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Environmental Assessment

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BLM Nomination of Minerals for Leasing
Allegan County, Michigan

Date:	July 2015
Type of Action:	Oil and gas Leasing
Serial Number(s):	EOI-2183, EOI-2184, EOI-2185, EOI-2186, EOI-2187, EOI-2188, EOI-2189, EOI-2190
Locations:	Casco, Dorr, and Lee Townships, Allegan County, Michigan (see Chapter 2.2 for legal land descriptions)
Project Acreage:	480 acres

Bureau of Land Management
Northeastern States District
626 E. Wisconsin Ave., Suite 200
Milwaukee, WI 53202
414-297-4400 (phone)
414-297-4409 (fax)

BLM

Northeastern States District

MISSION STATEMENT

It is the mission of the Bureau of Land Management to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

Technical Review.

Program	Reviewer	Signature	Date
Air Quality	Kyle Schumacher Natural Resources Specialist		7/8/15
Climate Change	Kyle Schumacher Natural Resources Specialist		7/8/15
Cultural/Paleontology	Jarrod Kellogg Archeologist	J Kellogg	7/8/15
Environmental Justice	Kurt Wadzinski Planning & Environmental Coordinator	Kurt J. Wadzinski	7/8/15
Fish and Wildlife	Derek Strohl Natural Resources Specialist		7/8/15
Geology/Mineral Resources/Energy Production	Fred Holzel Geologist	Fred Holzel	7/8/15
Hazardous Wastes	Kyle Schumacher Natural Resources Specialist		7/8/15
Invasive Species/Noxious Weeds	Derek Strohl Natural Resources Specialist		7/8/15
Native American Religious Concerns	Jarrod Kellogg Natural Resources Specialist	J Kellogg	7/8/15
Recreation	Jarrod Kellogg Archeologist	J Kellogg	7/8/15
Socioeconomics	Kurt Wadzinski Planning & Environmental Coordinator	Kurt J. Wadzinski	7/8/15
Soils	Derek Strohl Natural Resources Specialist		7/8/15
Vegetation	Derek Strohl Natural Resources Specialist		7/8/15
Visual Resources	Derek Strohl Natural Resources Specialist		7/8/15
Water Resources and Water Quality	Derek Strohl and Kyle Schumacher Natural Resources Specialists		7/8/15 7/8/15

Preparer — Date: 7/8/15

Planning & Environmental Coordinator — Date: 7/8/15

Associate District Manager — Date: 8 JULY 15

Contents

1 CHAPTER 1 – PURPOSE OF AND NEED FOR ACTION 7
1.1 Purpose of the Proposed Action 7
1.2 Need for the Proposed Action 7
1.3 Management Objectives of the Action 7
1.4 Conformance with BLM Land Use Plan(s) 7
1.5 Relationship to Statutes, Regulations and Other Plans 7
1.6 Decision to Be Made 8
1.7 Scoping and Issues 8
1.7.1 Issues identified through external scoping 8
1.7.2 Issues identified through internal scoping 8
2 CHAPTER 2 – ALTERNATIVES, INCLUDING THE PROPOSED ACTION 9
2.1 Introduction 9
2.2 Location 9
2.3 Proposed Action 10
2.4 Connected Action – Drilling and Production 10
2.4.1 Site-Specific Applications for Permit to Drill (APDs) 10
2.4.2 Well Drilling 10
2.4.3 Production, Abandonment, and Site Reclamation 11
2.5 No Action Alternative 12
2.6 Alternatives Considered But Not Analyzed in Detail 12
3 CHAPTER 3 – DESCRIPTION OF THE AFFECTED ENVIRONMENT 12
3.1 Introduction 12
3.2 Air Resources 12
3.2.1 Air Quality 12
3.2.2 Visibility 15
3.2.3 Global Climate Change 19
3.3 Fish and Wildlife 22
3.3.1 Sensitive Species 22
3.3.2 Migratory Birds 22
3.4 Geology/Mineral Resources/Energy Production 23
3.5 Soils 30

3.6 Vegetation 30
3.7 Invasive Species/Noxious Weeds 30
3.8 Water Resources and Water Quality 30
3.9 Wastes, Hazardous or Solid 31
3.10 Recreation 32
3.11 Cultural/Paleontology 32
3.12 Native American Religious Concerns 32
3.13 Visual Resources 33
3.14 Environmental Justice 33
3.15 Socioeconomics 33
4 CHAPTER 4 – ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION AND ALTERNATIVES 34
4.1 Introduction 34
4.2 Air Resources 35
4.2.1 Air Quality 35
4.2.2 Visibility 38
4.2.3 Global Climate Change 38
4.3 Fish and Wildlife 40
4.3.1 Types of Potential Impact 40
4.3.2 Sensitive Species 40
4.3.3 Migratory Birds 41
4.4 Geology/Mineral Resources/Energy Production 41
4.4.1 Mitigation 41
4.5 Soils 41
4.6 Vegetation 42
4.7 Invasive Species/Noxious Weeds 42
4.8 Water Resources and Water Quality 42
4.9 Wastes, Hazardous or Solid 43
4.9.1 Mitigation 44
4.10 Recreation 45
4.10.1 Mitigation 45
4.11 Cultural/Paleontology 45
4.12 Native American Religious Concerns 45

4.13 Visual Resources 45
4.14 Socioeconomics 45
5 PERSONS, GROUPS, AND AGENCIES CONSULTED 47
5.1.1 List of Persons, Agencies and Organizations Consulted 47
5.1.2 List of Preparers 48
6 REFERENCES 50
7 APPENDIX A – Figures 55
8 APPENDIX B – Stipulations and Notices 65

1 CHAPTER 1 – PURPOSE OF AND NEED FOR ACTION

1.1 Purpose of the Proposed Action

The purpose is to consider opportunities for private individuals or companies to explore and develop Federal oil and gas resources through a competitive leasing process. A Federal oil and gas lease is a legal contract that grants exclusive rights to the lessee to develop Federally-owned oil and gas resources but does not authorize surface-disturbing activities or obligate the lessee to drill a well on the lease.

1.2 Need for the Proposed Action

The parcels considered for lease in this analysis were nominated by Expressions of Interest (EOI) from the Bureau of Land Management (BLM). The oil and gas leasing program managed by the BLM encourages private exploration and development of domestic oil and gas reserves and the reduction of U.S. dependence on foreign sources of energy and is essential to meeting the nation's future needs for energy. The BLM's oil and gas leasing programs are codified under the authority of the Mineral Leasing Act of 1920, as amended, the Mineral Leasing Act for Acquired Lands of 1947, as amended, the Federal Land Policy and Management Act (FLPMA) of 1976, Executive Order 13212 (2001) and the Energy Policy Act of 2005.

1.3 Management Objectives of the Action

Since the BLM does not manage the surface, the BLM's sole management objective is to make Federal minerals available for economically feasible development in an environmentally sound manner.

1.4 Conformance with BLM Land Use Plan(s)

The proposed action and the no-action alternative described in Chapter 2 of this Environmental Assessment (EA) are in conformance with the existing *Michigan Resource Management Plan (RMP)*, available at the NSD, which makes all Federal mineral ownership available in the state for exploration and development "except where legal restrictions, intergovernmental consistency requirements, administrative or Congressional designations, or surface resource sensitivity prohibit such activities" (Record of Decision, *Michigan RMP*, Page 3) . This plan provides the basis for considering the proposed action and alternatives (43 CFR 1610.8). The *Michigan RMP* was developed with public participation and governmental coordination, and this EA provides the site-specific environmental analysis required by the *Michigan RMP* (Page 4, Section B.2.c.).

1.5 Relationship to Statutes, Regulations and Other Plans

This EA was prepared in accordance with the NEPA of 1969 and in compliance with all applicable laws and regulations, including Council on Environmental Quality (CEQ) regulations (40 C.F.R., Parts 1500-1508), U.S. Department of the Interior (DOI) requirements (Department Manual 516, Environmental Quality), the National Historic Preservation Act, the American Indian Religious Freedom Act, the Native American Graves Protection and Repatriation Act, Executive Order 13007 (Indian Sacred Sites), guidelines listed in BLM's NEPA Handbook, H-1790-1 , and/or other Federal statutes and executive orders. Any purchaser of a Federal oil and gas lease is required to comply with all applicable Federal,

State, and local laws and regulations including obtaining all necessary permits required prior to the commencement of project activities.

1.6 Decision to Be Made

The BLM must decide whether or not to lease all or part of the subject parcels in Allegan County at a future competitive oil and gas lease sale and what stipulations and notices must be attached to the lease parcels. The BLM's policy is to promote oil and gas development if it meets the guidelines and regulations set forth by the National Environmental Policy Act of 1969 and other subsequent laws and policies passed by the U.S. Congress.

1.7 Scoping and Issues

1.7.1 Issues identified through external scoping

The BLM conducted external scoping for leasing in the same vicinity within the last five years. Staff from the BLM met with staff from the Michigan Department of Natural Resources (MDNR) at the Allegan State Game Area (ASGA) in 2011 to discuss potential issues pertaining to oil and gas leasing at the ASGA. The parcels currently under consideration are privately owned lands just outside the boundaries of the ASGA. As such, they contain many of the same land forms, soil types, and native vegetation.

Issues identified during previous external scoping with the MDNR that could also pertain to the proposed action include:

1. Construction of roads and additional traffic by large vehicles will degrade wildlife habitat by spreading invasive species; and
2. Various construction-related activities could have adverse impacts on trout streams and designated Natural Rivers.

Additionally, letters were sent to the private surface owners requesting any comments and concerns regarding oil and gas leasing on their lands.

1.7.2 Issues identified through internal scoping

BLM staff visited the proposed parcels on April 15, 2015, and an interdisciplinary team identified issues to be considered in this EA:

1. Several of the proposed parcels contain riparian areas, some of which are part of the Kalamazoo State Natural River. Drilling in or near these riparian areas poses threats to water quality and the natural resource values that led to the designation of the Kalamazoo River as a Michigan Natural River.
2. The proposed lease parcels and surrounding areas contain many residential dwellings, which must be considered when locating drill pads.
3. Leased parcels may later be developed for oil and/or gas production and hydraulic fracturing technology may be used during the development stage.

2 CHAPTER 2 – ALTERNATIVES, INCLUDING THE PROPOSED ACTION

2.1 Introduction

The BLM has nominated 480 acres of Federal mineral estate for oil and gas development in Casco, Dorr, and Lee Townships in Allegan County (Figures 1 through 8, Appendix A). Parcels under EOI numbers 2183, 2184, 2185, 2186, 2187, 2188, and 2189 contain a 50% Federally-owned mineral interest. The remaining 50% of the mineral rights on these parcels would require a separate lease with the private surface owner. EOI-2190 contains 100% Federal minerals. Issuance of a competitive lease or leases would give the lessee exclusive rights to explore and develop Federal oil and gas minerals but would not authorize surface-disturbing activities or obligate the company to drill a well on the lease. A lease may be used to consolidate acreage to meet well spacing requirements, and a lease may be acquired for speculative value. The BLM will require applicants to adhere to lease stipulations that have been formulated while conducting this EA and are made part of the proposed action.

2.2 Location

The sites are located on private lands in the southwestern portion of Michigan's Lower Peninsula. Legal descriptions of the requested parcels are as follows, all in Allegan County:

T. 1 N., R. 15 W. (Lee Township)

EOI-2183: Sec. 6, SWNE.

T. 1 N., R. 16 W. (Casco Township)

EOI-2184: Sec. 2, West Thirty-eight (38) acres of the North Fifty-eight (58) acres of the Southwest Quarter; also beginning at a point 80 rods North of Southwest corner of said Quarter Section thence East 160 rods to the North and South Quarter line, thence North 20 rods on said Quarter line, thence West 53-1/3 rods, thence North 2 rods, thence West 90-2/3 rods to Northeast corner of that certain tract used for cemetery, thence South on East line of said cemetery 12 rods, thence West on South line of cemetery tract 16 rods to the West line of said Section; thence South on the Section line 10 rods to the place of beginning; excepting a rectangular tract beginning at a point 100 rods North from Southwest corner of said Section, thence running East at right angles with the West line of said Section 16 rods and 8 feet, thence North at right angles 34 feet, thence West at right angles 16 rods and 8 feet to West line of said Section; thence South on said Section line to the place of beginning,

EOI-2185: Sec. 13, East Four (4) acres of the E½SWSWNE, W½W½E½SWNE,

EOI-2186: Sec. 16, NWNW,

EOI-2187: Sec. 21, SE, East Sixty (60) acres of the SW,

EOI-2188: Sec. 33, NENW,

EOI-2189: Sec. 36, W½E½SESW, E½W½SESW.

T. 4 N., R. 12 W. (Dorr Township)

EOI-2190: Sec. 4, NESE.

2.3 Proposed Action

The proposed action is to lease the nominated parcels. If approved, a lease or leases would be offered for competitive sale with stipulations and notices generated through this process and other consultations.

2.4 Connected Action – Drilling and Production

2.4.1 Site-Specific Applications for Permit to Drill (APDs)

The proposed nominations, if approved, would be offered for competitive sale with stipulations and notices generated through this process and other consultations. Once a lease is awarded, the successful bidder is required to submit an Application for Permit to Drill (APD) to the BLM before any ground disturbance is authorized. In an APD, an applicant identifies a proposed drill site and provides the BLM with specific details on how and when the applicant proposes to drill the well within the constraints of the lease document. Upon receipt of an APD, the BLM conducts an onsite inspection with the applicant and, if possible, the private landowner or the surface-managing agency. NEPA and Endangered Species Act requirements must also be met at the APD stage, and, in cases with potential to affect Federally-listed or state-listed species, a site-specific biological assessment is written, including the results of any required biological surveys. This is submitted to the U.S. Fish and Wildlife Service (USFWS) and the MDNR for consultation. The lessee would be required, as a condition of approval, to comply with the recommendations of these consultations.

The State of Michigan has stipulated well drilling spacing of 40 acres for all wells, with several spacing exceptions for wells developed in specific formations. The spacing exceptions are:

- Antrim Spacing: an average spacing of no less than 80 acres per well developed in the Antrim Formation, the Sunbury, Bedford, and Ellsworth shales (but not the Berea sandstone), and a similar amendment to Supervisor of Wells Order (A) 14-9-94;
- Niagaran Spacing: an 80 acre spacing for the Niagaran Formation and deeper in many northern lower Michigan counties and some of the southern counties;
- Trenton-Black River Formation Spacing: a 40 acre spacing for the Trenton-Black River Formation for fifteen counties in Southern Michigan; and
- Glenwood and below Spacing: 640 acres for Glenwood and deeper in most of these counties (Michigan Department of Environmental Quality, 2015a).

2.4.2 Well Drilling

Oil and gas (hydrocarbon) wells are built in two phases – drilling and completion. Wells may be drilled vertically if the end of the well, or *bottom hole location*, is directly below the well pad, or directionally, if the well pad is not directly above the bottom hole location. For example, Federal minerals under a state park, where drilling is not permitted, can be accessed by directional drilling from a surface location outside of the park. The same method may be used to drill horizontally, with a wellbore extending up to several thousand feet through the hydrocarbon-producing rock formation. Preparation for the drilling process includes construction of a road, drilling pad, and reserve pit. Constructed access roads normally have a running surface width of 25-30 feet, the length depending upon the well's location in relation to

existing roads or highways. Land is cleared and graded for pad construction. If the well is productive, additional land may be affected by pipeline construction. For the purpose of this analysis, the total disturbed area for drilling a productive vertical well would be approximately 1.5 acres.

Drilling operations continue around the clock, and wells may be drilled in as little as two days. During well pad construction, topsoil is stockpiled for use during restoration activities.Wells drilled horizontally require somewhat larger well pads and reserve pits than conventional vertical or directional wells and typically accommodate several wells. The larger pads are required to store the larger amounts of equipment and supplies used in drilling horizontal wells. Lateral lengths exceeding one mile are common. For the purpose of this analysis, the total disturbance associated with horizontal drilling is 5 acres per well pad, including approximately 2 acres to be maintained for the life of the wells.

Once exploration drilling is completed, the well is tested and a determination is made if the well is capable of producing in "paying quantities". If the well is capable of producing in "paying quantities", then the well would then be completed as a producing well, which includes installing a wellhead. The well head usually consists of large diameter casing, blowout preventers, several gauges and valves, and can be up to 8 feet tall and as much as 5 feet in diameter. A completed well would also be expected to have a pump jack (for oil), a power source and piping to storage tanks including possibly production tanks, water tanks, and/or condensate tanks for gas. The size of the tanks would depend on the type and amount of production. A completed well may also require a treatment facilities such as a gas dehydration unit and/or a heater/treater that separates the water from the oil.

2.4.3 Production, Abandonment, and Site Reclamation

Production would continue for as long as the well is providing payable quantities of oil and/or gas. During the production phase the well may undergo maintenance, repairs or replacement of surface equipment. The well may be be maintained or cleaned periodically using a smaller drilling rig. If production decreases the lease holder or operator may decide to utilize downhole enhancements or stimulation techniques to restore or improve production levels. Formation water production, along with the oil and/or gas, is expected during a well's productive life, and separation, dehydration and other production processing may be necessary. This processing may require construction of temporary facilities, both on- and off-site. Oil or gas field fluid wastes may be injected into an approved underground formation in a manner that prevents waste in accordance with all applicable state and federal laws and regulations.

After production ceases or is no longer profitable, the well would be abandoned which will includes the following discrete operations: surface equipment removal, plugging and abandoning drill holes and wells, and surface rehabilitation. All surface disturbances must be reclaimed to BLM standards as agreed to by the surface owner. Reclamation includes removing all facilities, and restoration and stabilization, including seeding, of all surface disturbances to blend with the surrounding topography.

A notice in the proposed lease would encourage the use of non-invasive plant species during all restoration and stabilization activities. Final seed mixtures and plantings are determined by recommendations from the BLM with approval of the landowner.

2.5 No Action Alternative

Under the No Action Alternative, the BLM would not offer the proposed parcels for oil and gas leasing.

2.6 Alternatives Considered But Not Analyzed in Detail

No other reasonable alternatives were developed from scoping.

3 CHAPTER 3 – DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Introduction

The Decision Area includes the proposed lease parcels and for ease of reference, this EA has numbered the parcels 1 through 8 (Figures 1 and 2, Appendix A). These parcel numbers are assigned strictly for the purpose of analysis and are not related to lease parcel numbers.

The Decision Area is within the Southern Michigan/Northern Indiana Drift Plains level-III ecoregion. EOI-2183, 2184, 2185, 2186, 2187, 2188, and 2189, in the southwest portion of the Decision Area, are in the Black River watershed (HUC#04050002), and EOI-2190 is in the Kalamazoo River watershed (HUC#04050003). Both watersheds drain to Lake Michigan. Most of the Decision Area is directly accessible via improved roads.

3.2 Air Resources

3.2.1 Air Quality

The primary sources of air pollution are dust from blowing wind on disturbed or exposed soil, exhaust emissions from motorized equipment, oil and gas development, agriculture, and industrial sources. The Environmental Protection Agency (EPA) was given the authority for air quality protection with the provision to delegate this authority to the state as appropriate under Federal law. Most of the authority for air quality protection in Michigan has been delegated to the Michigan Department of Environmental Quality (MDEQ) . The Clean Air Act (CAA) of 1970, as amended, requires the establishment of National Ambient Air Quality Standards (NAAQS). NAAQS pollutants include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10} & $PM_{2.5}$), sulfur dioxide (SO_2), and lead (Pb). The NAAQS pollutants are monitored in Michigan by the MDEQ. The CAA identifies two types of national ambient air quality standards. Primary standards define levels of air quality that the Administrator of the EPA judges to be necessary, with an adequate margin of safety, to protect the public health. Secondary standards define levels of air quality that the Administrator of the EPA judges to be necessary to protect the public from any known or anticipated adverse effects of a pollutant. Both primary and secondary standards currently in effect are shown in Table 1.

The entire state of Michigan is currently designated “Attainment” with the NAAQS for:

- Carbon Monoxide (CO)
- Nitrogen Dioxide (NO_2)
- Ozone (O_3)
- Particulate Matter Less than 10 microns (PM_{10})

- Annual and 24-hour $PM_{2.5}$ (fine particles)

There are only two standards not met within the state of Michigan:

- Sulfur Dioxide (SO_2) – in Wayne County, a corridor that runs along U.S. 75 extending east to the shoreline border was recently designated by MDEQ with the new 2010 standard. It should be noted that this area is on the east side of the Lower Peninsula.
- Lead (Pb) – All Michigan Counties meet the Lead (Pb) NAAQS except for a small area in Ionia County (less than 1 square mile in Belding) about 50 miles southeast of the proposed project area.

Table 1. National Ambient Air Quality Standards (U.S. Environmental Protection Agency, 2014a)

	Primary Standards		Secondary Standards		
Pollutant [final rule cited]	**Level**	**Averaging Time**	**Level**	**Averaging Time**	**Form**
Carbon Monoxide [76 FR 54294, 8/31/2011]	9 ppm (10 mg/m^3)	8-hour [(1)]	None		Not to be exceeded more than once per year
	35 ppm (40 mg/m^3)	1-hour [(1)]			
Lead [73 FR 66964, 11/12/2008]	0.15 µg/m^3 [(1)]	Rolling 3-Month Average	Same as Primary		Not to be exceeded
Nitrogen Dioxide [75 FR 6474, 2/9/2010] [61 FR 52852, 10/8/1996]	53 ppb [(2)]	Annual (Arithmetic Average)	Same as Primary		Annual Mean
	100 ppb	1-hour	None		98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
Particulate Matter (PM_{10}) 12/14/2012	150 µg/m^3	24-hour	Same as Primary		Not to be exceeded more than once per year on average of 3 years
Particulate Matter ($PM_{2.5}$) 12/14/2012	12.0 µg/m^3	Annual (Arithmetic Average)	15.0 µg/m^3	Annual (Arithmetic Average)	Annual mean, averaged over 3 years
	35 µg/m^3	24-hour	Same as Primary		98th percentile, averaged over 3 years
Ozone [73 FR 16436, 3/27/2008]	0.075 ppm [(3)]	8-hour	Same as Primary		Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Sulfur Dioxide [75 FR 35520, 6/22/2010] [38 FR 25678, 9/14/1973]	75 ppb [(4)]	1-hour			99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
			0.5 ppm	3-hour [(1)]	Not to be exceeded more than once per year

as of October 2011

(1) Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved. The official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(2) The official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard. The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

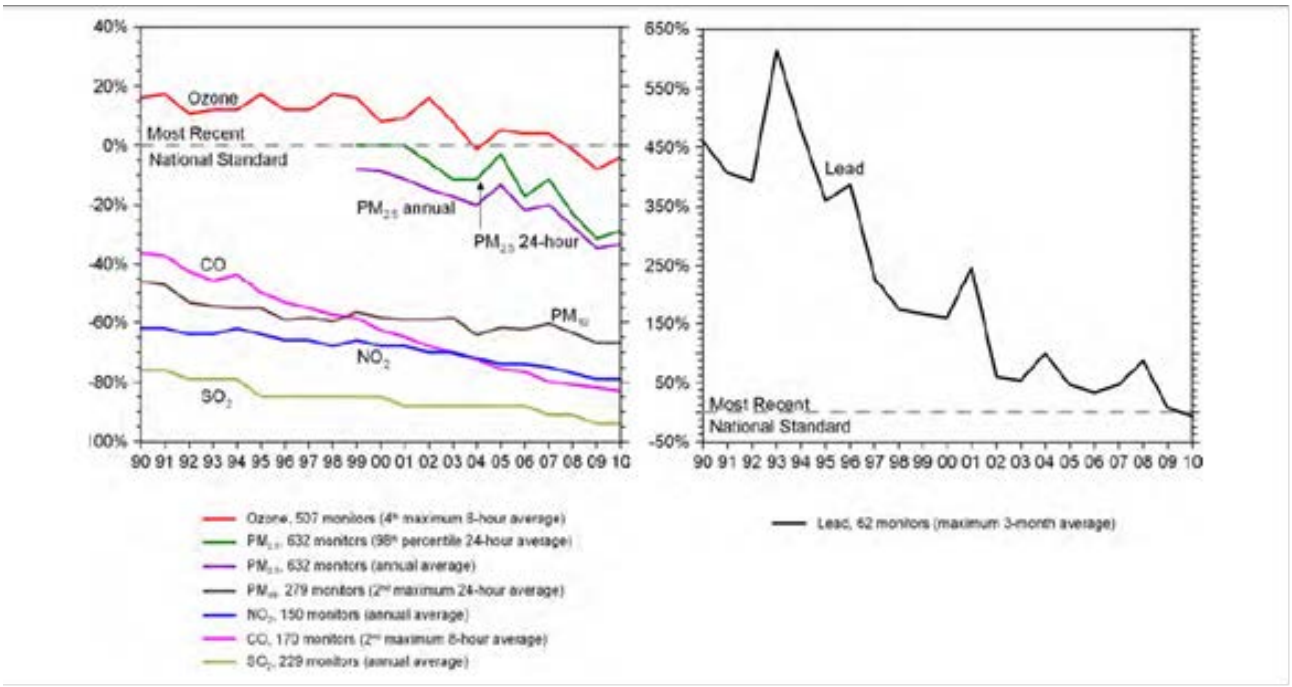
(3) Final rule signed March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, EPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

(4) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

According to the U.S. Environmental Protection Agency (EPA)(2014a), since 1990, nationwide air quality has improved significantly for six common air pollutants (Figure 1). These six pollutants are ground-level ozone, particle pollution [particles 2.5 micrometers in diameter and smaller ($PM_{2.5}$) and particles 10 micrometers and smaller (PM_{10})], lead, nitrogen dioxide (NO_2), carbon monoxide (CO), and sulfur dioxide (SO_2). Nationally, air pollution was lower in 2010 than in 1990 for:

- 8-hour ozone, by 17%
- 24-hour PM_{10} , by 38%
- 3-month average lead, by 83%
- annual NO_2 , by 45%
- 8-hour CO, by 73%
- annual SO_2 , by 75%

Figure 1. Comparison of national levels of the six common pollutants to the most recent NAAQS, 1990-2010. National levels are averages across all monitors with complete data for the time period (U.S. Environmental Protection Agency, 2014a).



Note: Air quality data for $PM_{2.5}$ starts in 1999 .

Nationally, annual $PM_{2.5}$ concentrations were 24% lower in 2010 compared to 2001 and 24-hour $PM_{2.5}$ concentrations were 28% lower in 2010 compared to 2001. Ozone levels did not improve in much of the East until 2002, after which there was a significant decline. Eight-hour ozone concentrations were 13% lower in 2010 than in 2001. This decline is largely due to reductions in oxides of nitrogen (NOx) emissions required by EPA rules including the NOx State Implementation Plan (SIP) call, preliminary implementation of the Clean Air Interstate Rule (CAIR), and Tier 2 Light Duty Vehicle Emissions Standards (U.S. Environmental Protection Agency, 2015a). In January 2015, the Cross-State Air Pollution Rule (CSAPR) replaced the CAIR and went into effect in Michigan and in 27 other eastern states, with the goal of significantly improving air quality by reducing power plant emissions that contribute to ozone and/or fine particle pollution in other states (U.S Environmental Protection Agency, 2015b).

The EPA concludes that total emissions of toxic air pollutants have decreased by approximately 42% between 1990 and 2005. Control programs for mobile sources and facilities such as chemical plants, dry cleaners, coke ovens, and incinerators are primarily responsible for these reductions. The EPA also found that monitored concentrations of toxic pollutants such as benzene, 1,3-butadiene, ethylbenzene, and toluene decreased by 5% or more per year between 2003 and 2010 at more than half of ambient monitoring sites. Other toxic air pollutants of concern to public health such as carbon tetrachloride, formaldehyde, and several metals, declined at most sites as well (U.S. Environmental Protection Agency, 2015).

3.2.2 Visibility

Visibility, also referred to as visual range, is a subjective measure of the distance that light or an object can clearly be seen by an observer. Light extinction is used as a measure of visibility and is calculated from the monitored components of fine particle mass (aerosols) and relative humidity. It is expressed in

terms of deciviews, a measure for describing perceived changes in visibility. One deciview is defined as a change in visibility that is just perceptible to an average person, which is approximately a 10% change in light extinction. Visibility can also be defined by standard visual range (SVR) measured in miles, which is the farthest distance at which an observer can see a black object viewed against the sky above the horizon. The larger the SVR, the cleaner the air. To estimate potential visibility impairment, monitored aerosol concentrations are used to reconstruct visibility conditions for each day monitored. The aerosol species include ammonium sulfate, ammonium nitrate, organic mass, elemental carbon, soil elements, and coarse mass (Malm, 1999). The daily values are then ranked from clearest to haziest and divided into three categories; the mean visibility for all days (average), the 20% of days with the clearest visibility (20% clearest), and the 20% of days with the worst visibility (20% haziest).

A wide variety of pollutants can impact visibility, including particulate matter, nitrogen dioxide, nitrates (compounds containing NO_3), and sulfates (compounds containing SO_4). Fine particles suspended in the atmosphere decrease visibility by blocking, reflecting, or absorbing light.

Two types of visibility impairment can be caused by emission sources: plume impairment and regional haze. Plume impairment occurs when a section of the atmosphere becomes visible due to the contrast or color difference between a discrete pollutant plume and a viewed background, such as a landscape feature. Regional haze occurs when pollutants from widespread emission sources become mixed in the atmosphere and travel long distances (Malm, 1999).

There are three classifications of areas that attain NAAQS: Class I, Class II, and Class III. Congress established certain national parks and wilderness areas as mandatory Class I areas where only a small amount of air quality degradation is allowed. Since 1980, the Interagency Monitoring of Protected Visual Environments (IMPROVE) network has measured visibility in Class I areas. These areas are managed as high visual quality under the federal visual resource management (VRM) program. The 1977 Clean Air Act (CAA) Amendments, Section 169A declared "as a national goal the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I federal areas which impairment results from manmade air pollution" (42 U.S.C. § 7491(a)(1)). All other areas of the U.S. are designated as Class II, which allow a moderate amount of air quality degradation. No areas of the U.S. have been designated Class III, which would allow more air quality degradation. The CAA gives federal managers the affirmative responsibility, but no regulatory authority, to protect air quality-related values, including visibility, from degradation.

According to Figure 2 below from the EPA's Regional Haze Program website (2015c), the Lower Peninsula of Michigan has no Mandatory Class I visibility areas. However, two Mandatory Class I locations exist in Michigan's Upper Peninsula, Isle Royale National Park and Seney Wilderness Area, which are, respectively, approximately 250 and 400 miles north northwest of the proposed parcels and are not likely to be impacted by any action taken on or within the area should the parcels be leased. Photochemical modeling has been performed to evaluate Michigan's impact on other Class I areas. The criteria used to define one state's "impact" on another state's Class I area was not determined by the EPA; therefore, each state and RPO was given its own discretion to determine impacts. Based on the

Midwest Regional Planning Organization (MRPO) modeling and using a 5% or more contribution to total light extinction as impact criteria, emissions sources within Michigan impact only Isle Royale and Seney (Michigan Department of Environmental Quality, 2010).

Based on the visibility analyses of other states, Michigan sources could impact areas within their jurisdiction in Acadia National Park (≈900 miles east), Moosehorn Wilderness Area in Maine (≈950 miles east), Great Gulf Wilderness Area in New Hampshire (≈750 miles east), Brigantine Wilderness Area in New Jersey (≈640 miles southeast), and Lye Brook Wilderness in Vermont (≈650 miles east) (Michigan Department of Environmental Quality, 2010).

Figure 2. Mandatory Class I Visibility Areas, United States

Prevention of Significant Deterioration (PSD) increments limit air quality degradation and ensure that areas with clean air continue to meet NAAQS, even during economic development. The PSD program goal is to maintain pristine air quality required to protect public health and welfare from air pollution effects and "to preserve, protect and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreation, scenic or historic value" (U.S. Environmental Protection Agency, 2013).

PSD increments have been established for NO_2, SO_2, and PM_{10}. Comparisons of potential PM_{10}, NO_2, and SO_2 concentrations with PSD increments are intended only to evaluate a threshold of concern. The allowable PSD increment depends on an area's classification. Class I areas have lower increments, due to their protected status as pristine areas.

The Michigan Department of Natural Resources and Environment's (DNRE) Reasonable Further Progress (RFP) plans modeled projection for 2018 include growth factors and the controls required by PSD, thus Michigan should attain its visibility goals even if new sources are permitted (Michigan Department of Environmental Quality, 2010).

3.2.2.1 Atmospheric Deposition

Atmospheric deposition refers to processes in which air pollutants are removed from the atmosphere and deposited into terrestrial and aquatic ecosystems. Air pollutants can be deposited by precipitation (rain and snow) or the gravitational settling of gaseous pollutants on soil, water, and vegetation. Much of the concern about deposition is due to secondary formation of acids and other compounds from emitted nitrogen and sulfur species, such as NOx and SO_2, which can contribute to acidification of lakes, streams, and soils and affect other ecosystem characteristics, including nutrient cycling and biological diversity.

Substances deposited include:

- Acids, such as sulfuric (H_2SO_4) and nitric (HNO_3), sometimes referred to as acid rain
- Air toxics, such as pesticides, herbicides, and volatile organic compounds (VOC)
- Heavy metals, such as mercury
- Nutrients, such as nitrates (NO_3-) and ammonium (NH4+)

The accurate measurement of atmospheric deposition is complicated by contributions to deposition by several components including but not limited to rain, snow, cloud water, particle settling, and gaseous pollutants. Deposition varies with precipitation and other meteorological variables (e.g., temperature, humidity, winds, and atmospheric stability), which in turn, vary with elevation and time.

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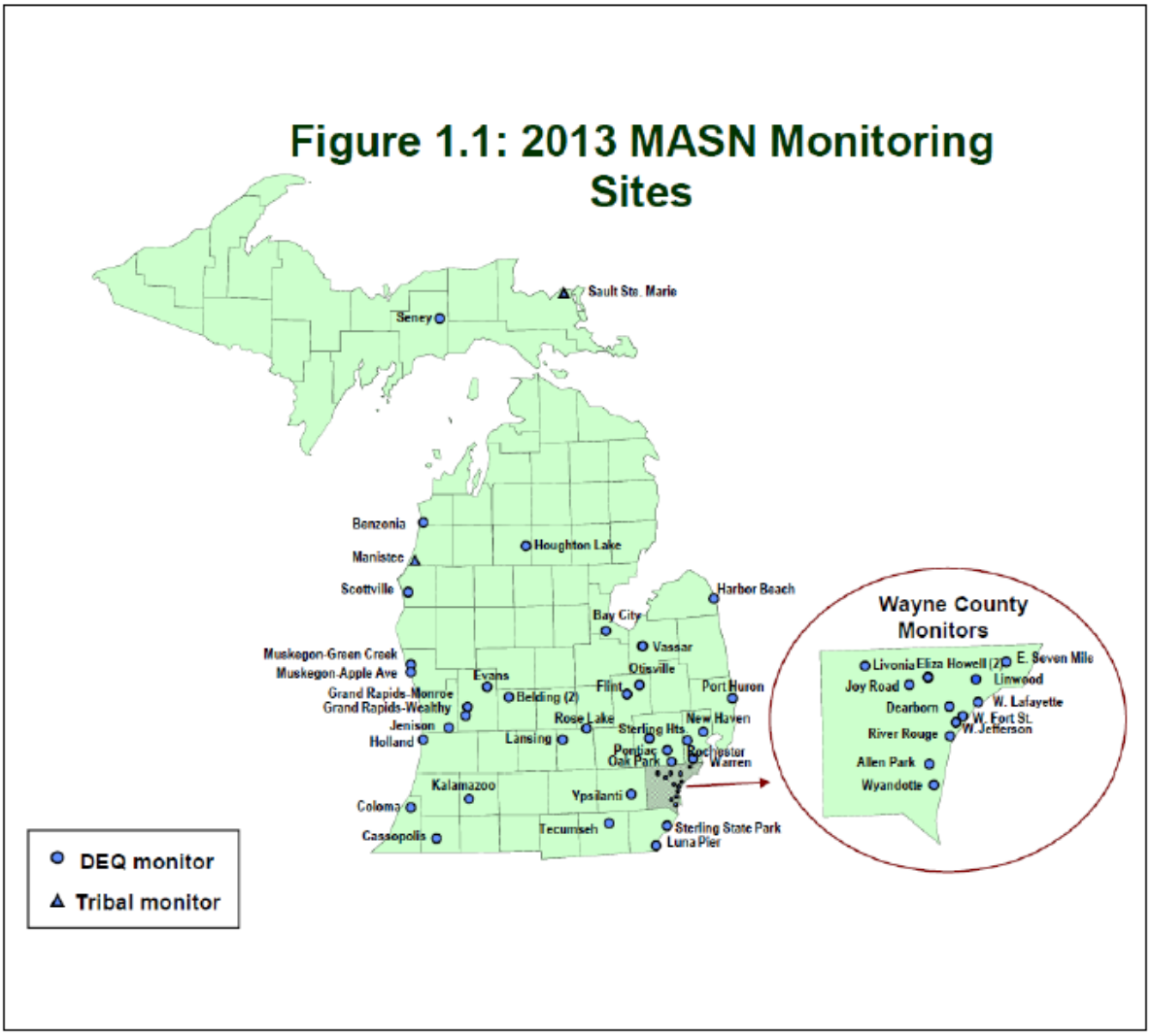
The USFS has established guidelines for Levels of Concern (LOC) for total deposition of nitrogen and sulfur compounds in Class I Wilderness Areas. Total nitrogen deposition of 1.5 kilograms (kg) per hectare (ha) per year or less is considered unlikely to harm terrestrial or aquatic ecosystems. For total sulfur deposition, the LOC is 5 kg per ha per year. The USFS is considering a sulfur LOC of 1.5 kg per ha per year. Note that these are the same LOCs the National Park Service uses (U.S. Forest Service, National Park Service, and U.S. Fish and Wildlife Service, 2010).

3.2.2.2 Current Pollution Concentrations

The Michigan Air Sampling Network (MASN) is operated by the MDEQ's Air Quality Division, as mandated by the EPA (40 CFR 50) and as part of the Michigan State Implementation Plan for Regional Haze. The closest DEQ air monitoring stations are located in Holland, Jenison, Coloma, and Kalamazoo (Figure 3)(Michigan Department of Environmental Quality, 2014). The *2013 Annual Air Quality Report for Michigan* shows Allegan County did not violate the 2008 standards nor did they contribute to a violation of ozone standards (Michigan Department of Environmental Quality, 2014).

Figure 3. 2013 MASN Monitoring Sites (Michigan Department of Environmental Quality, 2014)



3.2.3 Global Climate Change

Climate change refers to any significant change in measures of climate (e.g., temperature or precipitation) lasting for an extended period (decades or longer). Climate change may result from natural processes, such as changes in the sun's intensity and natural processes within the climate system (such as changes in ocean circulation), and human activities that change the atmosphere's composition (such as burning fossil fuels) and the land surface (such as urbanization) (Intergovernmental Panel on Climate Change (IPCC), 2007).

Northern Michigan is generally cooler in the summer and warmer in the winter than would be expected at its latitude, although this trend depends on proximity to the surrounding Great Lakes. Areas along the Great Lakes shorelines are generally warmer than interior areas with a growing season of approximately 160 days compared to 70 days interior. Average temperatures range from 20.5 in December – February to 64.9 in June through August. The area also receives substantial lake-effect snow along the Great Lakes coastlines. Annual precipitation for the area ranges from 28-34 inches. Winter and spring each account for approximately 20% of the annual precipitation with summer and fall each contributing approximately 30% of the annual precipitation (Handler et al., 2014).

Greenhouse gases (GHGs) are gases in the atmosphere composed of molecules that absorb and emit infrared electromagnetic radiation. When present in the atmosphere, these gases contribute to the greenhouse effect. The greenhouse effect is a process by which thermal radiation from a planetary surface is absorbed by atmospheric GHGs and is re-radiated in all directions. Since part of this re-radiation is back towards the surface and the lower atmosphere, it results in an elevation of the average surface temperature above what it would be in the absence of the gases. Some GHGs such as CO_2 occur naturally and are emitted to the atmosphere through natural processes and human activities. Other GHGs (e.g., fluorinated gases) are created and emitted solely through human activities. The primary GHGs that enter the atmosphere as a result of anthropogenic activities include CO_2, methane (CH_4), nitrous oxide (N_2O), and fluorinated gases such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Fluorinated gases are powerful GHGs that are emitted from a variety of industrial processes including production of refrigeration/cooling systems, foams and aerosols. Fluorinated gases are not primary to the activities authorized by the BLM and will not be discussed further in this document.

The *Michigan Greenhouse Gas Inventory 1990 and 2002* (University of Michigan, 2005) identifies activities in Michigan that accounted for approximately 62.59 million metric tons (MMt) of *gross* carbon dioxide equivalent (CO_2e) emissions in 2002, an amount equal to 3.3% of total U.S. gross GHG emissions. These emission estimates focus on activities in Michigan and are *consumption-based*. They exclude emissions associated with electricity that is exported from the state. Gross GHG emissions in Michigan increased 9% from 1990 to 2002, while national emissions rose by 13% from 1990 to 2002. Annual sequestration (removal) of GHG emissions due to forestry and other land-uses in Michigan were estimated at 15.14 MMtCO2e in 1990. For 2002, it is possible to calculate annual sequestration using the same method, but requires caution as inconsistency in data and methodology for 1997 and 2002 values increase uncertainty in the annual storage value. Michigan's per capita emission rate of 6.23 Metric Tons Carbon Equivalent (MTCE) is less than the national value of 6.57 MTCE per capita in 2002. Unlike the national per capita average, which decreased from 1990 to 2002, Michigan's per capita emissions increased over the same period. Both Michigan and national rates exhibited comparable percentage increases in emissions, but the national population grew at a rate nearly double that of Michigan. This large difference in population growth explains why Michigan's per capita emissions rate increased and the national per capita emissions rate decreased from 1990 to 2002 (University of Michigan, 2005).

Ongoing scientific research has identified the potential impacts of anthropogenic GHG emissions and changes in biological sequestration due to land management activities on global climate. Through complex interactions on a regional and global scale, these GHG emissions and net losses of biological carbon sinks may cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat energy radiated by the earth back into space. Although still debated, GHG levels have varied for millennia, and it is theorized that recent industrialization and burning of fossil carbon sources have caused CO_2e concentrations to increase dramatically, and are likely to contribute to overall global climatic changes. The IPCC (2007) recently concluded that "warming of the climate system is unequivocal" and "most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations".

It is important to note that GHGs will have a sustained climatic impact over different temporal scales. For example, recent emissions of CO_2 can influence climate for 100 years. In contrast, black carbon is a relatively short-lived pollutant, as it remains in the atmosphere for only about a week. It is estimated that black carbon is the second greatest contributor to global climate change behind CO_2 (Ramanathan and Carmichael, 2008). Without additional meteorological monitoring systems, it is difficult to determine the spatial and temporal variability and change of climatic conditions, but increasing concentrations of GHGs may accelerate the rate of climate change in either a positive or negative direction depending upon location and site specific factors.

Global mean surface temperatures have increased nearly 1.0°C (1.8°F) from 1890 to 2006 (National Aeronautics and Space Administration Goddard Institute for Space Studies, 2007). In 2001, the IPCC (2007) indicated that by the year 2100, global average surface temperatures would increase 1.4 to 5.8°C (2.5 to 10.4°F) above 1990 levels. The National Academy of Sciences (Hansen et al., 2006) has confirmed these findings, but also indicated that there are uncertainties regarding how climate change may affect different regions. Observations and predictive models indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Data indicates that northern latitudes (above 24° N) have exhibited temperature increases of nearly 1.2°C (2.1°F) since 1900, with nearly a 1.0°C (1.8°F) increase since 1970 alone. It also shows temperature and precipitation trends for the conterminous United States. For both parameters we see varying rates of change, but overall increases in both temperature and precipitation.

The lack of scientific tools designed to predict climate change at regional or local scales limits the ability to quantify potential future impacts. However, potential impacts to air quality due to climate change are likely to be varied. Oil and gas development activities can generate CO_2 and CH_4. CO_2 emissions result from the use of combustion engines, while CH_4 can be released during processing.

Because GHGs circulate freely throughout Earth's atmosphere, the planning area for this resource is the entire globe. The largest component of global anthropogenic GHG emissions is CO_2. Global anthropogenic carbon emissions reached about 7,000,000,000 metric tons per year in 2000 and an estimated 9,170,000,000 metric tons per year in 2010 (Boden, et al, 2013). Oil and gas production is a major contributor of GHGs. In 2006, natural gas production accounted for 8% of global methane emissions, and oil production accounted for 0.5% of global methane emissions (URS Corporation, 2010).

A description of the potential GHG emissions associated with the proposed leasing activities is included in Chapter 4

3.3 Fish and Wildlife

The Decision Area consists mostly of forests, wetlands, and agricultural fields (See **Floodplains, Wetlands, and Riparian Zones** and **Vegetation** sections below). The Decision Area harbors populations of diverse types of wildlife. The Decision Area contains 26 miles of trout streams, which are distributed across all eight parcels.

3.3.1 Sensitive Species

Six species are listed on the Fish and Wildlife Service's list of endangered species known to occur in Allegan County, Michigan (U.S. Fish & Wildlife Service, 2015a). Two of these, Pitcher's thistle (*Cirsium pitcheri*) and Rufa red knot (*Calidris canutus rufa*), are likely not present within the Planning Area because they are found in coastal areas or on dunes, which are not present in the Decision Area. The remaining four species are all animals and are all listed in the State of Michigan as well:

- Eastern massasauga (*Sistrurus catenatus*) – candidate
- Karner blue butterfly (*Lycaeides melissa samuelis*) – endangered
- Indiana bat (*Myotis sodalis*) – endangered
- Northern long-eared bat (*Myotis septentrionalis*) – endangered

3.3.2 Migratory Birds

The protection of birds is regulated by the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities (U.S. Fish & Wildlife Service, 2015b). Table 2 lists the 23 migratory bird species of concern that are likely to be present in the Decision Area.

Table 2. Migratory Bird Species of Concern Likely to be Present in Decision Area.

Species Name	Seasonal Occurrence in Project Area
American bittern (*Botaurus lentiginosus*)	Breeding
Bald eagle (*Haliaeetus leucocephalus*)	Year-round
Black tern (*Chlidonias niger*)	Breeding
Black-billed cuckoo (*Coccyzus erythropthalmus*)	Breeding
Blue-winged warbler (*Vermivora pinus*)	Breeding
Bobolink (*Dolichonyx oryzivorus*)	Breeding
Brown thrasher (*Toxostoma rufum*)	Breeding

Species Name	Seasonal Occurrence in Project Area
Canada warbler (*Wilsonia canadensis*)	Breeding
Cerulean warbler (*Dendroica cerulea*)	Breeding
Common tern (*Sterna hirundo*)	Breeding
Dickcissel (*Spiza americana*)	Breeding
Golden-Winged warbler (*Vermivora chrysoptera*)	Breeding
Henslow's sparrow (*Ammodramus henslowii*)	Breeding
Least bittern (*Ixobrychus exilis*)	Breeding
Marsh wren (*Cistothorus palustris*)	Breeding
Pied-billed grebe (*Podilymbus podiceps*)	Breeding
Prothonotary warbler (*Protonotaria citrea*)	Breeding
Red-headed woodpecker (*Melanerpes erythrocephalus*)	Breeding
Rusty blackbird (*Euphagus carolinus*)	Wintering
Short-eared owl (*Asio flammeus*)	Wintering
Upland sandpiper (*Bartramia longicauda*)	Breeding
Willow flycatcher (*Empidonax traillii*)	Breeding
Wood thrush (*Hylocichla mustelina*)	Breeding

3.4 Geology/Mineral Resources/Energy Production

Oil and gas leasing is a principal use of the public lands and current BLM policy encourages orderly development of leases to make mineral resources available to meet national, regional, and local energy needs. This policy is based in various laws, including the Mineral Leasing Act (MLA) of 1920 and Section 102(a)(12), 103(1) of the FLPMA of 1976. The Federal Onshore Oil and Gas Leasing Reform Act of 1987 (Section 5102(a)(b)(1)(A)) directs the BLM to conduct quarterly oil and gas lease sales in each state whenever eligible lands are nominated and available for leasing. Leases would be issued pursuant to 43 CFR 3100 and BLM Instruction Memorandum 2010-117. Stipulations attached to leases serve as terms and conditions which provide protections to other resources on the parcel(s).

Oil and gas resources are classified for regulation and management as a mineral; therefore, issues relating to the oil and gas resources are discussed in this section with all mineral resources. Separate descriptions of the surficial geology, mineral resources and oil and gas resources of the assessment area are presented below. The assessment of potential impact to oil and gas mineral resources resulting from additional oil and gas resource development are combined.

Michigan's Lower Peninsula is underlain by the Michigan Basin, a nearly circular bowl-like structural depression. The Michigan Basin contains up to 14,000 feet of slightly folded and faulted sedimentary rock layers ranging in age from Precambrian to the Triassic Period. The rock types include older marine sediments such as shales, sandstones, dolostones, limestones and evaporates and younger river, floodplain and swamp sediments such as sandstones, shales and coals (MDEQ, 2003). Overlying most of the lower peninsula is Pleistocene glacial material. The eight parcels in this analysis are underlain by Mississippian-aged rock.

Mineral resources of the region fall into two broad categories, nonfuel and fuel minerals. In 2011 iron ore was Michigan's leading nonfuel mineral commodity followed by Portland cement, construction sand and gravel, magnesium compounds and crushed stone. The state also produced clay, gypsum, salt, dimension stone and lime. The only nonfuel minerals reportedly being produced in Allegan County is construction sand and gravel (U. S. Geological Survey, 2015).

Oil and gas exploration within the Michigan Basin has occurred since the late 1800s and production has occurred since 1925. Petroleum hydrocarbons in this area may be grouped into six rock groups according to stratigraphic occurrence:

- Precambrian Nonesuch Formation;
- Lower Ordovician Foster Formation;
- Upper Ordovician Collingwood Shale and shale within the Upper Trenton Formation/Group;
- Upper Silurian Niagara Group and Salina Group;
- Lower and Middle Devonian Detroit River Group; and
- Upper Devonian and Lower Mississippian shale (Antrim and Ellsworth shale).

The major petroleum plays in the Michigan Basin include:

- Ordovician Prairie du Chien Group;
- Trenton Formation/Group and Black River Group;
- Silurian Burnt Bluff Group;
- Niagara Group;
- A-1 Carbonate;
- Devonian Detroit River Group;
- Dundee Limestone;
- Traverse Group;
- Antrim Shale;
- Berea Sandstone; and
- Mississippian Michigan Formation (USGS, 2008).

Historically, oil and gas has been produced in Allegan County from the Traverse Group although some production has been reported from the Salina Group, Detroit River Group, Berea Sandstone, A-1 Carbonate, and the Salina-Niagara Group.

According to the Michigan Department of Environmental Quality, permits have been issued for over 60,000 oil and gas wells in the state and approximately 1,637 producing wells in Allegan County. Records indicate that the total number of producing oil wells in the state of Michigan is 3,596 wells of which 160 are currently shut in and 191 are currently temporarily abandoned. Records indicate that the total number of producing gas wells in the state of Michigan is 10,165 wells of which 160 are currently shut in and 158 are currently temporarily abandoned. Approximately 7,980,000 bbl oil and 114,945,000 mcf gas reportedly were sold from Michigan wells in 2014 (Michigan Department of Environmental Quality, 2015b).

Oil and gas production within Allegan County has occurred since the 1930s with the production of oil from the Traverse Group. Allegan County oil and gas fields have also produced from the Berea Sandstone and Salina-Niagara Group. The most current production information shows the total number of producing oil wells in Allegan County is 195 wells of which 6 are currently shut in and total number of producing gas wells in Allegan County is 10 wells of which 6 are currently shut in. Approximately 51,913 bbl oil and 49,609 mcf gas reportedly were sold from Allegan County wells in 2014 (Michigan Department of Environmental Quality, 2015b).

General Reasonable Foreseeable Development (RFD) for Federal Oil and Gas Resources

Developing Federal oil and gas resources involves four phases: leasing, exploration, development/production, and final abandonment. The first phase is to issue a lease. Leasing of oil and gas resources confers an implied right to the lessee to explore and/or develop the oil and gas resources. The act of leasing does not directly result in surface disturbance activities; however, ground disturbance would occur during the second phase, exploration, and phase three, development. Phase four, final abandonment, would involve removing facilities and reclaiming the site. The BLM would require a separate site-specific NEPA analysis for exploration or development that includes final abandonment.

Any time during the 10-year term of the lease, the lessee, or operator, may submit specific plans for exploration and development to BLM for approval. These plans may be in the form of a Notice of Intent for Geophysical Exploration (NOI), or an APD, Notice of Staking, or Sundry Notice. The BLM then reviews the submission to determine if there are any other site-specific conditions of approval that should be applied. Such conditions of approval must be consistent with the lease rights granted.

A RFD scenario for oil and gas is a long-term projection of exploration, development, production, and reclamation activity. The RFD covers oil and gas activity in a defined area for a specified period of time. The RFD projects a baseline scenario of activity assuming all potentially productive areas can be open under standard lease terms and conditions, except those areas designated as closed to leasing by law, regulation, or Executive Order. The baseline RFD provides the mechanism to analyze the effects that discretionary management decisions have on oil and gas activity. The RFD also provides the basic information that is analyzed in the NEPA document under various alternatives. The RFD discloses future or potential impacts that could occur once the lands are leased. Prior to any future development, the BLM would require a site-specific analysis at the exploration and development stages in order to comply with NEPA.

The Proposed Action does not include any surface disturbance, such as exploration, development, production, or final reclamation of oil and gas resources. However, the authorization of oil and gas leasing does convey a right to subsequent exploration and production activities. Therefore, this EA will consider possible impacts from potential indirect effects under the RFD.

General Assumptions for Surface Disturbance Associated with Oil and Gas Resources

It is reasonably foreseeable to assume that up to one well per parcel could be associated with each assigned lease. Each well pad and its associated access road could disturb approximately five acres, totaling 40 acres. One pipeline could disturb approximately one acre. A main access and service road could result in five acres of disturbance. A power transmission line could disturb approximately five acres.

It is impossible to predict with certainty how resource development would occur in the future. The interaction of prices, markets, technology, environmental concerns, and viability of the potential oil and gas resource on the potential leases all play a role. It would be highly speculative to assume that eight production wells would be drilled in the proposal area, considering the advancements in directional drilling and well stimulation techniques.

The following paragraphs provide a general discussion of possible post-leasing activities. All of these activities may require additional NEPA review.

Geophysical exploration is used to obtain detailed geologic information. A variety of exploration methods are employed, ranging from placing electrodes in the ground, to detonating explosives to create shockwaves, to employing specially constructed off-road vehicles to produce vibrations.

Exploratory drilling begins development of a lease. An NOI or an APD is filed with the BLM. A field examination is conducted and NEPA review is completed before a drilling permit is issued. An access road and a well pad are constructed for each well, if needed. Total disturbance attributed to drilling an exploration well is usually limited to five acres for the pad and access road. Statistically, more than 95% of exploration wells are dry.

Well Stimulation/Hydraulic Fracturing (HF). Well Stimulation may be used to enhance oil and gas recovery. Several methods of well stimulation could be used. HF is one of these methods that is reasonably foreseeable for leases on this sale. HF is the process of applying high pressure to a subsurface formation via the wellbore, to the extent that the pressure induces fractures in the rock. Typically the induced fractures will be propped open with a granular “propellant” to enhance fluid connection between the well and formation. The process was developed experimentally in 1947 and has been used routinely since 1950. The Society of Petroleum Engineers estimates that over one million HF procedures have been completed in the United States and tens of thousands of horizontal wells have been drilled and hydraulically fractured (Cole, 2013).

To ensure that oil and gas exploration and development is conducted in a safe and environmentally sound manner, the BLM approves and regulates all drilling and completion operations, and related

surface disturbance on Federal public lands. Prior to approving an NOI or and APD, the BLM identifies all potential subsurface formations that will be penetrated by the wellbore. This includes all groundwater aquifers and any zones that would present potential safety or health risks that may need special protection measures during drilling, or that may require specific protective well construction measures.

Once the geologic analysis is completed, the BLM reviews the proposed casing and cementing programs to ensure the well construction design is adequate to protect the surface and subsurface environment, including the potential risks identified by the geologist and all known or anticipated zones with potential risks.

Before HF takes place, all surface casing and deeper, intermediate zones are required to be cemented from the bottom of the cased hole to the surface. The cemented well is pressure tested to ensure there are no leaks and a cement bond log is run to ensure the cement has bonded to the casing and the formation. If the fracturing of the well is considered to be a "non-routine" fracture for the area, the BLM would be onsite during those operations as well as when abnormal conditions develop during the drilling or completion of a well.

Wells that undergo HF may be drilled vertically, horizontally, or directionally and the resultant fracture induced by HF can be vertical, or horizontal, or both. Wells may extend to depths greater than 20,000 feet or less than 1,000 feet, and horizontal sections of a well may extend several thousand feet from the production pad on the surface.

Drilling muds, drilling fluids, water, and HF fluids are stored in on-site tanks or lined pits during the drilling and/or completion process. Equipment transport and setup can take several days, and the actual HF and flowback process can occur in a few days up to a few weeks. For oil wells, the flowback fluid from the HF operations is treated in an oil-water separator before it is stored in a lined pit or tank located on the surface. Where gas wells are flowed back using a "green completion process," fluids are run through a multi-phase separator, which are then piped directly to enclosed tanks or to a production unit.

Hydraulic Fracturing Technology

A general description of the HF technology follows:

All exploratory, testing, and production wells are multiply cased and sealed with cement between the wellbore and the formation. Well integrity is tested throughout the process.

Drilling and HF fluids can be contained in a pitless system (aboveground tanks) or a lined pit. Cuttings could be contained in roll-off boxes for hauling to disposal or surface casing interval cuttings could be spread over the site during reclamation.

HF fluids are recovered to a large degree in "flowback" or produced water when the well is tested or produced.

All recovered fluids are generally handled by one of four methods:

- Underground injection
- Captured in steel tanks and disposed of at an approved disposal facility
- Treatment and reuse
- Surface disposal pits

Drilling cuttings could be land farmed and buried on site three feet below root zones. Any cuttings that do not fit the waste profile would be disposed of at an approved disposal facility.

In-field drilling of additional exploration wells typically occurs when initial drilling has located oil and gas, to define the limits of the oil and gas reservoir. The process of in-field drilling is the same as that employed for initial exploratory drilling, although new roads and pads may not be required in every instance.

Production begins only if oil and gas can be transported to a market and sold at a profit. Production facilities may include one or more of the following: a well head, pumping equipment, a separation system, pipelines, a metering system, storage facilities, water treatment and injection facilities, cathodic protection systems, electrical distribution lines, compressor stations, communication sites, roads, salt water disposal systems, dehydration sites, and fresh/salt water plant sites.

Well abandonment may be temporary or permanent. Wells are sometimes shut-in because pipelines or roads needed for production and marketing do not exist and the cost for construction is not justified by the quantity of oil discovered. These wells may later be reentered when their production can be marketed. The permanent abandonment of a well occurs when the well is determined to no longer have a potential for economic production, or when the well cannot be used for other purposes.

Reclamation. Abandonment includes removal of facilities and reclamation of surface disturbance. In the case of exploration wells which do not find economically recoverable amounts of oil, initial reclamation (recontouring) is usually completed the following year which provides for sufficient time for the reserve pit to dry out. After revegetation of the site is completed, usually within two to three years, reclamation is complete. If an exploration well finds economically recoverable quantities of oil, all disturbed surface except the small amount needed for a pump and access is reclaimed immediately.

Induced Seismicity. Potential geologic hazards caused by HF include induced seismic activity. Earthquakes occur when energy is released due to blocks of the earth's crust moving along areas of weakness or faults. Earthquakes attributable to human activities are called "induced seismic events" or "induced earthquakes." In the past several years induced seismic events related to energy development projects have drawn heightened public attention. Although only a very small fraction of injection and extraction activities at hundreds of thousands of energy development sites in the United States have induced seismicity at levels that are noticeable to the public, seismic events caused by or likely related to energy development have been measured and felt in Alabama, Arkansas, California, Colorado, Illinois, Louisiana, Mississippi, Nebraska, Nevada, New Mexico, Ohio, Oklahoma, and Texas.

The National Research Council of the National Academies (2013) studied the issue of induced seismic activity from energy development. The study found that:

- The process of hydraulic fracturing a well as presently implemented for shale gas recovery does not pose a high risk for inducing felt seismic events; and
- Injection for disposal of waste water derived from energy technologies into the subsurface does pose some risk for induced seismicity, but very few events have been documented over the past several decades relative to the large number of disposal wells in operation.

The potential for induced seismicity cannot be made at the leasing stage; as such, it will be evaluated at the APD stage should the parcel(s) be leased, and a development proposal submitted.

Water Consumption. Public concern over the amount of water used in HF has increased over the last couple of years. There are numerous groundwater protection regulations already in place, and new increases in protection are in the works at state and federal levels, while the debate over HF continues at all levels of government. Prior to the advancements in HF and directional drilling, 20,000 to 80,000 gallons of water were typically consumed per well, but with today's advanced fracturing techniques, water consumption during fracturing can be in excess of 8,000,000 gallons of water per well (Kharaka, et al., 2013; Swackhamer, 2013). Water use in the Barnett, Fayetteville, and Marcellus Shales is under 4,000,000 gallons per well though (Jenner, Steffen & Lamadrid, 2013).

Water Contamination Potential. There is a broad array of chemicals that can be used as additives in a fracture treatment including, but not limited to, hydrochloric acid, anti-bacterial agents, corrosion inhibitors, gelling agents (polymers), surfactants, and scale inhibitors (Kharaka, et al., 2013). These chemical additives constitute up to 1-5% of the HF fluid (Swackhamer, 2013). This translates to a minimum of 5,000 gallons of chemicals for every 1.5 million gallons of water used to fracture a well (or at least 26,000 gallons of additive for an oil and gas well requiring 8,000,000 gallons of water for HF activities.

Produced water, a byproduct of oil and gas production, may be considered another potential contributor of groundwater contamination. This water has generally been confined to oil and gas bearing rock formations for a long period of time and can obtain high levels of dissolved solids, and dissolved gasses such as methane and radon (Kharaka, et al., 2013; Farag & Harper, 2014; Vengosh, et al., 2013). The BLM receives its guidelines and directions for disposal of produced water from Onshore Order #7. Certain oil and gas exploration and production wastes occurring at or near wellheads are exempt from the Clean Water Act (CWA), such as: drilling fluids, produced water, drill cuttings, well completion, and treatment and stimulations fluids to name a few. In general, the exempt status of exploration and production waste depends on how the material was used or generated as waste, not necessarily whether the material is hazardous or toxic. For example, some exempt exploration and production wastes might be harmful to human health and the environment, and many non-exempt wastes might not be as harmful (U.S. Environmental Protection Agency, 2002).

Air Quality. There is a potential for impacts to air quality associated with lease development activities, such as fugitive dust produced from well pad and access road construction, pipeline construction, hauling freshwater and produced water to and from well sites. All of these activities can be considered

temporary or short-term. Development of unconventional oil and gas resources has also been identified as a source of GHGs, particularly methane, and volatile organic compounds (VOCs) (Robinson, 2013). The level of production is a subject of debate in the literature (Howarth et al., 2011).

The activities that are associated with oil and gas exploration and production would be further analyzed in depth as part of a site-specific NEPA analysis when and if an NOI or an APD were received.

3.5 Soils

Soils in the Decision Area are predominantly sands and loamy sands with mucky soil types in the wetland areas. Almost all of the soils in the Decision Area are typical of slopes under six degrees, which is considered a low erosion hazard. A small portion of parcel 6 has a soil type that may have slopes up to 12 degrees.

The Decision Area contains 14 acres of land classified as *prime farmland*, 196 acres classified as *farmland of local importance* and 41 acres classified as *prime farmland if drained*. These areas are present in each parcel in the Decision Area except for the parcel in EOI-2185 (Natural Resources Conservation Service, 2015).

3.6 Vegetation

The largest single vegetation type in the Decision Area is the 280 acres of old fields and row crops, which are treated interchangeably here since the same field may be converted from one to the other and back repeatedly in a matter of years. The Decision Area contains 130 acres of woodlands, which include lowland hardwoods and upland hardwoods. The wetlands, as described in ***Water Resources and Water Quality***, are mostly marshes and floodplain forests associated with the streams that flow through the nominated parcels.

3.7 Invasive Species/Noxious Weeds

Many invasive species are present in and around the Decision Area and throughout Michigan and the Midwest. The Natural Resources and Environmental Protection Act 451 of 1994, Sections 324.41301-324.41325, regulates activities that may spread invasive species in Michigan. The Emerald ash borer (*Agrilus planipennis*) is widespread throughout Lower Michigan, and it is spread by people moving infested wood and wood products. All of Lower Michigan is under a quarantine that restricts the movement of wood and wood products to locations outside the quarantined area.

Many noxious weeds are spread by land-disturbing activities and by vehicle traffic. These species tend to be more abundant in areas with high road density. Roadsides throughout the Decision Area are likely locations for invasive species, since cars often spread seeds and other plant parts. The most likely locations for most of these species are in and around areas disturbed by road construction and land clearing.

3.8 Water Resources and Water Quality

The Decision Area contains 45 acres of wetlands. About 90 percent of these wetlands are forested wetlands, and the remainder is composed of shrubby wetlands, open water, and marshes. Every parcel except the parcel in EOI-2185 has wetlands that are shown by the National Wetland Inventory (NWI) (U.

S. Fish & Wildlife Service, 2015c), which is not considered a complete inventory, since it does not capture wetlands that are less than a tenth of an acre or in heavily wooded areas.

The Decision Area is drained by the Black River, Rabbit River, and Kalamazoo River. The parcels that are drained by the Black River contain several named and unnamed tributaries, including Butternut Creek, Middle Branch Black River, Scott Creek Drain, Spicebush Creek, and Tripp Drain.

Portions of Bear Creek, Big Dailey Bayou, Kalamazoo River, Rabbit River, Sand Creek, and Swan Creek are part of the Kalamazoo River natural rivers zoning district. The natural river zoning district may entail local zoning restrictions designed to protect the natural riparian habitat.

Most of the Decision Area is covered in unconfined glacial drift that may be an aquifer, with deeper sediments composed of interbedded aquifers and impermeable layers. Most of the parcels are in areas where groundwater recharge is estimated to be between five and 11 inches per year. Parcels 2 and 9 have estimated recharge between 12 and 13 inches per year, and parcel 8 has estimated recharge between 16 and 19 inches per year.

According to the "Wellogic Hydraulic Properties" database, the Decision Area contains only four wells, all of them for household use. There are hundreds of wells within a mile of the proposed lease parcels, which is a more important consideration than just the wells that are within the parcels, since spills or subsurface contamination due to leaky well casings or poor cementing can travel miles through an aquifer. These wells are primarily household drinking water wells, and a few of them are for crop irrigation (Michigan Department of Environmental Quality, et al, 2015).

3.9 Wastes, Hazardous or Solid

The Resource Conservation and Recovery Act (RCRA) of 1976 established a comprehensive program for managing hazardous wastes from the time they are produced until their disposal. The EPA regulations define solid wastes as any "discarded materials" subject to a number of exclusions. On January 6, 1988, EPA determined that oil and gas exploration, development and production wastes would not be regulated as hazardous wastes under the RCRA. The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980, deals with the release (spillage, leaking dumping, accumulation, etc.), or threat of a release of hazardous substances into the environment. Despite many oil and gas constituent wastes being exempt from hazardous waste regulations, certain RCRA exempt contaminants could be subject to regulations as a hazardous substance under CERCLA.

No hazardous or solid waste disposal sites are known to exist on the proposed lease parcels. Should a parcel be leased and developed, generation and temporary storage of waste materials (solid and liquid) would likely occur. Waste materials would be managed in accordance with Onshore Orders 1 & 7, RCRA, applicable Michigan DEQ regulations. Fluid handling would be evaluated at the development stage and fluids associated with any subsequent drilling, completions and/or production would either be treated, evaporated, or transferred to an approved Michigan DEQ treatment facility. Solids would be treated on site or transferred to a Michigan DEQ approved facility.

3.10 Recreation

The proposed lease parcels consist of private lands used mostly for agriculture and contain no developed recreation sites. The area in general contains recreational opportunities for hunting, hiking, fishing, nature watching, and solitude, and off-highway vehicle use, and it is known that some of these activities occur on private land.

3.11 Cultural/Paleontology

A cultural resource is a location of human activity, occupation, or use identifiable through field inventory, historical documentation, or oral evidence. Cultural resources include both historic and prehistoric archaeological sites, structures, places of architectural significance, locations with important public and scientific uses, and may include traditional cultural properties, which are definite locations of traditional and or cultural importance to specific social and or cultural groups. Cultural resources include but are not limited to the following types: prehistoric archaeological resource, ethnographic resource, and historic-period archaeological and built environment resources. Cultural resources may be, but are not necessarily eligible, for the National Register of Historic Places (NRHP).

There are no known cultural resources within the boundaries of the proposed parcels. The BLM initiated consultation with the Michigan State Historic Preservation Office (MISHPO) on February 3, 2015; no response has been received to date. Allegan County contains 31 properties listed in the National Register of Historic Places, none of which are known to be within the Decision Area.

Paleontology

Michigan's Lower Peninsula is comprised primarily of sedimentary rock deposited from a shallow sea during the Paleozoic Era. Fossils of brachiopods, trilobites, crinoids, and corals are found throughout Michigan from this period. Whale fossils have also been discovered. Pleistocene fossils, from the period after the last glacial retreat, are also found throughout Michigan, most notably in the form of mastodons.

Locations with paleontological remains are referred to as localities. No known paleontological localities are located in or immediately adjacent to the current proposed lease parcels. If the lease is approved, a paleontological records search will be required, as well as a report detailing the likelihood of finding fossils. No further analysis is necessary at this time.

Cultural/Paleontology

In accordance with BLM policy all archeological sites within the Decision Area will be avoided and declared No Surface Occupancy (NSO) during ground disturbing activities, when possible. Should development of the lease occur, site specific Section 106 compliance measures including surveys, records search, and Tribal and SHPO consultation, will be conducted prior to any ground disturbing activities. No further analysis is necessary at this time.

3.12 Native American Religious Concerns

The BLM sent letters to five Federally Recognized Indian Tribes on February 2, 2015, who have a known connection to the Decision Area, asking whether they can identify any concerns that would need special

consideration with respect to the proposed action. To date the BLM has only received one response, from the Bay Mills Indian Community, stating that while they know of potential cultural resources within the general area of the proposed action, they require additional time to complete an in-house records and literature search.

As the BLM's responsibility is limited to the area of surface disturbance if, or when, a proposal for development is submitted, there is no need for a full analysis for the proposed action at this time. The BLM would consider potential Native American religious concerns with each Application for Permit to Drill (APD) that is submitted under any lease(s) approved pursuant to this proposed action.

3.13 Visual Resources

Most of the Decision Area is used for agriculture (row crops), low-density residential, and forests. The Decision Area is broadly accessible by improved roads. None of the project area is known to occur within visibly sensitive areas since the area consists largely of agriculture and its associated development.

3.14 Environmental Justice

Executive Order 12898 (1994) formally requires Federal agencies to incorporate environmental justice as part of their missions. Specifically, it directs agencies to address, as appropriate, any disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority or low-income populations.

The Decision Area is located in a rural area. According to the RFDS, potential drilling within the project area is not anticipated to involve more than one well per parcel. The proposed action will not create disproportionately high and adverse human health or environmental effects on minority populations and low-income populations, including tribal populations. No further analysis is warranted for Environmental Justice factors on this project.

3.15 Socioeconomics

Allegan County is located in the southwestern part of Lower Michigan, its western border on Lake Michigan, and is 825.32 square miles, with a population density of approximately 135 persons per square mile. Its estimated 2014 population according to the U.S. Census was 113,847, a 2.2% increase from the 2010 census. The county seat is located in the city of Allegan, in the south-central part of the county. The project area encompasses 480 scattered acres underlying private lands within the Townships of Casco, Dorr, Ganges, and Lee, in the southwestern part of the county.

The distribution of population in Allegan County is 89% White, 7% Hispanic or Latino, 1.7% Two or More Races, 1.4% African American, 0.8% Asian, and 0.7% Native American or Alaska Native. 74.9% of Allegan County residents are 18 years of age or older, with 14.7% aged 65 years or older; the State of Michigan has a population 18 years of age and older of 79.3%, with 15% aged 65 or older.

In 2013, there were 49,384 housing units in the county with a homeownership rate from 2007-2011 of 81.9%, which is nearly 10% higher than the state as a whole. The median value of these owner-occupied homes was $140,200 for the period 2009-2013, slightly higher than that of the state.

For the period 2009-2013, median household income was $52,061 for Allegan County, over $3,600 higher than for the state. Approximately 13.5% of persons lived below the poverty level, much below the 16.8% statewide that live below the poverty level. 90% of the county population 25 years of age and over graduated from high school, about one percent higher than the state. 20.2% of county residents 25 years of age and older have a bachelor's degree compared to 25.9% for Michigan as a whole. About 6% of residents speak a foreign language in the home; in total, about 9% of Michigan residents speak a foreign language in the home (U.S. Census Bureau, 2015).

Demographically, in aggregate, Allegan County is more affluent, slightly less college-educated, more homogenous and younger than the average county in the State of Michigan.

The unemployment rate for Allegan County was 4.5% in March 2015, a 2.1% decrease from the rate in March 2014 (U.S. Dept. of Labor, 2015a). In 2013, manufacturing employed the most people in the county (12,958), followed by retail trade (5,839), and local government (5,162); there were 29 employees involved in mining in Allegan County in 2014 with wages that were over 25% higher than the county average (U.S. Department of Labor, 2015b).

The project area is located on private parcels in rural townships. There are no communities, businesses, or multiple family dwellings within a one-mile radius of the project area that are known to be inhabited or owned by predominantly low-income families or individuals.

4 CHAPTER 4 – ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION AND ALTERNATIVES

4.1 Introduction

This chapter assesses potential consequences associated with direct, indirect, and cumulative effects of the Proposed Action. The No-Action Alternative, which would be to withhold the Federal minerals from leasing, would have no impacts on resources.

General Direct Impacts on All Resources:
The action of leasing the nominated parcels would have no direct impacts on resources. Any potential effects on resources from the sale of leases would occur after a lease is issued during exploration (including possible geophysical and exploratory drilling), and development (including possible well stimulation/hydraulic fracturing), production and well abandonment/reclamation activities. At the time of this review, it is unknown whether a particular lease parcel would be sold and a lease issued.

General Indirect Impacts on All Resources:
Oil and gas exploration and development activities such as construction, drilling, production, infrastructure installation, vehicle traffic and reclamation are indirect impacts of leasing and production of federal minerals on the nominated parcels in the Proposed Action. It is unknown when, where, how, or if future surface disturbing activities associated with oil and gas exploration and development such as well sites, roads, facilities, and associated infrastructure would be proposed. It is also not known how many wells, if any, would be drilled and/or completed, the types of technologies and equipment that

would be used, and the types of infrastructure needed, for production of oil and gas. Thus, the types, magnitude and duration of potential impacts cannot be precisely quantified at this time, and would vary according to many factors. The potential impacts from exploration and development activities would be analyzed after receipt of an APD or sundry notice.

General Cumulative Impacts on All Resources:
Cumulative impacts are those impacts resulting from the incremental impact of an action when added to other past, present, and reasonably foreseeable actions regardless of what agency or person undertakes such other actions (40 CFR 1508.7). The ability to assess the potential cumulative impacts at the leasing stage for this project is limited for many resources due to the lack of site specific information for potential future activities. Upon receipt of an APD for any of the lease parcels addressed in this document, more site-specific planning would be conducted in which the ability to assess contributions to cumulative impacts in a more detailed manner would be greater due to the availability of more refined site-specific information about proposed activities.

4.2 Air Resources

4.2.1 Air Quality

The administrative act of offering any of the proposed parcels and the subsequent issuing of leases would have no direct impacts to air quality. Any potential effects to air quality would occur if and when the leases were developed. Any proposed development project would be subject to additional analysis of possible air effects before approval. The analysis may include air quality modeling for the activity. Over the last 10 years, the development of the federal oil and gas mineral estate in the Northeastern States District (NSD) has resulted in an average of one to two wells being spudded annually. These wells would incrementally contribute a small percentage of the total emissions (including GHGs) from oil and gas activities in the NSD.

An MOU between the Departments of the Interior and Agriculture and EPA (U.S. Department of Agriculture, U.S. Department of Interior, and U.S. Environmental Protection Agency, 2011) directs that air quality modeling be conducted for actions that meet certain emissions or geographic criteria:

- Creation of a substantial increase in emissions
- Material contribution to potential adverse cumulative air quality impacts
- Class I or sensitive Class II Areas
- Non-attainment or maintenance area
- Area expected to exceed NAAQS or PSD increment

The proposed project area includes no Class I, sensitive Class II or non-attainment areas. Due to the small number of wells projected to follow a lease on the proposed tracts in relation to the current volume of hydrocarbon, development of the lease is not likely to exceed the emissions criteria, NAAQS or PSD increment or contribute to adverse cumulative air quality impacts. As a result, air quality modeling is not required for the proposed project and likely will not be required at the APD stage, if development occurs on the proposed lease. Operations may require additional permitting by the

relevant state agency and will further insure that operations will not violate state or federal air quality standards.

The following sources of emissions are anticipated during oil and gas exploration or development:

- combustion engines (i.e. fossil fuel fired internal combustion engines used to supply electrical or hydraulic power for hydraulic fracturing to drive the pumps and rigs used to drill the well, drill out the hydraulic stage plugs and run the production tubing in the well;
- electric generators to power drill rig engines, pumps, and other equipment;
- compressors used to increase the pressure of the oil or gas for transport and use;
- tailpipe emissions from vehicles transporting equipment to the site);
- venting (i.e. fuel storage tanks vents and pressure control equipment);
- mobile emissions (i.e. vehicles bringing equipment, personnel, or supplies to the location); and
- fugitive sources (i.e. pneumatic valves, tank leaks, and dust).

A number of pollutants associated with combustion of fossil fuels are anticipated to be released during drilling including: CO, NOx, SO_2, Pb, PM, CO_2, CH_4, and N_2O. Venting may release VOC/HAP, H_2S, and CH_4. Mobile source emissions are likely to include fugitive particulate matter from dust and NOx associated with vehicle engine combustion, traffic and/or construction activities.

The actual emissions of each pollutant are dependent on the factors described in the previous paragraph. During the completion phase, the most significant emissions of criteria pollutants emitted by oil and gas operations in general are VOCs, particulate matter and NO_2. VOCs and NOx contribute to the formation of ozone. The EPA's Natural Gas STAR Program (2015d) is a voluntary program that identifies sources of fugitive methane sources and seeks to minimize fugitive CH_4 through careful tuning of existing equipment and technology upgrades. Data provided by STAR show that some of the largest air emissions in the natural gas industry occur as natural gas wells are fractured and are being prepared for production. During well completion, flowback, fracturing fluids, water, and reservoir gas come to the surface at high velocity and volume. This mixture includes a high volume of VOCs and CH_4, along with air toxins such as benzene, ethylbenzene, and n-hexane. The typical flowback process lasts from three to 10 days. Additional emissions from other processes and equipment during production and transportation of the oil and gas from the well to a processing facility may occur.

To reasonably quantify emissions associated with well exploration and production activities, certain types of information are needed. Such information includes a combination of activity data such as:

- The number, type, and duration of equipment needed to construct/reclaim, drill and complete (e.g., belly scrapers, rig, completions, supply trucks, compressor, and production facilities)
- The technologies which may be employed by a given company for drilling any new wells to reduce emissions (e.g. Selective Catalytic Reduction (SCR) on diesel powered drill rigs, natural gas fired drill rig engines, the use of "green" completion technology, and multi-stage flare stacks)

- Area of disturbance for each type of activity (e.g. roads, pads, pipelines, electrical lines, and compressor station)
- Compression per well (sales and field booster), or average horsepower for each type of compressor, if needed
- The number and type of facilities utilized for production operations.

The degree of impact will also vary according to the characteristics of the geological formations from which production occurs but emissions associated with oil and gas operations would incrementally contribute to increases in air quality emissions into the atmosphere.

Public health can be affected by ambient air pollution depending upon concentration of the emitted parameter and length/duration of exposure. Numerous scientific studies have linked air pollution to a variety of health problems including: (1) respiratory and cardiovascular disease, (2) decreased lung function, (3) increased frequency and severity of respiratory symptoms such as difficulty breathing and coughing, (4) increased susceptibility to respiratory infections, (5) effects on the nervous system, including the brain, such as IQ loss and impacts on learning, memory, and behavior, (6) cancer, and (7) premature death. Sensitive individuals or those at high risk appear to be at even greater risk for air pollution-related health effects, for example, those with pre-existing heart and lung diseases (e.g., heart failure/ischemic heart disease, asthma, emphysema, and chronic bronchitis), diabetics, older adults, and children. Operations that would violate a state and/or federal air quality standard would not be approved.

Significant degradation of air quality may also damage ecosystem resources. For example, ozone can damage vegetation, adversely impacting the growth of plants and trees. These impacts can reduce the ability of plants to uptake CO_2 from the atmosphere and can then indirectly affect the larger ecosystems.

4.2.1.1 Mitigation

The BLM encourages industry to incorporate and implement Best Management Practices (BMPs) designed to reduce impacts to air quality by reducing emissions, surface disturbances, and dust from field production and operations. Typical measures include:

- Flared hydrocarbon gases at high temperatures in order to reduce emissions of incomplete combustion.
- Watering dirt roads during periods of high use to reduce fugitive dust emissions.
- Co-location wells and production facilities to reduce new surface disturbance.
- Implementation of directional drilling and horizontal completion technologies whereby one well provides access to petroleum resources that would normally require the drilling of several vertical wellbores.
- Requiring that vapor recovery systems be maintained and functional in areas where petroleum liquids are stored.
- Performing interim reclamation to reclaim areas of the pad not required for production facilities and to reduce the amount of dust from the pads.

Additionally, the BLM encourages oil and natural gas companies to adopt proven, cost-effective technologies and practices that improve operational efficiency and reduce natural gas emissions.

In October 2012, EPA promulgated air quality regulations for completion of hydraulically fractured gas wells (U.S. Environmental Protection Agency, 2015b). These rules require air pollution mitigation measures that reduce the emissions of volatile organic compounds during gas well completions. Mitigation includes utilizing a process known as a "Green" completion in which natural gas brought up during flowback is captured in tanks rather than in open fluid pits. The captured gas is automatically sent to the gathering line.

4.2.2 Visibility

Michigan contributes to two Class I areas in the State: Seney National Wildlife Refuge and Isle Royale National Park. Based on the Midwest Regional Planning Organization's (MRPO) 2018 particulate Source apportionment modeling, Michigan contributes from using the Michigan Department of Natural Resources (MDNR) determination that a significant contribution to visibility impairment is a contribution over 5%. Michigan is not expected to significantly contribute to visibility impairment to any other Class I areas (Michigan Department of Environmental Quality, 2010).

Michigan had less than a 5% impact on Minnesota's Class I areas and was not indicated by Minnesota as contributing to their Class I areas. However, Michigan contributed less than 5% to all other Class I areas noted in the chapter three visibility section for Maine, New Hampshire, New Jersey and Vermont.

4.2.3 Global Climate Change

The administrative act of leasing all or part of the 29 parcels covering approximately 16,556 acres would not result in any direct GHG emissions. However, regarding future development, the assessment of GHG emissions and climate change is in its formative phase. While it is not possible to accurately quantify potential GHG emissions in the affected area as a result of making the proposed tracts available for lease, a general assumption can be made and that is offering the proposed parcels may contribute to the installation and production of new wells, which may consequently lead to an increase in GHG emissions.

According to the *Michigan Greenhouse Gas Inventory 1990 and 2002* (University of Michigan, 2005), expected climate changes in Michigan over the next century will likely show warmer average temperatures with longer periods of drought, most notably during the summer. The growing season is likely to extend by as much as ten weeks. Of significant cultural and economic concern to Michigan are the Great Lakes. It is estimated that the water levels of the Great Lakes will continue to decline, which could potentially be very costly to Michigan's fishing, tourism, and shipping industries.

Emissions from fossil fuel production were not reported in the *Michigan Greenhouse Gas Inventory 1990 and 2002* report; however, Michigan's GHG emissions grew approximately 9% from 1990 to 2002. Increases in energy emissions were the result of construction of new natural gas transmission and distribution pipelines and associated infrastructure, coke produced at coke plants, and increased use of hydrofluorocarbons (HFCs). It is worth noting that a significant portion of the emissions attributed to the natural gas industry are due to vented gas from processing plants, many of which are used for

injection in enhanced oil recovery operations. Additionally, many technological advances in emission control technology have been implemented by the oil and gas industry to reduce emission levels.

Many aspects of oil and gas production emit greenhouse gases (GHG). The primary aspects include the following:

- Fossil fuel combustion for construction and operation of oil and gas facilities – vehicles driving to and from production sites, engines that drive drill rigs, etc. These produce CO_2 in quantities that vary depending on the age, types, and conditions of the equipment as well as the targeted formation, locations of wells with respect to processing facilities and pipelines, and other site-specific factors.
- Fugitive CH_4 – CH_4 that escapes from wells (both gas and oil), oil storage, and various types of processing equipment. This is a major source of global CH_4 emissions. These emissions have been estimated for various aspects of the energy sector, and starting in 2011, producers are required under 40 C.F.R. §98, to estimate and report their CH_4 emissions to the EPA.
- Combustion of produced oil and gas – it is expected that operations will produce marketable quantities of oil and/or gas. Combustion of the oil and/or gas would release CO_2 into the atmosphere. Fossil fuel combustion is the largest source of global CO_2.

The assessment of GHG emissions, their relationship to global climatic patterns, and the resulting impacts, is an ongoing scientific process. It is not known with certainty the net impacts from the proposed action on climate – that is, while BLM actions may contribute to the climate change phenomenon, the specific effects of those actions on global climate are speculative given the current state of the science. The BLM does not have the ability to associate a BLM action's contribution to climate change with impacts in any particular area. The science to be able to do so is not yet available. Inconsistencies in the results of scientific models designed to predict climate change on regional or local scales limits the ability to quantify potential future impacts of decisions made at this level and determining the significance of any discrete amount of GHG emissions is beyond the limits of existing science. When further information on the impact to climate change is known, such information would be incorporated in the BLM's planning and NEPA documents as appropriate but an assessment of impacts on climate change from the release of GHG's is outside the scope of this document because it is a global phenomenon.

In recent years, many states, tribes, and other organizations have initiated GHG inventories, tallying GHG emissions by economic sector. The EPA provides links to statewide GHG emissions inventories (U.S. Environmental Protection Agency, 2015f). Guidelines for estimating project-specific GHG emissions are available (URS Corporation, 2010), but some additional data, including the volume of oil produced and the number of wells, are not available for the proposed action. Uncertainties regarding the numbers of wells and other factors make it impractical to project amounts of GHG that the proposed action would emit. At the APD stage, more site-specific information on oil and gas activities resulting in GHG impacts would be described in detail. Also at the APD stage, the BLM would evaluate operations, require mitigation measures, and encourage operators to participate in the voluntary STAR program.

4.3 Fish and Wildlife

4.3.1 Types of Potential Impact

Future development of the proposed lease parcels could potentially result in the clearing of land, which may include either forested or open habitat. Impacted areas would be reclaimed at the end of their use as well pads or construction areas. The most minor and temporary impact to wildlife would likely be caused by well pads and other construction being sited entirely in crop fields, since these areas already have disturbed soil and are tilled annually or more frequently, minimizing their use for shelter, migration corridors, or food sources to most wildlife species. Using an old field would create a slightly larger and more permanent impact to wildlife species, since a grassy habitat does provide burrows, vegetative cover, and other features that would take a growing season or more to regenerate after construction.

If shrubby or forested habitat were used for construction, then the woody cover, complex structure, and uncompacted soils would take between many years to decades to return to their pre-construction state.

If forested areas are used for construction, then the impacts to wildlife are more complicated than just the loss of a certain area of lost habitat for two main reasons. First, the area cleared will, as soon as it is vegetated, provide habitat for other species that do not thrive in the mature forest. In fact, wildlife managers in this region regularly use forestry practices, prescribed fire, and other types of disturbance to maintain habitat for game species and other wildlife.

Second, the area impacted by clearing an opening in a forest is typically larger than just the area cleared. Clearing a corridor for a road or pipeline separates a block of forest into smaller blocks, a process called *fragmentation*. A fragmented forest contains far less useful habitat for many species, such as many songbirds, than an equally-sized block of continuous forest. This is due in part to the fact that many species will not cross the open corridors, where they are more susceptible to predation than in the forest. A closely related concept to fragmentation is *edge effects*, which refers to the differences in climate, predation exposure, and other factors that exist at and near a boundary between wooded and open habitat types. Edge effects increase the area impacted beyond just the area directly disturbed.

4.3.2 Sensitive Species

The BLM has determined that the proposed lease and connected development, including protective measures, is not likely to adversely impact the species discussed in Section 3.3.1. The BLM submitted a letter and electronic biological assessment to the U.S. Fish and Wildlife Service (USFWS) pursuant to the Section 7 of the Endangered Species Act on January 22-23, 2015. USFWS responded to BLM on May 13, 2015 regarding Best Management Practices (BMPs) for the Proposed Action to avoid impacts to endangered species that may potentially occur in the Decision Area.

Restrictions on tree cutting are the primary measure that will protect both bat species. The BLM expects that habitat or presence/absence surveys will be used to determine how this restriction may be modified without impacting bats, and the BLM will reinitiate Section 7 consultation at the APD stage.

Karner blue butterflies will be avoided by prohibiting surface occupancy in open habitat that contains wild lupine. Since wild lupine is likely not present in the Decision Area, this stipulation is not expected to

limit development. Surveys conducted upon receipt of APDs will determine whether suitable habitat is present.

Wetland protection will prevent most potential impacts to eastern massasauga rattlesnakes. The BLM will avoid impacts to massasaugas in upland habitat by prohibiting surface occupancy in upland habitat that may be occupied by the species. The BLM will determine, at the APD stage, whether suitable habitat is present. If so, the BLM will require operators to perform presence/absence surveys to determine whether the habitat is occupied by massasaugas.

4.3.3 Migratory Birds

The BLM will require operators to use tanks instead of open pits for storage of any fluids other than fresh, uncontaminated water. Stacks and other structures that may be attractive to birds for perching or nesting will be covered to exclude birds and other wildlife. The proposed leases are not likely to harm migratory birds.

4.4 Geology/Mineral Resources/Energy Production

There would be no direct effects from issuing new oil and gas leases because leasing does not directly authorize oil and gas exploration and development activities. Direct impacts from these activities would be analyzed under a separate site-specific NEPA analysis. The reasonable foreseeable future development scenario discloses indirect future or potential impacts that could occur once the parcels are leased. Oil and gas activities within the project area would have to be coordinated with the surface owner.

No known impacts would occur to the surface geology of the area. Hydraulic fracturing activities, if any, should not impact the subsurface geology except for opening existing fractures and/or creating new fractures to allow hydrocarbons to more readily flow into the wellbore. Induced seismicity from direct and indirect actions are low probability because wastewater injection sites are located outside these parcels in EPA approved sites. No other known mineral resources would be affected by the Proposed Action. The activities associated with oil and gas exploration and production associated with Federal Minerals will be further analyzed as part of a site-specific NEPA analysis if an NOI or an APD were received.

4.4.1 Mitigation

The BLM has reviewed existing information and planning documents and, except as noted in other attached stipulations, knows of no reason why normal development—subject to the controls of applicable laws and regulations and the lease terms and conditions—cannot proceed on the leased lands. However, specific post lease issuance activities cannot be identified prior to lease issuance since the nature and extent of oil and gas resources are not known and specific operations have not been proposed. The lessee is hereby made aware that all post lease operations will be subject to appropriate environmental review and may be limited or denied by no surface occupancy stipulations.

4.5 Soils

Because permitted well pads could be scattered at various locations throughout the Decision Area, it is impossible to determine how much disturbance would occur on potentially highly erodible soils or

farmlands. The Michigan DNR and DEQ have compiled a guide to using BMPs to prevent erosion (Michigan Department of Natural Resources and Michigan Department of Environmental Quality, 2009). The Michigan water quality BMPs address several activities that are common in oil and gas drilling, such as building temporary roads and clearing land. The BLM would require the use of appropriate BMPs, through consultation with the MDNR, as conditions of approval for APDs. Hydric soils are protected by federal and state laws protecting wetlands.

4.6 Vegetation

As described in Chapter 2, the proposed action is expected to result in some amount of land clearing. As described in Section 4.3.1, above, the temporal scope of the impact would depend upon the type of vegetation cleared for well pads and other construction, ranging from no impact if construction is sited in bare crop field, to the longest-lasting and most severe impact in the case of construction in a mature forest. The BLM will consider the impacts of vegetation clearing on wildlife habitat, sensitive species, invasive species, and other issues that are described in other sections as it considers proposals for well and infrastructure construction.

4.7 Invasive Species/Noxious Weeds

Construction of roads, well pads, pipelines, and other structures associated with oil and gas development can be expected to spread invasive species and/or noxious weeds in two general ways. First, increased vehicle traffic may carry seeds, plant parts, or other live organisms that may become established within the Decision Area. This could introduce new species from outside the Decision Area or from one part of the Decision Area to another. The risk of such propagation may be estimated in terms of the area disturbed, the volume of vehicle traffic, and the presence of invasive species in locations along the routes that traffic uses on the way to and within the Decision Area. While the last two variables would be unreasonable to attempt to quantify without site-specific analysis, we may consider various scenarios of infestation. Areas that are disturbed by pads or other development would be susceptible to direct infestation by non-native, invasive plant species that thrive in disturbed conditions. However, many of these species are able to propagate into undisturbed areas, and large areas of otherwise intact habitat could be infested by plant parts that are introduced into the Decision Area on equipment and vehicles. Therefore, it is possible that far more than the directly-disturbed area of land could be infested in non-native, invasive plant species as a result of the disturbance.

The second way that oil and gas development may result in the propagation of invasive species is by creating open corridors and forest edges that are highly susceptible to edge-loving species. Where the forest canopy is broken, invasive species that thrive in sunny conditions may be introduced into the newly cleared area and quickly populate areas of disturbed soil. The BLM would incorporate appropriate BMPs (Wisconsin Council on Forestry, 2012) as conditions of approval into permits to drill in order to prevent the introduction or spread of invasive species into affected areas.

4.8 Water Resources and Water Quality

Lease stipulations will prohibit any surface occupancy within 300 feet of rivers, streams, and lakes and on parcels that contain abundant wetlands. Soil erosion and sedimentation will be minimized by

avoiding stream crossings to the extent practical. The BLM will closely analyze areas proposed for drilling in APDs, since regional wetland inventories often do not capture small wetlands.

As described in Chapter 2, drilling and completion phases consume water at rates that are regulated by the State of Michigan. Anyone wishing to withdraw water at a rate of more than 70 gallons per minute must use the online *Michigan's Water Withdrawal Assessment Tool* (Michigan Department of Environmental Quality, 2015c) and obtain a registration for the withdrawal. Depending on the need and local availability of groundwater, water would likely be obtained from a well or be delivered from a remote source by a pipeline or trucks. The volume of water required would depend on the completion methods used and depth of the oil/gas well, and the impacts of using a certain volume of water would depend upon the aquifer characteristics and the aquifer's proximity to surface water resources.

Construction of well pads produces water quality impacts similar to those from other types of construction, such as increased total suspended solids downstream of the sites. Lakes, streams, and wetlands will be protected from direct impacts by lease stipulations.

4.9 Wastes, Hazardous or Solid

Projects would typically generate the following wastes; (1) discharge of drilling fluids and cuttings into the reserve pits; (2) wastes generated from used lubrication oils, hydraulic fluids, and other fluids used during production of oil and gas, some of which may be characteristic or listed hazardous waste; and (3) service company wastes from exploration and production activities as well as containment of some general trash. Certain wastes unique to the exploration, development, and production of crude oil and natural gas have been exempted from Federal Regulations as hazardous waste under Subtitle C of the RCRA of 1976. The exempt waste must be intrinsic to exploration, development or production activities and cannot be generated as part of a transportation or manufacturing operation. The drilling fluids, drill cuttings, and produced waters are classified as a RCRA exempt waste, and potential drilling that could occur would not introduce hazardous substances into the environment if they are managed and disposed of properly under federal, state, and local waste management regulations and guidelines. Properly used, stored, and disposed of hazardous and non-hazardous substances greatly decreases the potential for any impact on any environmental resources. One way operators and the BLM ensure hazardous and non-hazardous substances are properly managed is through the preparation of a Spill Prevention, Control, and Countermeasure (SPCC) plan.

In hydraulic fracturing, chemical substances other than water make up a small percentage of the fluid composition; however, the very large volumes used require correspondingly large volumes of a variety of compounds. These substances range from the relatively benign to the highly toxic at certain concentrations. In addition to these added chemicals, naturally occurring toxicants such as heavy metals, volatile organics, and radioactive compounds are mobilized during extraction and return to the surface with the produced water. Of the millions of gallons of water used to hydraulically fracture a well one time, less than 30% to more than 70% may remain underground (Bamberger & Oswald, 2012). Although the risk is low, the potential exists for unplanned releases that could have serious effects on human health and environment. A number of chemical additives are used that could be hazardous, but are safe when properly handled according to requirements and long-standing industry practices. In

addition, many of these additives are common chemicals which people regularly encounter in everyday life (Ground Water Protection Council & ALL Consulting, 2009).

Surface spills of drilling mud and additives, hydraulic fracturing fluids and additives, flowback water, and other produced water can happen at a variety of points in the development and production phases. Spills that occur can span a range of different spill sizes and causes of failure at any point in the process. For example, small spills often happen as the result of poor pipe connections or leaks; large spills sometimes occur as the result of a major well blowout, but such blowouts rarely occur. Additionally, spills from some parts of the phases may be the result of human error (i.e. vehicle collisions, improper handling, improper equipment operation or installation, etc.), while others stem from equipment failure (i.e. broken pipes, torn pit liners, leading tanks, etc.) or acts of nature (Fletcher, 2012). The most common cause of spills comes from equipment failure and corrosion (Wenzel, 2012).

The cause of the spill, the spill size, the hazard rating of the spilled material, response time to clean up the spill and the effectiveness of the cleanup, all play a critical role in determining the overall impact on the environment. The volume of a spill can significantly vary with spill types. Pipe spills are not expected to release more than 1,000 gallons into the environment, retaining pit spills and truck spills are not expected to release more than 10,000 gallons of fluid, and blowouts are expected to cause the largest spills, with the potential to release tens of thousands of gallons into the environment. Small spills occur with greater frequency than large spills. Secondary containment or recovery for small spills would likely minimize, if not eliminate, any potential release into the environment. However, for spills on the order of several thousands of gallons of fluid, it is expected that less than half the fluid may be captured by secondary containment or recovery. The vast majority of operations do not incur reportable spills (5 gallons or more), indicating that the fluid management process can be, and usually is, managed safely and effectively (Fletcher 2012).

4.9.1 Mitigation

Specific mitigation is deferred to the APD process. However, the following measures are common to most projects: all trash would be placed in a portable trash cage and hauled to an approved landfill, with no burial or burning of trash permitted, chemical toilets would be provided for human waste, fresh water zones encountered during drilling operations would be isolated by using casing and cementing procedures, a berm or dike would enclose all production facilities if a well is productive, and all waste from all waste streams on site would be removed to an approved disposal site. Future development activities on these lease sale parcels would be regulated under the RCRA, Subtitle C regulations. Additionally, waste management requirements are included in the 12 point surface use plan and the 9 point drilling plan required for all APDs. Leaseholders proposing development would be required to have approved SPCCPs, if the applicable requirements of 40 C.F.R. §112 are met, and comply with all requirements for reporting of undesirable events. Lease bonds would not be released until all facilities have been removed, wells are plugged, and satisfactory reclamation has occurred.

The BLM would apply COAs in conjunction with the surface management agency at the APD stage regarding handling and disposing of wastes based on what the operator proposes at that time.

4.10 Recreation

This analysis does not consider the recreational values of private lands. Private lands indeed provide recreational opportunities, and sometimes these opportunities may be available to the public, since some state-sponsored land management programs require participants to permit public use of their lands. Recreational values of private lands would be considered in an EA evaluating an APD, since it would be more reasonable to assess such values on a site-specific basis.

4.10.1 Mitigation

As the BLM receives and processes APDs, the BLM, in consultation with MDNR, operators, and other parties, will seek to minimize auditory or visual impacts on recreational resources through simple, reasonable measures, such as restricting construction to certain times of year or requiring the preservation of plants that provide visual screening.

4.11 Cultural/Paleontology

In accordance with BLM policy all archeological sites within the leasing area will be avoided and declared NSO during ground disturbing activities, when possible. Should development of the lease occur, site specific Section 106 compliance measures including surveys, records search, and Tribal and SHPO consultation, will be conducted prior to any ground disturbing activities. No further analysis is necessary at this time.

4.12 Native American Religious Concerns

As the BLM's responsibility is limited to the area of surface disturbance if, or when, a proposal for development is submitted, there is no need for a full analysis of the proposed lease parcels at this time. The BLM would consider potential Native American religious concerns with each APD that is submitted under any approved lease(s).

4.13 Visual Resources

A well in an agricultural area would be visible from throughout the field, resulting in an industrial element being present in an otherwise agricultural setting. If a well were to be constructed in a forested area, it would be visible from only a short distance due to the forest cover. If we assume that the two-acre well pad construction site is roughly square-shaped and that the well pad will be visible from up to 100 feet into the forest, then the well pad would convert two acres of forest to an industrial appearance. If a well were productive, the well pad would then be reduced in size, and the area no longer in use would be restored with native vegetation or other vegetation appropriate for screening and other site-specific needs.

4.14 Socioeconomics

Local economic effects of leasing federal minerals for oil and gas exploration, development, and production are influenced by the number of acres leased and estimated levels of production.

The acres leased, number of wells drilled, and level of production all influence local employment, income, and public revenues (indicators of economic impacts).

Federal oil and gas leases generate a one-time lease bonus bid as well as annual rents. The minimum competitive lease bid is $2.00 per acre. If parcels do not receive the minimum bid, they may be leased later as noncompetitive leases that do not generate bonus bids.

Lease rental is $1.50 per acre per year for the first five years and $2.00 per acre per year thereafter. Typically, oil and gas leases expire after 10 years unless held by production. During the lease period annual lease rents continue until one or more wells are drilled that result in production and associated royalties.

For the state of Michigan in 2012, average wellhead prices were $90.91 per barrel (bbl.) for crude oil and $5.50 per thousand cubic feet (MCF) for natural gas. Statewide average output per producing well was 1,792 bbls. of crude oil and 11,653 MCF for natural gas from 3,885 producing crude oil wells and 10,253 producing natural gas wells, respectively. In 2012, the state of Michigan ranked 17th in crude oil production and 18th in natural gas production in the United States. Allegan County did not rank among the top ten oil and gas producing counties in Michigan, (Independent Petroleum Association of America, 2014).

Federal revenues from oil and gas production disbursed to the state of Michigan between 2007 and 2012 averaged approximately $345,140 per year (U.S. Department of Interior, 2015). From this amount, revenues are disbursed to each local county of production. These revenues help fund traditional county functions such as enforcing laws, administering justice, collecting and disbursing tax funds, providing for orderly elections, maintaining roads and highways, providing fire protection, and/or keeping records. Other county functions that may be funded include administering primary and secondary education and operating clinics/hospitals, county libraries, county airports, local landfills, and county health systems. Additionally, a severance tax is levied by the state of Michigan on each barrel of crude oil or each thousand cubic feet of natural gas produced. In 2012, Michigan received over $64 million in severance taxes from all oil and gas produced in the state (Independent Petroleum Association of America, 2014) and some of this money was disbursed to each county.

The proposed action and the associated RFD indicate that a total of up to one well per parcel may potentially be drilled on each lease. If the lease is sold and it leads to actual well drilling and economic production, it would likely bring modest revenues in the form of royalty payments, severance taxes, and rent monies to the state and county. Economic production would provide wages and salaries to employees, maintenance staff, and contractors employed in drilling wells, and sales to area hotels, restaurants, and other businesses that serve drillers for the duration of drilling and similar construction-related benefits later as wells are abandoned and sites restored.

Exploration, drilling and production could create an inconvenience to people living adjacent to leases due to increased traffic and traffic delays, and light, noise and visual impacts. This could be especially noticeable in rural areas where oil and gas development has not occurred previously. The amount of inconvenience could depend on the activity affected, traffic patterns within the area, noise and light levels, length of time and season these activities occur, etc. In addition, competition for housing could

occur in some communities. Considering the scale of oil and gas leasing and production in Allegan County, cumulatively, the proposed action should have a minimal effect upon the lives of local residents.

5 PERSONS, GROUPS, AND AGENCIES CONSULTED

Consultation and Coordination

5.1.1 List of Persons, Agencies and Organizations Consulted

Name	Purpose & Authorities for Consultation or Coordination	Findings & Conclusions
Brian D. Conway, State Historic Preservation Officer	Antiquities Act, Section 106 of the National Historic Preservation Act, 36 CFR 800 (as amended)	Application for Section 106 Review form sent to MI SHPO on Feb. 3, 2015. No response to date.
Scott Hicks and Tameka Dandridge, U.S. Fish and Wildlife Service	Section 7, Endangered Species Act	Letter and electronic Biological Assessment sent to USFWS on Jan. 22 & 23, 2015. USFWS responded to BLM on May 13, 2015 regarding Best Management Practices (BMPs) for the Proposed Action to avoid impacts to endangered species that may potentially occur in the Decision Area.
Levi Carrick, Sr., Executive Council Bay Mills Indian Community 12140 West Lakeshore Drive Brimley, MI 49715	36 CFR 800 (as amended), The National Historic Preservation Act, The American Indian Religious Freedom Act, The Native American Graves Protection and Repatriation Act, E.O. 13007, and/or other statutes and executive orders.	Reply received from Paula Carrick, Tribal Historic Preservation Officer on Feb. 25, 2015. Tribe stated that while they know of potential cultural resources within the general area of the proposed action, they require additional time to complete an in-house records and literature search.
Aaron Payment, Chairman Sault Ste. Marie Tribe of Chippewa Indians 523 Ashmun St. Sault Ste. Marie, MI 49783	36 CFR 800 (as amended), The National Historic Preservation Act, The American Indian Religious Freedom Act, The Native American Graves Protection and Repatriation Act, E.O. 13007, and/or other statutes and executive orders	No response to date.

Name	Purpose & Authorities for Consultation or Coordination	Findings & Conclusions
Fred Kiogima, Chairman Little Traverse Bay Bands of Odawa Indians 7500 Odawa Circle Harbor Springs, MI 49740	36 CFR 800 (as amended), The National Historic Preservation Act, The American Indian Religious Freedom Act, The Native American Graves Protection and Repatriation Act, E.O. 13007, and/or other statutes and executive orders.	No response to date.
Alvin Pedwaydon, Chairman Grand Traverse Band of Ottawa & Chippewa Indians 2605 N. West Bay Shore Dr. Peshawbestown MI 49682-9275	36 CFR 800 (as amended), The National Historic Preservation Act, The American Indian Religious Freedom Act, The Native American Graves Protection and Repatriation Act, E.O. 13007, and/or other statutes and executive orders.	No response to date.
Larry Romanelli, Tribal Ogema Little River Band of Ottawa Indians 375 River Street Manistee, MI 49660	36 CFR 800 (as amended), The National Historic Preservation Act, The American Indian Religious Freedom Act, The Native American Graves Protection and Repatriation Act, E.O. 13007, and/or other by pads or other development statutes and executive orders.	No response to date.

5.1.2 List of Preparers

BLM Preparers

Name	Title	Responsible for the Following Section(s) of this Document
Derek Strohl	Natural Resources Specialist	Farmlands, Floodplains, Invasive Species/Noxious Weeds, Recreation, Soils, Vegetation, Visual Resources, Water Resources, Wetland/Riparian Zones
Jarrod Kellogg	Archeologist	Cultural Resources, Paleontology, Native American Religious

		Concerns, Recreation
Kurt Wadzinski	Planning and Environmental Coordinator	Environmental Justice, Socioeconomics; Editor
Fred Holzel	Geologist	Geology/Mineral Resources/Energy
Kyle Schumacher	Natural Resources Specialist	Air Quality, Climate Change, Hazardous Wastes, Water Quality, Wildlife, Bureau-Sensitive Species

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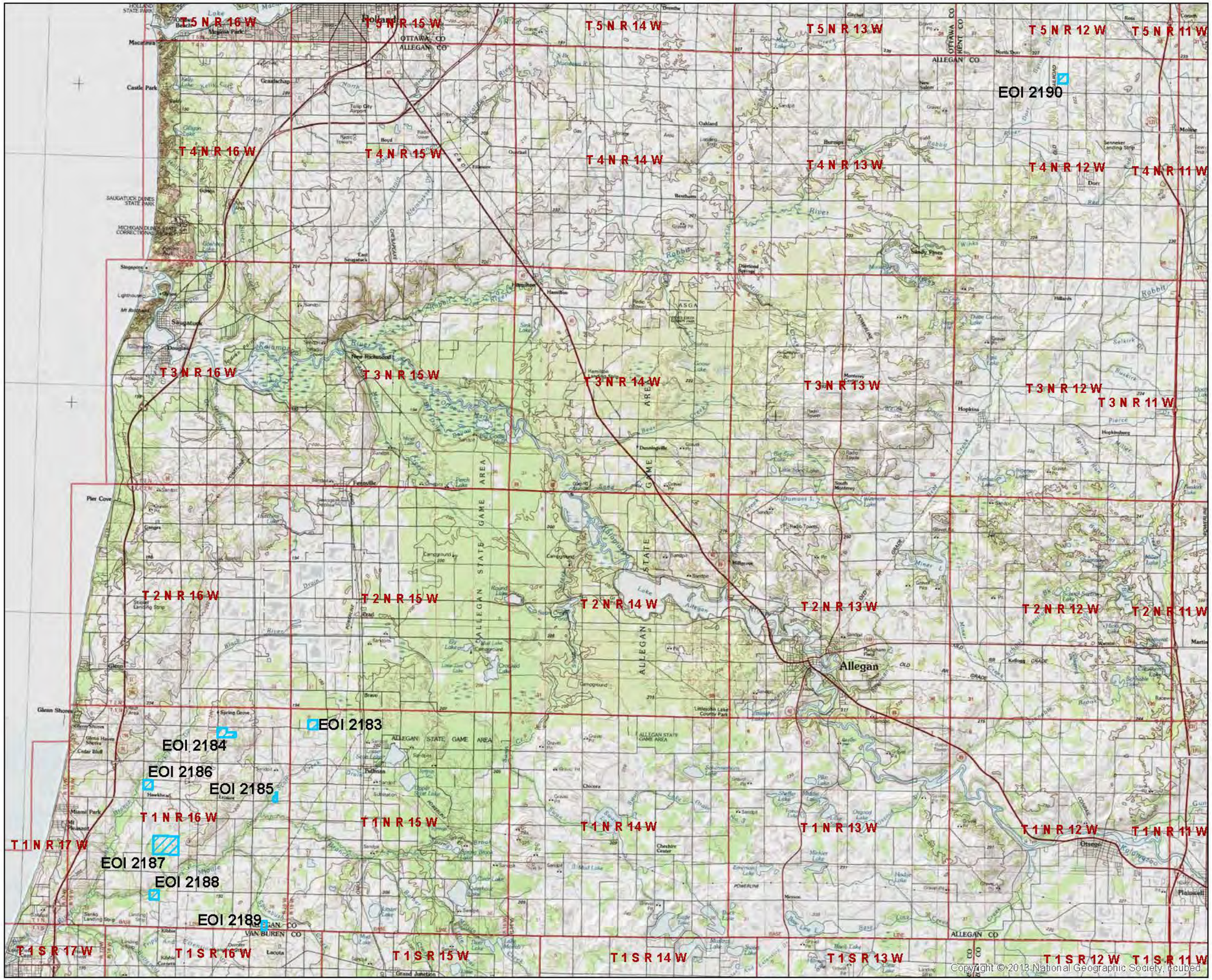
7 APPENDIX A – Figures

Expressions of Interest
Allegan County, Michigan

Nominated Lease Parcel

Township



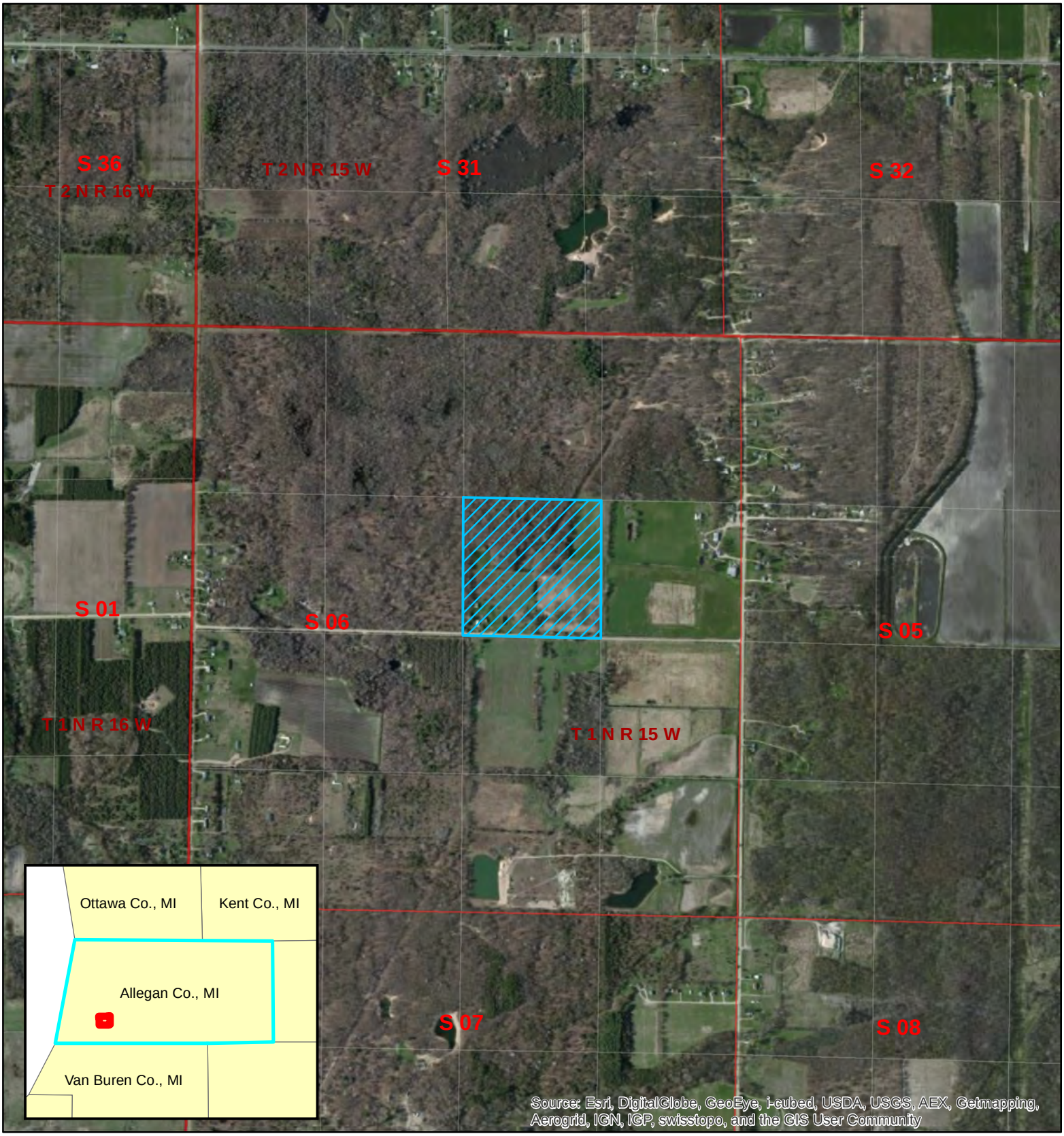
* No warranty is made by the Bureau of Land Management for use of map data for purposes otherwise intended by the BLM.

Map Produced By:
Bureau of Land Management
Northeastern States District
626 E. Wisconsin Ave, Suite 200
Milwaukee, WI 53202

July 1, 2015

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Miles
0 1.75 3.5 7



Expression of Interest (EOI 2183)
Allegan County, Michigan

Nominated Lease Parcel
Section
Township
Quarter Section

Miles
0 0.25 0.5 1

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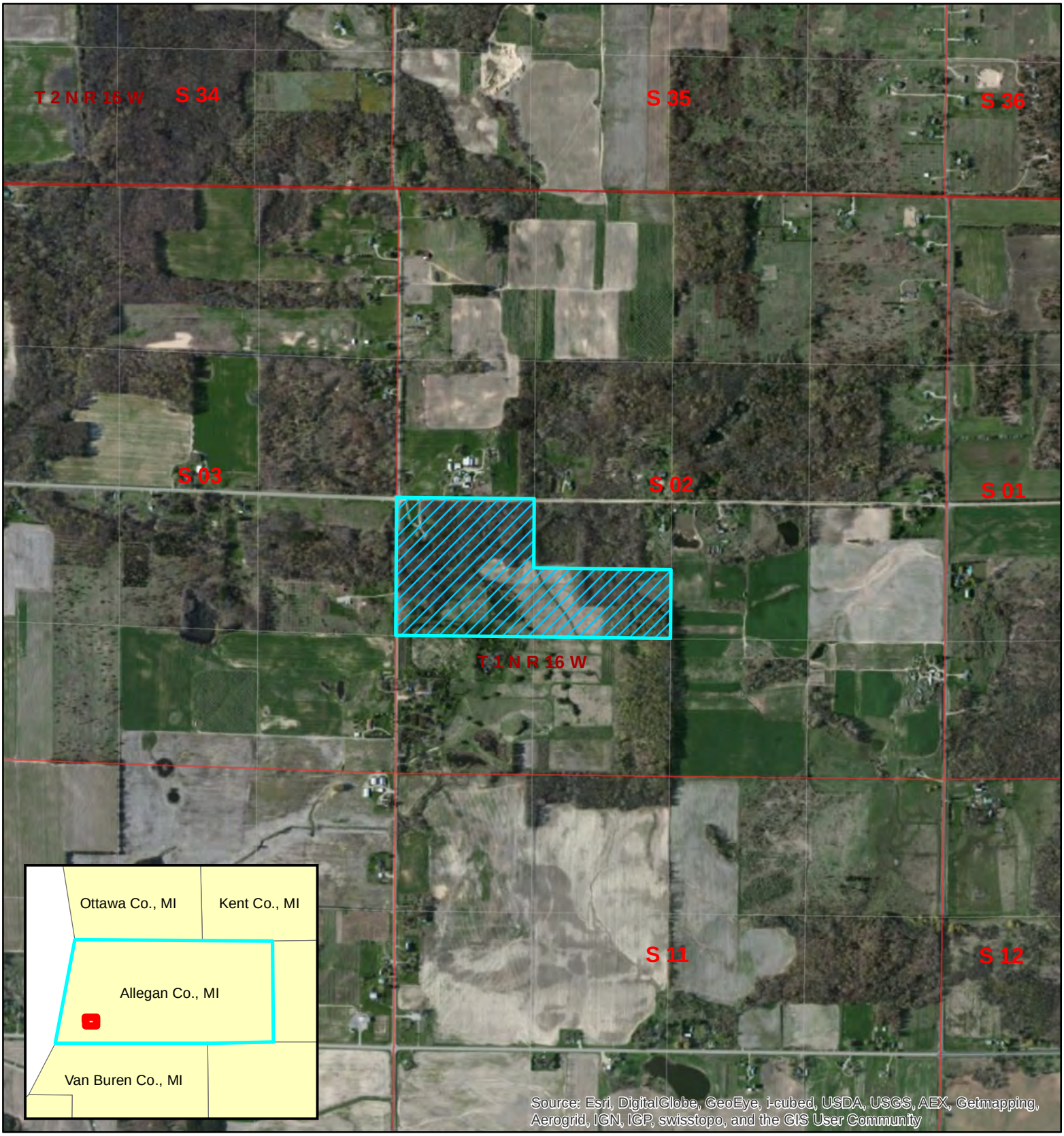
Map Produced By:
Bureau of Land Management
Northeastern States District
626 E. Wisconsin Ave, Suite 20
Milwaukee, WI 53202

June 5, 2015



Expression of Interest (EOI 2184)
Allegan County, Michigan

Nominated Lease Parcel
Section
Township
Quarter Section

Miles
0 0.25 0.5 1

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Map Produced By:
Bureau of Land Management
Northeastern States District
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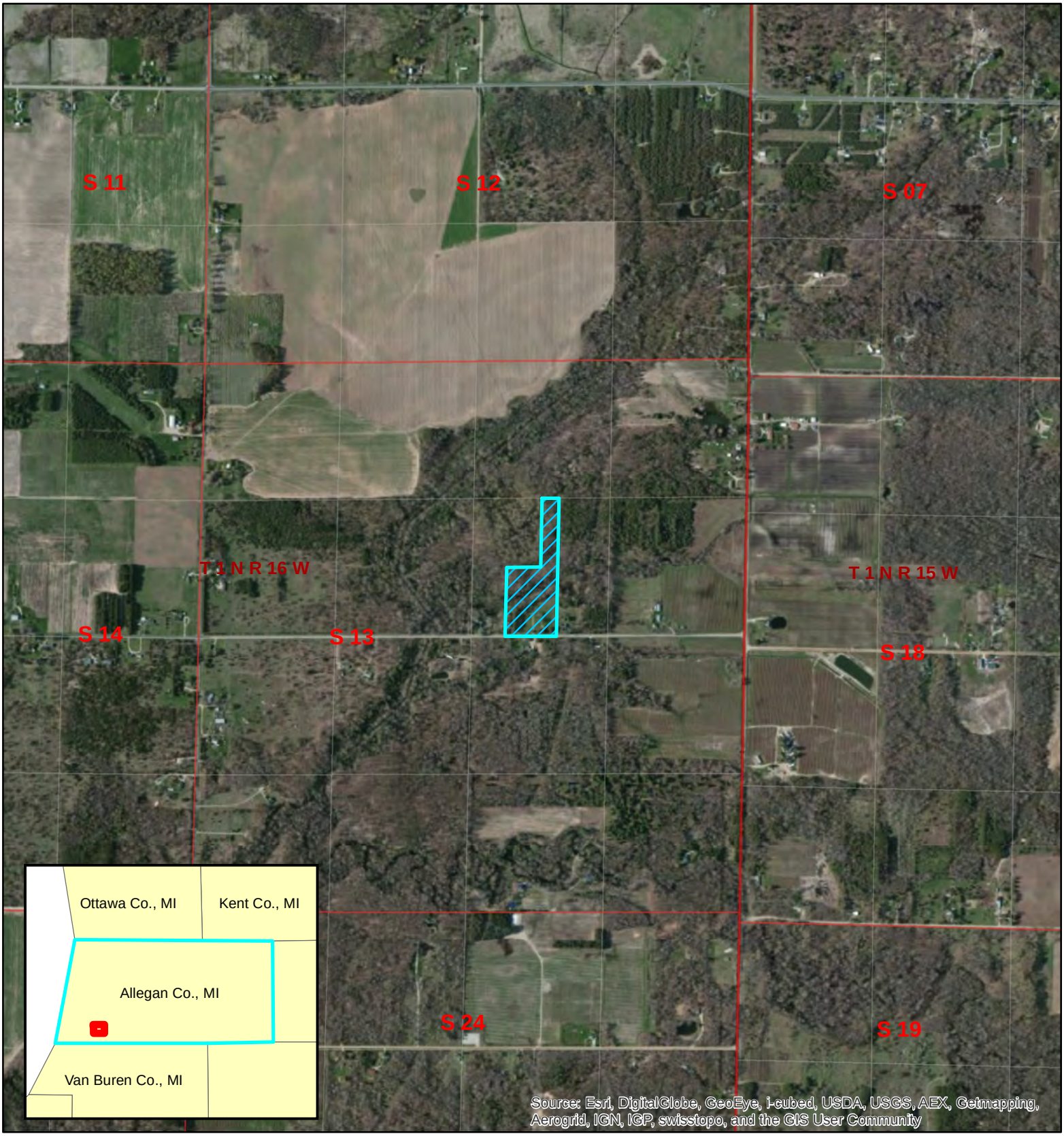
Milwaukee, WI 53202

June 5, 2015



Expression of Interest (EOI 2185)
Allegan County, Michigan

Nominated Lease Parcel
Section
Township
Quarter Section

Miles
0 0.25 0.5 1

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Map Produced By:
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Northeastern States District
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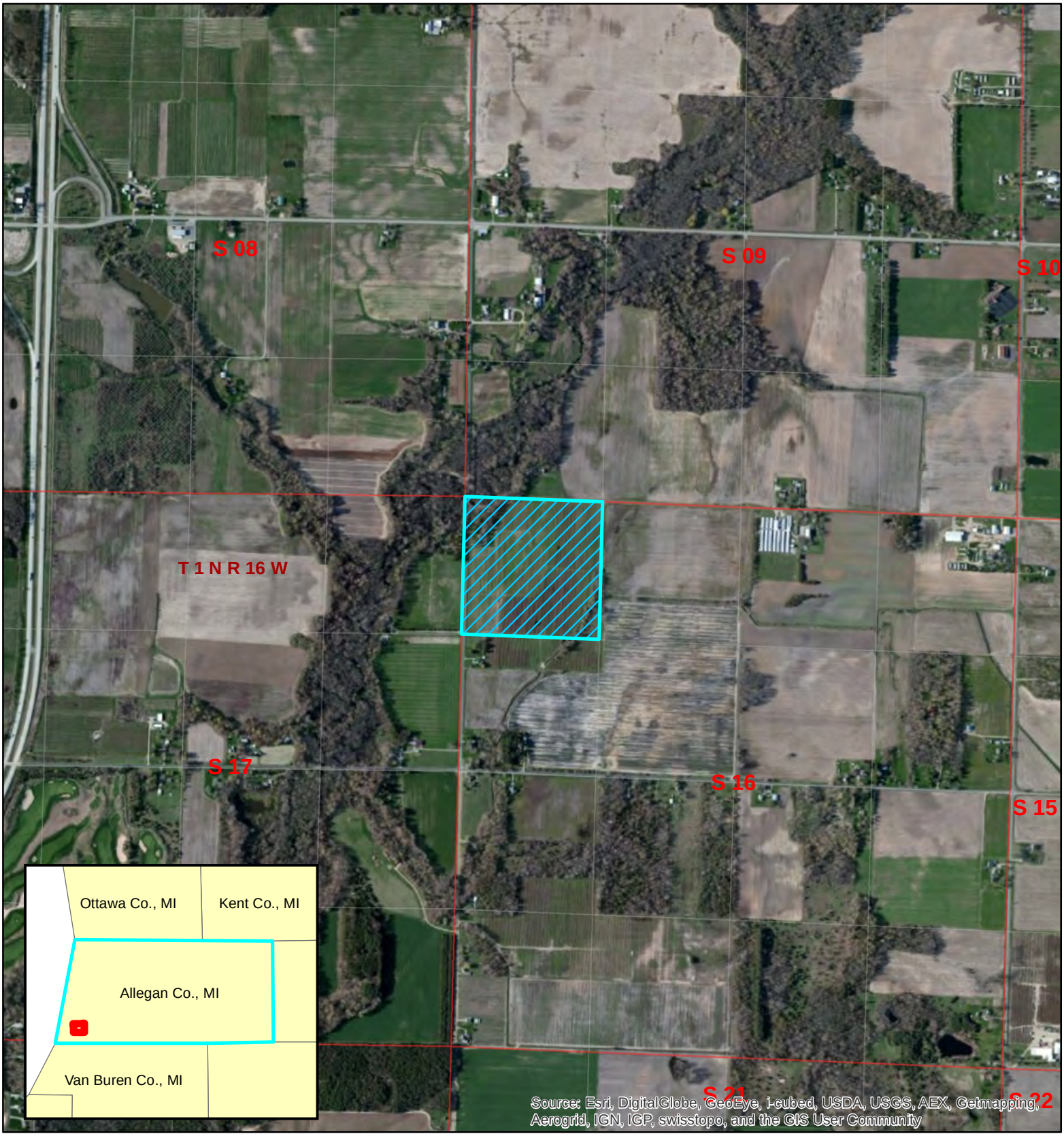
Milwaukee, WI 53202

June 5, 2015



Expression of Interest (EOI 2186)
Allegan County, Michigan

Nominated Lease Parcel
Section
Township
Quarter Section

0 0.25 0.5 1 Miles

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Northeastern States District
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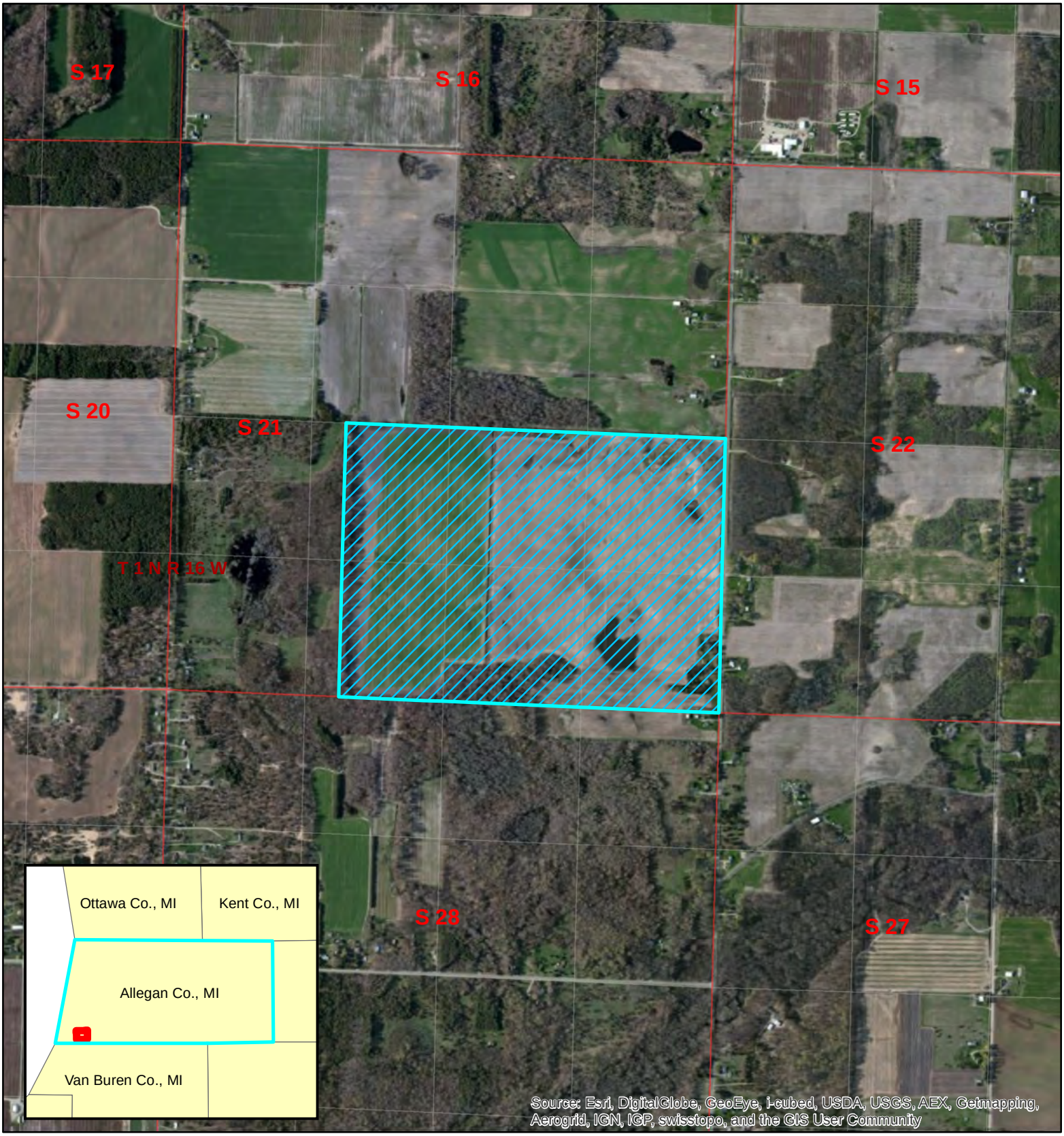
Milwaukee, WI 53202

June 5, 2015



Expression of Interest (EOI 2187)
Allegan County, Michigan

Nominated Lease Parcel
Section
Township
Quarter Section

0 0.25 0.5 1 Miles

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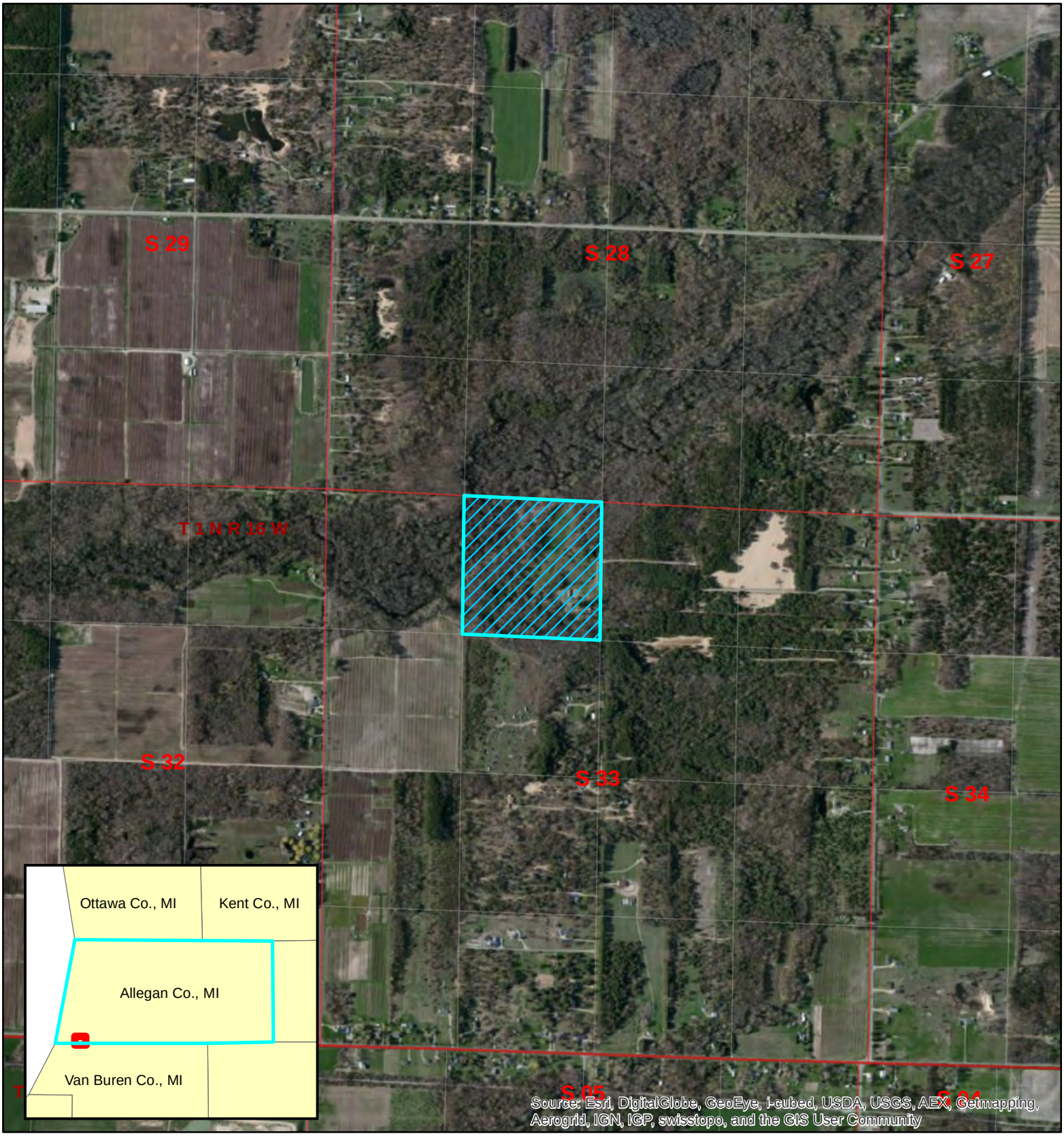
Map Produced By:
Bureau of Land Management
Northeastern States District
626 E. Wisconsin Ave, Suite 20
Milwaukee, WI 53202

June 5, 2015



Expression of Interest (EOI 2188)
Allegan County, Michigan

Nominated Lease Parcel
Section
Township
Quarter Section

Miles
0 0.25 0.5 1

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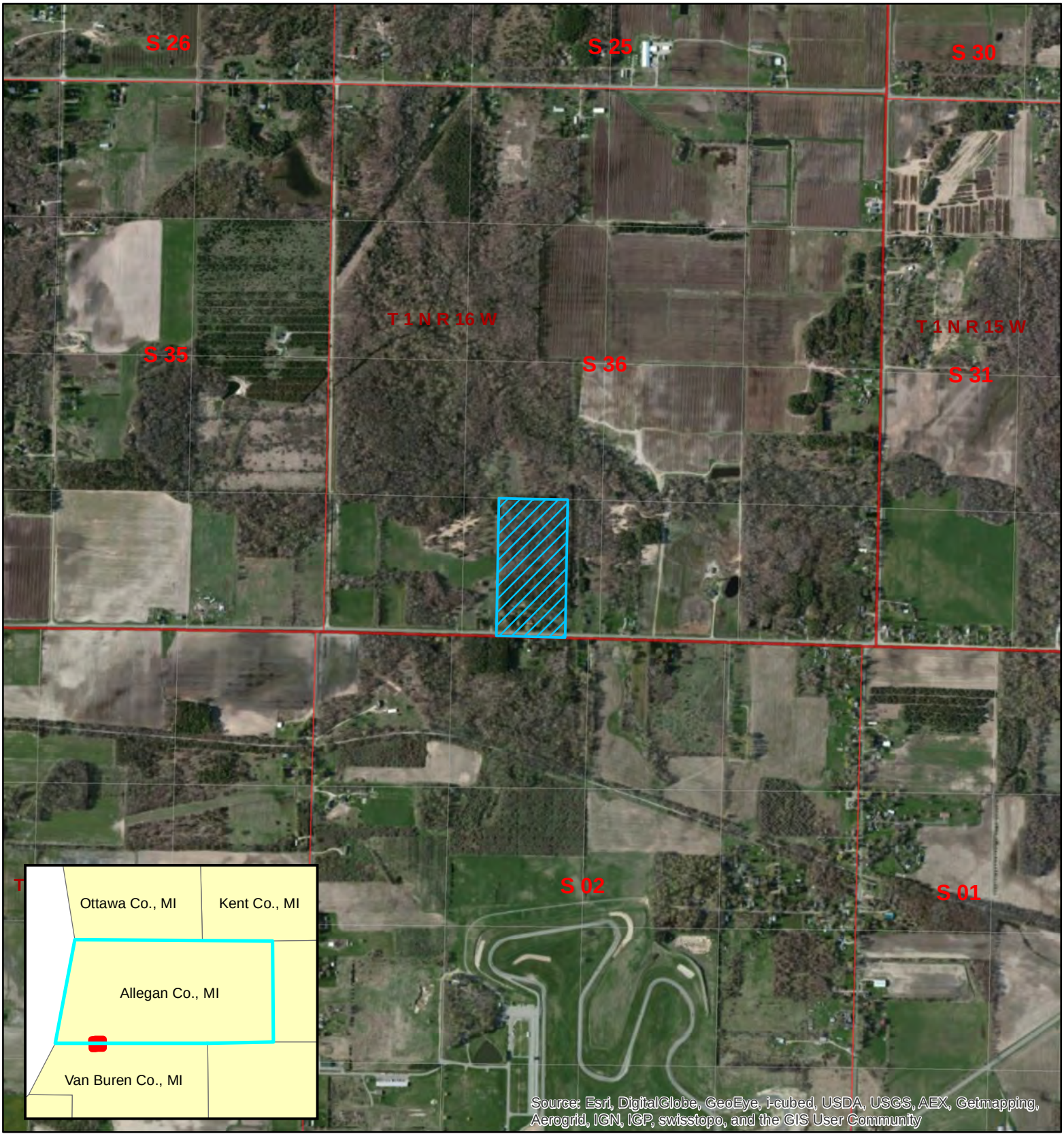
Map Produced By:
Bureau of Land Management
Northeastern States District
626 E. Wisconsin Ave, Suite 20
Milwaukee, WI 53202

June 5, 2015



Expression of Interest (EOI 2189)
Allegan County, Michigan

Nominated Lease Parcel
Section
Township
Quarter Section

0 0.25 0.5 1 Miles

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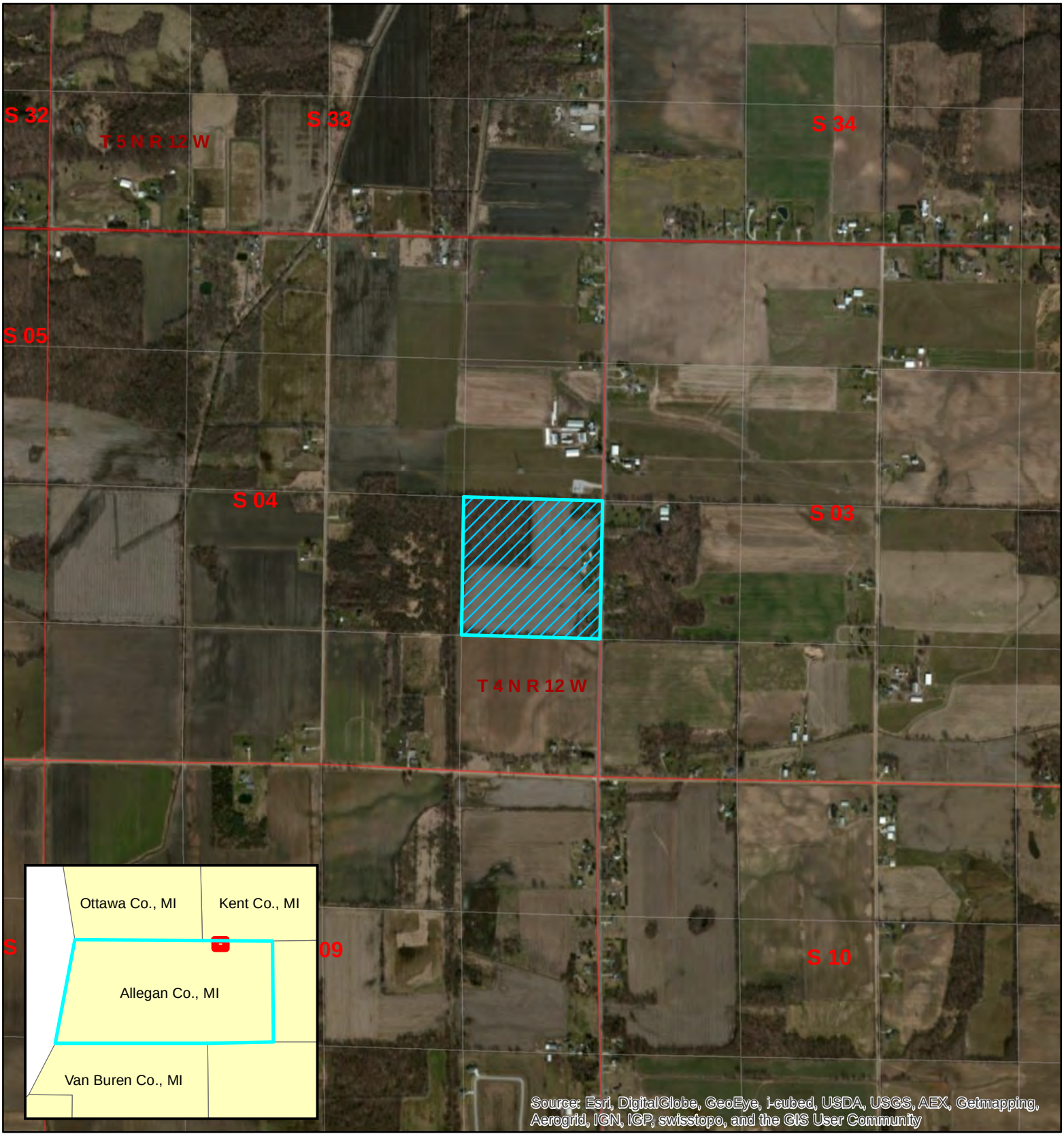
Map Produced By:
Bureau of Land Management
Northeastern States District
626 E. Wisconsin Ave, Suite 20
Milwaukee, WI 53202

June 5, 2015



Expression of Interest (EOI 2190)
Allegan County, Michigan

Nominated Lease Parcel
Section
Township
Quarter Section

Miles
0 0.25 0.5 1

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Map Produced By:
Bureau of Land Management
Northeastern States District
626 E. Wisconsin Ave, Suite 20
Milwaukee, WI 53202

June 5, 2015

8 APPENDIX B – Stipulations and Notices

Notices

1. Surface disturbance will be limited to that necessary for reasonable, safe and prudent extraction of the oil and gas. Measures will be implemented to minimize erosion and sedimentation. Road and stream crossings will be planned so as to eliminate stream crossings whenever practical.
2. Portions of this lease parcel have had occurrences of certain threatened, endangered, or sensitive species or communities. At the time a drilling permit application or other request for surface use is filed, a site-specific review will be done to determine potential effects to these species. Depending upon the findings of the site-specific review, additional operating constraints, such as seasonal restrictions or re-location of the proposed wellsite, may be necessary to mitigate effects to threatened, endangered, or sensitive species or communities.
3. A cultural resources Phase I survey will be required prior at the time an Application for Permit to Drill/Notice of Staking is submitted. Cultural Resource surveys may also be required prior to the start of subsequent well operations which involve additional surface disturbance. Mitigation measures or movement of planned ground disturbance may be necessary to avoid adverse effects to cultural resources. The need and requirements for mitigation or alterations will be based on consultation between the lessee, Bureau of Land Management, the Michigan State Historic Preservation Office, and the Advisory Council on Historic Preservation.
4. Any approved APD may require a Discovery Plan for accidental archaeological discoveries that occur during ground disturbing activities that were detected during initial surveys. This may include consultation between the Bureau of Land Management, Michigan State Historic Preservation Office, and the Advisory Council on Historic Properties.

8 APPENDIX B – Stipulations and Notices

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No Surface Occupancy Stipulation

No surface occupancy will be permitted within 300 feet of a navigable waterway.

Purpose: Protect surface water quality.

Exception: The BLM may grant exceptions for use of existing roadways and utility rights-of-way. Exceptions must be made in writing by the BLM.

Waiver/modification: No waivers or modifications will be made to this stipulation.

Controlled Surface Use Stipulation

No removal of trees of more than three (3) inches in diameter at breast height will be permitted.

Purpose: Avoiding impacts to Indiana and northern long-eared bats.

Exception: The BLM may grant an exception for removal of isolated trees that are determined unlikely to be used by bats for roosting or foraging.

Waiver: The BLM may waive this stipulation if it determined that the impacted area likely is not occupied by either Indiana bat or northern long-eared bat.

Modification: The BLM may grant a modification to this stipulation if it is determined that such a modification is not likely to adversely impact either Indiana bat or northern long-eared bat. Such modifications may include the following:

- Inclusion of an annual period during which trees may be removed,
- Increase of the minimum size of protected trees to five (5) inches if it determined that the impacted area is likely not occupied by northern long-eared bat.

No Surface Occupancy Stipulation

No surface occupancy will be permitted in habitat that may be occupied by eastern massasauga rattlesnake. Occupied habitat is defined as suitable habitat that has been determined to contain massasaugas or that has not been surveyed and shown likely not to contain the species. Survey protocol and definitions of occupied habitat are according to "The Eastern Massasauga Rattlesnake: A Handbook for Land Managers," available online at http://www.fws.gov/midwest/endangered/reptiles/eama/index.html.

Purpose: Avoiding impacts to the eastern massasauga rattlesnake.

Exception/waiver/modification: No exceptions, waivers, or modifications will be made to this stipulation.

No Surface Occupancy Stipulation

No surface occupancy will be permitted in open areas that contain wild lupine (*Lupinus perennis*). This includes the entire, contiguous, open, upland habitat that contains wild lupine. Since the project area contains no known populations of wild lupine, this stipulation is not expected to impact surface occupancy.

Purpose: Avoid impacts to endangered Karner blue butterfly.

Exception/waiver/modification: No exceptions, waivers, or modifications will be made to this stipulation.

Controlled Surface Use Stipulation

Surface occupancy on the entire lease is subject to the following:

> Operator shall delineate, within area to be disturbed, infestations of non-native, invasive plant species, including any species that is listed in *A Field Identification Guide to Invasive Plants in Michigan's Natural Communities* (Borland, et al, 2009). Operator shall prepare an invasive species control plan for approval by the BLM. Guides to the use of recommended best management practices for controlling the spread of invasive plant species are available from the Michigan Natural Features Inventory at http://mnfi.anr.msu.edu/. Many of the same practices that are employed for preventing soil erosion also function to prevent the spread of invasive species.

Purpose: Protecting native vegetation communities, agricultural production, and timber resources.

Exception/modification/waiver: No exceptions, modifications, or waivers will be made to this stipulation.