



Patoka River Planning Committee

Hazard and Vulnerability Analysis

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Table of Contents

Introduction and Information

Introduction and Background	Pg 1-2
-----------------------------	--------

Document Information and How-To	Pg 2-3
---------------------------------	--------

Feature Definition and Information	Pg 4-7
------------------------------------	--------

Maps, Summary Texts, and Tables

Index Overview Map	Pg 8
Index Summary Texts	Pg 9-11
Overview Summary Tables	Pg 12-13

Index A1 Map	Pg 15
Index A1 Summary Tables	Pg 16-17

Index A2 Map	Pg 18
Index A2 Summary Tables	Pg 19-20

Index A3 Map	Pg 21
Index A3 Summary Tables	Pg 22-23

Index A4 Map	Pg 24
Index A4 Summary Tables	Pg 25-26

Index B4 Map	Pg 27
Index B4 Summary Tables	Pg 28-29

Active Oil Well Operators

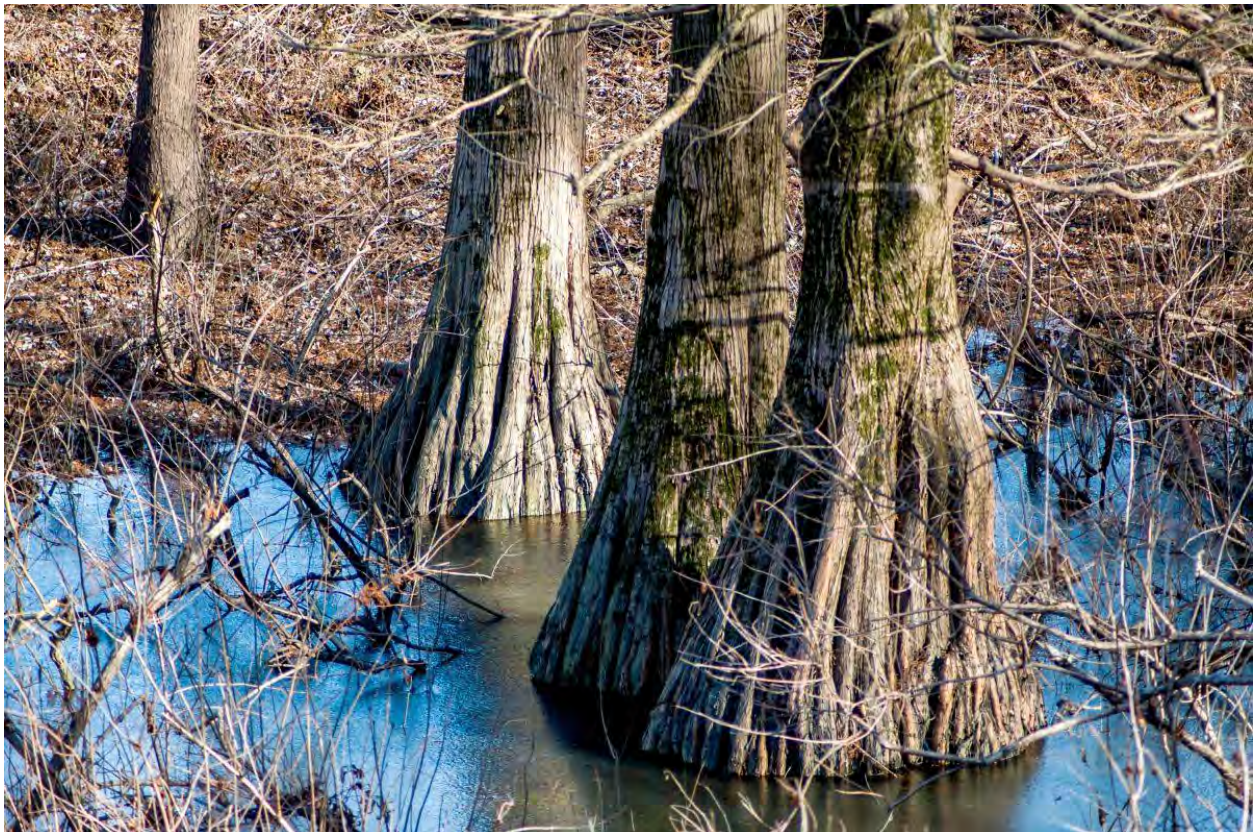
List of Active Oil Well Operators	Pg 30
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Legend

Legend	Pg 14
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Introduction:

The [Patoka River National Wildlife Refuge \(NWR\)](#)* has long been recognized for its wetland and wildlife value at local, statewide, and regional levels, especially the portions that contain some of the remaining expanses of bottomland hardwood forest wetlands in Indiana and the mid-western United States¹. With such valuable natural resources, generating information that can be utilized in hazardous material response planning is indispensable for protecting the floral, faunal, and human populations. To generate information that aids in hazardous material response planning, geographic information systems (GIS) techniques were utilized. GIS has the capability of analyzing multiple public and private datasets pertinent to the wildlife refuge and produce tailored information specific to this area of interest. From these datasets, summary maps, tables, and texts were created for decision-makers to utilize in case hazardous materials discharge into the refuge or surrounding areas.



Photograph 1: Indiana Bottomland Forest. Photograph Credit: [Natural Bloomington](#)

Background:

The study area represents a 125 square mile area that includes the Patoka River NWR and adjacent lands. Within the study area, 82.7 miles of oil and gas pipelines and 35.5 square miles of surface and underground mines are present. Of the well features present, active oil



Photograph 2: Federally Endangered Least Tern.
Photograph Credit: [Fish and Wildlife Service](#)

and gas wells dominate the well types with a count of 85. Orphaned and abandoned wells represent 21 wells of note and hydraulic fracture wells, Class II wells, and tank batteries have 11, 16, 15 features in the area, respectively. Pertaining to transit risks, 319.7 miles of roads cross the area with 14.8 miles belonging to Interstate routes. These roads contain 48 rail crossings and 63 bridges. Within the study area, tributaries flow into the Patoka River, which then flows west to the Wabash River. Though the area is characterized by bottomlands, there are only seven dams located within the 125 square mile study area. Related to the human, faunal, and floral populations, are six water intakes and 196 wells serving the local human population. And, there are 30.2 square miles of threatened and endangered species habitat that represent 39 different species.

Document Information and How-To:

In this document, feature definitions and information are presented first and descriptions of the study area and its sub-areas follow next in the form of text, maps, and tables. For orientation, an Index Overview Map is provided on page 8. For quick reference, each map contains a condensed legend with a more detailed legend included on the page preceding the first sub-area map. Later in the document, active oil well operators in the Patoka NWR area are noted to aid the user in identifying the appropriate parties involved in hazardous material extraction and transport in the area.

Overall, five sub-areas, referred here on out as indices, cover the Patoka River NWR study area. For each five by five-mile index map a data table** was generated. Data tables were



Photograph 3: Pioneer Francisco North Injection Well. Photograph Credit: [Indiana Department of Environmental Management](#)

grouped into three sets of features: hazards, transit risks, and vulnerabilities. Hazard features are made up of wells, facilities, and other associated features that have the potential to discharge into the environment. Transit risks summarize the transportation vectors that can either carry hazardous materials or be choke points where intervention or incidents may occur. Vulnerabilities, or vulnerable areas, are water intakes, water wells, floodplains, refuge lands, and sensitive species habitat – including threatened and endangered species. (Species data are summarized in tables and descriptive text; however, they do not appear on the map. For planning purposes, the entire management area can be considered environmentally sensitive habitat.)

Table columns represent different areas of concern across each of the indices. The first column denotes the feature that is being evaluated (e.g. Class II Wells or area of threatened and endangered species). The second column, “Total in Index,” denotes the count, area or length of the hazard, transit, and vulnerable features being evaluated in the index. The third column, “Total in PRNWR Acquisition Boundary,” limits the focus to the Patoka River NWR acquisition boundary and reports the count, area, or length of the hazard, transit, and vulnerable features within the acquisition boundary. The fourth column, “Total in Flood Zone,” tallies the hazard, transit, and vulnerable features within the 100-year floodplain. The fifth column, “Total within 1000 ft of Stream,” represents the hazard, transit, and vulnerable features that fall within a 1,000 foot buffer of NHDPlus stream lines.



Photograph 4: Kapp Well 2. Photograph Credit: [Indiana Department of Environmental Management](#)

* Information and Planning Committee Contacts for the Patoka River National Wildlife Refuge: https://www.fws.gov/refuge/patoka_river/ & <https://www.epaos.org/PatokaRiverPlanning>

** Area and length data were rounded to the nearest tenth.

Feature Definition and Information:

Hydraulic Fracture Well² - Oil well permitted for hydraulic fracturing (pumping of chemicals, water, and sand under high pressure to create controlled cracks in rock formations to improve permeability and extract resources). Risks include spills or the added pressure from injections penetrating or disturbing unintended substrates.

Enhanced Recovery³ - Class II oil well permitted for enhanced recovery (enhanced recovery methods usually entail using thermal recovery, chemical injection, or gas injection to recover more oil from a well). Risks include spills or the added pressure from injections penetrating or disturbing unintended substrates. Class II injection wells present an additional risk of release through increased pressure in the underground system. This can cause upward migration of fluid through well bores of nearby wells which may be deficient, improperly plugged, unplugged, or were previously unknown.

Saltwater Disposal⁴ - Class II oil well permitted for waste water/brinish fluids disposal. Risks include spills or the added pressure from injections penetrating or disturbing unintended substrates. The additional pressure can cause upward migration of fluid through the well bores of nearby wells which may be deficient, improperly plugged, unplugged, or were previously unknown.

Orphaned and Abandoned Well⁵ - Oil, gas, enhanced recovery, or other well type that has a revoked permit status or is orphaned with no viable owner/operator. Unplugged or improperly plugged wells can contaminate fresh water or release toxic gas.

1/4 Mile Area of Review⁶ - Class II injection wells are subject to review during the permitting process to determine the risk of release of injection of fluids at existing or previous well sites within ¼ mile of the Class II injection well site. Additionally, this same ¼ mile buffer was used to identify orphaned/abandoned wells close to a hydraulic fracture well.

Tank Battery⁷ - A crude oil storage device, usually near the well, have small pipelines leading to other nearby wells and thereby create spill potential.

IDEM Spill Location⁸ - Previous spill location as identified by the Indiana Department of Environmental Management.

TRI Facility⁹ - Toxic Release Inventory Facility where toxic chemicals are used or stored.

ICIS-NPDES Facility¹⁰ - Facility regulated by the National Pollutant Discharge Elimination System (NPDES) under the Clean Water Act (CWA).

Pipeline¹¹ - Potential oil/gas spill or leak hazard due to rupture.

Underground Coal Mine¹² - Mine subsidence (earth collapsing) risk.

Surface Coal Mine¹³ - Risk due to hazardous materials at the surface or in storage.

Bridge¹⁴, Railroad Crossing¹⁵, Road^{16, 17} - Hazardous material in transit creates a risk that may result in spills or leaks.

Non-potable Water Intake¹⁸ - Water intake for industrial or commercial use.

Potable Water Intake¹⁹ - Consumable water supply where contamination could constitute a serious risk to public health and safety.

Dam²⁰ - Oil can emulsify after passing over a dam and make it more difficult to recover.

100-year Flood Zone²¹ - Flooding could damage hazardous materials storage tanks, pipelines, or structures and quickly contaminate large areas.

Stream Gauge²² - Provides stream flow data that may be useful to emergency response.

Stream²³ - Transport mechanism for hazardous materials. Contamination from hazardous materials can degrade and alter habitat conditions or cause public health and safety issues.

Sensitive and Threatened and Endangered Species²⁴ - Area in which species, identified as vulnerable, imperiled, or critically periled, have been observed. Some observed species also have state legal protection or are listed as threatened or endangered under the U.S. Endangered Species Act. These data are derived from the NatureServe Natural Heritage Inventory. Data are included in summaries but do not appear on the index maps.

Support Services²⁵ - Police, hospital, fire department location within the study area.

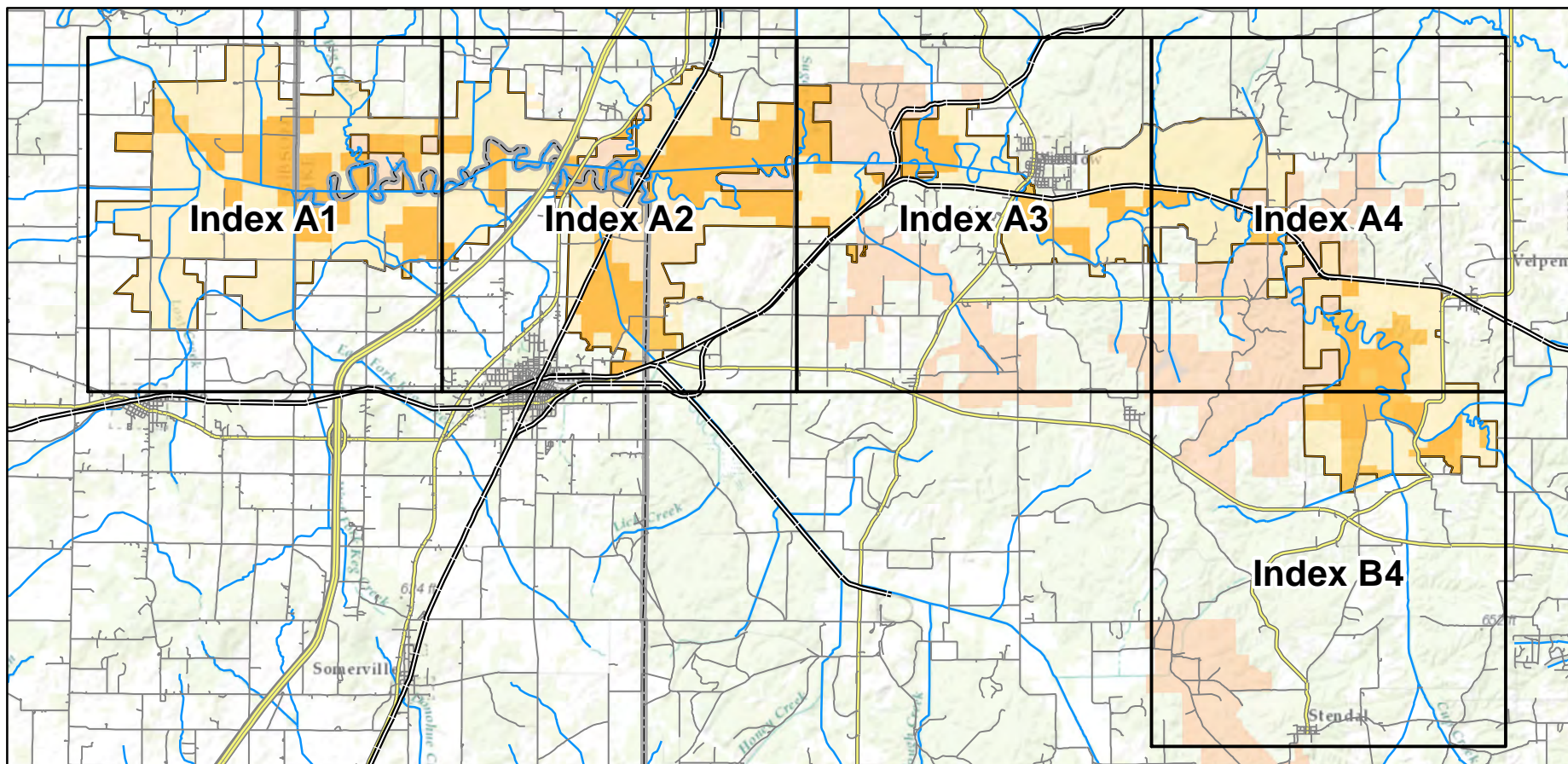
Airport²⁶ - Airstrip, airfield, or airport located within the study area.

Patoka River NWR Acquisition Area, Refuge Land, Approved Acquisition Area²⁷ - Main land holdings and approved acquisition boundaries for the Patoka River National Wildlife Refuge.

Indiana DNR State Land²⁸ - Natural and recreation areas owned or managed by the Indiana Department of Natural Resources. Data includes private lands with conservation easements.







County Boundary²⁹ - County boundary lines.

Active Oil Gas Well³⁰ - Spill or leak potential. Excludes hydraulic fracture and Class II wells, which have been listed separately.



0 1¼ 2½ 5 Miles



-  Patoka River NWR aquisition boundary
-  Refuge lands (Boundary lines not all signed)
-  Approved acquisition areas (Privately owned)
-  Indiana State Lands
-  Index Boundary
-  County boundary



Index Overview Map

Projection: NAD 1983 UTM Zone 16N

Index Summary Texts:

Index A1

Index A1 contains 3.2 square miles of refuge land and is the westernmost index of the Patoka River NWR study area. Index A1 contains high counts of many of the hazards, transit risks, and vulnerabilities. In reference to hazards, Index A1 contains about 50% of all orphaned and abandoned wells and Class II wells. Ten out of the 15 tank batteries found in the study area are also located in this index. Additionally, Index A1 has all but one of the hydraulically fractured wells (10 of 11), two-thirds of the active oil and gas wells and 55% of the total pipeline running through the study area. Overall, active oil wells are of special importance because of high counts and presence with the acquisition boundary, flood zone, and 1000 foot stream buffer. Similar to the other indices, Index A1 has about 20% of the index covered by active or former surface mining operations. The presumed transit risks at the infrastructural level for Index A1 include a high number of bridges on city and county roads. Of the 50 bridges found on city and county roads in the study area, 18 are located in Index A1. The road features in the index are also predominantly designated as local roads. Though there is not a potable water intake within Index A1, 58 water wells are present along with two non-potable water intakes. Of additional note is the greater proportion of area in the 100-year floodplain for Index A1 compared to the other indices. The nearly two square miles of vulnerable habitat found within the index, only represent about 6% of the total found within the study area.

Index A2

Index A2 contains 4.1 square miles of refuge land and is nestled directly east of Index A1 and west of Index A3. Index A2 contains a large portion of transit risks and vulnerabilities. Most notably, Index A2 contains the nearly mile-long I-69 bridge over the Patoka River floodplain. One of the two orphaned and abandoned wells in the index is located within the ¼ mile area of review of an active Class II injection well. This same well also is inside of the management area and lies within 1000 feet of the Patoka River. Five other active oil wells are present in the index, and although low in number, the majority of these wells have locations inside the acquisition boundary (1), flood zone (1), and within 1000 feet of a stream (2). Also included in Index A2, are three of the 15 tank batteries found in the study area. Additionally, four of the seven historic spills identified by IDEM are found in Index A2. The length of pipelines is the lowest in Index A2; with only two total miles. In terms of transit, Index A2

contains roughly half of the total length of railroads and a quarter of total roads - 8.6 miles of which are Interstate. In recent events, a June 2012 rail incident near Flat Creek, a tributary of the Patoka River, resulted in the release of 33,000 gallons of ethanol into the environment. Other vulnerabilities in the index include two of the three potable water intakes along with nearly 30% of the water wells. Also, the index contains a large area, 12.5 square miles, of habitat identified as having threatened, endangered or sensitive species.

Index A3

Index A3 contains 1.8 square miles of refuge land and lies directly east of Index A2 and directly west of Index A4. Index A3 contains moderate counts of hazards, transit risks, and vulnerabilities. In reference to hazards, Index A3 contains about 25% of the active oil and gas wells, one of the two TRI facilities, and slightly over half of the NPDES permitted locations. This index contains the second most active wells within the acquisition boundary. The flood zone and 1000 foot stream buffer each contain a portion of the 20 active wells in the index. Historically, three spills have occurred in Index A3. This area also contains 3.1 square miles of underground mines and 7.3 square miles of surface mines. The potential transit risks at the infrastructural level for Index A3 involve the presence of railroads (30% of total) and private, local and major roads (21% of total). Vulnerability concerns in Index A3 include: one potable water intake and a high square mileage (8.7) of threatened, endangered or sensitive species habitat.

Index A4

Index A4 contains 1.5 square miles of refuge land and is the northeasternmost index of the Patoka River NWR study area. Index A4 is relatively light on hazards, transit risks and vulnerabilities. Of the hazards, Index A4 has only two orphaned wells inside the Patoka River NWR Acquisition Boundary and one NPDES location. Index A4 has about 20% of the total pipeline running through the study area. Index A4 has only about 10% of the active or former surface mining operations and no underground mining operations. Potential transit risks for Index A4 include four dams and a network of primarily local roads. There are no potable or non-potable water intakes in Index A4, but there are 32 water wells, 7 of which lie within the Acquisition Boundary. Vulnerable habitat in this location includes 5.9 square miles of threatened, endangered, and sensitive species habitat.

Index B4

Index B4 contains 1.3 square miles of refuge and is located in the southeasternmost portion of the refuge, lying just south of Index A4. Index B4 contains a comparatively low number of hazards with 6.8 total miles of natural gas pipeline, five active oil wells, and one orphaned well. It also contains two NPDES permit locations. The index has 7.4 of the 30 square miles of active and former surface mines in the study area. There are nine dams within the index boundary. There are 51 miles of local and major roads and no railroads. There are 17 water wells and no water intakes. The total threatened, endangered, and sensitive species habitat covers 1.2 square miles.

Overview Summary Tables

Hazards

Feature	Total in Study Area	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Tank Batteries- PRNWR records	15	12	9	7
Orphaned Wells -of special interest in PRNWR	10	6	3	2
Additional Orphaned and Abandoned Wells -Indiana public GIS data	11	2	9	2
Hydraulic Fracture Wells	11	3	4	6
Class II Wells	16	6	4	5
Active Oil and Gas Wells	85	25	20	40
TRI Facilities	2	1	none	none
ICIS-NPDES Facilities	16	2	2	4
Spill Locations	7	1	none	1
Feature	Total Miles in Study Area	Miles in PRNWR Acquisition Boundary	Miles in Flood Zone	Miles within 1000 ft of Stream
Pipelines Total	82.7	23.6	22.7	30.7
• Crude Oil	28.8	11.1	12.5	14.4
• Natural Gas	37.5	7.4	7.5	12.9
• Refined Products	16.3	5.1	2.8	3.4
Feature	Total Square Miles in Study Area	Square Miles in PRNWR Acquisition Boundary	Square Miles in Flood Zone	Square Miles within 1000 ft of Stream
Surface Mine	30.0	5.4	1.6	4.8
Underground Mine	5.5	0.6	0.3	1.1

Transit Risks










Feature	Total in Study Area	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Bridges				
• on State & US Roads	13	6	9	12
• on City & County Roads	50	20	25	39
Dams	7	1	1	3
Railroad Crossings	48	6	7	9
Feature	Total Miles in Study Area	Miles in PRNWR Acquisition Boundary	Miles in Flood Zone	Miles within 1000 ft of Stream
Railroads	33.2	10.6	10.8	11.5
Roads Total	319.7	43.9	32.2	74.3
• Private roads	9.0	0.2	0.1	0.5
• Local road	260.0	39.5	26.1	56.8
• Major road	35.9	3.1	3.9	9.9
• Interstate	14.8	1.1	2.1	7.1

Vulnerabilities


Feature	Total in Study Area	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Potable Water Intake	3	1	1	1
Non-Potable Water Intake	3	1	1	2
Water Wells	196	21	9	48
Feature	Total Square Miles in Study Area	Square Miles in PRNWR Acquisition Boundary	Square Miles in Flood Zone	Square Miles within 1000 ft of Stream
Threatened/Endangered or Sensitive Species Habitat Total	30.2			
• Aquatic - Sensitive	2.8			
• Terrestrial - Sensitive	1.5			
• Multiple Species - Sensitive	0.5			
• Aquatic - T&E	14.0			
• Multiple Species - T & E	11.4			
100-year Floodplain	30.5	23.2		
Refuge Lands *boundary lines not all signed	11.9			

Legend

Transit / Support Services

-  Bridge
-  Local road
-  Major road
-  Interstate
-  Rail Road
-  Police
-  Hospital / Medical Center
-  Fire Department
-  Airport




Pipelines

-  Crude Oil
-  Natural Gas
-  Refined Products







Hazards

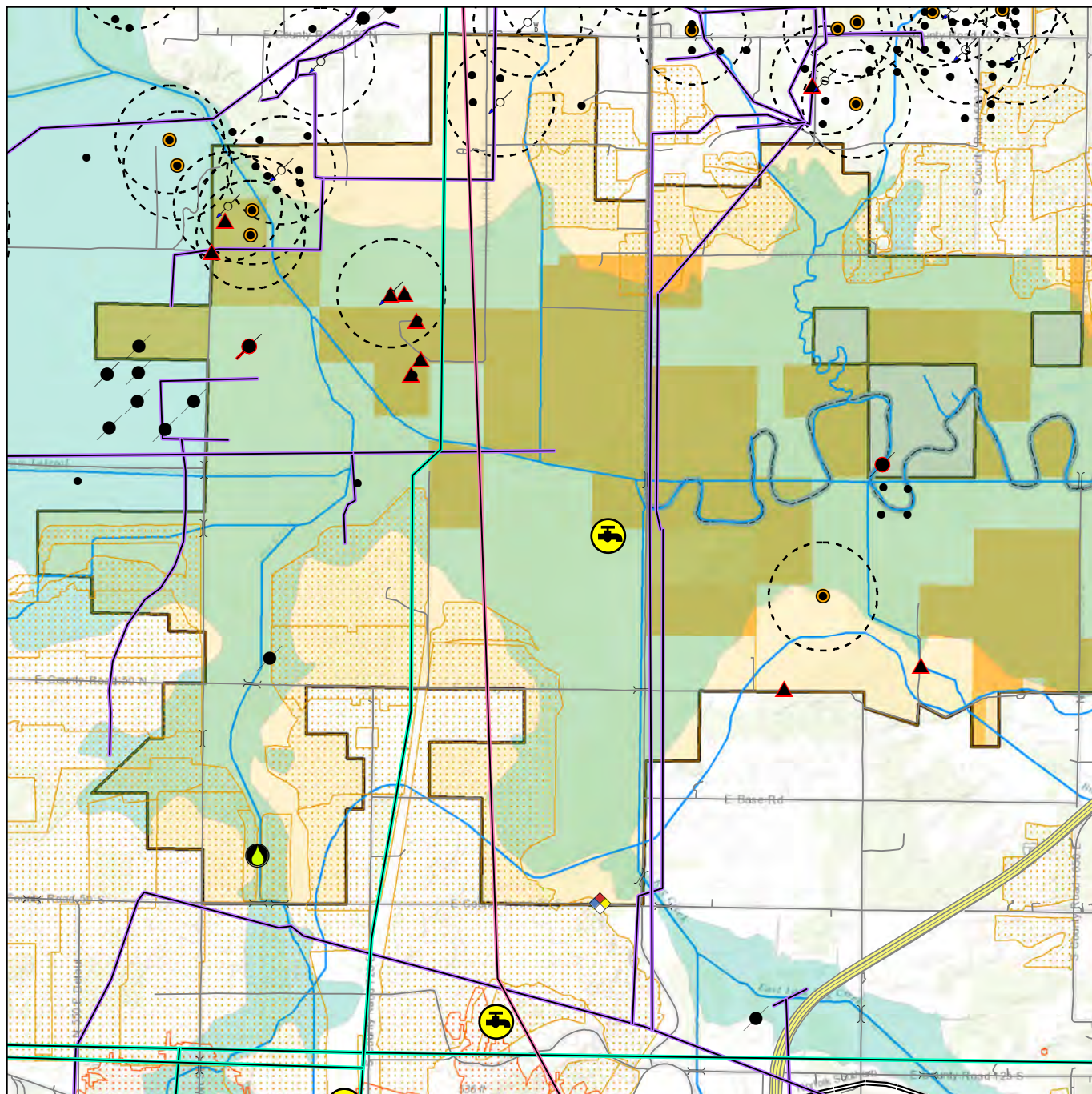
-  Oil Gas Well
-  Enhanced Recovery
-  Saltwater Disposal
-  Orphaned/Abandoned Well
-  Orphaned Well
-  Tank Battery
-  TRI Facility
-  Hydraulic Fracture Well
-  IDEM Spill Location
-  ICIS NPDES Facility
-  1/4 Mile Area of Review
-  Underground Mine
-  Surface Mine

Boundary Designations

-  Patoka River NWR Aquisition Boundary
-  Refuge Land (Boundary lines not all signed.)
-  Approved Acquisition Area (Privately owned)
-  Indiana State Land
-  County Boundary

Hydrography

-  Stream Gauge
-  Non-Potable Water Intake
-  Potable Water Intake
-  Dam
-  100-year Flood Zone
-  Stream



Index A1

*See Index A1 summary table for additional information.



0 ¼ ½ 1 Miles

Projection: NAD 1983 UTM Zone 16N

- | | | | |
|--|-------------------------|------------------|-------------------------|
| | TRI Facility | | Orphaned/Abandoned Well |
| | IDEM Spill Location | | Orphaned Well |
| | ICIS NPDES Facility | | Tank Battery |
| | Oil Gas Well | Pipelines | |
| | Hydraulic Fracture Well | | Crude Oil |
| | Enhanced Recovery | | Natural Gas |
| | Saltwater Disposal | | Refined Products |

Summary Tables - Index A1

Hazard

Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Tank Batteries -PRNWR records	10	8	7	4
Orphaned Wells -of special interest in PRNWR	2	1	2	1
Additional Orphaned and Abandoned Wells -Indiana public GIS data	11	2	9	2
Hydraulic Fracture Wells	10	3	4	6
Class II Wells	9	4	2	4
Active Oil and Gas Wells	55	19	15	30
TRI Facilities	1	1	none	none
ICIS-NPDES Facilities	1	1	1	1
Spill Locations	none	none	none	none
Feature	Total Miles in Index	Miles in PRNWR Acquisition Boundary	Miles in Flood Zone	Miles within 1000 ft of Stream
Pipeline Total	45.8	18.0	17.2	19.3
• Crude Oil	28.8	11.1	12.5	14.4
• Natural Gas	11.9	3.1	2.9	4.0
• Refined Products	5.1	3.8	1.8	0.9
Feature	Total Square Miles in Index	Square Miles in PRNWR Acquisition Boundary	Square Miles in Flood Zone	Square Miles within 1000 ft of Stream
Surface Mine	6.9	2.4	1.4	1.8
Underground Mine	0.2	none	0.1	0.1

Transit Risks

Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Bridges				
• on State & US Roads	none	none	none	none
• on City & County Roads	18	9	14	16
Dams	none	none	none	none
Railroad Crossings	1	none	none	none
Feature	Total Miles in Index	Miles in PRNWR Acquisition Boundary	Miles in Flood Zone	Miles within 1000 ft of Stream
Railroads	0.5	none	none	0.2
Roads Total	65.1	18.8	16.3	21.8
• Private road	1.1	0.2	none	none
• Local road	57.8	18.7	15.0	19.6
• Major road	none	none	none	none
• Interstate	6.2	none	1.3	2.1

Vulnerabilities

Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Potable Water Intake	none	none	none	none
Non-potable Water Intake	2	1	1	1
Water Wells	58	8	6	19
Feature	Total Square Miles in Index	Square Miles in PRNWR Acquisition Boundary	Square Miles in Flood Zone	Square Miles within 1000 ft of Stream
Threatened/Endangered or Sensitive Species Habitat Total	1.9			
• Aquatic - Sensitive	0.7			
• Terrestrial - Sensitive	0.1			
• Multiple Species - Sensitive	0.2			
• Aquatic - T&E	0.6			
• Multiple Species - T & E	0.4			
100-year Floodplain	12.1	8.7		
Refuge Lands *boundary lines not all signed	3.2			

Summary Tables - Index A2

Hazards

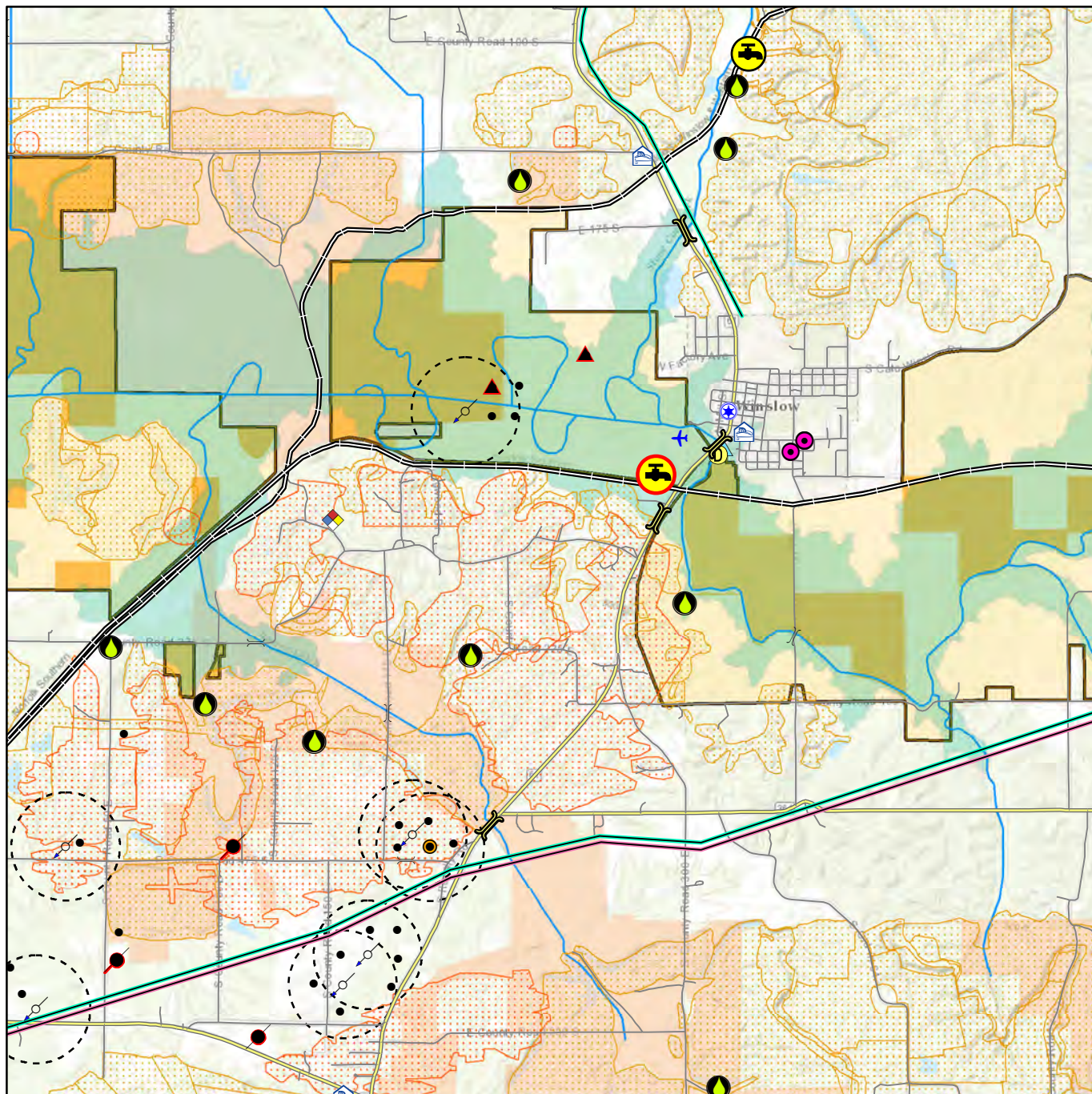
Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Tank Batteries - PRNWR records	3	2	1	1
Orphaned Wells -of special interest in PRNWR	2	2 (Includes 1 in Area of Review)	1 in Area of Review	1 in Area of Review
Additional Orphaned and Abandoned Wells -Indiana public GIS data	none	none	none	none
Hydraulic Fracture Wells	none	none	none	none
Class II Wells	1	1	1	none
Active Oil and Gas Wells	5	1	1	2
TRI Facilities	none	none	none	none
ICIS-NPDES Facilities	3	none	none	none
Spill Locations	4	1	none	1
Feature	Total Miles in Index	Miles in PRNWR Acquisition Boundary	Miles in Flood Zone	Miles within 1000 ft of Stream
Pipeline Total	2.0	none	none	none
• Crude Oil	none	none	none	none
• Natural Gas	1.3	none	none	none
• Refined Products	0.6	none	none	none
Feature	Total Square Miles in Index	Square Miles in PRNWR Acquisition Boundary	Square Miles in Flood Zone	Square Miles within 1000 ft of Stream
Surface Mine	5.3	1.0	0.1	0.8
Underground Mine	1.9	0.5	0.2	0.7

Transit Risks

Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Bridges				
• on State & US Roads	6	5	3	5
• on City & County Roads	15	6	6	12
Dams	1	none	none	none
Railroad Crossings	33	3	3	4
Feature	Total Miles in Index	Miles in PRNWR Acquisition Boundary	Miles in Flood Zone	Miles within 1000 ft of Stream
Railroads	15.3	4.8	2.9	4.6
Roads Total	86.1	14.4	8.7	26.5
• Private road	1.8	none	none	0.2
• Local road	66.1	11.7	5.7	17.3
• Major road	9.7	1.5	2.3	4.0
• Interstate	8.6	1.1	0.8	5.0

Vulnerabilities

Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total in 1000 ft Stream Buffer
Potable Water Intake	2	none	none	none
Non-potable Water intake	none	none	none	none
Water Wells	56	4	1	21
Feature	Total Square Miles in Index	Square Miles in PRNWR Acquisition Boundary	Square Miles in Flood Zone	Square Miles within 1000 ft of Stream
Threatened/Endangered or Sensitive Species Habitat Total	12.5			
• Aquatic - Sensitive	1.2			
• Terrestrial - Sensitive	0.2			
• Multiple Species - Sensitive	0.2			
• Aquatic - T&E	4.3			
• Multiple Species - T & E	6.6			
100-year Floodplain	7.7	6.8		
Refuge Lands *boundary lines not all signed	4.1			



Index A3

*See Index A3 summary table for additional information.



0 ¼ ½ 1 Miles

Projection: NAD 1983 UTM Zone 16N

- | | | | |
|--|-------------------------|------------------|-------------------------|
| | TRI Facility | | Orphaned/Abandoned Well |
| | IDEM Spill Location | | Orphaned Well |
| | ICIS NPDES Facility | | Tank Battery |
| | Oil Gas Well | Pipelines | |
| | Hydraulic Fracture Well | | Crude Oil |
| | Enhanced Recovery | | Natural Gas |
| | Saltwater Disposal | | Refined Products |

Summary Tables - Index A3

Hazards

Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Tank Batteries- PRNWR records	2	2	1	2
Orphaned Wells -of special interest in PRNWR	3	none	none	none
Additional Orphaned and Abandoned Wells -Indiana public GIS data	none	none	none	none
Hydraulic Fracture Wells	1	none	none	none
Class II Wells	6	1	1	1
Active Oil and Gas Wells	20	5	4	6
TRI Facilities	1	none	none	none
ICIS-NPDES Facilities	9	1	1	3
Spill Locations	3	none	none	none
Feature	Total Miles in Index	Miles in PRNWR Acquisition Boundary	Miles in Flood Zone	Miles within 1000 ft of Stream
Pipelines Total	12.1	none	0.2	2.4
• Crude Oil	none	none	none	none
• Natural Gas	6.9	none	0.1	1.5
• Refined Products	5.3	none	0.1	0.9
Feature	Total Square Miles in Index	Square Miles in PRNWR Acquisition Boundary	Square Miles in Flood Zone	Square Miles within 1000 ft of Stream
Surface Mine	7.3	0.6	0.1	1.1
Underground Mine	3.1	0.1	none	0.2

Transit Risks

Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Bridges				
• on State & US Roads	4	None	3	4
• on City & County Roads	4	1	2	3
Dams	1	none	1	1
Railroad Crossings	9	1	2	3
Feature	Total Miles in Index	Miles in PRNWR Acquisition Boundary	Miles in Flood Zone	Miles within 1000 ft of Stream
Railroads	11.1	2.0	4.7	4.4
Roads Total	66.7	2.8	3.5	12.4
• Private roads	1.3	none	0.1	0.2
• Local road	55.4	2.6	2.8	9.9
• Major road	10.1	0.2	0.6	2.3
• Interstate	none	none	none	none

Vulnerabilities

Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Potable Water Intake	1	1	1	1
Non-Potable Water Intake	1	none	none	1
Water Wells	33	none	2	3
Feature	Total Square Miles in Index	Square Miles in PRNWR Acquisition Boundary	Square Miles in Flood Zone	Square Miles within 1000 ft of Stream
Threatened/Endangered or Sensitive Species Habitat Total	8.7			
• Aquatic - Sensitive	0.5			
• Terrestrial - Sensitive	0.2			
• Multiple Species - Sensitive	none			
• Aquatic - T&E	5.0			
• Multiple Species - T & E	2.9			
100-year Floodplain	5.0	3.5		
Refuge Lands *boundary lines not all signed	1.8			

Summary Tables - Index A4

Hazard

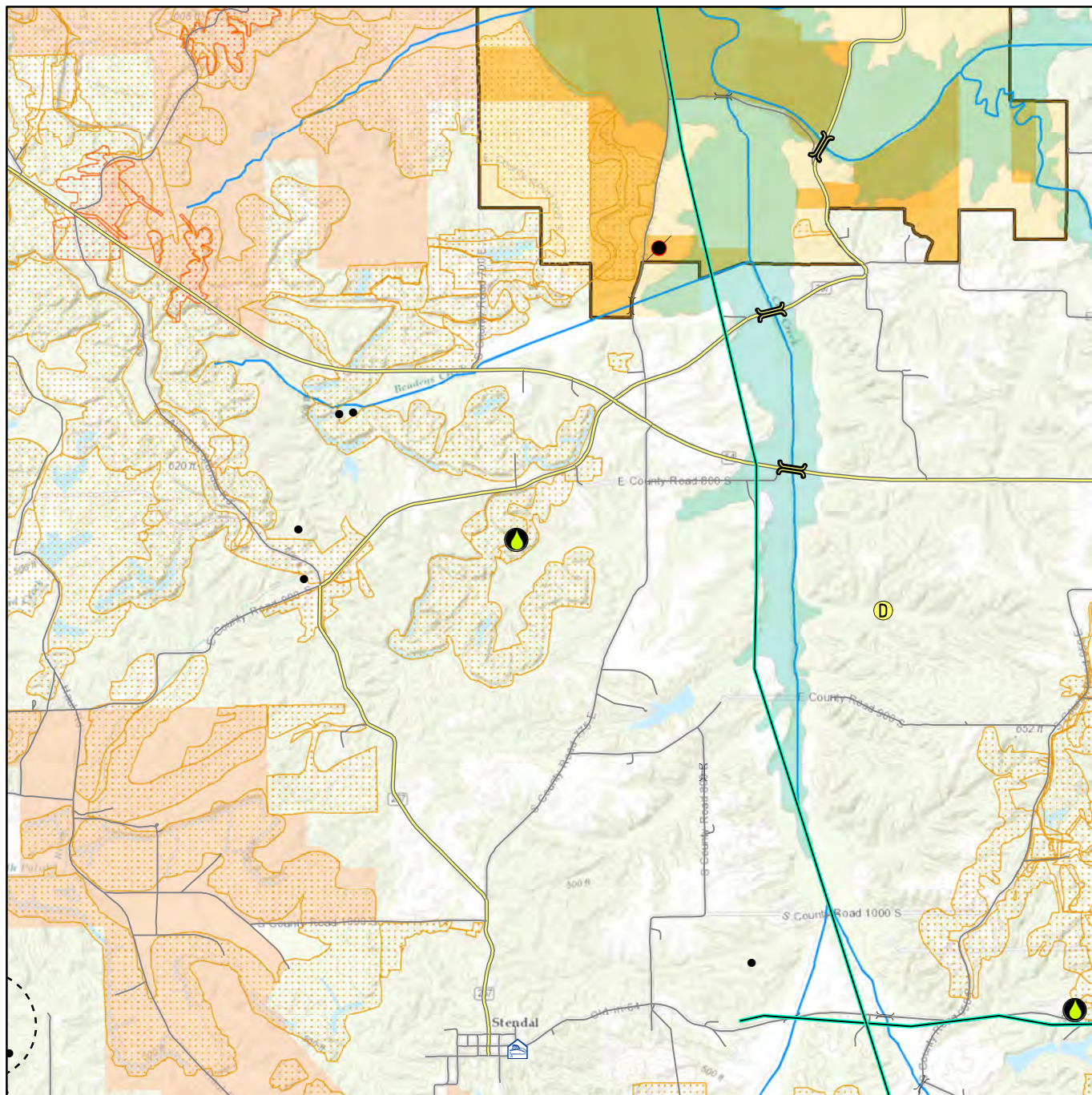
Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Tank Batteries -PRNWR records	none	none	none	none
Orphaned Wells -of special interest in PRNWR	2	2	none	none
Additional Orphaned and Abandoned Wells -Indiana public GIS data	none	none	none	none
Hydraulic Fracture Wells	none	none	none	none
Class II Wells	none	none	none	none
Active Oil and Gas Wells	none	none	none	none
TRI Facilities	none	none	none	none
ICIS-NPDES Facilities	1	none	none	none
Spill Locations	none	none	none	none
Feature	Total Miles in Index	Miles in PRNWR Acquisition Boundary	Miles in Flood Zone	Miles within 1000 ft of Stream
Pipeline Total	16.0	4.4	3.1	4.7
• Crude Oil	none	none	none	none
• Natural Gas	10.6	3.1	2.3	3.1
• Refined Products	5.3	1.3	0.8	1.6
Feature	Total Square Miles in Index	Square Miles in PRNWR Acquisition Boundary	Square Miles in Flood Zone	Square Miles within 1000 ft of Stream
Surface Mine	3.0	0.7	none	0.4
Underground Mine	none	none	none	none

Transit Risks

Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Bridges				
• on State & US Roads	none	none	none	none
• on City & County Roads	7	2	2	3
Dams	4	1	none	2
Railroad Crossings	5	2	2	2
Feature	Total Miles in Index	Miles in PRNWR Acquisition Boundary	Miles in Flood Zone	Miles within 1000 ft of Stream
Railroads	6.4	3.8	3.2	2.3
Roads Total	50.5	4.5	1.0	7.2
• Private road	4.6	none	none	none
• Local road	42.1	4.4	1.0	6.4
• Major road	3.7	0.1	none	0.8
• Interstate	none	none	none	none

Vulnerabilities

Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Potable Water Intake	none	none	none	none
Non-potable Water Intake	none	none	none	none
Water Wells	32	7	none	4
Feature	Total Square Miles in Index	Square Miles in PRNWR Acquisition Boundary	Square Miles in Flood Zone	Square Miles within 1000 ft of Stream
Threatened/Endangered or Sensitive Species Habitat Total	5.9			
• Aquatic - Sensitive	0.2			
• Terrestrial - Sensitive	0.8			
• Multiple Species - Sensitive	0.1			
• Aquatic - T&E	3.4			
• Multiple Species - T & E	1.5			
100-year Floodplain	3.3	2.6		
Refuge Lands *boundary lines not all signed	1.5			



Index B4

*See Index B4 summary table for additional information.



0 ¼ ½ 1 Miles

Projection: NAD 1983 UTM Zone 16N

- | | | | |
|--|-------------------------|------------------|-------------------------|
| | TRI Facility | | Orphaned/Abandoned Well |
| | IDEM Spill Location | | Orphaned Well |
| | ICIS NPDES Facility | | Tank Battery |
| | Oil Gas Well | Pipelines | |
| | Hydraulic Fracture Well | | Crude Oil |
| | Enhanced Recovery | | Natural Gas |
| | Saltwater Disposal | | Refined Products |

Summary Tables - Index B4

Hazards

Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total within 1000 ft of Stream
Tank Batteries - PRNWR records	none	none	none	none
Orphaned Wells -of special interest in PRNWR	1	1	none	none
Additional Orphaned and Abandoned Wells -Indiana public GIS data	none	none	none	none
Hydraulic Fracture Wells	none	none	none	none
Class II Wells	none	none	none	none
Active Oil and Gas Wells	5	none	none	2
TRI Facilities	none	none	none	none
ICIS-NPDES Facilities	2	none	none	none
Spill Locations	none	none	none	none
Feature	Total Miles in Index	Miles in PRNWR Acquisition Boundary	Miles in Flood Zone	Miles within 1000 ft of Stream
Pipelines Total	6.8	1.2	2.1	4.3
• Crude Oil	none	none	none	none
• Natural Gas	6.8	1.2	2.1	4.3
• Refined Products	none	none	none	none
Feature	Total Square Miles in Index	Square Miles in PRNWR Acquisition Boundary	Square Miles in Flood Zone	Square Miles within 1000 ft of Stream
Surface Mine	7.4	0.7	none	0.7
Underground Mine	0.2	none	none	none

Transit Risks

Feature	Total in Index	Total in PRNWR Acquisition boundary	Total in Flood Zone	Total within 1000 ft of Stream
Bridges				
• on State & US Roads	3	1	3	3
• on City & County Roads	6	2	1	5
Dams	1	none	none	none
Railroad Crossings	none	none	none	none
Feature	Total Miles in Index	Miles in PRNWR Acquisition Boundary	Miles in Flood Zone	Miles within 1000 ft of Stream
Railroads	none	none	none	none
Roads Total	51.3	3.4	2.6	6.4
• Private roads	0.2	none	none	none
• Local road	38.7	2.1	1.6	3.6
• Major road	12.4	1.3	1.0	2.8
• Interstate	none	none	none	none

Vulnerabilities

Feature	Total in Index	Total in PRNWR Acquisition Boundary	Total in Flood Zone	Total in 1000 ft Stream Buffer
Potable Water Intake	none	none	none	none
Non-potable water intake	none	none	none	none
Water Wells	17	2	none	1
Feature	Total Square Miles in Index	Square Miles in PRNWR Acquisition Boundary	Square Miles in Flood Zone	Square Miles within 1000 ft of Stream
Threatened/Endangered or Sensitive Species Habitat Total	1.2			
• Aquatic - Sensitive	0.3			
• Terrestrial - Sensitive	0.2			
• Multiple Species - Sensitive	none			
• Aquatic - T&E	0.7			
• Multiple Species - T & E	none			
100-year Floodplain	2.4	1.6		
Refuge Lands *boundary lines not all signed	1.3			

Active Oil Well Operators (Includes hydraulic fracture and Class II wells)

Index Page	Oil Well Operators	Number of Active Wells
A1	Andrews Oil Co., Inc.	1
	Countrymark Energy Resources, LLC	12
	Don W. Davis Enterprises	3
	Gary K. Tussey Oil Expl. & Prod.	39
	Gary Welch	1
	Hocking Oil Co., Inc.	4
	Jeff Thompson	1
	MAP Oil Company, Inc.	6
	Pioneer Oil Co., Inc.	5
	Sam Muncy	1
	Sutton Drilling LLC	1
	Total	74
A2	Geo-Bar Petroleum Inc	1
	J. D. Scott, Jr.	3
	K & J Oil Company, Inc.	2
	Total	6
A3	Countrymark Energy Resources, LLC	15
	Geo-Bar Petroleum Inc	5
	Hershel Edmonds	6
	Joseph D. Ermert	1
	Total	27
A4	A4 - No active wells listed	none
B4	Countrymark Energy Resources, LLC	1
	Jordan Oil Co., Inc.	3
	Terry Messmer Farms	1
	Total	5

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- ¹ Comprehensive Conservation Plan: Patoka National Wildlife Refuge and Management Area. U.S. Fish and Wildlife Service. 2008.
- ² Indiana DNR Oil and Gas Wells. Indiana Department of Natural Resources. 2015.
- ³ Ibid.
- ⁴ Ibid.
- ⁵ Orphaned Wells. Indiana Department of Natural Resources. 2015.
- ⁶ Class II Wells Buffer. Great Lakes Commission. 2016.
- ⁷ Patoka Refuge Oil Wells/Tank Batteries. Indiana Department of Environmental Management. 2015.
- ⁸ ULCERS Database, Spill Locations. Indiana Department of Environmental Management. 2009.
- ⁹ EPA Facility Registry Service. U.S. Environmental Protection Agency. 2015.
- ¹⁰ Integrated Compliance Information System National Pollutant Discharge Elimination System. U.S. Environmental Protection Agency. 2016.
- ¹¹ Natural Gas, Crude Oil, and Refined Oil Pipelines in Indiana. Indiana Geological Survey. 1988.
- ¹² Coal Mines in Indiana. Indiana Geological Survey. 2010.
- ¹³ Ibid.
- ¹⁴ National Transportation Atlas Databases. United States Department of Transportation. 2012.
- ¹⁵ Ibid.
- ¹⁶ National Transportation Dataset for Indiana. U.S. Geological Survey. 2015.
- ¹⁷ Interstate Extension for I-69 in Southern Indiana. Indiana Department of Transportation, Business Information and Technology Systems, GIS Mapping. 2012.
- ¹⁸ Inland Sensitivity Atlas Database. U.S. Environmental Protection Agency. 2011.
- ¹⁹ Ibid.
- ²⁰ Ibid.
- ²¹ National Flood Hazard Layer. Department of Homeland Security, Federal Emergency Management Agency. 2015.
- ²² USGS Stream Gauges Linked to the Medium Resolution NHD. U.S. Geological Survey. 2005.
- ²³ National Hydrography Dataset, NHD Flowline. U.S. Geological Survey. 2014.
- ²⁴ Inland Sensitivity Atlas Database. U.S. Environmental Protection Agency. 2011.
- ²⁵ USGS National Structures Dataset for Indiana. U.S. Geological Survey, National Geospatial Program. 2015.
- ²⁶ National Transportation Atlas Databases. United States Department of Transportation. 2001.
- ²⁷ National Cadastral Data. U.S. Fish and Wildlife Service. 2015.
- ²⁸ Indiana DNR State Lands. Indiana Natural Heritage Data Center, Indiana Department of Natural Resources. 2015.
- ²⁹ TIGER Data. U.S. Census Bureau. 2015.
- ³⁰ Indiana DNR Oil and Gas Wells. Indiana Department of Natural Resources. 2015.