PAFO and Erie NWR were conducted to exchange information for preparation of this report. No external meetings were held in preparation

of this CAP.
Comments: No comments provided

Assessment Considerations

The following section presents a number of issues that were taken into account when completing the Contaminants Assessment Process. These issues are the culmination of a number of related data sources such as Contaminant Information Management and Analysis System (CIMAS) and Refuges Management Information System (RMIS) as well as comments from the primary investigator.

General Information

This section presents some general information regarding the refuge such as a basic description of the lands, biodiversity, and endangered species with some specific comments from the primary investigator on the relevance of these items.

General Notes

Description

Region	Category	IFWS Number	Organization Code
5	NWR	523	52520

Description of FWS Unit
Erie NWR is located in the French Creek drainage basin. French Creek retains a biological diversity that is unique and biologically significant. Many of the aquatic species are endangered in Pennsylvania and the United States. Fifty-six percent of Pennsylvania's surviving mussel species inhabit the French Creek watershed, including the Clubshell and Northern riffleshell mussels, rayed bean, and snuffbox mussels, federally endangered species found on the Seneca Division of the refuge. Erie NWR's major management objective is to provide migratory birds with nesting, feeding, brooding and resting habitat. Overall, 250 bird species have been observed on the refuge, including the state endangered American bittern and the state threatened bald eagle. Workshops and educational activities are offered. Recreational activities include wildlife watching, photography, hunting, fishing, trapping, hiking and cross-country skiing or snowshoeing.

Comments on Description:
The 8,800-acre Erie National Wildlife Refuge (NWR) lies 35 miles south of Lake Erie in Crawford County in northwestern Pennsylvania. The Refuge headquarters and visitor contact station are located in Guys Mills. Wildlife-dependent recreation like hiking trails, wildlife observation overlooks, fishing, and hunting are popular on the Refuge, with most of these facilities on the Sugar Lake Division. The Refuge receives over 28,000 visitors a year. Numerous township and state roads cut through both Refuge Divisions.

Relevance to contaminant assessment:
The ecological and recreational values of the French Creek watershed are well-established. The area is rural and the predominant land use is agricultural. Pesticide use is common on properties surrounding the refuge. The prevalence of GM crops is undocumented, but the potential exists for cross-pollination and the development of herbicide-resistant invasive plant species. In addition, development and natural resource exploitation are on the rise. Both advancing uses have the potential to increase chemical stresses in the watershed, and thus, the refuge. Private interest in oil and gas exploration around the Seneca and Sugar Lake Divisions has prompted the Service to verify mineral rights for all parcels.

Geographic Location of Area

County	State
Crawford	Pennsylvania

Hydrologic Unit	Basin Name
5010004	FRENCH

Congressional District	Representative
PA03	Kathy Dahlkemper

Comments on Geographic Location of Area:
The Refuge has two separate Divisions: the 3,594-acre Seneca and the 5,206-acre Sugar Lake. The Sugar Lake Division lies 10 miles east of Meadville on the outskirts of Guys Mills village. The Seneca Division is about 10 miles north of the Sugar Lake Division or four miles southeast of Cambridge Springs. Erie NWR is located within the glaciated section of Appalachian Plateau biophysical region, in the highlands of northwestern Pennsylvania. This region is characterized by a series of broad stream valleys separated by gently undulating broad ridge tops (WPC 2002). The elevations within the Refuge range from 1,140 to 1,230 feet in the Seneca Division and 1,280 to 1,500 feet in the Sugar Lake Division (Kline 1998). The Seneca Division is situated in a forested valley encompassing the Muddy Creek drainage, a major tributary to French Creek, and the Dead Creek that flows into Muddy Creek. The approved acquisition boundary for the Seneca Division is 4,497 acres. The Sugar Lake Division lies in a narrow valley; the northern section encompasses the headwaters and mainstem of Woodcock Creek, draining north and then west into French Creek. The southern section, starting slightly north of Route 198, encompasses the headwaters of Lake Creek that drains south into the 90-acre Sugar Lake. Sugar Creek drains the lake and eventually flows into French Creek, about 4.5 miles above the confluence with the Allegheny River. The approved acquisition boundary for the Sugar Lake Division is 6,161 acres.

Relevance to contaminant assessment:
The non-contiguous divisions spreading across two different subwatersheds greatly increase the potential for contaminant migration onto the refuge from surrounding private lands and up gradient tributaries. Most of the soils along the tributaries are poorly drained which limits groundwater migration pathways for contaminants.

Interior Land Unit Purpose and Goals

Comments on Interior Land Unit Purpose and Goals:
Erie refuge was established in 1959. The land was purchased with funds provided from the sale of the Migratory Bird Hunting and Conservation Stamps (also known as Duck stamps). A management objective is to provide waterfowl and other migratory birds with nesting, feeding, brooding, and resting habitat. Additional objectives include providing habitat to support a diversity of other wildlife species and enhancing opportunities for wildlife-oriented public recreation and environmental education. Over 3,000 acres of wetlands, including beaver floodings, marshes, swamps, man-made impoundments (shallow ponds), creeks and wet meadows, provide desirable waterfowl habitat. The Refuge designated three areas as Research Natural Areas (RNAs):The Refuge designated three areas as Research Natural Areas: 1. The 100-acre Jacob Guy RNA in Sugar Lake; a sugar maple-beech-yellow birch forest on the east facing ridge of the Woodcock Creek stream valley 2. The 700-acre Lake Creek RNA in Sugar Lake; a marsh-swamp complex within the Lake Creek stream valley 3. The 1,041-acre Muddy Creek RNA in Seneca; relatively undisturbed broad floodplain with extensive marshes and swamps along two slowing meandering streams: Muddy and Dead Creeks

Relevance to contaminant assessment:
Supporting the high biodiversity of the refuge requires maintenance of low stress conditions. The integrated nature of the numerous tributaries and floodplain wetlands that creates dynamic habitat is also at high risk should a chemical release occur as migration would be very difficult to contain.

Biodiversity

Comments on Biodiversity:
The diverse habitat types found on Erie Refuge attracts many species of birds. The bird list for the Refuge includes 250; 136 of these species are known to nest on the Refuge. The Erie National Wildlife Refuge has been designated an Important Bird Area by the National Audubon Society because of the diversity of habitat it provides. In spite of past and current land use practices that can be detrimental to water quality, French Creek supports 89 fish species, 27 freshwater mussel species, and 158 species or natural communities listed as special concern by the Pennsylvania Natural Diversity Inventory (WPC 2002). Erie NWR lies entirely within the 790,000-acre French Creek Watershed, considered the most ecologically significant waterway in Pennsylvania and containing more species of fish and freshwater mussels than any other comparably sized stream in Pennsylvania (Map 2-4). French Creek has relatively good water quality, an abundance of wetlands, and a rural character within its watershed, features that may indicate why the waterway has retained nearly all species of fish and mussels that occurred here historically (WPC 2002). The Nature Conservancy listed French Creek as a watershed hot spot, with 10 or more at-risk freshwater mussel and fish species. Muddy Creek supports rare freshwater mussels and fish, and abundant scrub-shrub and forested wetlands in riparian areas as well as a rare shrub fen community . The Dead Creek riparian system contributes extensive marsh habitat and supports rare plants and fish habitats. The riparian system created by Muddy Creek and Dead Creek contains numerous types of forested, scrub-shrub and emergent wetlands characteristic of the glaciated region of northwest Pennsylvania. Beaver ponds, impoundments, and various types of forested, scrub-shrub and emergent wetlands along the creeks of Lake Creek watershed are bounded by upland forested slopes interspersed with croplands, grasslands, and wet meadows. Like Seneca, Sugar Lake has state rare plants, freshwater mussels, and uncommon natural plant communities. Some 48 species of mammals are present on the refuge. The most commonly seen are white-tailed deer, beaver, muskrat, and woodchucks. Common warm water fish occurring in refuge waters include black crappie, yellow perch, largemouth bass, bluegills, sunfish, and bullheads. Common cold water species include trout and white suckers, found in Woodcock Creek. The refuge is home to 37 species of amphibians and reptiles.

Relevance to contaminant assessment:
Numerous species, including rare, threatened, and endangered species, rely upon high quality habitat as residents or migrants. Habitats could be stressed by contaminants entering the refuge via surface water, ground water, or air deposition pathways. Even minor stresses to unique habitats on the refuge could have population level effects on plants or animals with narrow requirements.

Threatened and Endangered Species

Comments on Threatened and Endangered Species:
The portion of Muddy Creek that flows through the Refuge-Seneca Division provides habitat for 22 species of freshwater mussels, including the Federally endangered northern riffleshell, clubshell, rayed bean, and snuffbox mussels and several state listed and globally rare species (Mohler et al., 2006).

Relevance to contaminant assessment:
Sugar Lake is classified as an impaired water body. It is not currently part of the refuge, but is within the acquisition boundary. Prior to purchase, water, sediment, and biota sampling should be performed to ensure that nutrient loading is the only contaminant stressor. The data should also be used to design a stressor reduction effort to improve the ecology of the lake and protect the nesting birds. Baseline conditions in Muddy Creek must be established to prevent any stresses on the mussel populations. Mussel and fish surveys have been conducted. However, water and

sediment quality data are over 15 years old and benthic macroinvertebrates have never been characterized. These data will be critical to controlling permitting of discharges upgradient of the populations, as well as substantiating any NRD claims in the event of a spill in the watershed.

Documented Contaminant Concerns

Data from CIMAS:

Documented Problem	Source	Knowledge of Source	Location of Source
No problems reported			

Published Contaminant Reports
EFFECTS OF USING PRODUCTION WELL BRINES AS A ROAD DUST CONTROL AGENT ON ENVIRONMENTAL QUALITY AT THE ERIE NATIONAL WILDLIFE REFUGE, CRAWFORD COUNTY, PA (JAN. 1992)
CHEMICAL ANALYSIS OF FISH AND WOOD DUCK EGGS FROM THE ERIE NATIONAL WILDLIFE REFUGE, CRAWFORD COUNTY, PENNSYLVANIA, 1986 (1990)

Comments on Documented Contaminant Concerns:
Brine continues to be used on dirt roads in and surrounding the refuge. Metals contamination was documented in sediments within the refuge. Brine may be a contributor, but air deposition is likely to be the primary source of metals. Any future sampling of sediments should include analysis for all appropriate organic and inorganic contaminants.

Relevance to contaminant assessment:
With the observed increase in oil and gas exploration, brine availability and the risk of spills will increase. The primary concern for brine is the potential for acute toxic effects from uncontrolled releases.The refuge should work with the PA DEP Oil and Gas Program and the Crawford County Conservation District to ensure that brine stored on drilling sites is handled appropriately and that spill containment structures are in place at all active sites.

Other/Suspected Contaminant Concerns

Data from CIMAS:

Contaminant Issue	Source	Knowledge of Source	Location(s) of Source
Heavy Metals	Other	Suspected	On-Site
Sewage	Other	Suspected	Off-Site
Herbicides	Other	Suspected	On-Site
Pesticides	Agriculture Runoff	Suspected	On-Site

Comments on Other/Suspected Contaminant Concerns:
Baseline conditions in Muddy Creek must be established to prevent any stresses on the mussel populations. Mussel and fish surveys have been conducted. However, water and sediment quality data are over 15 years old and benthic macroinvertebrates have never been characterized. These data will be critical to controlling permitting of discharges upgradient of the populations, as well as substantiating any NRDA claims in the event of a spill in the watershed.

Relevance to contaminant assessment:
Sugar Lake is classified as an impaired water body. It is not currently part of the refuge, but is within the acquisition boundary. Prior to purchase, water, sediment, and biota sampling should be performed to ensure that nutrient loading is the only contaminant stressor. The data should also be used to design a stressor reduction effort to improve the ecology of the lake and protect the nesting birds.

Species Assessment

This section lists all species groups pertinent to the refuge. Each group is assessed for its importance to contaminant sources on or near the refuge.

Species Addressed:

Macroinvertebrates

Comments on species data:

No survey data are available for macroinvertebrates within the refuge.

Relevance to contaminant assessment:

This group of organisms is considered sensitive to contaminants. The lack of data has been identified and funding for surveys was requested in an on-refuge proposal submitted in 2012 to the EC program.

Exotic/Pest Species

Comments on species data:

The Mohawk Run Fen was dominated with poison sumac and alder-leaved buckthorn prior to refuge management. An invasive plant survey in 2003 within the shrub fen complex resulted in the mapping of several invasive plant populations. About half of the 9-acre shrub fen is dominated by or contains established infestations of four extremely aggressive non-native invasive plants: multiflora rose, reed canary grass, narrow-leaf cattail, and common reed. A fifth aggressive but newly established invasive plant, velvet grass, is also present, as well as a regional recognized invasive plant, coltsfoot. Non-native reed canary grass and common reed occur in the broadleaf-conifer swamp of Muddy Creek. Invasive plant species occur throughout the refuge. Management efforts are being made on the refuge for: Amur honeysuckle Lonicera maackii Autumn olive Elaeagnus umbellata Bells honeysuckle Lonicera X bella Canada thistle Cirsium arvense Coltsfoot Tussilago farfara Common reed Phragmites australis Garlic mustard Alliaria petiolata Guelder rose Virburnum opulus Japanese honeysuckle Lonicera japonica Morrows honeysuckle Lonicera morrowii Multiflora rose Rose multiflora Narrow-leaf cattail Typha angustifolia Purple loosestrife Lythrum salicaria Reed canary grass Phalarus arundinacea Velvet grass Holcus lanatus Two non-indigenous fish species, common carp and brown trout, were reported in Seneca streams. Carp is also prevalent in Lake Creek. Carp have been prevalent on the Refuge since early in its establishment and occur in impoundments and also occur in marsh systems including Lake Creek Marsh RNA. The zebra mussel (Dreissena polymorpha) and the Asian clam (Corbicula fluminea), two invasive mollusks, occur in the French Creek watershed although not, as yet, on the Refuge. Robert Anderson, PA Ecological Services Office mussel expert, is concerned that Sugar Lakes impoundments could provide a means of introduction for zebra mussels on the Refuge.

Relevance to contaminant assessment:

The agricultural areas surrounding the refuge received numerous applications of herbicides. The

development of herbicide resistant invasive species due to excessive herbicide use could impair the refuge's ability to control invasives in these rare habitats. Non-native mussels are known to tolerate poorer water quality than native species. Any contaminants that reduce water quality would favor population increases of invasive mussels leading to their spread into the refuge.

Raptors

Comments on species data:

Two pairs of bald eagles nest on Sugar Lake, one pair since 1988. A third pair of bald eagles nest on Seneca.

Relevance to contaminant assessment:

Any detrimental changes in water quality or prey quantity or quality could have significant effects on these species.

Other Species

Comments on species data:

see specific sections

Relevance to contaminant assessment:

see specific sections

Other Resident Birds

Comments on species data:

see specific sections

Relevance to contaminant assessment:

see specific sections

Plants - Terrestrial

Comments on species data:

Within Muddy-Dead Creek stream valley, 24 different areas support rare plants, animals, or natural communities. Two upland species of plants and two floodplain forest communities (silver maple floodplain forest and red maple-black ash palustrine forest) are of conservation concern to refuge biologists. The Muddy Creek RNA covers a portion of the over 1,000-acre expansive Muddy Creek floodplain. The RNA hosts many ecological features including the creek and associated wetlands, swamps, oxbows and beaver flowages, rare orchids, rare shrub fen complex, and noteworthy examples of several forest types: hemlock-yellow birch, black ash-American elm-red maple, white pine-hemlock, sugar maple-basswood, and aspen.

Relevance to contaminant assessment:

The agricultural areas surrounding the refuge received numerous applications of herbicides. Direct effects of herbicides on herbacous or seedling woody plants could affect the sustainability

of these plant species. The development of herbicide resistent invasive species due to excessive herbicide use could impair the refuge's ability to control invasives in these rare habitats.

Plants - Aquatic

Comments on species data:

The refuge lists five wetland communities as habitats of conservation concern along with 11 obl/facw plant species of conservation concern. The Mohawk Run Fen complex is within the Muddy Creek/Dead Creek Stream valley and encompasses four globally rare shrub fens scattered within a 15-acre area. The shrub fens range in size from ¼ acre to 9 acres. At the time of its discovery in 1998, the 9-acre shrub fen at the core of the shrub fen complex was considered one of the best examples of this vegetation association in northwest Pennsylvania. The sparse tree canopy was dominated by red maple. Scattered openings within the shrub fen were dominated by graminoids, particularly spikerushes. A 21-acre and a 52-acre broadleaf-conifer swamp are located on the lower wall and valley floor of Muddy Creek. This uncommon natural community supports two state rare plants, sweetflag and leafy northern green orchid (although the sweetflag was not reconfirmed in 2005). The dominant plants include eastern hemlock and various sedges. The swamp supports a high diversity of plant species.

Relevance to contaminant assessment:

Any detrimental changes in water quality could have significant effects on this species and communities. Spills associated with petroleum exploration including brine releases could be toxic to individuals or entire communities. For rare species and habitats, modest releases could have significant effects. The agricultural areas surrounding the refuge received numerous applications of herbicides. Direct effects of herbicides on herbacous or seedling woody plants could affect the sustainability of these plant species. The development of herbicide resistent invasive species due to excessive herbicide use could impair the refuge's ability to control invasives in these rare habitats.

Other Aquatic Birds

Comments on species data:

The refuge has nine species of waterbirds that are listed as species of concern. The Refuge has conducted marsh bird surveys since 1999. Virginia rail, sora, and common moorhen were regularly documented on both Divisions through 2005, although not always every year. American and least bitterns and pied billed grebe were picked up on some of the surveys. Other birds heard or observed on the marsh bird surveys included willow and alder flycatchers, sedge and marsh wrens, common yellowthroat, belted kingfisher, and red-winged blackbird.

Relevance to contaminant assessment:

Any detrimental changes in water quality or prey quantity or quality could have significant effects on these species.

Other Freshwater Species

Comments on species data:

The refuge has identified 12 species of fish and 22 species of mussels that are species of conservation concern. Many of these are state-listed or state candidate species. Kelly Run was included in the stream fishery inventory with documented rare fish species. Also in Muddy Creek, researchers collected 48 species of fish including 24 of the 31 species in the French Creek

watershed reported to serve as freshwater mussel hosts and seven of the 24 state-listed fishes thought to live in the French Creek watershed. Muddy Creek appears to be second only to the main stem of French Creek in providing habitat for the most diverse assemblage of freshwater mussels in Pennsylvania. The Pennsylvania Fish and Boat Commission stock rainbow, brook and brown trout just upstream of the Seneca Lake Division and in the Sugar Lake Division. Recreational fishing is popular on the Refuge. Warm water fish include smallmouth bass, rock bass, sunfish, grass pickerel, and various species of suckers.

Relevance to contaminant assessment:

Successful reproduction is critical to the maintenance and recovery of several rare freshwater mussel populations known to occur in Muddy Creek and their reproduction is dependent on the presence of the host fishes that carry the mussels glochidia larvae during a critical developmental period. Both host fish and mussels are dependent on high quality water.

Other Migratory Birds

Comments on species data:

The Erie NWR is recognized as a Pennsylvania Important Bird Area (IBA). The bird list for the Refuge includes 250 of which 136 species are known to nest on the Refuge. Thirty-seven of these birds are listed as species of concern for the refuge. Shrubland birds that were recorded on the Refuge in bird surveys in order of relative abundance include song sparrow, yellow warbler, red-winged blackbird, common yellowthroat, gray catbird, swamp sparrow, alder flycatcher, willow flycatcher, field sparrow, blue-winged warbler, and rufous-sided towhee. Other species that occur in the shrub field-forest edge on the Refuge in order of relative abundance include American crow, northern cardinal, indigo bunting, American goldfinch, house wren, eastern phoebe, eastern kingbird, and eastern bluebird. The grassland bird species on the refuge in order of relative abundance include savannah sparrow, bobolink, eastern meadowlark, and grasshopper sparrow (Erie NWR 1996 to 2000 bird surveys). American woodcock and common snipe both breed on the Refuge. Golden-winged warbler, a species of conservation concern, is confirmed as breeding in neighboring Venango County with a few possible accounts near the Refuge. Although landbird surveys on the Refuge have not detected golden-wings, more survey points within shrubland habitat may be needed to detect this bird. Blue-winged warblers occur on the Refuge. Cerulean Warbler distribution is being studied by Cornell University, but its presence on the refuge has not been confirmed. Landbird surveys conducted on the Refuge have detected cerulean warblers, a species of conservation concern. However, the Refuge is not currently included as a survey site for the Cornell Lab of Ornithologys Cerulean Atlas Project. Other common forest birds include scarlet tanager, wood thrush, eastern wood pewee, great-crested flycatcher, and veery, among several others William Palmer, Pennsylvania Game Commission woodcock biologist, estimated that about 25% of the Refuge supports woodcock habitat including the wet scrub shrub.

Relevance to contaminant assessment:

Upland areas are adjacent to private agriculture surrounding the refuge. Pesticide spills or misuse could result in direct toxicity or substantial declines in prey during the nesting season.

Mammals - Terrestrial

Comments on species data:

The refuge checklist of 51 species of mammals found on Erie NWR was compiled from staff observations, expert consultation, student internships, and literature research. The Pennsylvania Comprehensive Wildlife Conservation Strategy lists fifteen of those mammals as species of

greatest conservation concern. River otter are known to occur on the Refuge. Otter are likely making a return following reintroduction efforts in the Allegheny River in Pennsylvania and in western New York.

Relevance to contaminant assessment:

River otter require abundant fish populations and high water quality. As this species is just beginning to establish itself in this watershed, any detrimental changes in water quality or fish quantity or quality could have significant effects on this species. Many of the 15 species of concern are insectivores. Thus, pesticide spills or misuse could substantially affect the prey base for these species.

Reptiles

Comments on species data:

Biologists have identified five species of turtles on the refuge. Two of these species, the spotted and wood turtles, are listed as species of greatest conservation need for Pennsylvania. Eleven species of snakes round out the list of reptiles. Four of these snake species are listed on the State's list of conservation concern.

Relevance to contaminant assessment:

Toxicity data are lacking for reptiles, but it can be assumed that spills associated with petroleum exploration surrounding the refuge could affect these species.

Threatened/Endangered/Candidate Species (Fed Listed)

Comments on species data:

The portion of Muddy Creek that flows through the Refuge-Seneca Division provides habitat for 22 species of freshwater mussels, including the Federally endangered northern riffleshell, clubshell, rayed bean, and snuffbox mussels and several state listed and globally rare species. Host fish for the listed and rare mussels in Muddy Creek may also reproduce in tributaries.

Relevance to contaminant assessment:

The presence of a diverse freshwater mussel community in Muddy Creek indicates adequate water quality since mussels require good water quality. For example, the clubshell mussel is found in clean, coarse sand and gravel in runs, often just downstream of a riffle; it does not tolerate mud or slack water conditions and is very susceptible to siltation. Pennsylvania Fish and Boat Commission collected water quality samples from two locations on Muddy Creek upstream of the Refuge in 1990. Results were indicative of a productive, well-buffered stream. Soils in the Seneca Division are mostly from the Holly-Red Hook-Chenango Association, and primarily hydric Holly soils. All soils in this association have only a slight erosion hazard, but upstream activities that change surface runoff or sediment loads could cause greater erosion. Muddy Creek shows some evidence of erosion with cut banks devoid of vegetation. Stream corridors such as Muddy Creek are constantly adjusting to changes in stream flow and sediment loads. Functioning riparian systems typically have adequate vegetation, landform, or large woody debris (such as log jams) to dissipate stream energy associated with high flows. Maintaining these functional characteristics is particularly important in Muddy Creek because of its importance to rare freshwater mussels and host fish species that require clean, coarse sand and gravel bottoms downstream of riffles. Given the number of roads that traverse the Refuge, the aquatic resources are at some risk from accidental spills of gasoline, fuel oil, agricultural chemicals or runoff containing road salts and other contaminants.

Waterfowl

Comments on species data:

American black duck, wood duck, hooded merganser, mallard, blue-winged teal, and Canada goose regularly nest on the Refuge; another 18 waterfowl species use the Refuge during migration. The refuge lists 12 species of waterfowl as species of concern.

Relevance to contaminant assessment:

Any detrimental changes in water quality or food quantity or quality could have significant effects on these species.

State Listed/Candidate Species

Comments on species data:

State rare freshwater mussels, the creek heelsplitter (Lasimigona compressa), cylindrical papershell (Anodontoides ferussacianus), Long-solid mussel (Fusconaia subrotunda), Rabbitsfoot mussel (Quadrula cylindrical), Rayed bean mussel (Villosa fabalis), Round pigtoe (Pkuerobema sintoxia), Snuffbox mussel (Epioblasma triquetra), and Three-ridge mussel (Amblema plicata) occur in the refuge. Host fish for the listed and rare mussels in Muddy Creek may also reproduce in tributaries. Four state-listed plants were discovered in the Mohawk Fen: slender spikerush, thin-leaved cottongrass, drooping bluegrass, and swampfly honeysuckle. The drooping bluegrass is also considered globally rare. Four state-listed threatened or endangered bird species nest on the Refuge: bald eagle, American bittern, least bittern, and sedge wren. Several mammals are listed by the state as species of greatest conservation concern including the eastern small-footed bat and the northern myotis, both of which are thought to occur on the Refuge. The state-listed least shrew (Cryptotis parva) also occurs on the refuge. The hellbender and short-headed garter snake are considered vulnerable throughout their range. State-listed or candidate fish species on the refuge are Bluebreast darter (Etheostoma camurum), Brindled madtom (Noturus miurus), Eastern sand darter (Ammocrypta pellucida), Gilt darter (Percina evides), Longhead darter (Percina macrocephala), and Northern madtom (Notorus stigmosus).

Relevance to contaminant assessment:

While robust populations can sustain some toxic effects, these species are at much higher risk from any contaminant exposure which reduces survival, reproduction, and growth. As the refuge is habitat for numerous status species, prevention of contaminant exposure is critical.

Amphibians

Comments on species data:

The refuge species checklist has 13 salamanders, including the hellbender, a species of greatest conservation need in Pennsylvania. Eight species of toads and frogs occur on the Refuge with 3 species identified as "species of concern."

Relevance to contaminant assessment:

Maintenance of high water quality is critical to protection of these aquatic species, particularly those identified as species of concern.

Land Cover/Land Use

This section addresses specific land cover issues of importance to the contaminants assessment.

Data from RMIS:

Habitat Type	Percentage of Total Habitat
Cropland	6.0
Forest Upland	20.0
Grass Upland	4.0
Shrub Wetland	10.0
Water	60.0
Total	100

Land Cover/Land Uses Addressed:

Agricultural Lands

Comments on land use/land cover/habitat data:

Sugar Lake Division has 277 Acres and Seneca Division has no agricultural acreage resulting in 277 (3%) acres of agricultural land for the entire refuge. The Refuge has maintained dozens of crop fields through cooperative agreements with local farmers, with a primary purpose to provide food for fall migrating waterfowl. In 2012, the Refuge had 277 acres (17 fields) on the Sugar Lake Division in crops, dominated by corn, oats, and hay. The Refuge has not found these croplands to provide much benefit to waterfowl including the Southern James Bay population of Canada geese, and many are in close proximity to high value streams and wetlands.

Relevance to contaminant assessment:

The cooperative farming agreements require best management practices (BMPs) including buffers for streams and wetlands. Pesticides are used following Pesticide Use Proposal submission and according to Integrated Pest Management principles and BMPs including wetland and perennial stream setbacks. However, manpower is not available to enforce all activities on these parcels. During the 2007 site visit, it was evident that setbacks from streams on hay fields were not being observed. Spills or misuse of approved pesticides could cause serious terrestrial and aquatic effects.

Deciduous Forest

Comments on land use/land cover/habitat data:

Upland Forest exists on 1,412 acres of Sugar Lake (27%) and 366 acres (10%) of Seneca for a total of 1,778 acres (20%) refuge-wide (NatureServe, 2007). Most of the virgin timber within Woodcock Creek stream valley was cut in the late 1800s and early 1900s. In 1965, the average age of the second growth woodland was about 50 years, although some of the hemlock and sugar maples exceeded 75 years. The 100-acre Jacob Guy Research Natural Area in the Sugar Lake Division was designated in 1965 because the area was one of the few remaining stands of trees in this area that represents the transitional association which was once typical of northwestern Pennsylvania. Today the woodland likely averages over 100 years. In 1971, the

Jacob Guy woodland was dominated by hemlock, beech, and sugar maple. In 1994, another researcher recorded beech, sugar maple, and ash as the dominants. Both reports indicated a very diverse tree, shrub, and herbaceous plant community. Black cherry is now a dominant tree in this forest. Refuge biologists identified a mature 73-acre northern hardwood forest (cherry-maple variant) in the Lake Creek valley, situated on a glacial knoll bordering the graminoid marsh described above. Dominant species included beech, black cherry, red maple, sugar maple, and red oak. The common understory plants included mapleleaf viburnum, witch hazel, ironwood, violets, clubmosses, and various ferns .

Relevance to contaminant assessment:

Upland forest is bordered by private lands on many parts of the refuge. Air and water migration pathways are possible sources of exposure in these areas.

Medium Tall Grassland

Comments on land use/land cover/habitat data:

Medium Tall Grassland/old field occurs on 1006 acres (19%) of Sugar Lake and 663 acres (18%) of Seneca for a total of 1,669 acres (19%) refuge-wide (NatureServe. 2007). The Refuge has historically created and maintained many grasslands, primarily as nesting areas for waterfowl. In the latter 1990's the emphasis shifted to assessing these fields as habitat for grassland nesting birds (e.g., Henslow's sparrow, grasshopper sparrow). Starting in 1999, data was collected using the established regional protocol to ascertain the value of the fields on both Divisions for grassland birds. A recent preliminary GIS analysis of each of the fields indicated that all of the fields are less than ideal for grassland nesting land birds, because of small field size, isolation from other fields, lack of well-drained soils, or a combination of these factors.

Relevance to contaminant assessment:

Grassland is bordered by private lands on many parts of the refuge. Air and water migration pathways are possible sources of exposure in these areas.

Other Wetlands

Comments on land use/land cover/habitat data:

Forested Wetlands exist on 222 acres (4%) of Sugar Lake and 1096 acres (31%) of Seneca for a total of 1319 Acres (15%) refuge-wide. Emergent marsh occupies 597 acres (11%) of Sugar Lake and 302 acres (8%) of Seneca for a total of 899 acres (10%) refuge-wide. Shrub wetland eixsts on 599 acres (12%) of Sugar Lake and 380 acres (11%) of Seneca for a total of 979 acres (11%) refuge-wide. Wet meadow exists on 69 acres (1%) of Sugar Lake and 137 acres (4%) of Seneca for a total of 206 acres (2%) refuge-wide (NatureServe 2007). Patches of broadleaf-conifer swamp occur frequently throughout both Divisions. The vegetation in each patch varies somewhat, however, the dominant species include hemlock, green ash, black ash, red maple, yellow birch, spicebush, witch hazel, speckled alder, silky dogwood, skunk cabbage, jewelweed, cinnamon fern, and sensitive fern. These bottomland-forested swamps have suitable nest site characteristics for bald eagles. Native dogwoods and willows dominate wet shrublands on the Seneca Division. These natural shrublands seem to be self-sustaining. These shrublands provide nesting habitat for willow flycatcher and a resting and foraging (seeds and fruits) area for migrating songbirds.

Relevance to contaminant assessment:

While sediment sampling was not conducted in other wetland types in 1991, it is reasonable to assume that they also receive runoff from nearby roads, contaminated sediments from streams

during flood events, and air deposition. Follow-up sampling should include all wetland types on the refuge.

Lake/Pond/Impoundment

Comments on land use/land cover/habitat data:

Impoundments occupy 315 Acres (6%) of Sugar Lake and 0 Acres (0%) of Seneca for a total of 315 Acres (4%) refuge-wide. The Refuge-Sugar Lake Division has 14 freshwater impoundments that range in size from 1 to 175 acres, with most less than 30 acres. The Seneca Division has two dikes but no water control structures. Most of the impoundments were created as moist soil units to benefit waterfowl, and many were constructed within the main stem or tributaries of Lake Creek. . Since 2007, water levels in most of the impoundments have been lowered to provide more water depths conducive to developing habitat for BCR 13 priority breeding and migrating dabbling ducks, marsh birds, wading birds and inland shorebirds that regularly use refuge wetland habitats. Myers Pond and Pool K have been managed at full pool to maintain the existing fisheries. Some impoundments may be managed at drained conditions if there have been reported flooding issues on adjacent public roads. The Comprehensive Conservation Plan process will determine how impoundments will be managed in the future,

Relevance to contaminant assessment:

Most of the impoundments have been in place for many years. Appreciable sediment accumulation has occurred behind the dams. Sediment data collected in 1991 demonstrated that metals were accumulating within pond sediments. Of the 17 metals measured, 11 exceeded ecological screening levels, particularly for the ponds receiving brine runoff from roads. In the 16 years since those data were collected, brine has continued to be used on the roads. A follow-up sampling event is warranted to determine current concentrations, risk to aquatic organisms, and potential remediation/prevention actions.

Riverine

Comments on land use/land cover/habitat data:

Muddy Creek (83.6 mi 2) flows through the Seneca Division of the Erie National Wildlife Refuge and joins French Creek near the village of Miller's Station, Crawford County. Woodcock Creek (50.5 mi 2), which has been dammed by the Army Corps of Engineers to form Woodcock Creek Lake, joins French Creek near Saegertown. Sugar Creek (167 mi 2) which includes Lake Creek and all of the impoundments on the Sugar Lake Division joins French Creek at the village of Sugarcreek, Venango County.

Relevance to contaminant assessment:

The network of tributaries and streams is the backbone of the refuge. Both the aquatic and associated floodplain habitats associated within the watersheds rely on high quality water to support unique communities and rare species. The large irregular perimeters of the divisions result in many potential migration pathways into the tributaries from private lands. Those headwater tributaries that begin on private land are at greater risk than those buffered by upland refuge lands. Spills, runoff, and misuse of chemicals from agriculture, road treatments, and petroleum exploration are the acute concerns, while deposition of airborne heavy metals are a chronic pathway.

File Title	File Name	Comments	Size
Habitat Table	habitat table.bmp		983094

Management Activities

This section addresses specific management activities occuring on the refuge of import to the assessment of environmental contaminants effects on the resources managed by the refuge.

Data from RMIS:

Management Programs
The primary management objective of Erie NWR is to provide waterfowl and other migratory birds with nesting, feeding, brooding, and resting habitat. Over 2,500 acres of wetland, including beaver ponds, marshes, swamps, manmade impoundments, creeks, and wet meadows, provide desirable habitat for a variety of migratory birds and waterfowl. Water control structures on refuge impoundments permit the manipulation of water levels to encourage the growth of desirable wetland plants. Grasslands have been developed near wetlands to provide dense nesting cover for ground-nesting waterfowl and other grassland species. A cooperative farming program provides for a source of supplemental food for resident wildlife and migratory birds. Early successional habitat is being maintained by mowing and the use of selected forestry practices. Artificial nesting structures provide for a variety of wildlife needs. Erie NWR has been formally designated as an Important Bird Area, and a Globally Significant Watershed. There are twenty-two Natural Heritages Areas, Nineteen Special Plant and Animal Species Habitats, four Natural Communities of Biological Significance and Research and Public Use Natural Areas requiring management. Prescribed burning is accomplished on about 100 acres of warm season grassland on a annual basis. A trapping program is conducted to maintain healthy levels of wildlife populations and to prevent habitat damage. Population management is also a prime objective of the extensive refuge hunting program. Deer hunting is very popular and a significant biological tool in controlling deer numbers. Participation in the Pennsylvania Partners for Wildlife Program contributes to the goals of the Ohio River Valley Ecosystem and the North American Waterfowl Management. Erie NWR personnel contribute one staff year on an annual basis for this very popular wetlands restoration program.

Management Activities Addressed:

Previous Baseline or Reference Monitoring

Comments on land use/land cover/habitat data:

Mussel and fish surveys have been conducted in Muddy Creek. Water and sediment quality and benthic macroinvertebrates have never been characterized in Muddy Creek. Current monitoring of conductivity using sondes will established baseline conditions in Muddy Creek prior to Utica shale drilling. Sediment data from Lake Creek, its tributaries, and the refuge impoundments are over 15 years old. This effort was limited to a single round of sediment and surface water samples were tested to evaluate migration potential of brine applied to dirt roads.

Relevance to contaminant assessment:

Baseline conditions in Muddy Creek must be established to prevent any stresses on the mussel populations. Discrete water and sediment samples will be critical to controlling permitting of non-point discharges upgradient of the populations, as well as substantiating any NRDA claims in the event of a spill in the watershed. Sediment sampling will be needed prior to any dike removal for restore natural flows in Lake Creek.

On-Site Pest Management Activities

Comments on land use/land cover/habitat data:

Surveying and mapping of invasive species on the Sugar Lake and Seneca Division have been in progress for several years. Surveys for invasive plants have been conducted in the shrub fen complex (2003), Lake Creek Research Natural Area (2004), and in fields on both Refuge divisions in 2012. Invasive plant and animal species occur on both Divisions in altered habitats and naturally occurring ecosystems, including Research Natural Areas and rare natural ecological communities. The invasive species that the Refuge controls are listed under "exotic/pest species." The Refuge is trying to be proactive in preventing new invasions and identifying and treating established species. Nine acres of the shrub fen complex in Muddy Creek were found to contain infestations of multiflora rose, reed canary grass, narrow-leaf cattail, and common reed. Velvet grass and coltsfoot are also present.

Relevance to contaminant assessment:

BMPs are followed for any chemicals used in pest management activities conducted by the refuge. See agricultural lands for issues related to cooperative farming agreements.

Recreational Activities

Comments on land use/land cover/habitat data:

Fishing is common at the impoundments. A universally accessible fishing pier is located at Pool K. Available species include rainbow, brook and brown trout, largemouth bass, yellow perch, bluegill, sunfish, carp, crappie and bullhead. Population management is also a prime objective of the extensive refuge hunting program. Deer hunting is very popular and a significant biological tool in controlling deer numbers. Small game hunting with dogs is also permitted. Waterfowl hunting is popular at the impoundments in Sugar Lake Division.The Refuge has nine trapping units in the Sugar Lake Division and seven units in the Seneca Division. Five trails, through a variet of habitat types, offer walking, wildlife viewing, and hunting access. An observation Blind in Sugar Lake Division is an ideal spot to observe and photograph wildlife

Relevance to contaminant assessment:

Concentrations of bioaccumulative contaminants are not expected to be high enough to pose a human health risk via consumption of terrestrial, aquatic or semi-aquatic game species.

Research for species not T and E

Comments on land use/land cover/habitat data:

Surveys are conducted for waterfowl, bald eagles, woodcock, and bluebird nesting.

Relevance to contaminant assessment:

Bald eagles are top predators that could be exposed to high concentrations of bioaccumulative contaminants (e.g., mercury) if fish and avian prey have been consuming contaminated benthic invertebrates. Woodcock are at risk when soils are contaminated with bioaccumulative metals due to high proportion of earthworms in diet.

User-Identified Sites (Including Local Off-Interior Areas Important to Trust Resources)

This section addresses areas surrounding the refuge such as neighboring farms, fields and other habitat areas that may be used by trust resources also utilizing the refuge.

Areas:

1. **Air Deposition**

Location/Address Notes:

Numerous facilities are located west and southwest of one or both of the divisions. One or two are located northeast of the refuge.

Description of area and importance to study:

Numerous foundaries and electroplating RCRA facilities in surrounding communities are emitters of heavy metals. Many of these releases are up wind of one or both divisions of the refuge from a predominate wind direction. These documented presence of elevated metals in sediments in 1991 is likely due to air deposition from these emitters, as surface water discharges of metals do not exist up gradient of the refuge.

1. **Gas Wells - Shallow drilling**

Location/Address Notes:

Gas wells are located on surrounding properties in proximity to streams that enter the refuge.

Description of area and importance to study:

Oil and gas well sites have storage tanks for oil and brine.

1. **Local Development**

Location/Address Notes:

Areas surrounding the refuge that are being developed.

Description of area and importance to study:

Since Rockdale and Richmond Townships are considered growth communities in Crawford County, residential, industrial, and commercial development is likely to increase with associated increases in impermeable surfaces and greater runoff. Nonpoint source pollution caused by runoff of sediment, lawn fertilizers and pesticides, faulty septic systems, and other activities could have negative effects on Refuge aquatic systems (Mohler 2003).

1. **PA Game Commission Pheasant Farm**

Location/Address Notes:

The farm is located east of Cambridge Springs along the boundary of the Seneca Division along Route 408. The farm is bordered by two headwater tributaries and a wetland.

Description of area and importance to study:

A confined feeding operation for pheasant stocking program for the entire state. The farm trucks most poultry manure offsite with only a truckload-sized bin keep for composting on site. Ground water is tested annually for bacteria from runoff and has always been

negative. The most recent negative test was in January 2007. Vegetation buffer strips of 200 yards for the tributaries and 50 yards for the wetland are maintained to prevent runoff to surface water bodies.

1. **Pesticide Disposal**

Location/Address Notes:

Near the Visitors Center/headquarters: two 30-gallon drums of 2,4-D, three 55-gallon drums of 2,4,5-T, and 40 pounds of endrin; in an old house foundation along McFadden Road, about a mile south of the Visitors Center/headquarters: three drums of 2,4,5-T.

Description of area and importance to study:

On September 26, 1989, the U.S. Environmental Protection Agency (Region III) sent a letter to the Erie National Wildlife Refuge asking for additional information on a Preliminary Assessment of hazardous wastes which had been submitted to EPA. The preliminary assessment (PA) indicated that, around 1964, Erie NWR staff buried their supplies of chlorphenoxy herbicides and pesticides in two locations on the refuge property. The PA indicated that Erie NWR officials claimed that trees in the vicinity of the herbicide drum burial died 18 months after the drums were disposed in the area. The PA also stated that distressed vegetation was apparent on aerial photos taken in 1969. To assist Erie NWR in responding to EPA, the Pennsylvania Field Office contacted the U.S. Geological Survey in Pittsburgh, who provided information on groundwater hydrology in the area, and provided an underground pipe locator to survey the area. However, this survey, conducted on May 15, 1990, appeared to yield false signals over wet soils, so a geophysical survey was contracted. Kurz Associates of Bridgewater, MA, used a magnetometer and ground-penetrating radar on June 4, 1990, and identified areas for further investigation. On June 10 and 11, 1990, Petroclean excavated both locations. No drums were found at the McFadden Road location, only metal pipe, sheet metal, and what appeared to be pieces of metal furnace ducts. At the site near the Refuge, two crushed drums were found. There was no free product found in the drums, but the contractor took a sample of dirt from within the drums and from soil beneath the drums. 2,4-D was detected from soil inside the drums at 8.27 mg/kg. No other compounds were found, and no contamination was detected in the sample from beneath the drums. All excavations were backfilled, and the case considered closed.

1. **Roads**

Location/Address Notes:

Roads through and surrounding the refuge.

Description of area and importance to study:

Several State and Township roads pass through the Refuge, all with the potential to release contaminants into Refuge wetland systems. Some of the roads are quite low and flood several times a year. In this part of Pennsylvania salt is used in winter and brine is used in summer to reduce dust. Historically, brine from shallow wells has been used on roads under an individual permit to Crawford County. Current PA DEP regulations prohibit the use of Marcellus (and presumably Utica) shale brine on roads. It is unclear if Crawford County would apply for an individual permit for shale gas brine use on roads. Shale gas brine contains significantly higher concentrations of chloride, radioactive material, barium, bromide, arsenic, manganese, and sulfate than shallow gas brine. These substances are highly water soluble and could contaminate creeks and impoundments via runoff.

1. **Small sewage dischargers**

Location/Address Notes:

Four of the five are upgradient of the Seneca Division in the Muddy Creek watershed. One is located upgradient of the Sugar Lake Division in the Lake Creek watershed.

Description of area and importance to study:

Five single family or small unit sewage dischargers hold NPDES minor permits. Two similar facilities are located on Sugar Lake itself which is within the refuge's acquisition boundary. These facilities are not contributing appreciable wastes to the watershed. However, with increasing development in these watersheds, additional facilities are very likely to come on line. In these small tributaries surrounding and within the refuge, even modest increases in nutrient loading could have substantial effects on sensitive biota such as mussels.

1. **Stream Sediments**

Location/Address Notes:

Both Sugar Lake and Seneca Divisions.

Description of area and importance to study:

The Refuge-Sugar Lake Division has 14 freshwater impoundments that range in size from 1 to 175 acres, with most less than 30 acres. The Seneca Division has two dikes but no water control structures. Most of the impoundments were created as moist soil units to benefit waterfowl, and many were constructed within the main stem or tributaries of Lake Creek. Since 2007, water levels in most of the impoundments have been lowered to provide more water depths conducive to developing habitat for BCR 13 priority breeding and migrating dabbling ducks, marsh birds, wading birds and inland shorebirds that regularly use refuge wetland habitats. Myers Pond and Pool K have been managed at full pool to maintain the existing fisheries. Some impoundments may be managed at drained conditions if there have been reported flooding issues on adjacent public roads. The CCP process will determine how impoundments will be managed in the future. Dams affect flow velocity, timing of peak flows, sediment flushing and accumulation, floodplain flooding, nutrient loads, and other physical and chemical factors. Dams also restrict dispersal of aquatic organisms such as fish and mussels (Kline 1998). Sediment sampling conducted in 1991 indicated that 11 of 17 metals exceeded screening concentrations for the protection of ecological receptors. These same metals are reported as being released from downwind stacks in EPA's TRI.

1. **Utica Shale Gas**

Location/Address Notes:

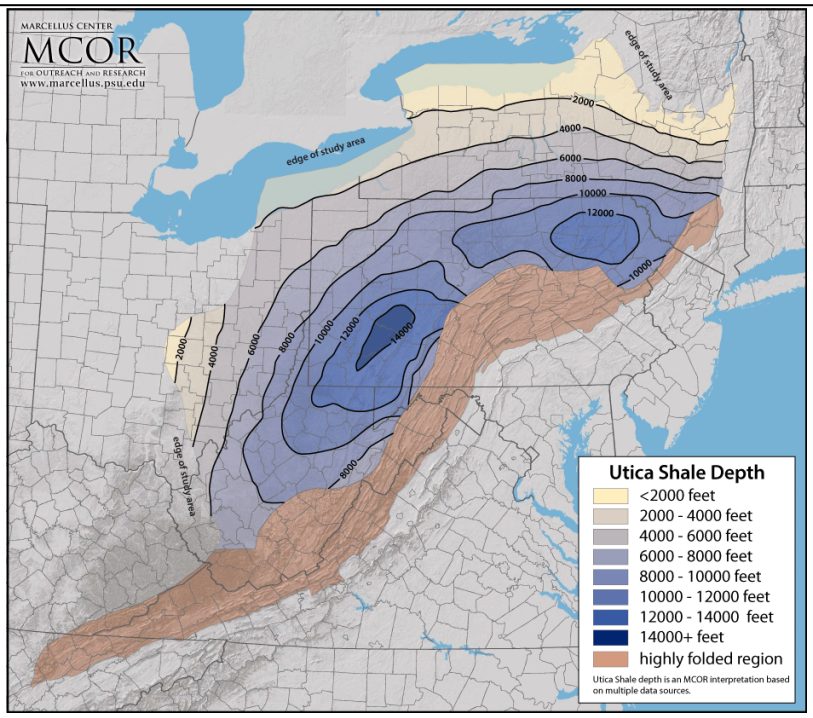
Utica shale gas deposit underlies all of Crawford County, PA. The deposit is nearest the ground surface in a contour that runs from southeast Ohio north then east to central New York. This contour runs through Crawford County (see attached Utica shale depth map). Utica shale drilling began in this contour in Ohio and has proceeded north and east into west-central PA. Companies are currently signing leases in northwest PA including the area surrounding the refuge. While few inholdings exist, wells could be drilled on private lands on the perimeter of the refuge or on parcels within the refuge where the seller retained mineral rights (see attached maps).

Description of area and importance to study:

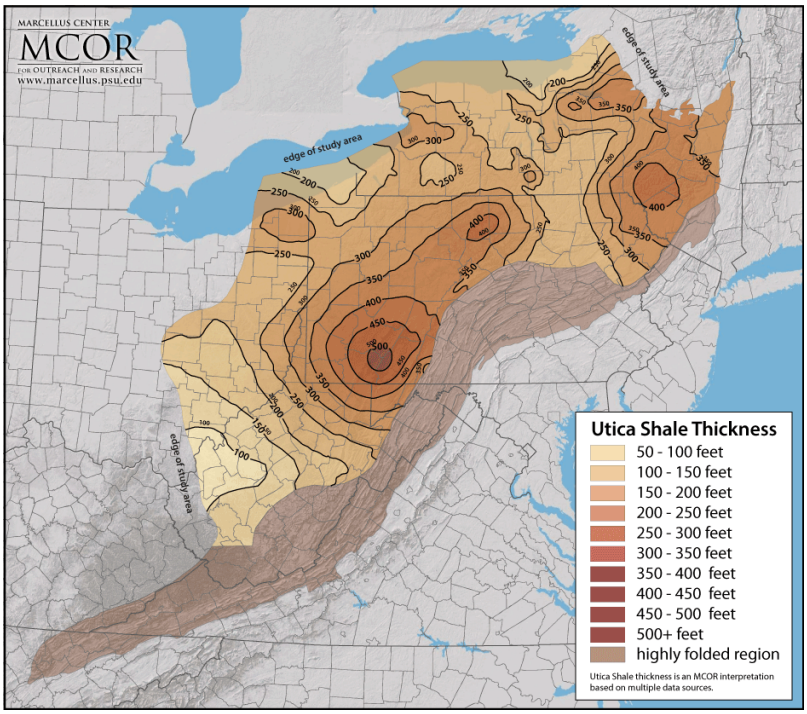
Utica shale is a shale layer that lies from 2000 to 14,000 feet below ground surface. It underlies the Marcellus shale deposit, but extends beyond it to the west and south. As

with Marcellus, drilling in this deposit typically uses 5-7M gallons of water, extends up to 1 mile laterally from the well pad, generates large amounts of bentonite slurry, and returns milions of gallons of brine waste water to the surface. Infrastructure includes waste water retention basins, mixing basins, and a network of waste water pipes that recycle brine waste water with freshwater for reuse. The primary risks to trust resources on the refuge are seismic testing, other noise, and light pollution effects on animal behavior, habitat degradation on inholdings and parcels lacking mineral rights, and water contamination from spills and leaks, particularly at stream crossings.

File Title	File Name	Comment
C:\Documents and Settings\kpatnode\My Documents\erie NWR\cap\Erie NWR Gas BMPs 2012.docx	Erie NWR Gas BMPs 2012.docx	Contains BMPs applicable to both shallow and Utica gas extraction
C:\Documents and Settings\kpatnode\My Documents\erie NWR\cap\MineralRights_Seneca_June2012.pdf	MineralRights_Seneca_June2012.pdf	
C:\Documents and Settings\kpatnode\My Documents\erie NWR\cap\MineralRights_SugarLake_June2012.pdf	MineralRights_SugarLake_June2012.pdf	
C:\Documents and Settings\kpatnode\My Documents\erie NWR\cap\UticaDepth.gif	UticaDepth.gif	



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Air Transport Pathways

Notes on Air Pathways

Documented Air Pathways

1. **North**

   General description of this wind pattern:

   Minor

   Description and/or comments about the wind pattern and its importance to the study:

   Insignificant

2. **North-East**

   General description of this wind pattern:

   Northeast contributes (6%). Speeds 3.34-8.49 predominate.

   Description and/or comments about the wind pattern and its importance to the study:

   Modest migration pathway.

3. **East**

General description of this wind pattern:

Minor

Description and/or comments about the wind pattern and its importance to the study:

Insignificant

4. **South-East**

General description of this wind pattern:

South southeast contributes (7%). Speed of 3.34 - 8.49 mps predominate.

Description and/or comments about the wind pattern and its importance to the study:

Modest transport pathway.

5. **South**

General description of this wind pattern:

Predominant single wind direction (15%). Speeds commonly 1.8 to 8.49 mps.

Description and/or comments about the wind pattern and its importance to the study:

Southern sources of airborne contaminant would be most likely to be migrate to refuge lands.

6. **South-West**

General description of this wind pattern:

South-southwest (11%), southwest (10%), and west southwest (8%) are second, third, and fourth most prominent directions. Collectively (29%) the predominant quadrant. Speeds are predominantly in the 3.34 - 8.49 mps range.

Description and/or comments about the wind pattern and its importance to the study:

Winds coming from the southwest directions are very likely to carry airborne contaminants toward the refuge.

7. **West**

General description of this wind pattern:

Modest contribution (7%). Speeds commonly range from 3.34-11.05 mps.

Description and/or comments about the wind pattern and its importance to the study:

In combination with west southwest and west northwest, a potentially significant migration pathway.

8. **North-West**

General description of this wind pattern:

West northwest and northwest collectively contribute 11%. Speeds commonly range from 3.34 - 8.49.

Description and/or comments about the wind pattern and its importance to the study:

Potentially significant transport pathway.

Biotic Transport Pathways

Documented Biotic Pathways

1. **Aquatic Invertebrates**

Locations on the FWS unit used extensively by this species:

Streams, impoundments, and wetlands

Description and/or comments about the species and its importance to the study:

Metals contamination in sediments may be affected benthic invertebrate communities. This pathway could also result in exposure in higher trophic organisms that feed on aquatic invertebrates.

2. **Mollusks**

Locations on the FWS unit used extensively by this species:

Freshwater mussels, including federally listed species, occur in the Seneca Division of the refuge.

Description and/or comments about the species and its importance to the study:

These mussels are very sensitivity to chloride and other ions that are present in high concentrations in brine from shallow and shale gas drilling. A spill or leaks from water retention basins on a drill site could lead to lethal and sublethal effects and take of listed species.

3. **Amphibians**

Locations on the FWS unit used extensively by this species:

Wetlands (salamanders, frogs and toads) and streams (hellbender)

Description and/or comments about the species and its importance to the study:

Runoff into wetlands or streams could have detrimental effects on these organisms, particularly juvenile life stages.

4. **fish**

Locations on the FWS unit used extensively by this species:

Lakes/Impoundments and streams

Description and/or comments about the species and its importance to the study:

Fish could be exposed to contaminated sediments in the lake/impoundments. Fish in the streams could be exposed to contaminants in runoff.

5. **Aquatic migratory birds**

Locations on the FWS unit used extensively by this species:

Lakes/Impoundments and Open water wetlands

Description and/or comments about the species and its importance to the study:

Insectivorous birds that feed by soil and sediment probing for invertebrates could be exposed to contaminated sediments and prey.

Transport Pathways

This section describes all of the surface water, ground water, air and biotic transport pathways pertinent to the refuge. This includes creeks and rivers in the watershed and identifies particular concern with regard to contaminant transportation.

Surface Water Transport Pathways

Documented Surface Water Pathways

1. **French Creek**

Location of the watercourse in relation to the FWS unit:

The refuge owns a segment of land that borders French Creek near its confluence with Muddy Creek.

Description and/or comments about the watercourse and its importance to the study:

The contaminants pathways for this stream would likely be the same as the others with the addition of railroad lines that use the tracks that parallel French Creek in this area.

2. **Lake Creek**

Location of the watercourse in relation to the FWS unit:

The southern portion of the Sugar Lake Division encompasses Lake Creek from its headwaters to its entry into Sugar Lake. The lake forms the southwest refuge boundary.

Description and/or comments about the watercourse and its importance to the study:

The Lake Creek valley contains a complex mosaic of natural communities, including a graminoid marsh (S3) and a circumneutral shrub swamp (S3). A long stretch of the stream and associated wetland complex just upstream of Sugar Lake was evaluated and was recognized as the Lake Creek Research Natural Area (RNA). The extensive undisturbed marsh was determined to be a natural marsh-swamp complex of excellent quality, size, habitat diversity, and viability. The wetland complex and surroundings also includes broadleaf-conifer swamp, beaver ponds, and mature northern hardwood forest. Invasive species, particularly reed canary grass, purple loosestrife and multifora rose, have gained a foothold in the RNA marsh. Beaver activity is common on the meandering, occasionally braiding, and low gradient stream with a mix of mudflats, emergent marsh, scrub-shrub wetlands, and forested swamps. A series of impoundments were constructed on Lake Creek upstream of the Lake Creek RNA wetland complex to benefit waterfowl. However, since 2007, water levels in most of the impoundments have been lowered to provide more water depths conducive to developing habitat for BCR 13 priority breeding and migrating dabbling ducks, marsh birds, wading birds and inland shorebirds that regularly use refuge wetland habitats. The CCP process will determine how impoundments will be managed in the future. Although not currently part of the refuge, the lake is within the planned acquisition boundary. Surface water quality and quantity are resources of concern. The Sugar Creek sub-basin has been heavily mined for sand and gravel, limestone, and oil and gas, and is extensively farmed.

3. **Mohawk Run**

Location of the watercourse in relation to the FWS unit:

The stream originates off refuge and passes through the Pheasant Farm property before entering the refuge.

Description and/or comments about the watercourse and its importance to the study:

Any releases via surface water runoff or groundwater expression associated with this confined animal feeding operation could affect water quality in Mohawk Run.

4. **Muddy Creek**

Location of the watercourse in relation to the FWS unit:

Originating near South Richmond Corners in Richmond Township, roughly half of Muddy Creek is located in the Seneca Division. Much of the Muddy Creek headwaters located off-Refuge is extensively farmed, while some portions flow through Pennsylvania State Game Lands. Muddy Creek varies in width from six to 12 feet as it flows through a broad valley with expansive wetlands. The stream meanders along highly erodible exposed soil streambanks creating turbid conditions characteristic of the stream. Muddy Creek has slow runs or bends and straight aways with side eddies as well as pools, log jams, and some riffles. Flow is moderate. The substrate is variable, including sand, gravel, silt, and organic debris. The Muddy Creek--Dead Creek stream valley in the Refuge is an area of high biological diversity, supporting uncommon and diverse natural communities and rare plants and animals. One reason for the rich diversity is the meandering nature of Muddy Creek that, over time, has created microhabitats within its broad floodplain. The Creek traverses the entire length of Seneca from southeast to northwest before flowing into French Creek on the northern Refuge boundary. The meandering pattern creates a stream length of over 10 miles (Mohler 2003). A portion of the Seneca Division borders the mainstem of French Creek for 0.5 miles north of Johnstown Road at the confluence of Muddy Creek. Dead Creek is almost entirely within Refuge boundaries. It is a much shorter and smaller drainage system than Muddy Creek that it feeds into. Dead Creek is

fed by a series of wetlands, seeps, and short tributaries; some reaches have a barely detectable flow. Beaver are active in Muddy and Dead Creeks, creating extensive emergent marsh communities.

Description and/or comments about the watercourse and its importance to the study:

The Muddy River starts and flows through a heavily farmed region before entering the Seneca Division of the Refuge. Sand and gravel mining of the large glacial deposits in northwestern Pennsylvania are prevalent north of the Seneca Division. The French Creek watershed has many active natural gas wells and many abandoned wells. Major portions of the Muddy Creek watershed lie in Rockdale, Richmond, Athens, and Steuben Townships. Rockdale and Richmond Townships are identified as growth municipalities given a 27 and 34% population growth, respectively, between 1970 and 1990.

5. **Woodcock Creek**

Location of the watercourse in relation to the FWS unit:

Woodcock Creek originates outside of the Refuge, flows about 2.25 miles through the Refuge, before leaving the northern boundary of the Sugar Lake Division and eventually discharging into French Creek.

Description and/or comments about the watercourse and its importance to the study:

The Refuge segment meanders north through a broad shallow stream valley with extensive emergent, shrub wetlands, and scattered aquatic beds and marsh. The stream substrate is clay and silt. Wetlands, tributaries, and the creek are critical habitats for the refuge. Surface water quality and quantity are resources of concern. Sand and gravel quarries are adjacent to the refuge near Woodcock Creek, on a tributary to Woodcock Creek, and upstream of the refuge on a tributary to Kelly Run.

Ground Water Transport Pathways

Documented Ground Water Pathways

1. **Bedrock aquifer**

Location of the aquifer in relation to the FWS unit:

The bedrock is part of the Mississippian Shenango formation. It is located from 50 to 100 feet below the sand and gravel glacial deposits. It is likely the source of the spring in Guys Mills which is the community's source of drinking water.

Description and/or comments about the aquifer and its importance to the study:

No ground water sampling has been conducted in the refuge. Not suspected to be a critical migration pathway due to high clay content and low infiltration of most refuge soils.

2. **Sand and Gravel Unit**

Location of the aquifer in relation to the FWS unit:

Shallow aquifer within the mile wide glacial valley. Supplies ground water to individual drinking wells.

Description and/or comments about the aquifer and its importance to the study:

No ground water sampling has been conducted in the refuge. Not suspected to be a critical migration pathway due to high clay content and low infiltration of most refuge soils.

Contaminant Source Information

Notes on Contaminant Sources

No notes have been entered

Total Contaminant Source Listing

The following list presents sites evaluated for the potential risk to trust resources utilizing this refuge.

TRI Site List for Contaminant Sources:

1. **ADVANCED CAST PRODS. INC.**

   Distance from FWS unit: 8.14 km

   Comments: Approximate distance from AOI = 30 km west of Sugar Lake Division

2. **AMERICAN INDUSTRIAL CONTAINER, CORP.**

   Distance from FWS unit: 18.36 km

   Comments: Approximate distance from AOI = 30 km

3. **ARRO FORGE INC.**

   Distance from FWS unit: 24.85 km

   Comments: Approximate distance from AOI = 30 km

4. **CHANNELLOCK INC., PLANT 1**

   Distance from FWS unit: 19.46 km

   Comments: Approximate distance from AOI = 30 km

5. **CHANNELLOCK INC., PLANT 2**

   Distance from FWS unit: 19.41 km

   Comments: Approximate distance from AOI = 30 km

6. **CORRY MFG. INC.**

   Distance from FWS unit: 35.43 km

Comments: Approximate distance from AOI = 30 km nickel and chromium discharges

7. **LORD CORP**

   Distance from FWS unit: 4.61 km

   Comments: No comments entered

8. **LORD CORP.**

   Distance from FWS unit: 16.31 km

   Comments: Approximate distance from AOI = 30 km northwest of Sugar Lake Division soutwest of Seneca Division

9. **LORD CORP. CAMBRIDGE SPRINGS FACILITY**

   Distance from FWS unit: 4.76 km

   Comments: Approximate distance from AOI = 10 km actually <4 miles west northwest of Seneca Division boundary volative organic solvents and zinc are emitted to air quantities are not reported similar contaminants released surface water, but down gradient of refuge

10. **MEADVILLE FORGING CO.**

    Distance from FWS unit: 4.93 km

    Comments: No comments entered

11. **MEADVILLE FORGING CO.**

    Distance from FWS unit: 20.81 km

    Comments: Approximate distance from AOI = 30 km actually within 10 miles of Sugar Lake Division manganese, chromium and nickel air emissions

12. **MORCO MFG**

    Distance from FWS unit: 8.47 km

    Comments: No comments entered

13. **PPG INDS. INC. WORKS 8**

    Distance from FWS unit: 24.97 km

    Comments: Approximate distance from AOI = 30 km actually within 10 miles of Sugar Lake Division boundary cobalt and selenium air emissions from a predominant wind direction

14. **SNAP TITE INC. / UNION CITY SITE**

    Distance from FWS unit: 15.98 km

    Comments: Approximate distance from AOI = 30 km actually northeast of the Seneca Division numerous metals emitted to air

15. **SPECTRUM CONTROL INC., (MATERIAL SCIENCE DIV.)**

    Distance from FWS unit: 17.72 km

    Comments: Approximate distance from AOI = 30 km southwest of Seneca Divison northwest of Sugar Lake Division

16. **U.S. BRONZE FNDY. & MACHINE INC.**

    Distance from FWS unit: 18.24 km

    Comments: Approximate distance from AOI = 30 km copper and lead release to air

PCS/NPDES Site List for Contaminant Sources:

1. **FAITH BUILDERS EDUCATIONAL**

   Distance from FWS unit: 0.15 km

   Comments: No comments entered

2. **MAPLEWOOD JR SR HIGH SCH**

   Distance from FWS unit: 1.5 km

   Comments: No comments entered

3. **MARVIN WEAVER**

   Distance from FWS unit: 0.31 km

   Comments: No comments entered

CERCLIS Site List for Contaminant Sources:

1. **ARCO GATC - SUGAR CREEK SITE**

   Distance from FWS unit: 22.42 km

   Comments: No comments entered

2. **SAEGERTOWN INDUSTRIAL AREA**

   Distance from FWS unit: 15.99 km

   Comments: No comments entered

AIRS Site List for Contaminant Sources:

1. **AA ROBBINS**

   Distance from FWS unit: 4.9 km

   Comments: No comments entered

2. **ADVANCED CAST PROD I/MEADVILLE**

   Distance from FWS unit: 10 km

   Comments: Approximate distance from AOI = 10 km <10 miles west of Sugar Lake Division

3. **CHANNELLOCK INC**

   Distance from FWS unit: 10 km

   Comments: Approximate distance from AOI = 10 km

4. **COINCO INC DBA MORCO/MORCO**

   Distance from FWS unit: 10 km

   Comments: Approximate distance from AOI = 10 km

5. **DEVORE TOOL**

   Distance from FWS unit: 8.76 km

   Comments: No comments entered

6. **DIC TOOL CO/MEADVILLE**

   Distance from FWS unit: 30 km

   Comments: Approximate distance from AOI = 30 km no data available on air emissions

7. **ELECTRO TECH INC/MEADVILLE**

   Distance from FWS unit: 30 km

   Comments: Approximate distance from AOI = 30 km

8. **LAUREL MTN MIDSTREAM LLC/TOWNVILLE STA**

   Distance from FWS unit: 2.24 km

   Comments: No comments entered

9. **LORD CORP**

   Distance from FWS unit: 4.61 km

   Comments: No comments entered

10. **LORD CORP/IND PROD DIV**

Distance from FWS unit: 1 km

Comments: Approximate distance from AOI = 1 km Within 1 mile of the west boundary of Seneca Division

11. **LORD CORP/SAEGERTOWN**

Distance from FWS unit: 5 km

Comments: Approximate distance from AOI = 5 km northwest of Sugar Lake Division southwest of Seneca Division

12. **MEADVILLE MED CTR/MEADVILLE**

Distance from FWS unit: 30 km

Comments: Approximate distance from AOI = 30 km no emissions data available

13. **MERCER SPRING & WIRE**

Distance from FWS unit: 8.51 km

Comments: No comments entered

14. **MERCER SPRING & WIRE/TOWNVILLE**

Distance from FWS unit: 10 km

Comments: Approximate distance from AOI = 10 km actually less than 5 miles northeast of Sugar Lake Division unable to access any emissions data

15. **MORCO MFG**

Distance from FWS unit: 8.47 km

Comments: No comments entered

16. **PPG INDUSTRIES INC/WORKS 8**

Distance from FWS unit: 10 km

Comments: Approximate distance from AOI = 10 km

17. **RELIANT ENERGY MID A/WAYNE COMBUSTION TURBINE SITE**

Distance from FWS unit: 6.6 km

Comments: No comments entered

18. **SAEGERTOWN PATTERN C/SAEGERTOWN**

Distance from FWS unit: 30 km

Comments: Approximate distance from AOI = 30 km no emissions data available

19. **US BRONZE FOUNDRY & /US BRONZE**

Distance from FWS unit: 10 km

Comments: Approximate distance from AOI = 10 km

20. **WL DUNN CONST CO/E FAIRFIELD**

    Distance from FWS unit: 10 km

    Comments: Approximate distance from AOI = 10 km approximately 8 miles southwest of Sugar Lake Division in violation of reporting schedule for unknown contaminants

21. **WL DUNN CONST CO/E FAIRFIELD**

    Distance from FWS unit: 8.46 km

    Comments: No comments entered

RCRIS Site List for Contaminant Sources:

1. **KDL IDUSTRIES**

   Distance from FWS unit: 3.28 km

   Comments: No comments entered

2. **TRESCO TOOL INC**

   Distance from FWS unit: 0.48 km

   Comments: No comments entered

OTHER (User-Identified) Site List for Contaminant Sources:

1. **Air Deposition**

   Distance from FWS unit: Unknown

   Comments: No comments entered

   Contacts linked to this area: KATHLEEN A PATNODE;

2. **Gas Wells - Shallow drilling**

   Distance from FWS unit: Unknown

   Comments: No comments entered

   Contacts linked to this area: Lelaina Marin; KATHLEEN A PATNODE;

3. **Local Development**

   Distance from FWS unit: Unknown

Comments: No comments entered

Contacts linked to this area: Lelaina Marin;

4. **PA Game Commission Pheasant Farm**

   Distance from FWS unit: Unknown

   Comments: No comments entered

   Contacts linked to this area: Lelaina Marin;

5. **Roads**

   Distance from FWS unit: Unknown

   Comments: No comments entered

   Contacts linked to this area: Lelaina Marin;

6. **Small sewage dischargers**

   Distance from FWS unit: Unknown

   Comments: No comments entered

   Contacts linked to this area: Lelaina Marin;

7. **Stream Sediments**

   Distance from FWS unit: Unknown

   Comments: No comments entered

   Contacts linked to this area: Lelaina Marin; KATHLEEN A PATNODE;

8. **Utica Shale Gas**

   Distance from FWS unit: Unknown

   Comments: No comments entered

   Contacts linked to this area: Lelaina Marin; KATHLEEN A PATNODE;

Contaminant Sites Summarized by Transport Pathway

Surface Water Transport Pathways:

Name of Transport Pathway	Associated Contaminant Sites
	• FAITH BUILDERS EDUCATIONAL

Lake Creek	• MARVIN WEAVER • MAPLEWOOD JR SR HIGH SCH • WL DUNN CONST CO/E FAIRFIELD • MORCO MFG • MERCER SPRING & WIRE • DEVORE TOOL • RELIANT ENERGY MID A/WAYNE COMBUSTION TURBINE SITE • TRESCO TOOL INC • Local Development • Air Deposition • Small sewage dischargers • Stream Sediments • Roads • Utica Shale Gas • Gas Wells - Shallow drilling
Muddy Creek	• MERCER SPRING & WIRE • LORD CORP/IND PROD DIV • LAUREL MTN MIDSTREAM LLC/TOWNVILLE STA • LORD CORP • AA ROBBINS • LORD CORP/SAEGERTOWN • Local Development • Air Deposition • PA Game Commission Pheasant Farm • Roads • Utica Shale Gas • Gas Wells - Shallow drilling
Woodcock Creek	• LORD CORP/IND PROD DIV • LAUREL MTN MIDSTREAM LLC/TOWNVILLE STA • LORD CORP • AA ROBBINS • LORD CORP/SAEGERTOWN • Local Development • Air Deposition • Roads • Utica Shale Gas • Gas Wells - Shallow drilling
Mohawk Run	• LORD CORP/IND PROD DIV • LAUREL MTN MIDSTREAM LLC/TOWNVILLE STA • LORD CORP • AA ROBBINS • LORD CORP/SAEGERTOWN • Local Development • Air Deposition • Roads • Utica Shale Gas

	• Gas Wells - Shallow drilling
French Creek	• LORD CORP/IND PROD DIV • LORD CORP • AA ROBBINS • LORD CORP/SAEGERTOWN • KDL IDUSTRIES • Air Deposition • Roads • Utica Shale Gas • Gas Wells - Shallow drilling

Ground Water Transport Pathways:

Name of Transport Pathway	Associated Contaminant Sites
Sand and Gravel Unit	• Local Development • Air Deposition • Roads • Utica Shale Gas • Gas Wells - Shallow drilling
Bedrock aquifer	• Utica Shale Gas

Air Transport Pathways:

Name of Transport Pathway	Associated Contaminant Sites
West	• U.S. BRONZE FNDY. & MACHINE INC. • PPG INDS. INC. WORKS 8 • AMERICAN INDUSTRIAL CONTAINER, CORP. • ADVANCED CAST PRODS. INC. • LORD CORP. CAMBRIDGE SPRINGS FACILITY • MEADVILLE FORGING CO. • US BRONZE FOUNDRY & /US BRONZE • ADVANCED CAST PROD I/MEADVILLE • CHANNELLOCK INC • DIC TOOL CO/MEADVILLE • ELECTRO TECH INC/MEADVILLE • MEADVILLE MED CTR/MEADVILLE • PPG INDUSTRIES INC/WORKS 8 • Local Development • Air Deposition • Stream Sediments

South-West	• CHANNELLOCK INC., PLANT 2 • ARRO FORGE INC. • LORD CORP. • CHANNELLOCK INC., PLANT 1 • SPECTRUM CONTROL INC., (MATERIAL SCIENCE DIV.) • COINCO INC DBA MORCO/MORCO • WL DUNN CONST CO/E FAIRFIELD • Local Development • Air Deposition • Stream Sediments
North-West	• LORD CORP. CAMBRIDGE SPRINGS FACILITY • LORD CORP. • SAEGERTOWN PATTERN C/SAEGERTOWN • SAEGERTOWN INDUSTRIAL AREA • LORD CORP • MEADVILLE FORGING CO. • LORD CORP/IND PROD DIV • LORD CORP/SAEGERTOWN • Local Development • Air Deposition • Stream Sediments
North-East	• SNAP TITE INC. / UNION CITY SITE • CORRY MFG. INC. • SPECTRUM CONTROL INC., (MATERIAL SCIENCE DIV.) • MERCER SPRING & WIRE/TOWNVILLE • LORD CORP • AA ROBBINS • Local Development • Air Deposition • Stream Sediments
South	• MORCO MFG • WL DUNN CONST CO/E FAIRFIELD • MORCO MFG • DEVORE TOOL • RELIANT ENERGY MID A/WAYNE COMBUSTION TURBINE SITE
North-West	• LORD CORP. CAMBRIDGE SPRINGS FACILITY • LORD CORP. • SAEGERTOWN PATTERN C/SAEGERTOWN • SAEGERTOWN INDUSTRIAL AREA • LORD CORP • MEADVILLE FORGING CO. • LORD CORP/IND PROD DIV

	• LORD CORP/SAEGERTOWN • Local Development • Air Deposition • Stream Sediments
South-East	• ARCO GATC - SUGAR CREEK SITE • Local Development • Air Deposition • Stream Sediments
East	• MERCER SPRING & WIRE • LAUREL MTN MIDSTREAM LLC/TOWNVILLE STA
North-East	• SNAP TITE INC. / UNION CITY SITE • CORRY MFG. INC. • SPECTRUM CONTROL INC., (MATERIAL SCIENCE DIV.) • MERCER SPRING & WIRE/TOWNVILLE • LORD CORP • AA ROBBINS • Local Development • Air Deposition • Stream Sediments

Biotic Transport Pathways:

Name of Transport Pathway	Associated Contaminant Sites
Aquatic Invertebrates	• FAITH BUILDERS EDUCATIONAL • MARVIN WEAVER • MAPLEWOOD JR SR HIGH SCH • WL DUNN CONST CO/E FAIRFIELD • MORCO MFG • MERCER SPRING & WIRE • DEVORE TOOL • LORD CORP/IND PROD DIV • LAUREL MTN MIDSTREAM LLC/TOWNVILLE STA • LORD CORP • AA ROBBINS • LORD CORP/SAEGERTOWN • RELIANT ENERGY MID A/WAYNE COMBUSTION TURBINE SITE • TRESCO TOOL INC • KDL IDUSTRIES • Local Development • Air Deposition • PA Game Commission Pheasant Farm • Small sewage dischargers

	• Stream Sediments • Roads • Utica Shale Gas • Gas Wells - Shallow drilling
Amphibians	• FAITH BUILDERS EDUCATIONAL • MARVIN WEAVER • MAPLEWOOD JR SR HIGH SCH • WL DUNN CONST CO/E FAIRFIELD • MORCO MFG • MERCER SPRING & WIRE • DEVORE TOOL • LORD CORP/IND PROD DIV • LAUREL MTN MIDSTREAM LLC/TOWNVILLE STA • LORD CORP • AA ROBBINS • LORD CORP/SAEGERTOWN • RELIANT ENERGY MID A/WAYNE COMBUSTION TURBINE SITE • TRESCO TOOL INC • KDL IDUSTRIES • Local Development • Air Deposition • PA Game Commission Pheasant Farm • Roads • Utica Shale Gas • Gas Wells - Shallow drilling
Aquatic migratory birds	• FAITH BUILDERS EDUCATIONAL • MARVIN WEAVER • MAPLEWOOD JR SR HIGH SCH • WL DUNN CONST CO/E FAIRFIELD • MORCO MFG • MERCER SPRING & WIRE • DEVORE TOOL • LORD CORP/IND PROD DIV • LAUREL MTN MIDSTREAM LLC/TOWNVILLE STA • LORD CORP • AA ROBBINS • LORD CORP/SAEGERTOWN • RELIANT ENERGY MID A/WAYNE COMBUSTION TURBINE SITE • TRESCO TOOL INC • KDL IDUSTRIES • Local Development • Air Deposition • PA Game Commission Pheasant Farm • Small sewage dischargers • Stream Sediments • Roads • Utica Shale Gas • Gas Wells - Shallow drilling

fish	• FAITH BUILDERS EDUCATIONAL • MARVIN WEAVER • MAPLEWOOD JR SR HIGH SCH • WL DUNN CONST CO/E FAIRFIELD • MORCO MFG • MERCER SPRING & WIRE • DEVORE TOOL • LORD CORP/IND PROD DIV • LAUREL MTN MIDSTREAM LLC/TOWNVILLE STA • LORD CORP • AA ROBBINS • LORD CORP/SAEGERTOWN • RELIANT ENERGY MID A/WAYNE COMBUSTION TURBINE SITE • TRESCO TOOL INC • KDL IDUSTRIES • Local Development • Air Deposition • PA Game Commission Pheasant Farm • Small sewage dischargers • Stream Sediments • Roads • Utica Shale Gas • Gas Wells - Shallow drilling
Mollusks	• MERCER SPRING & WIRE • LORD CORP/IND PROD DIV • LAUREL MTN MIDSTREAM LLC/TOWNVILLE STA • LORD CORP • AA ROBBINS • LORD CORP/SAEGERTOWN • KDL IDUSTRIES • Local Development • Air Deposition • PA Game Commission Pheasant Farm • Roads • Utica Shale Gas • Gas Wells - Shallow drilling

Field Reconnaissance

This is a list of the areas that have been visited for a field reconnaissance.

Notes on Field Reconnaissance:

Patnode has visited the refuge twice in 2012. The focus of these visits has been assisting refuge biologist Lelaina Marin with collection of baseline water quality data. Potential sources of contaminants listed above were not inspected.

Field Reports

1. **Gas Wells - Shallow drilling**

   Reconnaissance date:

   2012-11-27 09:03:00.0

   Reconnaissance by:

   1. Lelaina Marin

   Relevance to the contaminant assessment:

   Refuge staff make routine observations of gas well pads on lands surrounding the refuge to ensure BMPs are in place.

   Flora and/or Fauna seen during the reconnaissance:

   Major habitat types/land uses that apply to this area:

   1. Agricultural Lands
   2. Medium Tall Grassland
   3. Other Wetlands
   4. Riverine

2. **PA Game Commission Pheasant Farm**

   Reconnaissance date:

   2012-11-27 09:06:00.0

   Reconnaissance by:

   1. Lelaina Marin

   Relevance to the contaminant assessment:

   Refuge staff will be meeting with PGC to discuss issues of joint interest. Maintenance of the riparian buffer and E&S BMPs for the farm will be discussed.

   Flora and/or Fauna seen during the reconnaissance:

   Major habitat types/land uses that apply to this area:

   1. Agricultural Lands
   2. Riverine

3. **Roads**

   Reconnaissance date:

   2012-11-27 09:08:00.0

   Reconnaissance by:

   1. Lelaina Marin
   2. KATHLEEN A PATNODE

Relevance to the contaminant assessment:

Patnode discussed the brine use for dust suppression with PADEP. This practice is under an individual permit issued by DEP to Crawford County which the township uses. DEP recommends that FWS challenge the permit when it comes up for renewal. Brine use for dust suppression is not covered under the General Permit for brine use as winter pretreatment. No Marcellus (or presumably Utica) brine can be used on roads for any purpose. Refuge should track dates of brine application on any dirt roads near Muddy Creek in summer 2013 to determine if conductivity spikes are recorded on the sondes. Alternatively, additional sondes should be placed in stream reaches near dirt roads that are routinely treated. These data would be critical to a FWS request to DEP for denial of a permit renewal.

Flora and/or Fauna seen during the reconnaissance:

Major habitat types/land uses that apply to this area:

1. Other Wetlands
2. Riverine

Potentially Contaminated Areas

The purpose of this section is to determine the areas where sampling activities will be conducted. The purpose of sampling in these areas is to confirm the presence of contaminants or their effects, or to collect baseline information to support potential natural resource damage assessments.

Notes on Potentially Contaminated Areas:

PCA Reports

1. **Gas Wells - Shallow drilling**

Rationale for selecting this site:

Wells surrounding the refuge need to be monitored to ensure that BMPs are being followed.

Level of contamination that applies to this area:

Level 3 - Known contaminant sources, suspected contaminant presence, no documented contaminant problems or habitat degradation

Habitats linked to this site:

1. Other Wetlands
2. Riverine

Species linked to this site:

1. Amphibians
2. Macroinvertebrates
3. Other Freshwater Species

4. State Listed/Candidate Species
5. Threatened/Endangered/Candidate Species (Fed Listed)

Pathways that allow contaminant(s) to reach the area:

Surface Water:

1. French Creek
2. Lake Creek
3. Mohawk Run
4. Muddy Creek
5. Woodcock Creek

Ground Water:

1. Sand and Gravel Unit

Air:

No pathways

Biotic:

1. Amphibians
2. Aquatic Invertebrates
3. Mollusks
4. fish

2. **Stream Sediments**

Rationale for selecting this site:

Sediments contaminated from runoff and air deposition are located behind the impoundment dikes. These sediments will need to be sampled to determine metals concentrations prior to removal of dikes to restore creek flow.

Level of contamination that applies to this area:

Level 2 - Known contaminant sources and contaminant presence, no documented contaminant problems or habitat degradation

Habitats linked to this site:

1. Lake/Pond/Impoundment

Species linked to this site:

1. Amphibians
2. Macroinvertebrates
3. Other Aquatic Birds
4. Other Freshwater Species
5. Shorebirds

Pathways that allow contaminant(s) to reach the area:

Surface Water:

1. Lake Creek

Ground Water:

No pathways

Air:

No pathways

Biotic:

1. Amphibians
2. Aquatic Invertebrates
3. Aquatic migratory birds
4. fish

Areas Subject to Spills

This section presents a list of areas on the refuge particularly subject to potential spills.

Notes on Areas Subject To Spills:

Spill Area Reports

1. **Utica Shale Gas**

   Rationale for selecting this site:

   Utica well permits have already been issued for parcels in the vicinity of the refuge. Within the next 5 years, it is likely that numerous Utica wells will be installed around the refuge boundary and potentially on refuge parcels without mineral rights. Spills will be larger than shallow wells releases due to the substantial amount of waste water generated from shale gas wells. Pipelines will likely be installed for both waste water recycling and gas transmission which will require stream crossings. Both bentonite releases during HDD drilling under stream beds and waste water releases from pipes running between wells could result in aquatic life mortality including freshwater mussels.

Recommendations

Documented Recommendations

Title	Completion Information	Time Sensitivity	Recommended Actions	Narrative Description
Sediment Contaminant	[Incomplete]	Long Term Need	• Create Contaminant	Refuge and PAFO staff should coordinate analytical sampling of sediments with management decisions to

Evaluation Prior to Dike Removal			Investigation Proposal	remove dikes from impoundments to restore creek flow.
Utica shale and shallow gas wells	[Incomplete]	Long Term Need	• Create Contaminant Investigation Proposal • Collect Baseline Samples	Refuge and PAFO staff should continue to collect baseline data to document existing conditions in the event of a brine waste spill. Benthic macroinvertebrate surveys and water chemistry analysis are needed to establish high biodiversity and water quality in addition to ongoing conductivity recording. These data are necessary for any future NRDA claims related to gas drilling.
Brine Use for Dust Suppression on Gravel Roads	[Incomplete]	Short Term Need	• Collect Baseline Samples	Refuge and PAFO staff should continue to collect baseline conductivity data and track brine applications to evaluate runoff effects. These data should be used to request that the PADEP deny the next permit renewal for this practice.

Narrative Report of Contaminant Issues

The primary contaminant issues for Erie NWR are high potential for spills and leads into tributaries from gas exploration; accumulating contaminants in sediments, particularly behind dikes in the impoundments; high risk of acute effects of runoff from brine-treated roads; and gradual deterioration of water quality due to increasing development on lands surrounding the refuge and the resulting increase in small sewage dischargers.

Shale gas extraction is rising in western Pennsylvania with Utica well permits being issued in Crawford County and wells being drilled in adjacent Ohio and Pennsylvania counties. Property owners near the refuge have begun to sign shale gas leases and the refuge received a request for seismic testing. With Utica well development, the probability of a spill or leak into a tributary will increase. The refuge needs to work closely with PA DEP to ensure that spill prevention and containment measures are in place. The refuge will need a response plan should there be a chemical spill that threatens refuge resources. A spill or leak of contaminants or sediment/bentonite in mussel habitat could be lethal due to high salt concentrations or smothering of animals, respectively. Baseline data on the aquatic community and water and sediment quality are needed to establish baseline natural resources for any future NRDAR resulting from a spill or leak.

Shale gas extraction uses copious amounts of freshwater. The amount of water being taken from small tributaries to install wells may also threaten water quality during low flow periods. The PA DEP controls the manner in which exploration and extraction are performed. They also need to report instances where water flows are at risk in small tributaries due to tanker filling for well

drilling operations. Lowering flows in streams could exacerbate potential effects of runoff on roads treated with brine during the summer months for dust suppression. If conductivity data from streams within the refuge demonstrates that brine applied to roads is reaching the streams, then the refuge will need to contest renewal of the Crawford County permit for brine use.

Contaminants deposited in streams, wetlands, or floodplain areas are likely to be retained in these low gradient watersheds, particularly within floodplain wetlands and behind dikes. Sediment data from 1991 needs to be updated as concentrations were already at potential ecological risk levels and streams and wetlands in the Seneca Division were not sampled. The potential that sediment metals concentrations have increased since 1991 is high due to ongoing deposition from air and lack of flushing of streams due to the presence of dikes. Concentrations could have reached levels that are affecting the benthic macroinvertebrates, fish, and mussel communities in the streams. Additional sediment contaminant testing is warranted prior to any alterations of the dikes to restore stream flows.

Currently, sewage discharges are not posing any significant risk. However, residential development is increasing on private property around the refuge. This development is not clustered around existing towns where municipal treatment facilities can be expanded. Rather the building is dispersed and located in rural areas where there are no existing treatment facilities. This pattern will likely lead to more single family or small treatment facilities being permitted in the future. On properties up gradient of the refuge, more facilities will increase nutrient, pharmaceutical, and household chemical loading to the watershed. As the refuge supports stream and wetland species that depend on high quality water, contaminant loading could put these populations are risk. The refuge should become involved in local land use planning and should promote the use of non-traditional sewage treatment options such as treatment wetlands to reduce stream inputs. The natural resources of the refuge are diverse and include many species and habitats of special ecological concern. The key to maintaining those resources is to prevent and reduce wherever possible contaminant stresses in the watershed. In the future, it will be critical to have baseline information that demonstrates the conditions necessary to sustain healthy populations of the species currently present on the refuge.