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DRAFT ENVIRONMENTAL ASSESSMENT FOR THE CONSTRUCTION AND OPERATION OF THE PROTON IMPROVEMENT PLAN-II PROJECT AT FERMI NATIONAL ACCELERATOR LABORATORY BATAVIA, ILLINOIS

U.S. Department of Energy
Office of Science, Fermi Site Office

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EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) is proposing to construct and operate the Proton Improvement Plan-II (PIP-II) Project at Fermi National Accelerator Laboratory (Fermilab) in Batavia, Illinois. The PIP-II facilities would be an internationally designed, coordinated and funded program, hosted at Fermilab, powering the world's highest-intensity neutrino beam and advanced underground detectors designed to both exploit this beam and observe galactic neutrinos from supernovae. Throughout this Environmental Assessment (EA), the PIP-II Project is referred to as the Proposed Action.

DOE's Office of Science (DOE-SC) is the lead Federal entity responsible for energy and particle physics research. The challenge of particle physics is to discover, among other things, the composition of the Universe and how it works. Fermilab is an established DOE National Laboratory that has designed, constructed, and operated proton accelerators and high-intensity neutrino beams for years and is a leader in high-energy particle physics research.

In accordance with the National Environmental Policy Act of 1969 (NEPA), Council on Environmental Quality (CEQ) regulations at Title 40, Code of Federal Regulations (CFR) Part 1500-1508 and DOE NEPA implementing procedures at Title 10, CFR Part 1021, DOE has prepared this EA as required by NEPA (42 U.S. Code [U.S.C.] 4321 et seq.). Information contained in this EA would be used by DOE to determine if the Proposed Action would significantly affect human health and the environment. If the Proposed Action would have a significant environmental impact, an Environmental Impact Statement (EIS) would be required to complete the NEPA process. The EA evaluates the potential environmental impacts that could result from implementing the Proposed Action and the No Action Alternative. If the Proposed Action would not result in significant environmental impacts, a Finding of No Significant Impact (FONSI) would be issued, thus completing the NEPA process.

ES.1 PURPOSE AND NEED

The PIP-II Project would encompass a number of improvements and additions to the existing Fermilab accelerator complex to upgrade the existing proton beam power as needed to meet two main capability gap and mission need goals of the DOE-SC and Fermilab:

- To reduce the time for existing and planned experiments to achieve world-class results; and
- To sustain high reliability operation of the Fermilab accelerator complex.

ES.2 DESCRIPTION OF PROPOSED ACTION

Under implementation of the Proposed Action, Fermilab would construct and operate the PIP-II Project facilities at Fermilab. An 800-MeV superconducting linear accelerator (Linac), upgradable to 1-GeV, constructed of continuous wave-capable components, operated initially in pulsed mode, located on the Main Ring infield, accompanied by necessary modifications to the existing Booster/Recycler/Main Injector accelerators. ("Linac" is a common abbreviation for "linear accelerator," in which the particle beam proceeds along a straight path.) The Proposed Action includes construction and operation of a new proton linear accelerator housed in a 730-foot long underground enclosure.

ES.3 ALTERNATIVES

As required by Council on Environmental Quality (CEQ) regulations, the PIP-II EA evaluates a No Action Alternative to serve as a basis for comparison with the action alternatives. Under the No Action

Alternative, PIP-II would not be constructed and operated and the enhanced opportunities for neutrino research would not be pursued. The No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab.

DOE also considered other design alternatives; however, these alternatives were eliminated and not evaluated in the EA because they did not meet the Purpose and Need and/or certain other criteria deemed necessary for the Project. Without the PIP-II facilities, it would take 2 to 3 times longer to achieve world class physics results. Fermilab's high-energy physics data collection would occur at a slower rate and be prolonged, which threatens the viability of Fermilab's high-energy physics mission. Other future accelerator-based experiments that rely on higher beam power would also not be constructed.

ES.4 AFFECTED ENVIRONMENT

Fermilab is located 38 miles west of downtown Chicago, Illinois, in an area of mixed residential, commercial, and agricultural land use. Fermilab is an established national laboratory that has designed, constructed, and operated proton accelerators and high-intensity neutrino beams for years, beginning with the Main Ring in 1972, followed by the Tevatron in 1983 and later facilities. The Tevatron closed in 2011 when the more powerful Large Hadron Collider (LHC) opened in Geneva, Switzerland. However, Fermilab has been operating the Neutrinos at Main Injector (NuMI) project with a detector in Soudan, Minnesota, since 2005, and recently completed construction of the NuMI Off-axis νe Appearance (NO*ν*A) Project, with a detector in Ash River, Minnesota (note that the ν is the designation for the neutrino particle, in this case the electron neutrino). These projects have extensive underground and surface facilities including a large accelerator, the site's Main Injector (MI); and existing power and cooling water systems, research laboratories, and other facilities.

This section of the EA describes the existing conditions of the physical, biological, cultural, and socioeconomic resources that have the potential to be affected by activities related to the Proposed Action as described in Chapter 2. These resources include those that occur within, are adjacent to, or are associated with the PIP-II Project site (i.e., Proposed Action footprint).

ES.5 ENVIRONMENTAL IMPACTS

The Environmental Impacts sections of the EA analyzes the potential impacts associated with implementation of the Proposed Action and No Action for each resource. The EA covers a range of potential designs and environmental impacts, including some dealing with radiation, both contamination and exposure. Potential environmental impacts were evaluated for the following resources:

- Land Use and Recreation
- Biological Resources
- Cultural Resources
- Health and Safety
- Hydrology and Water Quality
- Noise and Vibration
- Transportation
- Air Quality and Greenhouse Gases

- Visual Resources
- Geology and Soils
- Socioeconomics and Environmental Justice
- Sustainability
- Utilities
- Waste Management
- Accident Analysis
- Cumulative Effects

ES.6 SUMMARY AND COMPARISON OF POTENTIAL IMPACTS

The EA evaluates the potential environmental impacts that could result from implementing the Proposed Action and the No Action Alternative. The potential environmental impacts evaluated in the EA are summarized and compared in **Table ES-1**. Detailed impact analyses are provided in the Environmental Impacts subsections in Section 3.

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Table ES-1 Potential Impacts for the Proposed Action and Alternatives

Resource	Potential Impacts	
	Proposed Action	**No Action Alternative**
Land Use and Recreation	The entire PIP-II Project site was previously disturbed during construction of the Tevatron Project and past farming activities. The Proposed Action would occur on Fermilab property; however, public access to Fermilab's open space and recreational amenities would continue unchanged. The Proposed Action is entirely consistent with Fermilab's existing land use and mission: conducting state-of-the-art high-energy physics research. During construction, the Proposed Action would temporarily affect 28 acres of undeveloped vegetated prairie. Approximately 5 acres of land would be displaced long-term by the footprint of the aboveground facilities. The Proposed Action would have very low direct or indirect impacts on off-site land uses and the character of properties in the surrounding community. The Proposed Action facilities would not be visible from off-site locations, the Illinois Prairie Path or the interpretive nature trail. The aboveground Project facilities would be visible to visitors traveling along the east side of Wilson Hall and from the observation areas that overlook the PIP-II Project site and Main Ring. Surface buildings would be landscaped comparable to the existing buildings at Fermilab. Construction and operation of the Proposed Action would have very low impacts on existing or future on-site land uses at Fermilab or on the character or use of land in the surrounding community.	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue. Public access to the Fermilab facilities and use of Fermilab's open space and recreational amenities would continue similar to current conditions. Fermilab's high-energy physics mission would be unchanged. Fermilab's existing research projects and planned projects, and off-site projects would implement Standard Environmental Protection Measures (SEPMs) to reduce indirect impacts, including noise, dust, and visual impacts. Fermilab would continue to implement ecological and natural resources restoration projects. The No Action Alternative would have no adverse effects on on-site or off-site land uses, including adjacent residential and recreational land uses.
Biological Resources	The entire PIP-II Project site was previously disturbed during construction of the Tevatron Project and past farming activities. Construction of the Proposed Action would require placement of clean fill material within non-jurisdictional vegetated wetlands; however, potential impacts would be minimized to the extent practicable. The Proposed Action would require clearing of vegetation and removal of up to 20 trees. Because few trees would be removed and migratory birds do not use the Main Ring, potential impacts to migratory birds, potentially summer-roosting Indiana bat, and Northern long-eared bats would be low. Rusty-patched bumble bee may be present in the existing prairie habitat in the Main Ring. To avoid impacts to the bee, construction workers and managers	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue to be constructed and operated (with associated impacts to biological resources) and Fermilab would minimize biological effects in accordance with federal, DOE, and state requirements; and comply with the monitoring requirements of the project permits and other federal and state authorizations. Wetland impacts associated with other planned projects would be offset through purchase of wetland credits or other wetland and stream

Table ES-1 Potential Impacts for the Proposed Action and Alternatives

Resource	Potential Impacts: Proposed Action	Potential Impacts: No Action Alternative
	would be required to comply with U.S. Fish and Wildlife Service (USFWS) requirements. Impacts to biological resources were analyzed for both pulsed and CW-mode operations. Operations would occur within the area previously disturbed by construction and would be designed to minimize exposure of biota to activated materials. With implementation of Fermilab's SEPMs and compliance with USFWS requirements, biological resource impacts would be low during construction and operations.	habitat replication, as appropriate.
Cultural Resources	Comprehensive surveys for prehistoric and historic sites have been conducted within the Fermilab boundaries. These surveys are summarized in the Fermilab Cultural Resources Management Plan (CRMP) which was submitted to the Illinois Historic Preservation Agency (IHPA) in 2015. IHPA concurred with the findings of the CRMP. Based on the CRMP, there are no known historic properties or paleontological resources in the PIP-II Project site. Should unanticipated resources be encountered during construction of the Project, construction in that area would be stopped, an archaeologist or paleontologist would be notified, and that individual would implement the procedures outlined in the CRMP. During operations, the Proposed Action would involve access to and use of the proposed facilities and service buildings, maintenance, and landscaping. Because these activities would not typically require ground disturbance or excavations, operation of the Proposed Action would have very low impact on cultural or paleontological resources.	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no new excavation, grading or other ground disturbances in the PIP-II Project site; therefore, there would be no effects on historic properties or paleontological resources. Existing research projects and planned projects would continue. Projects that require ground disturbances would comply with the CRMP and relevant monitoring requirements.
Health and Safety	During construction of the Proposed Action, the primary potential health and safety risk would be worker accidents and injuries. To minimize worker accidents and injuries and to protect the public and environment, construction activities would comply with Fermilab Integrated Safety Management System, the Fermilab Environment, Safety and Health Manual, relevant federal and state regulations and pertinent building codes. There would be no new occupational or radiological health or safety impacts on workers or the public.	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue to be managed in accordance with established programs, policies, and procedures. Existing and planned projects would result in potential exposure of Fermilab workers to radiation; however, these risks would be similar to other Fermilab

Table ES-1 Potential Impacts for the Proposed Action and Alternatives

Resource	Potential Impacts: Proposed Action	Potential Impacts: No Action Alternative
	Except for demolition activities, construction workers would not be exposed to radiation. Demolition activities could result in minor radiation exposures; however, exposures to activated materials would be minimized by complying with SEPMs outlined in the Fermilab Radiological Control Manual. Impacts analyzed for exposure of Fermilab workers to radiation account for both pulsed and CW-mode operations. Operations would result in potential exposure of Fermilab workers to radiation; however, these risks would be similar to other Fermilab experiments, would be managed by adhering to existing SEPMs, and would be minimized by engineering controls. Radiation exposures would be reduced to As Low as Reasonably Achievable (ALARA) and would be below Fermilab and DOE exposure standards (1,500 mrem per year, 5,000 mrem per year, respectively) for workers. Exposures to the public would be less than the DOE standard of 10 mrem per year. Because a very small number of additional personnel would be required for operations, the Proposed Action would result in a very low increased risk of injuries and illnesses.	experiments and would be managed by adhering to existing SEPMs and would be minimized by engineering controls.
Hydrology and Water Quality	During construction of the Proposed Action, potential impacts on surface water hydrology and water quality may occur as a result of ground disturbances and associated stormwater runoff. The PIP-II Project site is not within the 100-year floodplain; therefore, construction and operation of the Project would have very low impacts on flooding in the vicinity of the Project and would comply with Executive Order (EO) 11988, *Floodplain Management*, EO 11990, *Protection of Wetlands* and federal regulations. Fermilab would apply for an Illinois Environmental Protection Agency (IEPA) for coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Construction Site Activities (IL10) by submitting a Notice of Intent (NOI) and developing a Project-specific construction Stormwater Pollution Prevention Plan (SWPPP). During operations, stormwater at the Project would be managed according to Fermilab's existing site-wide SWPPP. With	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue with associated potential impacts to hydrology and water quality. Potential impacts would continue to be addressed through existing water quality controls, stormwater management procedures, and the ongoing site-wide groundwater monitoring program.

Table ES-1 Potential Impacts for the Proposed Action and Alternatives

Resource	Potential Impacts	
	Proposed Action	**No Action Alternative**
	implementation of the best management practices (BMPs) outlined in the SWPPPs, impacts to surface water hydrology and water quality would be low. Excavations may require temporary dewatering of groundwater, which would result in short-term impacts on groundwater elevations in the immediate vicinity of pumping. Pumped groundwater would be collected in Fermilab's existing cooling water ditches and ponds. If dewatering is necessary, Fermilab's existing NPDES permit (IL0026123) would be modified as appropriate. Impacts analyzed for surface water and groundwater quality account for both pulsed and CW-mode operations. Operations would have low effects on surface water quality. The Project would be designed with thick shielding for radiation and other engineering controls to minimize surface water contact with irradiated materials. Radionuclide concentrations in the cooling ponds are very low and would be anticipated to be below surface water quality standards, such as the DOE surface water standard of 1,900 picoCuries per milliliter (pCi/ml for tritium; 10 CFR 835). Groundwater radionuclide concentrations would be below DOE surface water and the United Stated Environmental Protection Agency drinking water standard for tritium (20 pCi/ml). Groundwater near the PIP-II Project site is subject to institutional controls on the Fermilab property and is not available for consumption. During construction and operations, leaks and spills of oil, fuel, solvents, and other materials could affect surface water and groundwater quality without protective measures in place. The potential for surface water and groundwater contamination would be minimized by implementation of SEPMs, including the BMPs outlined in the existing Fermilab Spill Prevention, Control, and Countermeasure (SPCC) Plan, the BMPs in the SWPPP, and the ongoing site-wide groundwater monitoring program.	

Table ES-1 Potential Impacts for the Proposed Action and Alternatives

Resource	Potential Impacts	
	Proposed Action	**No Action Alternative**
Noise and Vibration	During construction, the use of heavy earth-moving equipment and vehicle traffic would generate noise. No blasting would be required; therefore, construction activities for the Project would not result in excess vibration and are not anticipated to increase noise levels above existing ambient conditions. Noise levels within the Main Ring would diminish rapidly with distance because much of the construction for the underground facilities would be conducted within excavations that would attenuate much of the sound. The construction noise would normally be limited to daytime hours and would be temporary and localized. Noise impacts were analyzed for both pulsed and CW-mode operations. During operations, chillers and heating, ventilation and air conditioning units would be designed to include quiet equipment and incorporate sound-dampening equipment or enclosures, if needed, to maintain noise at levels below State of Illinois octave band threshold limits. Operational noise impacts would be low.	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue to generate noise, as would existing ambient noise sources. Construction of other planned projects would coincide with PIP-II construction; therefore, there would be noise/vibration experienced from construction near Kirk Road and these residents would still experience some noise and vibration.
Transportation	During construction, the Proposed Action would result in a minor increase in the annual average daily traffic (AADT) on public roadways near Fermilab. Even with a conservative assumption that all construction traffic used the same route, the public roads in the vicinity of Fermilab would experience an increase in average daily traffic of less than 1.0% during construction. With implementation of traffic SEPMs, traffic volume and commensurate potential for accidents and injuries on public roads would be low.	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue to generate traffic on Fermilab on-site roads and public roads near Fermilab, along with the potential for traffic accidents. Public travel on Kirk Road, Butterfield Road, Interstate 88 (I-88), and other nearby travel routes, as well as the on-site roads within the Fermilab property, would be consistent with existing conditions and trends. Impacts to traffic volume and commensurate potential for accidents and injuries on public roads would be very low.
Air Quality and Greenhouse Gases	During construction, the Proposed Action would generate particulate emissions from dust and combustion emissions from equipment and vehicles, including various gasoline and/or diesel-powered vehicles, excavation equipment, cranes, and other motorized equipment. Construction would generate both attainment and non-attainment pollutants; however, emissions would not exceed the	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue to generate air emissions, including Greenhouse Gases

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	Proposed Action	**No Action Alternative**
	general conformity *de minimis* threshold (100 tons) for non-attainment pollutants (e.g., ozone precursors such as nitrous oxides and volatile organic matter). Air emissions from excavation, soil stockpiling, and construction activities would be minimized by using SEPMs including erosion and dust control BMPs. The increase in criteria pollutant emissions for operations would be less than 1 ton per year of any individual criteria pollutant. Impacts analyzed for air quality account for both pulsed and CW-mode operations. During operations, a permanent 250-kilowatt diesel generator would supply emergency power for the Proposed Action for the life of the project. No other operational air emission sources are anticipated as part of this Project. The Proposed Action, when considered together with other planned Fermilab projects, would not delay attainment for these criteria pollutant. Potential releases of hazardous air pollutants (HAPs) from operations could include radionuclides; however, these emissions would be controlled and monitored to ensure the emissions would be well below regulatory limits. Radionuclide emissions during operations would be controlled and monitored to verify that radionuclide emissions from all sources would be well below DOE requirements, Fermilab air permit limits, USEPA dose limits, and site-specific Fermilab policy. Air quality impacts would be low.	(GHGs) and HAPs, including radionuclides; however, these emissions would be controlled and monitored to ensure that the emissions would be well below regulatory limits. Air quality impacts would be low.
Visual Resources	Construction of the Proposed Action would not be visible from off-site locations or on-site recreational areas, including the Illinois Prairie Path or the interpretive nature trail. The aboveground Project facilities would be visible to visitors traveling along the east side of Wilson Hall and from the observation areas that overlook the PIP-II Project site and Main Ring. The surface buildings would be landscaped comparable to the existing buildings at Fermilab. Overall, visual impacts would be low.	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue to be visible from on-site and off-site locations. Existing facilities visible from off-site locations include the Pine Street entrance, the Main Injector buildings and ponds, and Wilson Hall (a prominent Fermilab feature).
Geology and Soils	During construction, the Proposed Action would unavoidably affect soils during clearing of vegetation, grading, and excavation of soils; however, topsoil would be preserved to the extent practicable and reused to restore other areas. SEPMs would include development and implementation of a Project-specific SWPPP to minimize erosion.	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue with some associated soil disturbances. SEPMs would be implemented to

Table ES-1 Potential Impacts for the Proposed Action and Alternatives

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	Geological resources (i.e., rock) would be affected by the unavoidable excavation of bedrock; however, this would not result in loss of important geological resources (i.e., mineral resources of commercial quality) or unique scientific data. Impacts analyzed for soils account for both pulsed and CW-mode operations. The Project would be designed with thick shielding for radiation and other engineering controls to minimize contact of soils with irradiated materials. Operations would have very low impacts on soils and bedrock.	minimize erosion and contact with irradiated materials.
Socioeconomics and Environmental Justice	Construction and operation of the Proposed Action would have marginally positive economic benefits on the local and regional economy resulting from construction-related spending, worker salaries, and the purchase of goods and services from area merchants and specialty vendors. The potential off-site effects associated with the Proposed Action include increased traffic during construction. In accordance with DOE's Environmental Justice Strategy (DOE 2008a), residents, including the minority populations, would be provided access to information regarding the Project. Project environmental impacts would be low and borne equally by both minority and non-minority municipalities. The off-site communities proximate to the Proposed Action are neither low income nor disproportionately minority communities. Hence, there is no environmental justice concern.	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue to result in marginally positive local economic benefits from continued experimental activity and spending of visiting scientists. Under the No Action Alternative, existing research projects and planned projects would continue to result in low potential environmental impacts, which would be borne equally by both minority and non-minority municipalities. The off-site communities proximate to the Fermilab are neither low income nor disproportionately minority communities. Hence, there is no environmental justice concern.
Sustainability	The Proposed Action would comply with the goals set forth in Fermilab's current Site Sustainability Plan (SSP), which would be updated to comply with the new EOs, including GHG emissions reduction, energy conservation, water conservation, pollution prevention, sustainable acquisition, and innovation. Although the Proposed Action would increase energy consumption, its operation would minimize the net increase by complying with the energy efficiency measures outlined in Fermilab's SSP and continuing to purchase Renewable Energy Certificates (REC).	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue to generate GHGs, use energy and water, and generate and dispose of waste materials. Existing research projects and planned projects would comply with the goals set forth in Fermilab's current SSP, which would be updated to comply with the new EOs, in a manner consistent with the goals of the SSP.

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Resource	Potential Impacts: Proposed Action	Potential Impacts: No Action Alternative
		Impacts to sustainability would be low.
Utilities	Construction of the Proposed Action would require utility construction, relocation and short-term interruptions in service to nearby facilities. Interruptions would be limited to Fermilab and would occur primarily within the vicinities of the substation and roadways. The increased power, gas, water, and other utility requirements of the Proposed Action and other planned projects at Fermilab would be within the capacity of power, gas, and water suppliers and the POTWs existing treatment capacity, such that the Proposed Action would not create a level of additional demand that would require the expansion or modification of off-site utilities or result in induced growth. Construction would require limited power, water, wastewater treatment, and natural gas. Power demand for construction would be temporary and would be limited to lighting construction trailers, operating small tools, and powering ventilation and pumps. Water demand during construction, including potable water and water for dust control, would be supplied by Fermilab for use by the construction Contractor, and would have very low impacts on the capacity of the municipal water supply or wastewater treatment utilities. Energy consumption impacts were analyzed for both pulsed and CW-mode operations. The power load required by PIP-II for construction, along with 40 years of operation, would not exceed power or distribution system capacity. Electrical power for the Project would be included in bulk power purchased by DOE for overall operations at Fermilab. The Proposed Action would also require expanded utilities for operation, including potable water, wastewater treatment, and natural gas. PIP-II's utility needs would be within the capacity of local providers. Impacts on local utilities would be low.	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue to require power, gas, water, wastewater treatment, and utility upgrades The utility demands of existing research projects and planned projects would be within the capacity of local providers. Impacts on local utilities would be low.
Waste Management	Waste management impacts were analyzed for both pulsed and CW-mode operations. The Proposed Action would generate nominal amounts of non-hazardous, hazardous, and radioactive waste in the form of construction wastes/debris (e.g., wood, packaging) and oily waste. These waste streams would be very similar to those generated by other past and ongoing research	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue to generate nominal amounts of non-hazardous,

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Resource	Potential Impacts	
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	at Fermilab, and would be handled in accordance with Fermilab's approved plans and procedures. In compliance with Fermilab policies, state and local regulations, DOE Orders, and federal EOs, much of this waste would be reused or recycled, reducing waste management impacts. The Project would comply with Fermilab's existing waste management programs, SEPMs, and relevant federal, state and local requirements. The Proposed Action would not generate new waste streams that would require development of new procedures or construction of new facilities on-site or off-site. Overall, impacts on waste management would be low.	hazardous, radioactive, and oily waste requiring waste management and disposal. The types and quantities of waste generated and disposed by Fermilab would be managed in compliance with Fermilab's existing waste management programs; SEPMs; and relevant federal, state and local requirements, and would not require construction of new facilities on-site or off-site. Therefore, impacts on waste management would be low.
Accident Analysis	Based on the PIP-II Preliminary Hazard Analysis Report, the Proposed Action design incorporated protection measures to reduce potential hazards to no more than minor on-site and negligible off-site impacts to people and the environment during construction and operations (Fermilab 2017d). Because of design measures and existing safety programs, there is no reasonably foreseeable "major" accident scenario arising from construction of the Proposed Action or an intentional destructive act. The accident analysis for operations accounts for both pulsed and CW-mode operations. Operational incidents would be minimized by shielding and safety procedures; however, mis-steering of the beam and failure of safety systems caused by an accident or malevolent act would result in irradiation of beamline components. Workers involved in entering the beam enclosure and replacing irradiated or damaged components would be exposed to irradiated materials. Hazards to radiation workers would be managed by limiting the exposure time to individuals, based on dose measurements, to ensure that administrative radiation limits for workers were not exceeded. Public exposure would be very low because the damaged components would be contained within the underground enclosures. Therefore, the probability for accidents or malevolent acts with the potential to affect human health or the environment would be low.	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Existing research projects and planned projects would continue, along with the associated potential for accidents or malevolent acts. In the event of operational incidents. hazards to radiation workers would be managed by limiting the exposure time to individuals, based on dose measurements, to ensure that administrative radiation limits for workers were not exceeded. Public exposure would be very low because the damaged components would be contained within the underground enclosures. Therefore, the probability for accidents or malevolent acts with the potential to affect human health or the environment would be low.
Cumulative Effects	Cumulative impacts of the Proposed Action in both pulsed and CW-mode operations at Fermilab were evaluated in view of past, present, and reasonably foreseeable projects, which were primarily existing and planned projects at	Under the No Action Alternative, Fermilab would not construct or operate the PIP-II facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and

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	Fermilab. Fermilab seeks to continually improve accelerator beam efficiency and intensity through accelerator improvement activities. Other projects with potential cumulative impacts include only those in the immediate area. Under the Proposed Action, the increased beam power at PIP-II would have cumulative effects from tritium generated at targets and detectors at other existing and future experiments at Fermilab. In addition to the planned projects, the existing NuMI target and Booster Neutrino Beam target are big producers of tritium with potential impacts on worker radiation exposure, along with exposure of surface water, groundwater and soils to irradiated materials; however, the Project would comply with Fermilab's stringent health and safety program and use design measures and Project-specific SEPMs and BMPs to minimize exposures of workers, surface water, groundwater, and soils to irradiated materials. In general, the Proposed Action would result in low cumulative impacts on land use and recreation, biological resources and jurisdictional wetlands, cultural and paleontological resources, surface and groundwater hydrology and water quality, noise and vibration, traffic, air quality and GHGs, visual resources, geology and soils, socioeconomics and environmental justice, sustainability, utilities, waste disposal, and accidents. Cumulative impacts would be minimized through implementation of Fermilab's existing environmental health and safety regulatory programs, sustainability guidelines, SEPMs, BMPs and compliance with relevant Federal, state and local laws and requirements. Overall, the Proposed Action is anticipated to result in low potential cumulative impacts.	Fermilab. Existing research projects and planned projects would continue, and other planned projects (including those at Fermilab) could have cumulative impacts. Some planned projects would generate noise and vibration noticeable at off-site locations. Potential impacts on biological, wetlands, floodplains, cultural, water resources, noise, traffic, air quality, soils and other resources would be avoided or minimized by complying with federal, state and local laws and requirements, as well as by implementation of Fermilab's existing environmental health and safety regulatory programs, SEPMs and BMPs. Under the No Action Alternative, the cumulative impacts associated with ongoing research and planned projects at Fermilab would be low.

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
$\mu g/m^3$	micrograms per cubic meter
µm	microns
AADT	average annual daily traffic
ac	acre(s)
ACGIH	American Congress of Governmental Industrial Hygienists
ALARA	As Low as Reasonably Achievable
amsl	above mean sea level
AoA	analysis of alternatives
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
B.P.	before present
bgs	below ground surface
BLS	Bureau of Labor Statistics
BMP	best management practice
BO	Biological Opinion
BTU	British thermal unit
CAA	Clean Air Act of 1973
CAP	criteria air pollutants
CD	Critical Decision
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CHW	Chilled Water
Ci	curie(s)
cm	centimeter
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	CO_2 equivalent
CR 14	Eola Road
CR 77	Kirk Road
CRMP	Cultural Resources Management Plan
CUB	Central Utility Building
CW	continuous wave
CWA	Clean Water Act of 1972

DART	Days Away, Restricted, or Transferred
dB	decibel
dBA	decibel – A weighted scale
DOE	Department of Energy
DOE-SC	DOE Office of Science
DUNE	Deep Underground Neutrino Experiment
DWS	Domestic Water Supply
EA	Environmental Assessment
EcoCAT	Ecological Compliance Assessment Tool
EENF	Environmental Evaluation Notification Form
EIS	Environmental Impact Statement
EISA	Energy Independence and Security Act of 2007
EJ IWG	Interagency Working Group on Environmental Justice
EJ	environmental justice
EMS	Environmental Management System
EO	Executive Order
EPFO	Eastern prairie fringed orchid
ESA	Endangered Species Act
ESH&Q	Environment, Safety, Health, and Quality
FEMA	Federal Emergency Management Agency
Fermilab	Fermi National Accelerator Laboratory, Batavia, Illinois
FESHM	Fermilab Environment, Safety and Health Manual
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FONSI	Finding of No Significant Impact
FRCM	Fermi Radiological Control Manual
FSRIA	Farm Security and Rural Investment Act of 2002
ft	feet
ft^3	cubic feet
FTA	Federal Transit Administration
FTE	full-time equivalent
FY	Fiscal Year, Federal (October 1 through September 30)
g	gram
gal	gallon(s)
GC	general commercial
GCL	geosynthetic clay liner

GeV	Giga electron volt; Billion electron volts
GHG	Greenhouse Gas
GI	general industrial
gpm	gallons per minute
GWP	global warming potential
HA	Hazard Analysis
HAP	Hazardous Air Pollutant
HEP	high energy physics
HEPAP	High Energy Physics Advisory Panel
HPSB	High Performance Sustainable Buildings
HVAC	heating ventilating and air conditioning
Hz	Hertz
I-88	Interstate 88
IAC	Illinois Administrative Code
IARC	Illinois Accelerator Research Center
ICW	Industrial Cooling Water
IDNR	Illinois Department of Natural Resources
IDOT	Illinois Department of Transportation
IEMA	Illinois Emergency Management Agency
IEPA	Illinois Environmental Protection Agency
IESA	Illinois Endangered Species Act
IGPA	Illinois Groundwater Protection Act of 1987
IHPA	Illinois Historic Preservation Agency
IL 10	General Permit for Stormwater Discharges from Construction Site Activities
IL 38	Roosevelt Road
IL 56	Butterfield Road
IL 59	State Highway 59
in	inch
IPaC	Information for Planning and Consulting
ISCORS	Interagency Steering Committee on Radiation Standards
ISMS	Integrated Safety Management System
ISO	International Standards Organization
JD	Jurisdictional Determination
K	Kelvin
kg	kilogram
km	kilometer(s)

KRS	Kautz Road Substation
kV	kilo (1000) volts
kW	kilowatt(s)
L	liter(s)
LAr	liquid argon
lb	pound(s)
LBNF	Long Baseline Neutrino Facility
LCF	Latent cancer fatality
LCW	Low Conductivity Water
Ldn	day-night average sound exposure
Leq	Equivalent Sound Level
LI	light industrial
Linac	linear accelerator
LLRW	low-level radioactive waste
LN	liquid nitrogen
LO/TO	lockout/tagout
Lv	Vibration Velocity Level
m	meter(s)
m^3	cubic meter
Ma	million years ago
MBTA	Migratory Bird Treaty Act of 1918
MeV	megaelectron volt
mg/m^3	milligrams per cubic meter
MI	Main Injector (at Fermilab)
mi	mile(s)
MicroBooNE	Micro Booster Neutrino Experiment
MINOS	Main Injector Neutrino Oscillation Search
MINERvA	Main Injector Experiment with vs on As
ml	milliliter
mm	millimeter
mrem	millirem
MSS	Master Substation
MVA	megavolt ampere
MW	Megawatt
MWh	Megawatt hour
NAAQS	National Ambient Air Quality Standards

NC	normal-conducting
NCRP	National Council on Radiation Protection & Measurements
NEPA	National Environmental Policy Act of 1970
NERP	National Environmental Research Park
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act of 1966
N_2O	nitrous oxide
NO_2	nitrogen dioxide
NOI	Notice of Intent
NOνA	NuMI Off-axis νe Appearance
NO_x	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NRHP	National Register for Historic Places
NuMI	Neutrinos at Main Injector (Neutrino Beam at Fermilab)
O_3	ozone
ODH	Oxygen Deficiency Hazard
OSHA	U.S. Occupational Safety and Health Administration
oz	ounce(s)
P5	Particle Physics Projects Prioritization Panel
Pb	lead
PCB	polychlorinated biphenyl
pCi	picocurie
PFI	public facilities and institutional
PGA	peak ground acceleration
PHAR	Preliminary Hazard Analysis Report
PIP-II	Proton Improvement Plan-II Project
PM	pulsed mode
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PM_{10}	particulate matter less than 10 microns in diameter
POTW	publicly owned treatment works
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million

PPV	peak particle velocity; the maximum instantaneous positive or negative peak of the vibration signal
Project	PIP-II Project
psig	pounds per square inch gauge
qt	quart
R4	multi-family medium density
RAW	Radioactive Water
RCRA	Resource Conservation and Recovery Act of 1976
REC	Renewable Energy Certificate
RF	radio frequency
ROSS	Registration of Small Sources
RPBB	Rusty-patched bumble bee
SAAQS	State Ambient Air Quality Standards
SARA	Superfund Amendments and Reauthorization Act of 1986
SC	superconducting
SDWA	Safe Drinking Water Act of 1974
sec	second
SEPM	Standard Environmental Protection Measures
sf	square foot/feet
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SLI	Science Laboratories Infrastructure
SO_2	sulfur dioxide
SOP	Standard Operating Procedure
SPCC	Spill Prevention Control and Countermeasures
SRF	superconducting radio frequency
SS	Sanitary Sewer
SSP	Site Sustainability Plan
SSPP	Strategic Sustainability Performance Plan
SSS	Soil Survey Staff
SSURGO	Soil Survey Geographic Database
SURF	Sanford Underground Research Facility
SWMU	solid waste management unit
SWPPP	Stormwater Pollution Prevention Plan
Tevatron Ring	Main Ring
TMDL	total maximum daily load
TRC	Total Recordable Cases

TSCA	Toxic Substances Control Act of 1976
U.S.	United States
U.S.C.	United States Code
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
v	volt
νe	electron neutrino, one of three types of neutrinos
VdB	velocity in decibels
VOC	volatile organic carbon compound
VOM	volatile organic material
WAC	Waste Acceptance Criteria
WBK	WBK Engineering LLC
WOUS	waters of the U.S.
WWTP	Wastewater Treatment Plant
yd	yard(s)
yd^3	cubic yard
yr	year

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CONVERSION CHART

Into metric units			Into English units		
If you know	*Multiply by*	*To get*	*If you know*	*Multiply by*	*To get*
Length			**Length**		
inches (in)	25.40	millimeters (mm)	millimeters	0.03937	inches
inches	2.54	centimeters (cm)	centimeters	0.393701	inches
feet (ft)	0.3048	meters (m)	meters	3.28084	feet
yards (yd)	0.9144	meters	meters	1.0936	yards
miles (statute) (mi)	1.60934	kilometers (km)	kilometers	0.62137	miles (statute)
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet (ft^2)	0.09290304	square meters	square meters	10.7639	square feet
square yards	0.8361274	square meters	square meters	1.19599	square yards
square miles	2.59	square kilometers	square kilometers	0.386102	square miles
acres (ac)	0.404687	hectares	hectares	2.47104	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir.)	28.34952	Grams (g)	grams	0.035274	ounces (avoir.)
pounds (avoir.) (lb)	0.45359237	kilograms	kilograms	2.204623	pounds (avoir.)
tons (short)	0.9071847	tons (metric)	tons (metric)	1.1023	tons (short)
Volume			**Volume**		
Ounces (U.S. liquid) (oz)	29.57353	milliliters	milliliters	0.033814	Ounces (U.S. liquid)
Quarts (U.S. liquid) (qt)	0.9463529	liters	liters	1.0567	Quarts (U.S. liquid)
Gallons (U.S. liquid) (gal)	3.7854	liters	liters	0.26417	Gallons (U.S. liquid)
cubic feet (ft^3)	0.02831685	cubic meters (m^3)	cubic meters	35.3147	cubic feet
cubic yards (yd^3)	0.7645549	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit (F)	subtract 32 then multiply by 5/9ths	Celsius (C)	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
Energy			**Energy**		
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
Kilowatt (kw)	0.94782	British thermal unit per second	British thermal unit per second	1.055	kilowatt
British thermal units (BTU)	1054.18	Joule	Joule	0.00094845	BTU
Megaelectron volts (MeV)	1.602×10^{-13}	Joule	Joule	6.24×10^{12}	MeV
Force/Pressure			**Force/Pressure**		
pounds (force) per square inch (psi)	6.894757	Kilopascals	kilopascals	0.14514	
Torr	133.32	Pascals	Pascals	0.0075	

Source: Lindeburg 1993

Power 1 watt = 3.414 BTU/hr; 1 BTU/hr = 0.2929 watt
Radiation
1 becquerel = 2.703 × 10-11 curies; 1 curie = 3.70×10^{10} becquerels
1 sievert = 100 rem; 1 rem = 0.01 sievert
1 Kelvin (K) = -272.15 degrees Celsius (˚C); 1 Kelvin (K) = -457.87 degrees Fahrenheit (˚F)

SCIENTIFIC NOTATION CONVERSION CHART

Numbers that are very small or very large are often expressed to scientific or exponential notation as a matter of convenience. For example, the number 0.000034 may be expressed as 3.4×10^{-5} or 3.4E-05, and 65,000 may be expressed as 6.5×10^{4} or 6.5E+04. In this document, some of the numerical values less than 0.001 or greater than 9999 are generally expressed in exponential notation, or 1.0E-03 and 9.9E+03, respectively.

Multiples or sub-multiples of the basic units are also used. A partial list of prefixes that denote multiple and sub-multiples follows, with the equivalent multiplier values expressed in scientific and exponential notation:

Name	Symbol	Value Multiplied by:		
pico	p	0.000000000001	or 1×10^{-12}	or 1E-12
nano	n	0.000000001	or 1×10^{-9}	or 1E-09
micro	µ	0.000001	or 1×10^{-6}	or 1E-06
milli	m	0.001	or 1×10^{-3}	or 1E-03
cento	c	0.01	or 1×10^{-2}	or 1E-02
deci	d	0.1	or 1×10^{-1}	or 1E-01
--		1	or 1×10^{0}	or 1E+00
deka	Da	10	or 1×10^{1}	or 1E+01
hecto	H	100	or 1×10^{2}	or 1E+02
kilo	K	1,000	or 1×10^{3}	or 1E+03
mega	M	1,000,000	or 1×10^{6}	or 1E+06
giga	G	1,000,000,000	or 1×10^{9}	or 1E+09
tera	T	1,000,000,000,000	or 1×10^{12}	or 1E+12

The following symbols are occasionally used in conjunction with numerical expressions.

Symbol	Indicates the preceding value is:
$<$	less than
$\leq$	less than or equal to
$>$	greater than
$\geq$	greater than or equal to

In some cases, numerical values in this document have been rounded to an appropriate number of significant digits to reflect the accuracy of data being presented. For example, the numbers 0.021, 21, 2100, and 2,100,000 all contain 2 significant digits. In some cases, where several values are summed to obtain a total, the rounded total may not exactly equal the sum of its rounded component values.

GLOSSARY

Accelerator. A device that accelerates charged particles (such as electrons, protons, and atomic nuclei) to high velocities, thus giving them high kinetic energies.

ALARA. As low as reasonably achievable, means making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical in compliance with. U.S. Department of Energy (DOE) requirements specified in Title 10 of the Code of Federal Regulations (CFR), Part 835, Occupational Radiation Protection.

Ambient Air. The surrounding atmosphere, usually the outside air, as it exists outside the proximity of an emission source.

Aquifer. A body of rock or sediment that is capable of transmitting groundwater and yielding usable quantities of water to wells or springs.

Attainment. An area is designated as being in attainment by the U.S. Environmental Protection Agency (USEPA) if it meets the National Ambient Air Quality Standards (NAAQS) for a given criteria pollutant. Non-attainment areas are areas in which any one of the NAAQS have been exceeded, maintenance areas are areas previously designated as non-attainment and subsequently redesignated as attainment, and unclassifiable areas are areas that cannot be classified on the basis of available information as meeting or not meeting the NAAQS for any one criteria pollutant.

Background radiation. Radiation present in the environment from cosmic sources, naturally occurring radioactive materials, and global fallout.

Beam. A stream of particles or electromagnetic radiation, going in a single direction.

Criteria Pollutants. The Clean Air Act (CAA) requires USEPA to set air quality standards for common and widespread pollutants after preparing criteria documents summarizing scientific knowledge on their health impacts. Currently, there are standards in effect for six criteria pollutants: sulfur dioxide (SO_2), carbon monoxide (CO), particulate matter equal to or less than 10 microns in diameter (PM_{10}), nitrogen dioxide (NO_2), ozone (O_3), and lead (Pb).

Cryogenics. The branches of physics and engineering that involve the study of very low temperatures, how to produce them, and how materials behave at those temperatures. Cryogenic cooling of devices and material is usually achieved via the use of liquid nitrogen or liquid helium.

Cultural resources. The prehistoric and historic districts, sites, buildings, objects, or any other physical activity considered important to a culture, subculture, or a community for any scientific, traditional, religious, or other reasons.

Cumulative impact. The impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Decibel (dB). A logarithmic measurement unit that describes a particular sound pressure level compared to a standard reference value. A-weighted decibels (dBA) refer to measured decibels whose frequencies have been adjusted to correspond to the highest sensitivity of human hearing, which is typically in the frequency range of 1,000 to 4,000 hertz.

Detectors. Detectors are sensitive equipment that can detect particles or electromagnetic radiation that pass through it and indicate such passage through the generation of an electrical signal. Detectors are made of many layers specialized to identify and record information about the many particles that result from a collision of a proton and an antiproton.

Electron volt. A unit of energy equal to the kinetic energy (or energy of motion) an electron gains when being accelerated through a potential difference of 1 volt. Another unit of energy is the joule and 1 joule equals 6.2415×10^{18} electron volts. One joule is roughly the energy needed to lift 1 kilogram (2.2 pounds) on the surface of the earth 0.1 meter (4 inches) high.

Groundwater. Water below the ground surface in a zone of saturation.

General Conformity Rule. The General Conformity Rule is applicable to non-attainment or maintenance areas (see attainment) as designated by USEPA and ensures that federal actions conform to each State Implementation Plan for air quality. These plans, approved by USEPA, are each state's individual plan to achieve the NAAQS as required by the CAA. The USEPA is required to promulgate a Federal Implementation Plan if a state defaults on its implementation plan. A conformity requirement determination for the action is made from influencing factors, including, but not limited to, non-attainment or maintenance status of the area, types of emissions and emission levels resulting from the action, and local impacts on air quality.

Greenhouse gases. Gases that trap heat in the atmosphere and may contribute to climate change, including global warming. Some greenhouse gases are emitted to the atmosphere through natural processes. Other greenhouse gases are created and emitted solely through human activities. The principal greenhouse gases are carbon dioxide, methane, nitrous oxide, water vapor, ozone, and fluorinated gases.

Half-life. The time during which half the (large number of) atoms of a particular radionuclide disintegrate. The half-life is a characteristic property of each radioactive isotope.

Hazardous Air Pollutant. Hazardous Air Pollutants, also known as toxic air pollutants, are those pollutants that are known or suspected by USEPA to cause cancer or other serious health impacts, such as reproductive impacts or birth defects, or adverse environmental impacts.

Hazardous chemical. Any chemical that is a physical or health hazard.

Hazardous Material. The U.S. Department of Transportation defines a hazardous material as a substance or material, which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety and property when transported. The term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials as defined in 49 CFR 172.8, materials designated as hazardous under the provisions of 49 CFR 172.101, and materials that meet the defining criteria for hazard classes and divisions of 49 CFR 173.

Hazardous waste. Waste that contains chemically hazardous constituents regulated under Subtitle C of the Resource Conservation and Recovery Act (RCRA), as amended (40 CFR 261) and regulated as a hazardous waste and/or mixed waste by the U.S. Environmental Protection Agency (USEPA).

Kilowatt. A thousand watts.

Latent cancer fatalities. Deaths from cancer resulting from, and occurring after, exposure to ionizing radiation or other carcinogens.

LBNF/DUNE Project. Long Baseline Neutrino Facility and Deep Underground Neutrino Experiment Project.

Mesic. Of, characterized by, or adapted to a moderately moist habitat.

Millirem. A unit of radiation dose equivalent that is equal to 1/1000 of a rem.

Muon. The muon is a fundamental particle that is part of the Standard Model of particle physics. It is an unstable subatomic particle of the same class as an electron (a lepton), but with a mass around 200 times greater. They exist for only a fraction of a second (about 10-6 seconds) before decaying usually into an electron, and electron-antineutrino, and a muon neutrino. Muons make up much of the cosmic radiation reaching the earth's surface.

Neutrinos. Neutrinos are elementary particles, which exist in three different types or “flavors”-electron, muon, and tau neutrinos. They are uncharged, non-ionizing particles and only rarely interact with ordinary matter.

PicoCurie (pCi). One trillionth of a curie

PM_{10}. Particulate matter having a median aerodynamic diameter less than 10 micrometers.

$PM_{2.5}$. Particulate matter having a median aerodynamic diameter less than 2.5 micrometers.

Proton. One of the basic particles that make up an atom. The proton is found in the nucleus and has a positive electrical charge equal to the negative charge of an electron and a mass similar to that of a neutron.

Radionuclide. A radionuclide is an atom with an unstable nucleus which, to become more stable, emits energy in the form of rays or high speed particles. This energy is called ionizing radiation because it can create “ions” by displacing electrons in the body e.g. in the DNA, disrupting its function. The three major types of ionizing radiation are: alpha particles, beta particles and gamma rays.

Radioactive decay. The change of one radionuclide into a different radionuclide by the spontaneous emission of radiation such as alpha, beta, or gamma rays, or by electron capture. The end product is a less energetic, more stable nucleus. Each decay process has a definite half-life.

Radiation dose. The amount of energy from ionizing radiation deposited within tissues of the body; it is a time-integrated measure of potential damage to tissues from exposure to radiation and as such is related to health-based impacts.

Radiation. The emitted particles (alpha, beta, neutrons) or photons (X-rays, gamma rays) from the nuclei of unstable (radioactive) atoms as a result of radioactive decay. Some elements are naturally radioactive; others are induced to become radioactive by bombardment in a nuclear reactor or other particle accelerator. The characteristics of naturally occurring radiation are indistinguishable from those of induced radiation.

Radioactive waste. Materials that are radioactive and for which there is no further use.

Risk. The product of the probability of occurrence of an event or activity and the impacts resulting from that event or activity. For example, an accident that is expected to occur once in 100 years and result in a 1 in 1,000 probability of latent cancer fatality (LCF) in the affected population would be associated with a risk of (0.01 per year) x (0.001 LCF) = 0.00001 LCF/year, or a risk of LCF equal to 1 in 100,000 per year of operation.

Shielding. A protective barrier, usually a dense material that reduces the passage of radiation from radioactive materials to the surroundings by absorbing it.

Sievert. The International System of Units (SI) unit of radiation dose equivalent. (1 SV = 100 rem). To convert millisieverts to millirem, multiply by 100.

Source. A radioactive material that produces radiation for experimental or industrial use.

Total Effective Dose Equivalent (TEDE). The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). TEDE is expressed in units of rem.

Tritium. Tritium is a weakly radioactive form of hydrogen. In nature, it's formed when cosmic particles hit Earth's atmosphere. At Fermilab, tritium is an expected byproduct of the operation of the particle accelerators.

1 INTRODUCTION

The U.S. Department of Energy (DOE) is proposing to construct and operate the Proton Improvement Plan (PIP)-II Project (the Project) at the Fermi National Accelerator Laboratory (Fermilab) in Batavia, Illinois. The Project is referred to throughout this document as the Proposed Action. This Environmental Assessment (EA) provides an evaluation of the potential environmental impacts of the Proposed Action as required by the National Environmental Policy Act of 1969 (NEPA) (42 U.S. Code [U.S.C.] 4321 et seq.).

1.1 NATIONAL ENVIRONMENTAL POLICY ACT COMPLIANCE

The EA was prepared in compliance with the NEPA of 1969 (42 U.S.C. 4321 et seq.), regulations of the President's Council on Environmental Quality (CEQ; 40 Code of Federal Regulations [CFR] 1500–1508), Order 413.3 B, which outlines a series of staged project approvals, referred to as Critical Decision (CD) and as a requirement for CD-1, as well as DOE Policy 451.1 and DOE's NEPA implementing regulations (10 CFR 1021). This EA for the PIP-II Project (DOE/EA-2072) evaluates the potential environmental impacts of the Proposed Action and the No Action Alternative. In 2017, Fermilab submitted an Environmental Evaluation Notification Form (EENF) to the DOE Fermi Site Office for the Proposed Action (DOE 2017a), which comprises a number of improvements and additions to the Fermilab accelerator complex with the goal of providing a proton beam power from the Main Injector of 1.2 MW delivered to the neutrino production target over the energy range of 60 to 120 GeV at the initiation of LBNF operations. The Proposed Action is necessary to implement the vision articulated in the May 2014 report from the Particle Physics Projects Prioritization Panel (P5) and in the Mission Need Statement issued for PIP-II the DOE Office of Science (DOE-SC), both of which highlight the opportunity for the U.S. to host a world-leading long baseline neutrino program of intensity frontier research. The Project would support the long-term development of a broad multi-MW program at Fermilab as future resources become available (DOE 2017a).

DOE would use information contained in this EA to determine if the Proposed Action would significantly affect human health and the environment. If the Proposed Action would have a significant environmental impact, preparation of an Environmental Impact Statement (EIS) would be required to complete the NEPA process. If the Proposed Action would not result in significant environmental impacts, a Finding of No Significant Impact (FONSI) would be issued, thus completing the NEPA process.

1.2 COMPLIANCE WITH WETLAND AND FLOODPLAIN REVIEW

Under Executive Order (EO) 11988, *Floodplain Management*, and EO 11990, *Protection of Wetlands*, federal agencies are required to consider the impact of proposed actions on wetlands and floodplains. DOE requirements for compliance with EO 11988 and 11990 are included in Title 10, CFR, Part 1022, "Compliance with Floodplain/Wetlands Environmental Review Requirements." The EOs require federal agencies to implement floodplain and wetland requirements through existing procedures, such as those established to implement NEPA. This EA and supporting documentation support compliance with Floodplain and Wetland Environmental Review Requirements (10 CFR Parts 1021 and 1022).

1.3 BACKGROUND

DOE-SC is the lead federal entity responsible for energy and particle physics research. The challenge of particle physics is to discover, among other things, the composition of the Universe and how it works. Fermilab is one of DOE's National Laboratories and is a leader in high-energy particle physics research. At facilities such as Fermilab, scientists can make neutrino beams for experimental purposes with particle accelerators.

Fermilab is an established National Laboratory and has designed, constructed, and operated proton accelerators and high-intensity neutrino beams for years, beginning with the Main Ring in 1972, followed by the Tevatron Project in 1983. Later facilities include the Main Injector Neutrino Oscillation Search (MINOS), Neutrinos at Main Injector (NuMI) Project, and the lab recently completed and is now operating the NuMI Off-axis νe Appearance (NO*v*A) Project. These projects have extensive underground and surface facilities including a large accelerator - Fermilab's Main Injector (MI), existing power and cooling water systems, research laboratories, and other facilities. Fermilab completed EAs for the NuMI Project (DOE 1997), NO*v*A Project (DOE 2008), and for the Long Baseline Neutrino Facility and Deep Underground Neutrino Experiment (LBNF/DUNE) Project (DOE 2015).

The LBNF/DUNE Project proposes to construct facilities that would extract a proton beam from Fermilab's existing particle accelerator complex, generate a high-intensity neutrino beam, and direct the beam at an underground detector with one or more modules constructed 800 miles away at the Sanford Underground Research Facility (SURF) located in Lead, South Dakota. The beam would be generated underground and would travel through the Earth at depths of up to approximately 20 miles. The Fermilab components of the LBNF/DUNE Project would be constructed adjacent to Fermilab's existing accelerator ring and would include beamline facilities to extract and focus the beam (by means of target horns and magnets).

The PIP-II Project is a proposed upgrade of Fermilab's particle accelerator complex to generate an unprecedented stream of neutrinos (subtle, harmless, subatomic particles that could hold the key to understanding the Universe's evolution) by creating the world's most intense high-energy neutrino beams. The PIP-II Fact Sheet is provided in **Appendix A**.

To generate the high-intensity beam, protons are first emitted from a source and formed into a beam. The proton beam then travels down a 730-foot (250-meter [m]) superconducting linear accelerator, called a Linac. As the proton beam travels down the Linac, the beam energy is continually increased to 800 million electronvolts (or 800 megaelectronvolts [MeV]). At an energy of 800 MeV, the proton beam is traveling at approximately 84.2% of the speed of light. Once the proton beam exits the 800 MeV Linac, the proton beam is steered towards the existing Booster accelerator, where it is accelerated to 8 billion electronvolts (or gigaelectronvolts [GeV]). At an energy of 8 GeV, the proton beam is traveling at approximately 99.8% of the speed of light and is aimed at target horns to create neutrinos.

The PIP-II Project, in concert with other experiments at Fermilab, would help to advance our understanding of the basic physics of the elementary particles called neutrinos and thereby help us to understand the physical nature of our Universe. Neutrinos are harmless, elementary subatomic particles that have no electrical charge and are one of the most abundant particles in the Universe. In nature, they are produced in great quantities by sources such as our sun, stellar explosions known as supernovas, and in smaller quantities on earth by man-made facilities, such as nuclear power plants. Neutrinos stream to the Earth each day. The very small size of neutrinos means that they pass right through matter largely unimpeded, and only very rarely interact with other particles.

Neutrinos in flight naturally transform themselves by oscillating back and forth among three different states or "flavors" (muon neutrinos, electron neutrinos, and tau neutrinos). Neutrinos are non-ionizing particles and only rarely interact with ordinary matter. PIP-II would enable the most precise measurements yet of this neutrino oscillation phenomenon, which could potentially help physicists discover whether neutrinos violate the fundamental matter-antimatter symmetry of the Universe. If they do, then physicists at Fermilab and elsewhere would be a step closer to answering the puzzling question of why the Universe currently is filled preferentially with matter, while the antimatter that was created equally by the Big Bang has all but disappeared.

The United States (U.S.) currently occupies a leading position in the exploration of neutrino properties. The DOE-SC is the Nation's largest supporter of fundamental research in the physical sciences, which it pursues in partnership with national laboratories, universities, institutions, and other organizations with related missions around the world. Fundamental research involves investigation and analysis focused on obtaining a better or fuller understanding of a subject, phenomenon, or a basic law of nature, not necessarily specific practical application of the results. One important research area within the physical sciences is elementary particle physics, of which one goal is helping us to understand the physical nature of our Universe.

Since 1967, Fermilab has worked to answer these and other fundamental questions. As the U.S.' premier particle physics laboratory, scientists work on the world's most advanced particle accelerators and investigate the smallest building blocks of matter. Fermilab's focused scientific mission, coupled with its accelerator and detector facilities and research and development infrastructure, keep the U.S. a world leader in particle physics research. Fermilab's program, which would be enhanced by PIP-II, also provides opportunities for international partners to study particle physics at facilities in the U.S.

In September 2013, the DOE and the National Science Foundation charged the High Energy Physics Advisory Panel (HEPAP) to convene a P5 to develop a 10-year strategic plan for U.S. high energy physics in the context of a 20-year global vision. In May 2014, HEPAP unanimously approved the P5 report and its recommendations. The report provides a practical, long-term strategy that enables discovery and maintains the U.S. position as a global leader in particle physics. Consistent with the P5 report, a centerpiece of the High Energy Physics (HEP) program strategy is exploration of neutrino physics.

1.4 STATEMENT OF PURPOSE AND NEED

The current neutrino beam production capabilities at Fermilab are insufficient for the further study of neutrino physics called for by the HEPAP strategic plan. The performance requirements for the PIP-II Project must meet the "essential functions and capabilities" outlined in the approved PIP-II November 2015 Mission Needs Statement prepared by the DOE-SC, and the capabilities derived from the P5 report. Both documents highlight the opportunity for the U.S. and Fermilab to host world-leading neutrino research. These documents call for a performance upgrade of the Fermilab accelerator complex to support a world-leading neutrino program, while maintaining high-reliability operations through the rejuvenation of aging systems within this complex and providing a platform for future enhancements. PIP-II would support the long-term development of a broad multi-MW program at Fermilab as future resources become available.

The PIP-II Project at Fermilab would help to meet two key mission needs of the HEP program:

- *"To illuminate and answer questions about the unification of the forces of nature, the nature and origin of dark energy and dark matter, and the origins of the universe," and*
- *"To deliver scientific breakthroughs and extend our knowledge of the natural world by capitalizing on the capabilities available at the national laboratories, and through partnerships with universities and industry."*

The purpose of the PIP-II Project is to upgrade the existing proton beam power at the Fermilab accelerator complex to meet two main capability gap and mission need goals of the DOE-SC and Fermilab:

- To reduce the time for existing and planned experiments to achieve world-class results
- To sustain high reliability operation of the Fermilab accelerator complex

The need for higher proton beam power comes at a time when many components of the existing Fermilab accelerator complex that delivers beams to the MI, especially the Linac and the Booster, are approaching 50 years in age. Fermilab plans to form a new international collaboration to design and construct the PIP-II Project.

The conceptual development for PIP-II Project was developed based on the following design criteria:

- Deliver 1.2 MW of proton beam power from the Fermilab Main Injector, over the energy range 60 to 120 GeV, at the start of operations of the LBNF/DUNE program;
- Sustain high reliability operations of the Fermilab accelerator complex through the initial phase of LBNF/DUNE operations;
- Support the currently operating and envisioned 8-GeV program at Fermilab, including the Mu2e, g-2, and the suite of short-baseline neutrino experiments;
- Provide a flexible platform for long-range development of the Fermilab complex; specifically, to provide an upgrade path for an approximately 10-fold increase in beam power to the Mu2e experiment, and for extension of accelerator capabilities to include flexible high-bandwidth pulse formatting/high beam power operations.

The PIP-II Project at Fermilab would increase the production rates of neutrinos and reduce the time for the LBNF/DUNE Project to achieve world class results. Future experiments would also use the intense proton beam provided by PIP-II and/or laboratory infrastructure and may provide additional opportunities for basic research in other areas of physics. The PIP-II Project and ancillary experiments would further our understanding of neutrinos and their role in shaping our Universe, and would support all of the accelerator-based research at Fermilab. However, these future experiments which require higher levels of energy are not within the scope of the EA because implementation would require additional infrastructure that is not reasonably foreseeable at this time.

2 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

This section describes DOE's Proposed Action for the PIP-II Project. The rationale for not fully analyzing certain other alternatives and the No Action Alternative are also described.

2.1 OVERVIEW

The PIP-II Project is an accelerator upgrade project that would provide increased beam intensity and power to generate an unprecedented stream of neutrinos (subatomic particles that could unlock our understanding of the Universe and enable a broad program of physics research for many years to come). The goal of PIP-II is to generate proton beams at strengths greater than 1 MW, about 60% higher than current capabilities of the existing accelerator complex. These powerful beams of protons would in turn create intense beams of neutrinos. Future PIP-II upgrades would triple the lab's current beam power. PIP-II's high-intensity proton beams would provide a flexible platform for the long-term future of the Fermilab accelerator complex and the U.S. accelerator-based particle physics program (Fermilab 2018a).

Of the members of the subatomic particle family, neutrinos are ubiquitous yet fleeting particles and are the most difficult to detect. One method used by scientists to study neutrinos is to send neutrino beams generated from particle accelerators to large, stories-high detectors. The greater the number of neutrinos sent to the detectors, the greater the chances the detectors would catch them, and the more opportunity there is to study these particles.

To increase the number of neutrinos sent to the detectors, the PIP-II accelerator complex would generate proton beams of significantly greater power t than that currently available. The increase in beam power translates into more neutrinos that can be sent to the laboratory's various neutrino experiments. The result would be the world's most intense high-energy neutrino beam.

The centerpiece of the PIP-II Project is the construction of a new superconducting radio-frequency (SRF) linear accelerator, which would become the initial stage of the upgraded Fermilab accelerator chain. It would replace the current Fermilab Linac. The plan is to install the SRF Linac under 25 feet of soil in the infield of the now decommissioned Tevatron Ring (Main Ring).

The new SRF Linac would provide a big boost to its particle beam from the beginning, doubling the beam energy of its predecessor from 400 million to 800 million electronvolts. That boost would enable the Fermilab accelerator complex to achieve megawatt-scale beam power.

In the Linac, superconducting components called accelerating cavities would impart energy to the particle beam. The cavities, which look like strands of jumbo silver pearls, are made of niobium and would be lined up end to end. The particle beam would accelerate down the axis of one cavity after another, picking up energy as it goes. The Linac cavities would be encased in 25 cryomodules, which house cryogenics to keep the cavities cold (to maintain superconductivity). In PIP-II, a beam of protons would be injected into the Linac. Over the course of its 176 meters (3.5 Olympic-size pool lengths), the beam would accelerate to an energy of 800 million electronvolts (megaelectronvolts [MeV]). The Linac enclosure has space for 2 additional cryomodules that would upgrade the energy to 1 billion electronvolts (gigaelectronvolts [GeV]). Once it passes through the superconducting Linac, it would enter the rest of Fermilab's current accelerator chain – a further three accelerators – which would also undergo significant upgrades over the next few years to handle the higher-energy beam from the new Linac. By the time the beam exits the final accelerator, it would have an energy of up to 120-GeV and more than 1 MW of power.

After the proton beam exits the chain, it would strike a segmented cylinder of carbon. The beam-carbon collision would create a shower of other particles, which would be routed to various Fermilab experiments. Some of these post-collision particles would become (or "decay into," in physics lingo) neutrinos, which would by this point already be on the path toward their detectors (Fermilab 2018a).

The Proposed Action and No Action Alternative are summarized below and described in detail in the following subsections.

2.2 PROPOSED ACTION

The Proposed Action would include construction and operation of the PIP-II Project facilities at Fermilab in Batavia, Illinois. The proposed facilities and their construction and operation are described in detail in the following subsections.

Under implementation of the Proposed Action, Fermilab would construct and operate the PIP-II Project facilities at Fermilab. The proposed facilities would enhance the capabilities of the existing accelerator complex at Fermilab. Under the Proposed Action, the increased beam intensity would provide for an increase in beam power and result in increased levels of accelerator produced radionuclides, including tritium and sodium-22, at the targets and detectors (air, soil, surface water, and groundwater activation) throughout the accelerator complex and other experiments. Accelerator produced radionuclides have been previously evaluated in other Fermilab EAs for the LBNF/DUNE (DOE 2015), NuMI (DOE 1997) and NO*v*A (DOE 2008) Projects. These were all found to be well within regulatory limits. The PIP-II Project would not change the previous EA evaluations.

The total DOE-approved cost range for the PIP-II Project is $653 to $928 million (Bihary 2018). This assumes a contribution from Indian and (potentially) European collaborators.

The Proposed Action would include implementation of Fermilab's standard environmental protection measures (SEPMs) as used in all Fermilab construction contracts, such as post-construction re-vegetation, erosion control, and traffic control. The planned SEPMs are introduced in **Section 2.4**.

2.2.1 Location

Fermilab is located 38 miles west of downtown Chicago, Illinois, in an area of mixed residential, commercial, and agricultural land use **(Figure 2.2-1**). The proposed Project facilities would be located within DuPage and Kane Counties, with the aboveground facilities in DuPage County (**Figure 2.2-2, Figure 2.2-3** and **Figure 2.2-4**). The location of the PIP-II Project site was driven primarily by the physics requirement for proximity to the existing Booster accelerator and for siting for future upgrades, along with access to existing infrastructure to minimize cost. The proposed facilities would be constructed inside the Main Ring (Tevatron Ring) portion of the Fermilab property, adjacent to the footprint area of the Fermilab central campus, including the existing Wilson Hall, Transfer Gallery, and Booster Ring facilities, to allow direct access to existing electrical, water, and cryogenic infrastructure currently located in the vicinity. In addition, the Project location is well suited to extensions of chilled water service from the existing Central Utility Building (CUB). At the same time, the PIP-II Project site provides space for future expansion. The location of the proposed PIP-II facilities was chosen to minimize the impact to existing known wetlands within the Main Ring, and to conform to the 2015 Fermilab Campus Master Plan (Fermilab 2015a), which has designated the area east of Wilson Hall as the Superconducting Linac Complex. Every effort would be made to avoid impact on these existing wetlands and minimize unavoidable impacts during both the construction period and during operation of the new facilities.

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Source: Adapted from Fermilab GIS 2018

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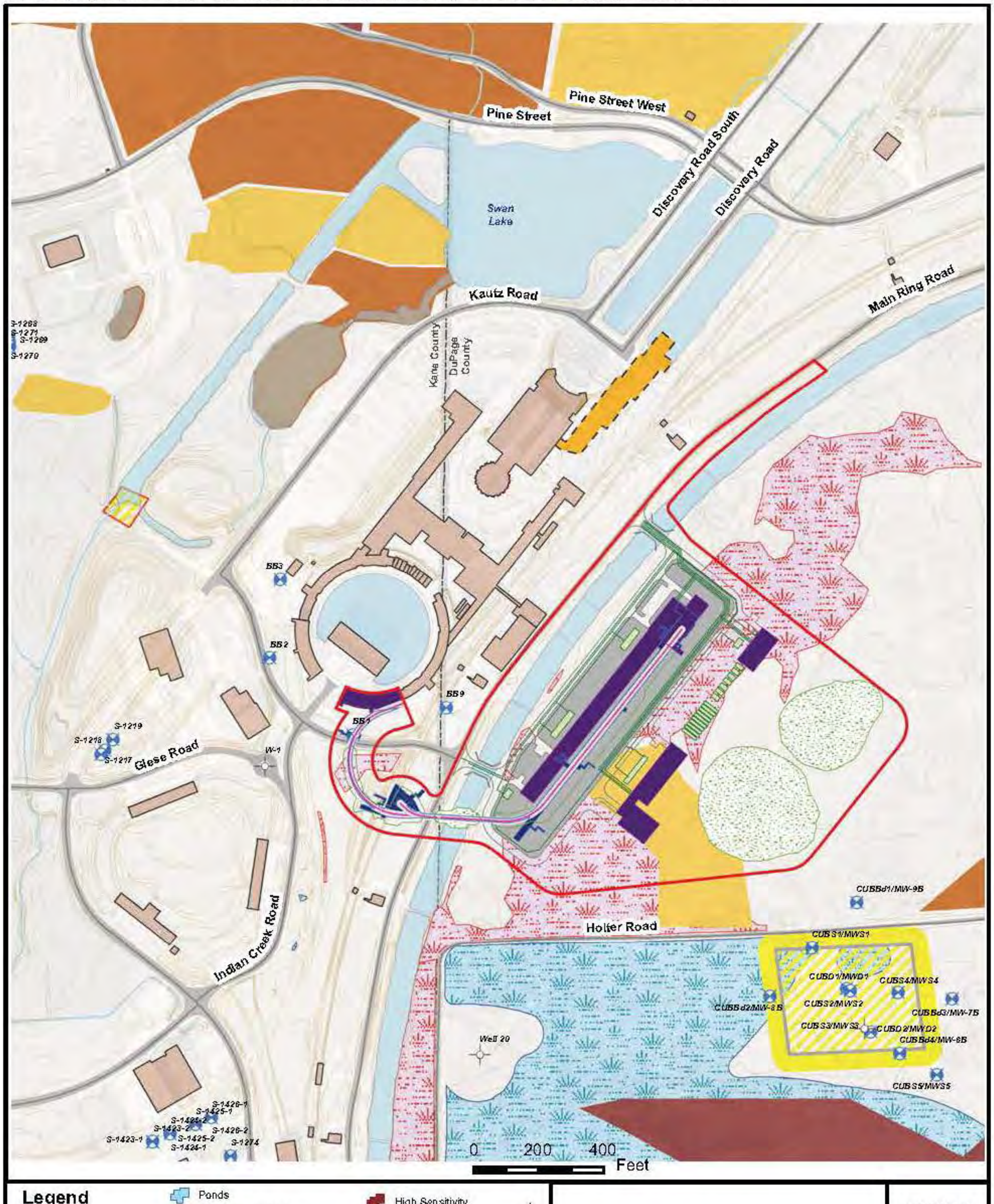

PIP-II EA	FIGURE 2.2-2
Site Plan	

Source: Adapted from Fermilab GIS 2018

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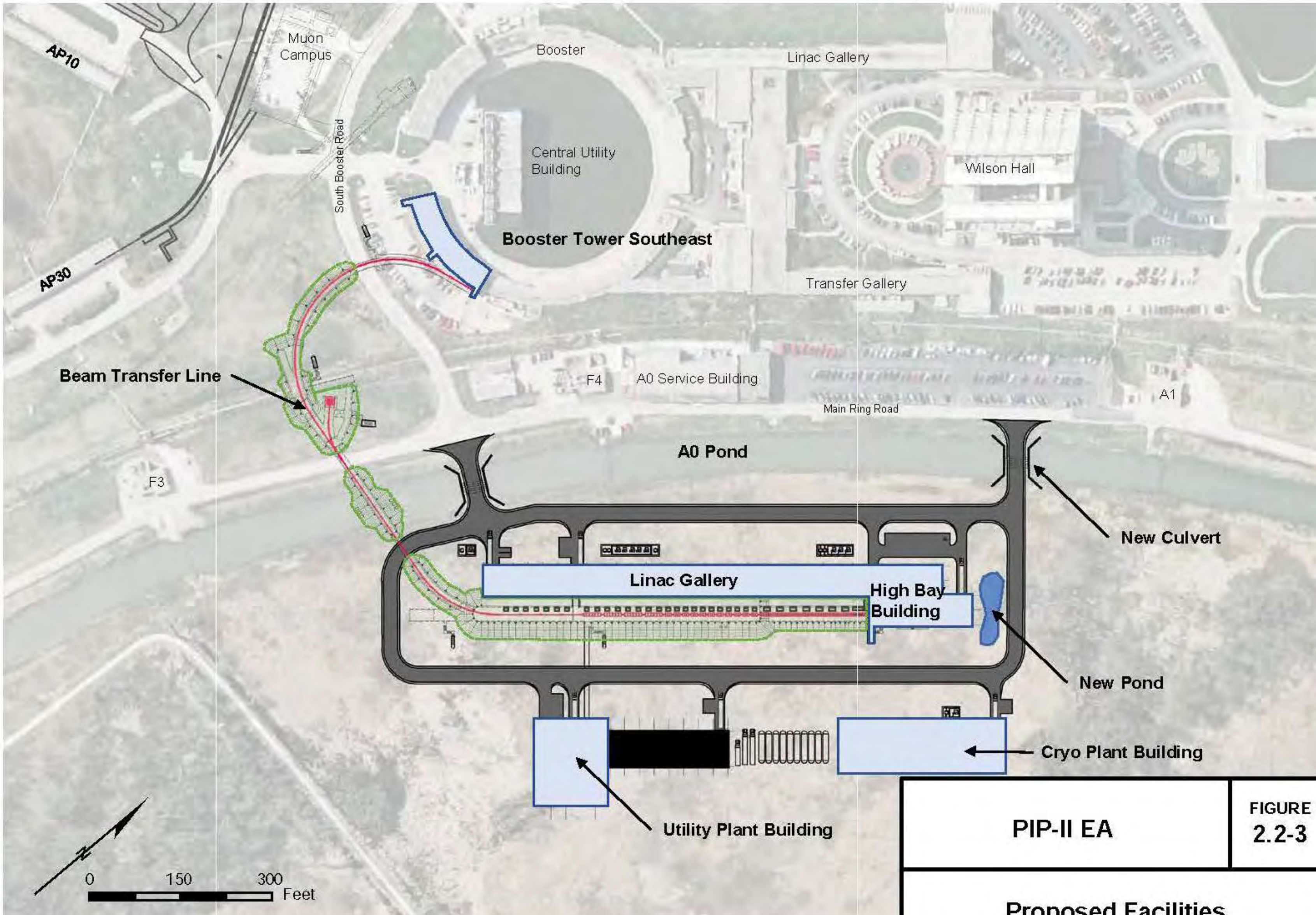

Source: Dixon 2018

PIP-II EA	FIGURE 2.2-3
Proposed Facilities	

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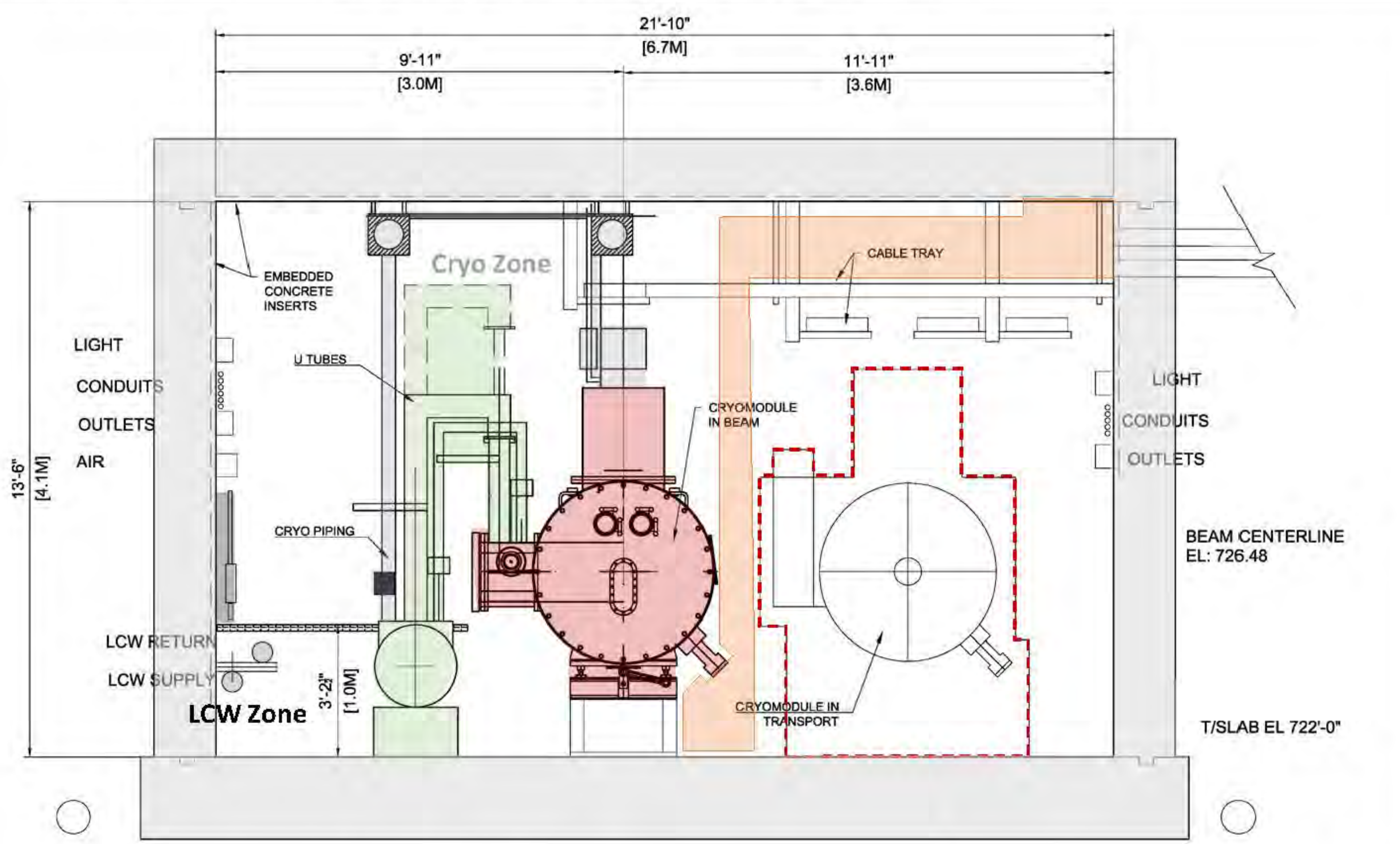


Section Through Linac Tunnel (Looking South)

PIP-II EA	FIGURE 2.2-4
Linac Tunnel Section	

Source: Derwent 2018

2.2.2 Proposed Facilities

The PIP-II Project would comprise several improvements and additions to the Fermilab accelerator complex with the goal of providing a proton beam power from the Main Injector of 1.2 MW delivered to the neutrino production target over the energy range of 60 to 120 GeV at the initiation of LBNF operations. The Proposed Action would involve considerable new construction, including underground enclosures and surface facilities along with support utilities extended from existing systems. Upgrades to several systems in the Booster, Recycler, and MI would be required to support the higher beam energy and intensity.

The proton beam would enter the Booster from the Linac and accelerate through its approximately 1,500-foot-circumference ring to an energy of 8 GeV. The Recycler is a 2-mile-circumference ring where the proton beam would be staged after exiting the Booster. Once the beam enters the Recycler, it would be "slip stacked" or combined into batches of protons to form a more intense beam. Subsequently, the proton beam would enter the MI, located directly beneath the Recycler in the same underground enclosure. The beam would then be accelerated in the MI up to an energy of 120 GeV before being sent to LBNF.

To support the higher Booster injection energy and higher beam intensity, upgrades to the Booster injection system, the radio frequency (RF) systems in all rings (the RF systems are used to accelerate the beam), and various feedback systems would be required. The upgrade to the Booster injection system is the most significant of these.

The primary element of the Proposed Action for the PIP-II Project would be the construction and operation of a new proton Linac housed in a 730-foot (250-m) long underground enclosure. The new Linac would have an adjacent 650-foot long surface Gallery that houses supporting power supplies and related equipment. The Linac would be connected to the existing Booster accelerator by a transfer beamline housed in a new underground enclosure that connects the end of the new Linac Tunnel to the existing Booster enclosure. Construction of this new Beam Transfer Line enclosure and Booster Connection would necessitate the partial demolition of approximately 30 feet of the existing Booster enclosure as well as approximately 120 feet of the existing Main Ring enclosure (Ball et al. 2017).

Conventional elements are required to house and support the Superconducting Linac, its Beam Absorber and the Linac-to-Booster transfer line. Four aboveground buildings would be constructed (Dixon 2018a) as shown on **Figure 2.2-2** and **Figure 2.2-3**. All above-grade buildings, roads, parking, utilities, and services to accommodate the equipment for the operation of the facility would be installed on the Fermilab property.

New roadways would be located adjacent to the Linac alignment and parking areas at the surface buildings. There would also be a new utility corridor adjacent to the Linac alignment that would extend through the PIP-II Project site and connect to the existing CUB and Fermilab infrastructure. A description of each of the proposed facilities is provided in **Table 2.2-1**.

Table 2.2-1 Proposed Action Facilities

Facility	Description	Approximate Dimensions
Roadway and Parking Areas	A new road system would be built along the length of the new Linac connecting the parking area at each of the new surface buildings to the existing Main Ring Road.	Total new paved or hardstand road: 80,000 square feet
Utility Corridor	A new utility corridor would extend from the Project site and connect to the Central Utility Building and other Fermilab infrastructure at the south end and to existing electrical infrastructure at the north end.	1,900 linear feet
Utility Plant Building	Surface building would house the mechanical equipment to support accelerator operations located near the Linac Tunnel.	7,995 square feet
Linac Tunnel	Underground concrete enclosure would house accelerator components	22 feet wide 19,935 square feet
Linac Gallery	Surface building would be located directly adjacent to the underground Linac Tunnel	50 feet wide 650 feet long 32,905 square feet
Beam Transfer Line/Booster Connection	Underground concrete enclosure would connect the Linac Tunnel to the existing Booster enclosure and house accelerator components.	10 feet wide 14,435 square feet/ 7,750 square feet
Cryogenic Plant Building	The Cryogenic Plant Building would support cryogenic operations of the Linac components and would house cryogenic equipment. The surface building would be located near the Linac Tunnel.	23,245 square feet
High Bay Building	Surface building would be located near the upstream end of the Linac Tunnel; would house the warm front-end accelerator components, and provide a means of equipment access to the underground Linac Tunnel enclosure below.	21,275 square feet

2.2.3 Construction

The Proposed Action would involve new construction, including surface facilities and underground enclosures, along with support utilities extended from existing systems. In all cases, the construction would be completed with a priority to minimize environmental impacts to the PIP-II Project site.

The potential planned schedule for construction and assembly of components, including interruption to operations, is over the period of 7 years, currently from 2020 through 2026. A summary of the estimated PIP-II Project schedule is provided in **Section 2.4**.

Construction would require an approximate average of 18 construction workers per day, with a peak workforce of approximately 38 workers per day. Construction parking would be temporary and located close to the final service building locations.

Conventional construction would be required to install, house, and operate the cooling systems to support PIP-II accelerator operations. Conventional facilities would be constructed to house and support the Superconducting Linac, its Beam Absorber, and the Linac-to-Booster transfer line. Surface construction includes the buildings listed in **Table 2.2-1**, road and parking relocation, and additional roadways and access from the Fermilab Central Campus. All aboveground buildings, roads, parking, utilities, and services to accommodate the equipment for the operation of the facility on the Fermilab property are also included. The architectural style of the new buildings would reflect and be harmonious with the existing buildings.

Currently, the layout has been optimized based on accelerator requirements. In addition, the layout considers existing land uses, topography, sustainability, watersheds, vegetation, natural habitat, and wetlands.

The methods for construction of the conventional facilities work would be similar to that which has been employed on the Fermilab property for decades. Construction of the below-grade facilities, as well as the aboveground service buildings, are similar to proven construction methods previously executed at Fermilab.

The PIP-II scope includes the conventional elements of work normally included in construction, such as earthwork, utilities, structural concrete, structural steel, architectural cladding, finishes, roofing, plumbing, process piping, heating ventilation and air conditioning (HVAC), fire protection, fire detection, lighting, and electrical. This also includes the work required to extend the utilities to the PIP-II Project site, excavation associated with the below-grade cast-in-place concrete enclosures, creation of a shielding berm, and site restoration.

Underground construction includes the Linac Tunnel, the Beam Transfer Line, and Beam Absorber enclosure. Construction of the below-grade structures would use the conventional “open cut and cover” method. This method has been used successfully at Fermilab for the construction of most of the existing on-site shielded enclosures of a similar depth and use.

The major components of construction are described in the following subsections.

2.2.3.1 Site Preparation

Site preparation would require clearing and excavation of the construction work zone. The site work would include the extension of existing utilities to the Proposed Action facilities, installation of permanent access roads to the service buildings and associated parking areas, and related work to provide the supporting infrastructure. Site work for extension of utilities would require shutoffs for local gas, power, communication, and domestic water services, as well as short-term interruptions in utility services to some adjacent facilities.

Construction would require limited power, potable water, water for dust control, wastewater treatment, and natural gas. Power demand for construction would be short-term and would be limited to lighting construction trailers, operating small tools, and powering ventilation and pumps. The increased power, water, and other utility requirements of the Proposed Action would be within the capacity of current electricity and water suppliers.

During site preparation, the affected area would be greater than 1 acre; therefore, an Illinois Environmental Protection Agency (IEPA) National Pollutant Discharge Elimination System (NPDES) permit would be required for stormwater discharges during construction. Fermilab would apply to the IEPA for coverage under the NPDES General Permit for Stormwater Discharges from Construction Site Activities (IL10) by submitting a Notice of Intent (NOI). The Proposed Action would require preparation of a Project-specific construction Storm Water Pollution Prevention Plan (SWPPP) that would conform to “Illinois Urban Manual” standards (NRCS 2002). Stormwater would be managed according to the Project-specific construction SWPPP and Fermilab’s existing site-wide SWPPP. Site drainage would be controlled by ditches and culverts, preserving the existing watershed characteristics during construction and subsequent operation.

The existing South Booster Road would be reconfigured to allow for the installation of the Beam Transfer Line and associated shielding. New access roads would provide vehicular access to the PIP-II facility from existing Fermilab roads. These roads would be constructed in a manner similar to that of existing

Fermilab roads and would be suitable for all-weather access. The access road would intersect the existing Main Ring Road at two locations to prevent dead ends. Paved parking would be provided for vehicles at major entries to the buildings along with a gravel hardstand that would provide a staging area during installation. A paved approach to the at-grade loading dock with suitable truck maneuvering space would be provided.

The existing A0 cooling pond is currently used for cooling existing beamline components in the Main Ring tunnel as well as a return path for Industrial Cooling Water (ICW) discharge from cryogenic loads in the A0 service building. The existing A0 cooling pond would be reconfigured and upgraded to serve as a return path for the ICW to provide cooling for process load heat exchangers.

2.2.3.2 Demolition and Decommissioning of Existing Infrastructure

The Proposed Action would include decommissioning any existing Main Ring or Booster Ring equipment before the start of construction. Demolition activities would require shutoffs for local gas, power, communication, and domestic water services for removal and capping, as well as short-term interruptions in utility services to some adjacent facilities.

Construction of the underground enclosure for the Beam Transfer Line and connection to the existing Booster Ring would necessitate the demolition of approximately 30 linear feet of the existing Booster Ring enclosure, as well as approximately 120 linear feet of the existing Main Ring enclosure.

Decommissioning of any existing Main Ring or Booster Ring equipment would be completed before the start of construction. Decommissioning would be conducted by Fermilab personnel in accordance with established Fermilab policies and procedures and standard SEPMs (**Section 2.3**) required by regulation and DOE directives. The construction Contractor would be required to implement standard SEPMs for managing hazardous and radioactive waste pursuant to DOE Orders, DOE's Manual 435.1-1 for Radioactive Waste Management, the Fermilab Environment Safety and Health Manual (FESHM) and the Fermilab Radiation Control Manual (FRCM).

Demolition would primarily include demolition, removal, and recycling of various building materials such as reinforced concrete, perimeter drain tile, and excavated materials. Demolition activities would require shut-offs for local gas, power, communication, and domestic water services for removal and capping. The Contractor would be required to dispose of all construction and demolition waste with a recycling vendor and obtain a report on the amounts of each material recycled for submittal to Fermilab.

Before demolition, the structures would be inspected, and in some cases tested, for the presence of any regulated waste materials/items, including asbestos. Regulated waste would be segregated before proper removal by the Subcontractor.

It is possible that some of these materials would be activated at low levels. If found, any activated material, along with metals to be recycled, would be segregated and managed in accordance with Fermilab standards and procedures in coordination with the Fermilab Radiological Control Organization.

2.2.3.3 Utilities

During construction, some existing utilities would be extended to the Proposed Action facilities, including power, industrial water, domestic water, and communications. Construction crews would install supporting utilities including electrical, plumbing, HVAC, and safety systems, largely inside the enclosures, buildings, and underground halls.

The following utilities are required to support the operation of the facility. The list incorporates current assumptions and would require further refinement as the design process progresses.

- Electrical power includes new duct banks and use of existing duct banks from two sources including the Kautz Road Substation (KRS) and the Master Substation (MSS), along with a permanent 250 kilowatt (kW) diesel standby generator to supply emergency power. Separate high-voltage feeders with backup would be provided for conventional, machine and cryogenic power.
- Natural gas for building heating would be supplied via new supply lines from the existing site-wide natural gas system.
- Communications include new duct banks tied into the existing communication network along Main Ring Road.
- Domestic water supply (DWS) for potable water and facilities would be supplied via new supply line from the existing site-wide DWS system.
- Sanitary Sewer (SS) for facilities would be supplied via new sewer main and lift station from to the existing site-wide SS system.
- Low-conductivity water (LCW) for machine cooling would be supplied via new supply and make-up water from the existing MI Ring LCW system.
- Chilled water (CHW) for machine and building cooling would be supplied via new supply and return lines from the existing CUB.
- ICW for fire protection would be supplied via new supply and return lines along Main Ring Road.

The total estimated power requirements for the PIP-II Superconducting Linac operating in the pulsed mode (PM) and the Beam Transfer Line to the Booster is approximately 6 MW. Fermilab currently has sufficient power supplied by local utilities for the PIP-II upgrades. The existing 13.8 kilovolt (kV) Fermilab-wide electrical feeder system would be extended to PIP-II, served primarily from the MSS. A backup feeder, capable of powering critical portions of PIP-II, would be served from the existing KRS. The MSS network would be connected at manhole P71 in the Main Ring and installed in a new concrete encased duct bank to the PIP-II Project site. A new substation, consisting of transformers, air switches, and related electrical gear, would be installed adjacent to the PIP-II Linac Gallery and the Cryogenics Plant Building.

The PIP-II facility is estimated to require a peak electrical demand of 25 megavolt ampere (MVA). The source of power would be from the existing Fermilab 13.8 kV electrical distribution system. Electrical transformers are required to change the 13.8 kV system voltage to a useable 480 V at the facility. The electrical transformers would be mineral oil-filled type. The estimated number of transformers is 10, each containing approximately 650 gallons of mineral oil of a type that complies with Fermilab standards.

Electrical transformers with oil represent a possibility of an abnormal situation that would result in the release of mineral oil from the transformers. During the design phase methods of preventing an unintended release to the environment would be investigated. In the past, two such methods have been approved for similar work. The first method would involve the construction of a secondary containment structure around the electrical transformers designed to contain the oil spill. The other method is to demonstrate an engineered environmental equivalent that accomplishes the same goal of preventing an unintended release to the environment. Either method would comply with Fermilab best practices and environmental guidelines.

The existing natural gas service would be extended from the existing site-wide network at Booster Tower Road near CUB. Natural gas would provide a fuel source for HVAC heating. The existing CUB chillers have the capacity to supply 300 tons of CHW to PIP-II for cooling. The CHW Supply and CHW Return lines would be connected near Booster Tower Road near CUB and would be routed to the PIP-II Project site. The overall HVAC system is designed to be modular and operated at lower heat loads in PM operations using CHW from CUB, and supplemented using the new chiller located in the PIP-II Utility Plant Building to operate at the higher heat loads anticipated during Continuous Wave (CW) operations.

The existing data and communication system would be extended in new duct banks to the PIP-II Project site from existing below-grade duct banks along the Main Ring Road. The connection location is assumed to be the existing communication manhole located adjacent to the existing Transfer Gallery.

The existing DWS service would be extended from the intersection of Booster Tower Road near the CUB to provide potable water and make up water for process systems. As part of the subsequent design phases, a looped system connecting to other segments of the site-wide DWS system would be investigated and incorporated as required.

The new buildings for the Proposed Action would require new connections to the sanitary and storm sewers. Additionally, existing sanitary and storm sewers would be rerouted as necessary. Sanitary waste and any maintenance discharge from the PIP-II Utility Plant would be directed to the existing on-site SS system which is connected to the Batavia publicly owned treatment works (POTW).

A new ICW pond may be constructed on the PIP-II Project site. This approximately 0.25- acre pond would extend the cooling water surface area of the existing cooling pond network. The pond would be located within the PIP-II Project site to collect cooling water from the Cryogenic Plant Building and sump pump discharges. This pond would discharge by gravity through a control structure to the existing A0 pond, where it would then be returned by existing means to the site-wide ICW network.

Surface stormwater and sump pump discharges would be directed to the on-site cooling water system. PIP-II would connect to the existing SS system at Booster Tower Road near CUB. The PIP-II SS system would accommodate discharges from the toilet facilities as well as backwash from process loads. A new lift station at the PIP-II facility would collect the sanitary discharge locally and pump it via a force main to a new manhole installed in the existing SS system.

Radioactive water (RAW) systems would be used for the programmatic equipment in the Beam Absorber area of the Beam Transfer Line enclosure. Based on existing Fermilab system designs for groundwater protection, the RAW system would be double-isolated from surface water and would reject the heat to the LCW system.

Fermilab would implement SEPMs (**Section 2.3.3**) to minimize the impacts of radiation on surface water and groundwater and would design and operate the beamline to comply with DOE and U.S. Environmental Protection Agency (USEPA) water quality standards. To protect groundwater quality in accord with the Fermilab Groundwater Program, Fermilab would implement a Project-specific groundwater monitoring plan to establish flow patterns and conduct groundwater quality sampling in the vicinity of the Project facilities. The details of the groundwater monitoring plan (e.g., number of wells, installation details, or locations) have not yet been developed.

To provide cooling, a supplemental CHW system would be used to provide the CHW used under CW-Linac operations. This chiller system would be located in the PIP-II Utility Plant Building, and supply and return piping would be routed underground to the Linac Gallery. The mechanical system inside the Gallery space would be based on ducted air handling units.

The ICW service would provide a cooling medium for the cryogenic compressors housed in the Warm Compressor Station of the Cryogenic Plant Building. The existing site-wide ICW system would be extended from the existing lines located near the intersection of Booster Tower Road and Main Ring Road to the PIP-II Project site. The ICW would be strained/filtered to achieve the PIP-II water quality requirements. To provide a cooling medium that meets the cryogenic compressor requirements, the ICW supply would be routed through a heat exchanger located in the PIP-II Utility Plant Building. This would allow the compressor side of the heat exchanger to be a closed loop system with water treated to meet the cryogenic compressors requirements. The ICW would be discharged into a new return ditch and routed through existing return routes to Casey's Pond.

The existing site-wide ICW service is fed from Casey's Pond at the north end of the Fermilab property, where it is filtered and treated as it is pumped into the piping network. This service is anticipated to supply treated ICW for fire protection in the sprinkler system and hydrants in addition to 1,400 gallons per minute (gpm) of process cooling to serve as a cooling medium for the cryogenic compressors. The ICW discharge would be piped west of the Main Ring Tunnel so that it would flow to Casey's Pond via existing cooling ponds and return ditches.

A series of evaporative fluid coolers would provide a cooling medium for the LCW system without the use of chillers. This modular design approach would provide the direct cooling of the LCW system without the need for heat exchangers, or cooling ponds. ICW was considered a cooling medium, however the site-wide ICW system lacks the capacity to provide this cooling.

The Linac Tunnel would be designated as an Oxygen Deficiency Hazard (ODH) location and would require a protection system. The Linac Tunnel would be ventilated with neutral, dehumidified air as required by code. The underground air flow would include the provision for ODH ventilation.

2.2.3.4 Linac Complex

Construction would include installation of a below-grade Frontend and Linac Tunnel and the associated above ground High Bay Building and Linac Gallery Building (**Figure 2.2-3**). The Linac site is close to the Booster, in the Main Ring. This location affords direct access to existing electrical, water, and cryogenic infrastructure. It has the added benefit of minimizing the impact to existing wetlands. The proximity of the Linac to the Booster is constrained by various existing utilities and buildings along Main Ring Road.

The aboveground portions of the Linac would provide space for the support services required to install, operate and maintain the PIP-II beamline components. The aboveground and below-grade portions of the Linac Gallery and High Bay Building would be designed to include egress, construction type, emergency lighting, exit signage and smoke control ventilation in accordance with the International Building Code and National Fire Protection Association (NFPA). Automatic sprinkler systems for the Linac Support Building would comply with the standards for an Ordinary Hazard Group 1 classification, in accordance with latest edition of the NFPA Codes and Standards. The facilities would be designed and configured to minimize the potential for future prairie burns in the Main Ring.

The below-grade Linac Tunnel would house the accelerator components, as well as provide space for support functions, including the Linac hardware, penetrations for utilities (power, water, cryogens) and cabling, as well as for equipment installation and maintenance. The Linac Tunnel would also accommodate the logistics of installation, repair, and removal of beamline components and related support equipment.

The depth below-grade of the Linac Tunnel is based on the beamline components matching the elevation of the existing Booster component. The base slab of the Linac Tunnel is at elevation 722 feet (220 m) amsl or approximately 25 feet below existing grade. A concept cross-section of the enclosure is provided on **Figure 2.2-4**.

The below-grade enclosure would be equipped with code-compliant exit stairways to the required maximum distance to an exit. These exit stairs would be configured to maintain the radiation safety shielding requirements. Fire detection would be via air sampling and line type sensors.

Installation would include painting of the interior walls and ceiling of the Linac Tunnel and moisture-proofing of the exterior to provide a safe and dry semi-conditioned space for personnel and equipment. The below-grade structures would be flanked with underdrain piping that would negate the hydraulic pressure on the walls and roof of the enclosure. The underdrains would be routed to duplex sumps that would carry water away from the structure and discharge it to existing surface water features.

The walls and ceiling of the Linac Tunnel would be fitted with channel inserts to support cable trays, cooling water, electrical conduits, and fire detection equipment. In addition to required emergency and exit lighting, light fixtures would be provided to supply a minimum of 20 foot-candles. Some of these lights would be on uninterruptible power supply circuits to provide emergency lighting during power failures.

The south (downstream) end of the Linac Tunnel would include an elevator to accommodate the movement of the test carts, diagnostic equipment, and related items needed for Linac operations and maintenance. Note that a passage from the downstream to the upstream end of the below-grade portion of the High Bay Building would be obstructed by the Linac-to-Booster transfer line located at the same height as the Linac or 4.3 feet (1.3 m) above the tunnel floor.

Construction of the below-grade structures would use the conventional “open cut and cover” method. This method has been used successfully at Fermilab for the construction of most of the existing on-site shielded enclosures of a similar depth and use. The soil stockpiles shown on **Figure 2.2-2** would be used temporarily during construction; however, approximately 120,000 cubic yards (yd^3) of material would remain at the stockpile location, unless other locations are identified on the Fermilab property.

Based on an initial shielding analysis, the design of the Linac Tunnel would accommodate 18.5 feet (5.6 m) of Earth-equivalent, passive shielding to achieve unlimited occupancy of the Linac Gallery and surrounding spaces. In general, this would be accomplished with an earthen berm with maintainable side slopes. For road crossings and areas where berms are not feasible, the design would use steel plates to achieve the required equivalent shielding. The 18.5 feet (5.6 m) of shielding is based on a preliminary assessment which would be finalized during the final design. Shielding documentation would be prepared and initial approval for construction obtained before the start of construction.

2.2.3.5 High Bay Building

The High Bay Building includes a high bay service building with a loading dock and related services to accommodate the installation and servicing of beamline components (**Figure 2.2-3**). The High Bay Building would provide space for unloading, staging and assembling beamline components. This includes an at-grade loading dock with a 20-ton overhead bridge crane for moving equipment from grade to the below-grade portion of the high bay. The High Bay Building would be designed to accommodate visitor tours as part of the Fermilab outreach program.

The below-grade portion of the High Bay Building would be sized to accommodate the low-energy portion of the PIP-II beamline components that do not require radiation shielding as well as space for staging and preparing beamline components for installation. The below-grade portion of the High Bay Building would also contain the support equipment and infrastructure required to operate the adjacent beamline components.

2.2.3.6 Linac Gallery and Support Space

The Linac Gallery would house the equipment needed to operate the beamline components in the adjacent, below-grade Linac Tunnel (**Figure 2.2-3** and **Figure 2.2-4**). The Linac Gallery would include a loading dock and related services to support installation and services of beamline components. The support space of the Linac Gallery would house the equipment and services required to support the operation of the building. One bay of the Linac Gallery would provide space for beamline power supplies, control equipment and related equipment.

The Linac Gallery would run parallel to the below-grade Linac Tunnel and house the components required to operate the PIP-II accelerator. The Linac Gallery is of similar length as the underground Linac enclosure, housing the utilities and support equipment to operate the RF power systems, magnets, vacuum, and controls.

The Gallery would be approximately 690 feet (210m) long; constructed parallel to the below-grade Linac Tunnel; and would provide penetrations for utilities, controls, cooling water, cryogens and related operational services. The south (downstream) end of the Gallery would include access to the elevator to the Linac Tunnel to accommodate the movement of the test carts, diagnostic equipment and related items needed for Linac operations and maintenance.

2.2.3.7 Beam Transfer Line

The Beam Transfer Line would bring the beam from the Linac end to the Booster. The Beam Transfer Line would include the below-grade enclosures to house the beamline components required to transport the proton beam from the new Linac Tunnel to the existing Booster enclosure and includes the conventional construction work required to cross the existing Main Ring tunnel, as well as the work required to transport the beam into the existing Booster accelerator enclosure and space and equipment to house the Beam Absorber.

The Beam Transfer Line enclosure would cross the Main Ring tunnel, which holds the existing 120 GeV transfer line used for beam delivery to the Fixed Target Area Switchyard, which is assumed to continue operating during PIP-II operations. The floor of the Beam Transfer Line enclosure would match the elevation of the Linac Tunnel to facilitate the installation of beamline components.

The Beam Transfer Line would house the beamline components required to bring the proton beam from the downstream end of the Linac Tunnel to the existing Booster accelerator. The 737-foot (225-m) long Beam Transfer Line enclosure would generally have a 10-foot (3 m) wide by 8-foot (2.45 m) high cross-section.

To accommodate the crossing of the new Proposed Action transport line and the existing Main Ring beamline, the PIP-II beamline would rise up and over the existing Main Ring beamline components. A portion of the existing precast Main Ring Tunnel would be removed and replaced with a cast-in-place concrete structure capable of accommodating both beamlines. This portion of the Beam Transfer Line enclosure would have an 11-foot (3.4-m) high enclosure (**Figure 2.2-5**).

The method of construction for the Beam Transfer Line enclosure would be the traditional "open cut and cover" method, in which earth material is excavated, the concrete beamline enclosure is constructed, and the completed enclosure is then covered with the excavated material with granular material of the sides of the enclosure to facilitate drainage. This method has been used successfully at Fermilab for the construction of most of the shielded enclosures on-site.

Installation would include painting of the interior walls and ceiling of the Beam Transfer Line and moisture-proofing of the exterior to provide a safe and dry semi-conditioned space for personnel and equipment. The enclosure would be flanked with underdrain piping that would negate the hydraulic pressure on the walls and roof of the enclosure. The underdrains would be routed to a duplex sump that would discharge water onto grade and away from the enclosure. The walls and ceiling of the enclosure would be fitted with channel inserts to support cable trays, cooling water piping, electrical conduits, and fire detection equipment.

The Beam Transfer Line enclosure would be separated from the Linac Tunnel by an air barrier to contain the evaporated cryogens within the Linac Tunnel. Fire detection would be via air sampling and line type sensors. The fire detection devices would report to the fire panel in the Linac Gallery.

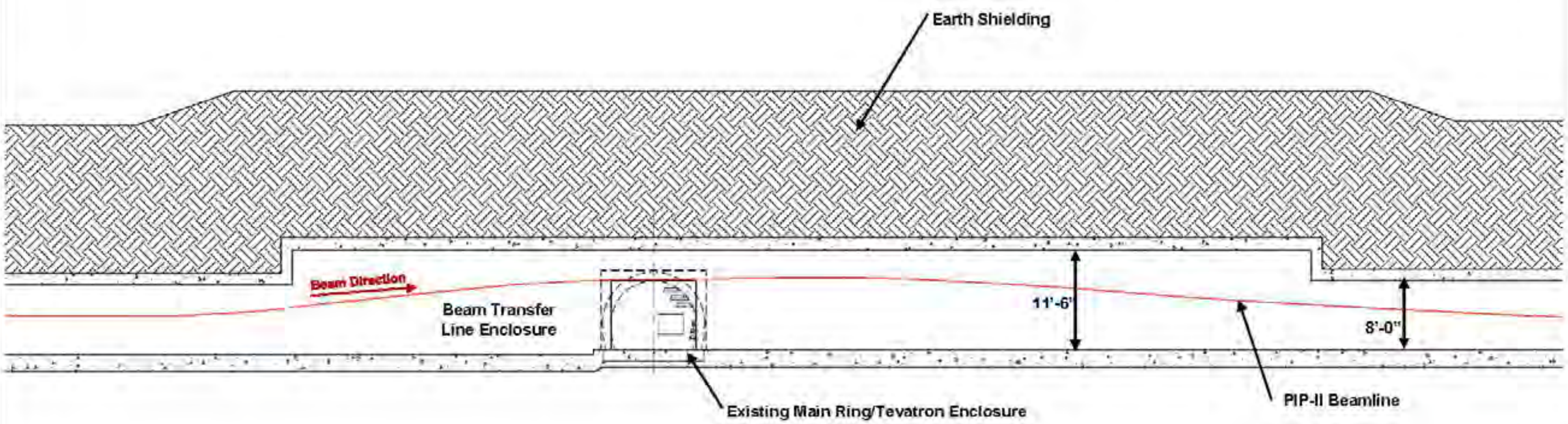
A Beam Absorber enclosure would house the 50 kW Beam Absorber, RAW system, and related equipment. The Beam Absorber enclosure would be on the right side (looking downstream) of the Beam Transfer Line enclosure. This configuration determines that the worker passage along the tunnel would be at its left side.

The Beam Transfer Line enclosure would be installed beneath the existing Booster Tower East parking lot and building to allow for the PIP-II beam to intercept the existing Booster beamline at the existing Long 11 straight section, which results in minimal displacements of the existing Booster tunnel equipment and reduces interference with existing support services.

The installation of the Beam Transfer Line enclosure would require partial demolition of the existing Booster Tower East building to excavate and install the cast-in-place concrete connection to the existing Booster enclosure.

The Booster Tower Southeast parking lot would be replaced with a shielding berm similar in style and construction to that constructed when the MI 8GeV line was installed at Booster Tower Southwest. Vehicular access to existing electrical equipment in the northeast corner of the parking lot would be provided for maintenance of the electrical equipment.

Path: Z:\GISProjects_ENV_ALPHA_ENV_E-F\FERMILAB\AdobeIllustrator\AI\PIP_II_EA\Fermi_PIP_II_Fig2.3-5_Beam Transfer Section.ai Last Saved By: JChen Last Saved On: 05/03/2018



Section Through Beam Transfer Line (Looking South)

Source: Derwent 2018

PIP-II EA

FIGURE 2.2-5

Beam Transfer Section

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The Beam Transfer Line would be designed to support up to 18.5 feet (5.6 m) of earth and concrete shielding in order to provide for "unlimited occupancy" of all aboveground areas accessible to the general public. The Beam Transfer Line enclosure includes code-required egress paths. The 18.5 feet (5.6 m) of shielding is based on a preliminary assessment, which would be finalized during the final design. Shielding documentation would be prepared and initial approval for construction obtained before the start of construction.

2.2.3.8 Cryogenic Plant Building

The Cryogenics Plant Building would provide space to house the cryogenics equipment needed to support operation of the accelerator components (**Figure 2.2-3**). The Cryogenics Plant Building would be located at the downstream end of the Linac Tunnel and positioned to allow for future expansion.

Conventional construction methods would be used to install, house and operate the cryogenic plant to support PIP-II accelerator operations. The Cryogenic Plant Building would contain the Cold Box Station, the Warm Compressor Station and Exterior Space, as described below.

2.2.3.9 Cold Box Station

The Cold Box Station would contain the equipment to install, operate and maintain the cold box. This includes the following criteria:

- Building Size: 50 feet x 131 feet (15 m x 40 m);
- Overhead crane with a capacity of 15 tons;
- Overhead door 17 feet x 17 feet (5 m x 5 m);
- Maximum floor loading: 4,096 pounds/square foot (sf; 20,000 kilogram [kg]/square meter);
- Space for five 2,641-gal (10,000-liter [L]) dewars;
- 565 liters/minute (150 gpm) of chilled water;
- Coordination Center to house four to eight people;
- Control Room to accommodate equipment, monitors and related control equipment; and
- Control Room and Coordination Center should have an isolated HVAC system capable of pressurizing the room to reduce the ODH of the space.

2.2.3.10 Warm Compressor Station

The Warm Compressor Station would contain the equipment to install, operate and maintain the compressor and related equipment to support the Cold Box Station. This includes the following criteria:

- Building Size: 66 feet x 100 feet (20 m x 30 m);
- Overhead crane with a capacity of 25 tons;
- Overhead door 17 feet x 17 feet (5 m x 5 m);
- Space for five 2,641-gal (10,000-L) dewars; and
- The cooling medium for the cryogenics compressors can be ICW if it meets PIP-II quality requirements. The ICW is anticipated to require additional filtration to meet the solids requirements.

2.2.3.11 Exterior Space

The exterior space for the Cryogenic Plant Building would provide access to the Cold Box Station and Warm Compressor Station. This includes the following criteria:

- Space for ten 30,000-gal (113,000 L) storage tanks and related piping;
- Space for one 9,000-gal (34,000 L) liquid nitrogen dewar and related piping;
- Space for one truck mounted mobile purifier;
- Space for tanker truck for servicing the storage tanks/dewar;
- Parking for eight to ten vehicles;
- Loading dock access to both the Warm Compressor Station and the Cold Box Station; and
- Underground utility tunnel that connects the Cryogenics Plant Building to the Linac Tunnel.

2.2.3.12 Utility Plant Building

The Utility Plant Building would house the mechanical infrastructure to cool the Cryogenic Plant Building, LCW systems and HVAC systems (**Figure 2.2-3**). The Utility Plant Building is sized to accommodate the anticipated equipment for both Pulsed Mode and Continuous Wave-compatible mode operations. The Utility Plant Building would be located at the upstream end of the Linac Tunnel and would include the following:

- Heat exchangers, pumps, electrical equipment and controls for the LCW and CHW systems;
- Water treatment and filtration systems;
- Electrical equipment;
- Control Room; and
- Exterior space for cooling towers.

2.2.3.13 Fire Protection Systems

Fire Alarm/Fire Suppression systems would be designed in accordance with the applicable sections of the Fermilab Engineering Standards Manual. Automatic sprinkler systems would be designed to a minimum of an Ordinary Hazard Group 2 classification, in accordance with NFPA latest standards. The most commonly used NFPA standards relative to automatic sprinkler systems are: 13, 20, 25, 318, and 750. Automatic sprinklers would be installed in buildings. Automatic sprinklers are not required in the enclosures or vertical exit passageways. Automatic sprinklers were installed in the MI at enclosure stairs connecting to surface buildings and for 50 feet on either side of the stair alcove. These assumptions would be validated during subsequent design phases by life safety consultants.

The below-grade enclosures would be designed to allow for safe passage of personnel through the enclosure during operations and installation. Egress would be spaced so that travel distances are no greater than 300 feet where there are two paths of travel to an exit and no more than 50 feet when equipped with sprinklers (25 feet without sprinklers) where there is a single path of travel to a vertical exit. Doors would be located at the enclosure levels at each exit, but because the vertical distance to the exit discharge is less than 30 feet, double doors are not required. All exits from below-grade enclosures would lead to an exit discharge without requiring travel through a building. The facility would be equipped with a hard-wired, zoned, general evacuation fire alarm system. Fire alarm systems would be designed with a minimum standby power (battery) capacity capable of maintaining the entire system in a non-alarm condition for 24 hours, in addition to 15 minutes in full load alarm condition. The fire alarm system would comply with NFPA standards relative to fire alarm systems, including 70, 72, 90A, and 318. Manual pull stations and alarm notifications would be provided in enclosures and buildings. In addition, fire extinguishers would be provided in accordance with FESHM 6000: Fire Safety.

2.2.3.14 Radiation Safety

During demolition where activated materials are anticipated, all personnel involved in these activities would be provided with appropriate radiation badging in accordance with established DOE and Fermilab policies and procedures. Radiation survey, sampling, and monitoring would be required during excavation and demolition, and would be provided by Fermilab personnel. Activated materials would be segregated and disposed of by Fermilab personnel in accordance with established Fermilab policies and procedures. Any activated earth would be stockpiled separately and would be the first material to be used as backfill around the new underground construction. No other hazardous waste is anticipated to be generated during demolition or decommissioning.

The conventional facilities would be designed to incorporate the applicable radiation safety requirements as contained in FESHM 11000: Radiation Safety, to reduce exposure to as low as reasonably achievable (ALARA) levels, including shielding labyrinths, exit passageways, and passive shielding. The conceptual design is based on a preliminary review of the expected beam intensities and historical data from similar equipment. A complete radiation assessment would be conducted in subsequent Project phases. The results of these assessments would be incorporated into the conventional facilities design.

The conventional facilities portion of the Project would incorporate physical space for the radiation safety interlock system, but the installation of the equipment, extension of monitoring devices, and programming of the system would be conducted as part of the equipment installation. These systems would be designed in accordance with the FRCM (Fermilab 2017a). In accordance with current FRCM requirements, all sump discharges from the Linac enclosure and the Transport Line enclosure would be discharged to cooling ponds or ditches.

2.2.3.15 Construction Waste

The construction Contractor would be required to dispose of all construction and demolition waste with a recycling vendor and obtain a report on the amounts of each material recycled for submittal to Fermilab. Before demolition, the structures would be inspected, and in some cases tested, for the presence of any regulated waste materials/items including asbestos. Regulated waste would be segregated before removal by the construction Contractor. Recycling of metals would be coordinated with the Fermilab Radiological Control Organization.

Typical construction and demolition waste is anticipated. Recycling of waste material would follow Fermilab procedures. Detailed information on types and quantities of demolition waste would be determined in the design phase.

2.2.3.16 Restoration and Landscaping

The facilities would be designed and configured to minimize the potential for future prairie burns in the Main Ring. Disturbed areas would be restored after construction activities are completed. Construction yards and stockpile areas would be removed after completion of the construction phase of the Project. All disturbed areas would be returned to a natural state or landscaped in a similar manner as that installed at other Fermilab experimental sites. Erosion control would be maintained during all phases of construction, including restoration activities.

2.2.4 Operations

Fermilab would operate and maintain the Proposed Action facilities in coordination with DOE and other partners over a planned operational lifetime of approximately 40 years. The proposed Linac would provide an 800 MeV proton beam, upgradeable to 1 GeV, with flexible beam intensity and time structure. The primary purpose would be to provide a beam to the Fermilab Booster accelerator, with subsequent acceleration in the Recycler and MI to provide the 1.2 MW beam to LBNF/DUNE. Operations would run 24/7 and approximately 8 months of the year. Under control of the operations crew in the Fermilab Main Control Room, operators and scientists optimize the beam for intensity and performance-related characteristics. The Proposed Action would require approximately ten on-site workers at any one time over the 40 years of operations. As the proposed Linac would replace an existing accelerator, the Proposed Action would require few additional Fermilab employees.

Before to operations, the Linac would be subject to cryogenic safety and ODH Analysis and an Accelerator Readiness Review by an Environmental Safety and Health Review Panel as described in the FESHM (Fermilab 2017a). The responsible operational Fermilab Division, Fermilab Management, and DOE would then provide operational approval.

2.2.4.1 Air Emissions

A permanent 250-kilowatt diesel generator would be provided as part of the PIP-II Project to supply emergency power. No other stationary air emission sources are anticipated for operations. During construction, various gasoline and/or diesel-powered vehicles, excavation equipment, cranes, and other equipment would be used for excavation, backfilling, material movement, and general construction activities.

2.2.4.2 Chemical Use or Storage

Helium gas would be required for the Cryogenic Plant operation. Storage facilities for both helium and liquid nitrogen would be provided as part of this PIP-II Project. No other gases or chemicals would be required, used, or stored as part of this PIP-II Project. It is estimated that annual consumption would be approximately 1,200 liters of helium (15% of the helium inventory) and 1,000 liters of liquid nitrogen.

2.2.4.3 Radioactive Exposure or Radioactive Emissions

Accelerator-produced radionuclides, including tritium and other short-lived radionuclides, are expected byproducts of accelerator operations at Fermilab. The primary element of the PIP-II Project is a new proton linear accelerator. The increased beam intensity and power would generate increased levels of radionuclides at targets and detectors (air, soil, surface water, and groundwater activation). It is anticipated that operation of this new accelerator may result in low-level irradiation of the soil and groundwater adjacent to the accelerator enclosure similar to that previously experienced with the Tevatron and MI accelerator enclosures. Radiation levels would be monitored in accordance with existing established Fermilab policies and procedures.

Although there is no indication that operation of the PIP-II accelerator would result in tritium in the groundwater, the Project would comply with the requirements of the Fermilab tritium monitoring and management plan. Fermilab would implement SEPMs **(Section 2.3.3**) to minimize the impacts of radiation on surface water and groundwater, and would design and operate the beamline to comply with DOE, IEPA, and USEPA water quality standards. To protect groundwater quality in accord with the Fermilab Groundwater Program, Fermilab would implement a Project-specific groundwater monitoring plan, to establish flow patterns and conduct groundwater quality sampling in the vicinity of the Project facilities. The details of the groundwater monitoring plan (e.g., number of wells, installation details, or locations) have not yet been developed.

Based on a preliminary shielding assessment, the design of the Linac Tunnel would accommodate 18.5 feet (5.6 m) of earth equivalent, passive shielding to achieve an unlimited occupancy of the Linac Gallery and surrounding spaces. The tunnel shielding design, which is an integral part of the tunnel detailed design, would allow the PIP-II Linac to operate at its maximum design proton beam power capability. In addition, a radiation safety interlock system integrated with beam controls would be installed at all access points to the machine areas. Personnel involved in these activities would be provided with appropriate radiation training and badging in accordance with established Fermilab policies and procedures. Fermilab would monitor and maintain system components, including replacement of irradiated or damaged components; monitor groundwater; maintain ventilation and cooling water systems; and monitor staff for health and safety. The Project would develop a detailed radiological shielding assessment in accordance with established laboratory policies outlined in FESHM. Key aspects analyzed in the shielding assessment are listed below.

Radiological Shielding Assessments have been developed for the existing laboratory experimental program areas. These assessments analyze the radiological impacts from both normal and accidental beam losses. Items assessed include prompt, residual, air, soil, groundwater, and surface water activation. The analysis compares potential impacts against regulatory requirements to ensure compliance. These assessments define the maximum annual and hourly beam intensity allowed to each area of the facility.

Under the Proposed Project, increased beam intensity and power would result in increased levels of radionuclide generation throughout the accelerator complex and other experiments. Although PIP-II would have the ability to provide more protons than the existing Linac, the existing facility areas would remain limited to their currently approved beam operational limits. Fermilab's existing radiological programs ensure compliance with beam intensity limits.

Accelerator produced radionuclides have been previously evaluated in other Fermilab EAs for the LBNF/DUNE, NuMI and No*v*A Projects which would utilize the increased beam intensity and power from PIP-II. These were all found to be well within regulatory limits. The PIP-II Project would not change the previous EA evaluations.

2.2.5 Future Decommissioning

The PIP-II upgrade would not be decommissioned for many years, and it is too speculative to evaluate future decommissioning impacts in this EA. Similar to the LBNF/DUNE EA, the environmental impacts of decommissioning the PIP-II facilities would need to be evaluated as part of a future NEPA review process.

2.2.6 New or Modified Permits

There are no streams or creeks within the PIP-II Project site. The Proposed Action would not involve activities within a 100-year or 500-year floodplain (FEMA 2004).

The Main Ring infield has known wetlands. In the spring of 2016, DOE conducted a wetland delineation to refine the understanding of the extent of the wetlands within the PIP-II Project site. During construction of the Proposed Action facilities, placement of fill would displace up to 16.9 acres of non-jurisdictional wetlands (WBK 2016).

The PIP-II Wetland Assessment Report (WBK 2016) and Project plans were submitted to the U.S. Army Corps of Engineers (USACE) with a request for a Jurisdictional Determination (JD) regarding whether the impacted wetlands would be considered jurisdictional waters of the U.S. (WOUS; 33 CFR § 328.3). The USACE issued a JD on July 23, 2018 (USACE 2018; **Appendix B**) verifying that the wetlands within the PIP-II Project site are not jurisdictional; therefore, these wetlands would not be subject to the Clean Water Act (CWA) Section 404 permitting process.

Construction would disturb greater than 1 acre of ground; therefore, an IEPA NPDES permit would be required for stormwater discharges during construction. Fermilab would apply to the IEPA for coverage under the NPDES General Permit for Stormwater Discharges from Construction Site Activities (IL10) by submitting a NOI. The Proposed Action would require preparation of a Project-specific construction SWPPP that would conform to "Illinois Urban Manual" standards (NRCS 2002). Stormwater at the PIP-II Project site would be managed according to the PIP-II Project-specific construction SWPPP and Fermilab's existing site-wide SWPPP.

During construction of the Proposed Action facilities, dewatering may be required. If dewatering is necessary, pumped groundwater would be collected in Fermilab's existing cooling water ditches and ponds. Fermilab has an existing NPDES permit (IL0026123) authorizing stormwater discharges into cooling waters from designated Solid Waste Management Units (SWMUs), industrial activity areas, and services support areas. The current NPDES permit expires in March 2019; therefore, if dewatering is required during construction of the PIP-II facilities, a permit modification would be made at the time of renewal, if necessary. DOE would prepare a dewatering plan in compliance with the NPDES permit requirements.

2.3 STANDARD ENVIRONMENTAL PROTECTION MEASURES

Fermilab would implement standard SEPMs required by regulation, DOE directives, and site policies to minimize environmental impacts of PIP-II construction and operation. The following SEPMs, as well as standard industry practice Best Management Practices (BMPs), would be implemented as part of the Proposed Action to minimize environmental impacts. The FESHM describes many of these measures. Several examples are listed below.

2.3.1 Biological, Cultural, and Geological Resources

Fermilab would implement SEPMs to preserve on-site habitat and soil, including protecting trees adjacent to construction areas, stockpiling and reusing topsoil, managing stormwater, and restoring vegetation. All construction workers and managers would be required to become familiar with and apply U.S. Fish and Wildlife Service (USFWS) and State Historic Preservation Office (SHPO) requirements and the relevant laws and reporting procedures, as well as other applicable requirements, to protect biological and cultural resources that could be encountered during excavations. Training would be provided to Fermilab workers, construction Contractor and Subcontractors to address permit conditions and SEPMs to protect migratory birds and summer roosting bats, including avoiding vegetation removal at specific times of the year. Training would also address recognition of the rusty-patched bumble bee (RPBB), reporting measures for observations, and the appropriate SEPMs for the RPBB (a special status wildlife species known to occur in the PIP-II Project site) based on the USFWS Conservation Guidance 2018 (USFWS 2018a).

The Cultural Resources Management Plan (CRMP) outlines a process for evaluating potential impacts if unanticipated cultural resources are encountered during ground disturbance. Fermilab workers, construction Contractors and Subcontractors would be trained and become familiarized with the CRMP requirements.

2.3.2 Health and Safety

Fermilab would implement SEPMs such as preparing and implementing construction health and safety plans pursuant to the Fermilab Integrated Safety Management Systems (ISMS), DOE requirements (e.g., 10 CFR 851, Worker Safety and Health Program), Occupational Safety and Health Administration (OSHA) 29 CFR Parts 1910 and 1926, American Conference of Governmental Industrial Hygienists (AGCIH) silica requirements, and pertinent building codes (e.g., National Electrical Code).

To minimize worker exposures to activated materials during operations, the Project would comply with operational SEPMs outlined in the FRCM and 10 CFR 835, Occupational Radiation Protection. The Proposed Action facilities would be designed with sufficient shielding and operated such that worker and public radiation doses would comply with the FESHM, DOE standards, and Fermilab policy. Other SEPMs would include worker training and badging, monitoring of excavated soil by a radiological control technician, and cryogen safety training.

2.3.3 Air and Water Resources

During construction of the PIP- II Project, Fermilab would minimize fugitive dust emissions and construction impacts on air and water quality. These SEPMs are outlined in Fermilab manuals and would include preparation of a PIP-II Project-specific SWPPP outlining appropriate stormwater BMPs, as well as spill prevention measures. BMPs would be tailored to the site and could include placing erosion control measures (e.g., silt fence, straw bales), preserving existing vegetation, covering stockpiled soil, sweeping access roads, and spraying disturbed areas with water. If dewatering is necessary during construction, Fermilab would also prepare a dewatering plan in compliance with the NPDES permit requirements.

During operations, Fermilab would minimize air emissions, comply with existing air permits, implement and maintain operational stormwater BMPs, and comply with NPDES permits. Fermilab would incorporate appropriate SEPMs to minimize air emissions and to protect groundwater and surface quality.

Fermilab would implement SEPMs to minimize the impacts of radionuclides on surface water and groundwater, and would design and operate the beamline to comply with DOE and USEPA water quality standards. To protect groundwater quality in accordance with the Fermilab Groundwater Program, Fermilab would implement a Project-specific groundwater monitoring plan to establish flow patterns and conduct groundwater quality sampling in the vicinity of the Project facilities. The details of the plan (e.g., number of wells, installation details, or locations) have not yet been developed.

To minimize migration of radionuclides to the groundwater, the cooling ponds are underlain by naturally occurring clay. In addition to the redundant interceptor system and bedrock grouting, Fermilab would evaluate the installation of a monitoring well program adjacent to these structures to allow sampling of each of the shallow bedrock zones. The number of monitoring wells and their specific locations have not yet been determined and would be identified in the site-specific groundwater monitoring plan and based on the site-wide Fermilab Groundwater Monitoring Plan (Fermilab 2015b). The monitoring program encompasses both radionuclides and chemical contaminants. At present, there are numerous monitoring wells adjacent to the proposed PIP-II Project site. Once operations commence, process samples would be analyzed and the results used to evaluate whether additional monitoring wells are required for the Project.

2.3.4 Noise and Vibration

During construction, Fermilab would implement SEPMs to minimize noise and vibration. Fermilab construction would normally be conducted during daytime hours. Fermilab would utilize quiet equipment where practicable and add enclosures around ventilation systems. Fermilab would also comply with Project-specific requirements and local noise ordinances regulating construction and operational noise and vibration to minimize impacts to the surrounding communities.

2.3.5 Transportation

Fermilab would implement traffic and transportation SEPMs outlined in the FESHM including preparing a construction traffic management plan, scheduling worker and delivery arrivals during off-peak commuter hours, and complying with the Federal Highway Administration (FHWA) Manual on Uniform Traffic Control Devices. This manual provides specifications for signage, detours, speed limits, flaggers, and other traffic safety measures. Traffic SEPMs would also include implementing a traffic control plan, worker training, posting speed limits, regular inspection of construction vehicles, and installing signage.

2.3.6 Visual Resources

Construction activities and permanent aboveground facilities within the PIP-II Project site would not be visible from off-site locations or on-site recreational areas, including the Illinois Prairie Path or interpretive nature trail. The Project-specific architectural styles for the new buildings would be harmonious with the existing buildings at Fermilab. Fermilab would implement SEPMs to minimize visual impacts, including re-vegetation of disturbed areas, landscaping similar to other Fermilab facilities, and directing outdoor lighting downward. Revegetation would reduce contrast with adjacent grassy areas, agricultural fields, and restored prairie.

2.3.7 Hazardous and Radioactive Materials

Fermilab would implement SEPMs for managing hazardous and radioactive waste pursuant to DOE Orders, DOE’s Manual 435.1-1 for Radioactive Waste Management, the FESHM and the FRCM (Fermilab 2017a). These measures would govern how the material would be characterized and how to manage any radiological or hazardous waste encountered during demolition, excavation and construction. During demolition activities, materials that have been exposed to ionizing radiation would be surveyed before removal by radiological control technicians and documented before release for disposal or reuse. SEPMs for hazardous waste management would include Contractor compliance with USDOT requirements for the transportation of any hazardous materials, the existing Fermilab Emergency Response Plan, Spill Prevention, Control, and Countermeasures (SPCC), and Waste Management Plan, along with the Project-specific SWPPP. The electrical transformers would be designed with adequate secondary containment to contain an inadvertent spill of mineral oil. Accelerator-produced radionuclides are an expected outcome of operating the planned accelerator complex. Similar to past and ongoing experiments, Fermilab would comply with operational SEPMs outlined in the FRCM and DOE’s Occupational Radiation Protection regulations, 10 CFR Part 835, for management of operational waste including worker training and badging, and managing pumped groundwater in on-site cooling water ponds.

2.4 CONSTRUCTION AND INSTALLATION PROPOSED ACTION SCHEDULE

Construction and equipment installation of Proposed Action facilities at Fermilab would require a total of approximately 7 years (2020 to 2026). This schedule is preliminary and subject to change. Start dates depend on completion of the NEPA process and receipt of all permits and approvals. Availability of funding could also impact the schedule. In the case of schedule slippage, the durations of individual work components and sequencing would not be expected to change substantially. As described below, many of the major components would be constructed concurrently.

Site Work/Installation of Utilities	2020 – 2022
Linac Complex	2021 – 2026
Buildings: High Bay, Cryogenic Plant, Utility Plant	2019 – 2024
Operations	2026 – 2066
Decommissioning (not included in Proposed Action)	2066 – 2076

2.5 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED NEPA ANALYSIS

In addition to the Proposed Action, other action alternatives considered for the NEPA analysis included PIP-II Alternatives 2, 3 and 4. This section describes the rationale for not fully analyzing these three implementation alternatives.

Four design alternatives for implementation of the PIP-II Project were assessed in the Analysis of Alternatives (AoA) Report (Fermilab 2016a). Other than power and operational differences, the environmental and safety impacts associated with Alternatives 2, 3, and 4 would be the same as or very similar to those associated with the Proposed Action. After detailed internal evaluation of all the factors related to PIP-II, Fermilab concluded that Alternatives 2, 3, and 4 would not meet all of the goals developed for the PIP-II Purpose and Need because these alternatives would not provide the long-term missions and upgrades required for the evolution of the Fermilab complex as envisioned in the P5 report. For these reasons, Alternatives 2, 3, and 4 were eliminated from detailed consideration under the NEPA analysis in this EA.

2.6 NO ACTION ALTERNATIVE

As required by CEQ regulations at Title 40 CFR Parts 1500-1508, the PIP-II EA evaluates a No Action Alternative as a basis for comparison with the Proposed Action. Under the No Action Alternative, the Proposed Action would not be constructed or operated; therefore, none of the impacts (adverse or beneficial) analyzed in **Section 3** would occur from the Proposed Action; however, other unrelated impacts would occur as a result of ongoing experiments, operations, and other planned projects. The existing large physics research programs, including other ongoing neutrino experiments, as well as planned projects would continue at Fermilab and would be subject to their own environmental analyses, permitting, and monitoring.

The ongoing research and planned projects not related to or dependent on the PIP-II Project, such as the LBNF/DUNE, NuMI, NO*v*A, and other projects, would continue to advance neutrino science at Fermilab. Potential effects associated with the LBNF/DUNE Project were previously analyzed in the LBNF/DUNE EA (DOE 2015). Potential effects associated with the NO*v*A Project impacts were analyzed in the NO*v*A EA (DOE 2008). The potential impacts resulting from the NuMI Project were analyzed in the NuMI EA (DOE 1997).

The No Action Alternative would not include the upgrades to the existing proton beam power needed to meet the capability gap and long-term mission need goals of the DOE-SC and Fermilab:

- To reduce the time for existing and planned experiments to achieve world-class results
- To sustain high reliability operation of the Fermilab accelerator complex

The scientific goals of studying neutrino oscillations would not be achieved in the U.S. in the near future, and thus neither the purpose nor the need for the PIP-II Project (see Purpose and Need statement in **Section 1**) would be fulfilled. Without the PIP-II facilities, it would take two to three times longer to achieve world-class physics results. Fermilab's high-energy physics data collection would occur at a slower rate and would be prolonged, which would threaten the viability of Fermilab's high-energy physics mission. Other future experiments that rely on the ability to provide increased beam intensity and power would also not be constructed. The No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab.

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This section describes the existing physical, biological, and socioeconomic features of the PIP-II Project site and the potential environmental impacts of implementing the Proposed Action and No Action Alternative. Potential impacts are analyzed by evaluating the types and magnitudes of the impacts on each resource. Specifically, the impacts are analyzed by evaluating the following factors:

- Type - beneficial or adverse, direct or indirect impact
- Context - the geographic, biological, physical, and social contexts in which the impacts would occur, whether site-specific, local, regional, national, or global
- Duration and frequency - short-term or long-term; singular event or with a pattern of recurrence
- Intensity - the severity of the impact, in whatever context(s) it occurs.

Sections 3.1 through **3.16** describe and summarize the affected environment and discuss the analysis of the potential environmental consequences based on the Project description provided in **Section 2**. The impact analysis is intended to accommodate the full range of potential impacts from the Proposed Action and No Action Alternative so that the range of impacts has been considered. The final design may differ slightly from that discussed in this EA, and all facility sizes and dimensions (e.g., sizes of excavation, square foot capacities of facilities, volume or weight of excavated material) described are approximate. However, the nature, scope, and potential environmental impacts of the Proposed Action and No Action Alternative (discussed in this section) would be very similar to those identified in this EA.

To evaluate potential impacts from construction and operation of industrial facilities, the impact assessment methodology used in **Section 3** includes comparison of impacts with regulatory thresholds such as those contained in DOE regulations; USEPA limits; and other guidelines, standards, and numerical criteria. Regulatory thresholds for health and safety, water quality, and air quality are risk- or technology-based and were developed to evaluate, regulate, and control discharges/emissions to minimize exposure risks and adverse environmental impacts.

This EA evaluates the potential environmental impacts that could result from implementing the Proposed Action or the No Action Alternative. The potential environmental impacts evaluated in this EA are summarized below.

3.1 LAND USE AND RECREATION

This section describes the current land uses at Fermilab, including the types of land uses present (on-site research facilities and on-site recreational facilities), adjacent land uses, and the potential land use and recreational impacts from the Proposed Action and the No Action Alternative. The affected environment includes areas at Fermilab potentially impacted by the Proposed Action construction and operations, as well as off-site areas where land use or recreation could be affected indirectly by visual, noise, dust, traffic, or other impacts.

3.1.1 Affected Environment

Fermilab is located on 6,800 acres approximately 38 miles west of downtown Chicago, Illinois. It straddles the boundary between eastern Kane and western DuPage Counties in an area of mixed residential, commercial, and agricultural land use. Adjacent municipalities include the Towns of Warrenville (east), Batavia (west), West Chicago (north), and Aurora (south and southwest).

Land uses directly adjacent to Fermilab, west of Kirk Road and extending to the west and north, are residential. To the south and to the west of the Prairie Path are areas zoned general commercial (GC) and multi-family medium density (R4). At the corner of Kirk Road and Giese Road, there is a parcel zoned public facilities and institutional (PFI). To the north on Kirk Road, there are large areas zoned light industrial (LI) and general industrial (GI). Land uses south of Butterfield Road in Aurora Township are primarily commercial.

The U.S. Atomic Energy Commission commissioned Fermilab under a bill signed by President Lyndon B. Johnson in 1967 and has been a visible and continuing presence in the surrounding community since that time. Many existing facilities on the Fermilab property are currently visible from off-site locations. Land uses surrounding the facility have developed and evolved over time, increasing in both diversity and intensity. By all measures, the changes in surrounding land use have progressed in harmony with operations at Fermilab.

Land uses within the Fermilab property are primarily devoted to DOE-funded research facilities. Fermilab's primary mission and associated land use is the conduct of high-energy physics research experiments. For several decades, extensive underground and surface facilities, including a large accelerator complex, power and cooling water systems, research laboratories, and other facilities, have supported Fermilab’s mission. The use and character of developed land within the Fermilab property is consistent with its primary mission as a high-energy physics research facility. While fulfilling this mission, Fermilab has maintained a balance with the environment by preserving and restoring natural habitats within the property limits and, by allowing public access to restored open spaces.

The Fermilab property occupies lands that were historically farmed. Approximately 2,200 acres are currently licensed for crop production. Portions of Fermilab are devoted to restoration of native prairie, and approximately 68 acres of pasture are used for bison grazing; however, bison do not graze on restored prairie lands or oldfield grasslands. Currently, approximately 986 acres of tallgrass prairie, ranging from moderately moist (mesic) to wet habitats, have been restored with native prairie vegetation. Fermilab has two remnant tallgrass prairie areas, each occupying less than 3 acres (Fermilab 2018b).

In 1989, Fermilab was designated a National Environmental Research Park (NERP). The DOE established seven NERPs around the U.S. for environmental research. The preserve and research areas are not generally open to the public.

Fermilab supports recreational activities for the community, including an interpretive nature trail near the Lederman Science Center and public areas for birding, as well as various educational programs. In addition, the 62-mile-long Illinois Prairie Path crosses the southwest corner of the Fermilab property. Within Fermilab, the path is used for hiking and biking.

The entire PIP-II Project site was previously disturbed during construction of the Tevatron Project (shut down in 2011) and currently contains roadways, utilities, undeveloped land, and wetlands. The PIP-II Project site is located within the Main Ring adjacent to the footprint area of the Central District of the Fermilab campus, including the existing Wilson Hall, Transfer Gallery, and Booster Ring facilities. The PIP-II Project site was chosen to conform to the Fermilab 2015 Campus Master Plan (Fermilab 2015a), which has designated the area east of Wilson Hall as the Superconducting Linac Complex, to allow direct access to existing electrical, water, and cryogenic infrastructure currently located in the vicinity and to minimize impacts to existing wetlands.

The Illinois Prairie Path is located approximately 4,600 feet southwest of the Proposed Action aboveground facilities. The PIP-II Project site is not visible from off-site locations or from on-site recreational areas, including the Illinois Prairie Path and the interpretive nature trail.

3.1.2 Environmental Impacts

3.1.2.1 Proposed Action

3.1.2.1.1 Construction

The Proposed Action aboveground facilities would be located on land inside the Main Ring portion of the Fermilab property. Before construction, approximately 28 acres of prairie vegetation would be cleared for the temporary construction laydown areas and soil stockpiles within the PIP-II Project site.

There would be no direct off-site land use impacts because the Proposed Action is contained within the Fermilab property. The Proposed Action facilities would not be visible to the public from off-site locations. Recreational use of the Illinois Prairie Path and the interpretive nature trail on the Fermilab property would not change. Public access to Fermilab’s open space and recreational amenities would continue unchanged.

Construction of the Proposed Action would have very low impacts on existing or future on-site land uses at Fermilab as a research facility, in that the Proposed Action is entirely consistent with the mission of the facility to conduct state-of-the-art, high-energy physics research. Construction of the Proposed Action would enable Fermilab to maintain its leadership in the field of neutrino physics research. Construction activities and future aboveground structures would not change the character, type, or intensity of land use in the surrounding community. The construction workforce would commute to the site from surrounding areas; therefore, they would not stimulate the need for new permanent housing, schools, medical facilities, mass transportation, or other community services that could otherwise influence surrounding land use. Fermilab and Wilson Hall are existing land uses that have been integral elements of the existing land character for the past 40 years; therefore, the Fermilab facilities are considered as background visual elements. The PIP-II facilities would be consistent with the surrounding and existing land uses within the Fermilab property. Construction activities would have very low indirect impacts on off-site land use and very low impacts on the character of properties in the surrounding community.

3.1.2.1.2 Operations

Operations would occur within the approximately 28 acres previously affected by the Proposed Action construction. Of the 28 acres within the PIP-II Project site, the footprint of Proposed Action aboveground facilities would be approximately 5 acres. The remaining 23 acres would be revegetated.

Operation of the Proposed Action would have no direct impacts on adjacent, off-site land uses, including residential areas along Kirk Road. The operations workforce would be recruited from existing staff and therefore would not stimulate the need for new permanent housing, schools, medical facilities, mass transportation, or other community services that could otherwise influence land use in the immediate area. Operations would not change the character, type, or intensity of land use in the surrounding community. Operations would have very low, indirect impacts on off-site land uses.

Operations would not affect lands used for recreation, natural resource preservation and research, or NERP activities. The Proposed Action facilities would not be visible to off-site land uses or onsite recreational areas, including the Illinois Prairie Path or the interpretive nature trail. The Proposed Action would be visible to visitors traveling along the east side of Wilson Hall; however, the surface buildings would be landscaped in a manner comparable to the existing buildings at Fermilab. In addition, the proposed facilities would be visible from the observation areas that overlook the PIP-II Project site and Main Ring.

The low operational noise levels associated with the Proposed Action would not be noticeable at the Illinois Prairie Path or the interpretive nature trail; therefore, operations would have very low impacts on recreational use of the Illinois Prairie Path or the interpretive nature trail.

3.1.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no impacts on land use or recreation from the Proposed Action; however, existing research projects and planned projects would continue at Fermilab. Without the PIP-II facilities, Fermilab's high-energy physics data collection would occur at a slower rate and would be prolonged, which would threaten the viability of Fermilab's high-energy physics mission. Potential impacts associated with the LBNF/DUNE Project were previously analyzed in the LBNF/DUNE EA and determined to have no significant impacts on land use or recreation (DOE 2015). The No Action Alternative would have very low impacts on on-site or off-site land uses, including adjacent residential and recreational land uses. Fermilab would continue to implement ecological and natural resources restoration projects.

3.2 BIOLOGICAL RESOURCES

This section assesses potential impacts on biological resources, including wetlands and aquatic habitat, terrestrial vegetation, protected species, wildlife, and fisheries. The affected environment includes areas directly affected by construction and operation of the Proposed Action, including excavation and fill areas, construction staging areas, soil stockpiles, ingress and egress routes, and adjacent habitat and downstream areas where biological resources could be indirectly affected.

3.2.1 Affected Environment

Fermilab occupies lands that were historically farmed. Approximately 2,200 acres are currently licensed for crop production. Portions of Fermilab are devoted to restoration of native prairie, as well as 68 acres of pasture for the bison herd (Fermilab 2018b). In 1989, Fermilab was designated a NERP. The preserve and research areas of Fermilab are not generally open to the public.

Currently, about 986 acres of tallgrass prairie, ranging in character from mesic to wet, are being restored with native prairie vegetation. Fermilab has two remnant tallgrass prairie areas, each occupying less than 3 acres (Fermilab 2018b). Other biological communities at Fermilab include forested uplands and wetlands, oak savannas, marshes, and non-native grasslands. Fermilab supports a variety of wildlife populations including common insect, bird, and mammal species characteristic of open fields, forests, and forest-edge communities. Many bird species use the site during spring and fall migration. The following sections describe the existing biological resources in the vicinity of the PIP-II Project site.

Sensitive areas within the PIP-II Project site are shown on **Figure 2.2-2**. Sensitive areas were mapped by superimposing multiple sources of biological data (representing thousands of samples across many years) on a map of the site and using established criteria to determine areas of high, medium, or low sensitivity.

Endangered and threatened species, if static location is known, were automatically-determined to be the highest sensitivity, as was remnant prairie habitat. Remnant savanna, woodland, forest, or marsh habitat was automatically-determined medium sensitivity. All habitat areas are important and carry intrinsic weight, but the mapped sensitive areas are worthy of deeper consideration and protection to avoid impacts, if practicable (Fermilab 2018b).

3.2.1.1 Wetlands and Aquatic Habitats

The PIP-II Project site has very limited topographic relief. There are no streams or creeks within the PIP-II Project site. The Proposed Action would not involve activities within a 100-year or 500-year floodplain (FEMA 2004).

The Main Ring area has known wetlands. The wetlands on the PIP-II Project site were initially delineated and characterized in 2010. In the spring of 2016, a wetland delineation was conducted to further refine the extent of the wetlands on the PIP-II Project site. The assessment was based on field reconnaissance conducted using techniques outlined in the USACE 1987 Delineation Manual, the 2010 Midwest Regional Supplement, historical maps, and aerial images depicting the condition of the site.

Based on the PIP-II Wetland Assessment Report (WBK 2016), five wetland areas occupying a total of approximately16.9 acres were identified within the PIP-II Project site (**Figure 2.2-2**). The PIP-II Wetland Assessment Report (WBK 2016) and Project plans were submitted to the USACE with a request for a JD regarding whether the impacted wetlands would be considered jurisdictional WOUS (33 CFR 328.3). The USACE issued a JD on July 23, 2018, verifying that the wetlands within the PIP-II Project site are not considered jurisdictional; therefore, they would not be subject to the CWA Section 404 permitting process. A copy of the JD (USACE 2018) is provided in **Appendix B**.

Based on the JD (USACE 2018), there is a jurisdictional wetland immediately south of Holter Road (**Figure 2.2-2**). This wetland is beyond the PIP-II Project boundary.

3.2.1.2 Vegetation

The majority of the PIP-II Project site was previously disturbed during construction of the Tevatron Project. The PIP-II Project site is located within the northwest quadrant of the Main Ring, which was planted with tallgrass prairie habitat between 1975 and 1981.

The PIP-II Project site consists of a matrix of upland, wetland, and riparian habitats. Habitats include upland grasslands, wetlands, woodland, and moderately wet to mesic restored prairie on fine-textured soils. There is also a small wooded area in the northwest corner of the PIP-II Project site. Reed canary grass (*Phalaris arundinacea*) and crown vetch (*Securigera varia*) are common invasive species in this unit. These species can be controlled by herbicide application. Overseeding with seed of native prairie and wetland plants helps with the recovery of these areas. In general, upland fields are dominated by grasses such as tall fescue (*Festuca elatior*), quackgrass (*Agropyron repens*), and Kentucky bluegrass (*Poa pratensis*). Grass fields are typically mowed to a summer height of approximately 6 inches. Dominant species within the wetlands include reed canary grass, sedges (*Carex* sp.), Indian-hemp (*Apocynum cannabinum*), wand panic grass (*Panicum virgatum*), field horsetail (*Equisetum arvense*), and Kentucky bluegrass. Tree species include black willow (*Salix nigra)*, southern hardwoods (*Populus deltoides),* and northern red oak *(Quercus rubra)*. Saplings/Shrubs include green ash (*Fraxinus pennsylvanica)*, Amur honeysuckle (*Lonicera maackii)*, sandbar willow (*Salix interior)*, gray dogwood (*Cornus racemosa)*, and buckthorn (*Rhamnus carthartica*).

Over the past 40 years, approximately 986 acres of tallgrass prairie have been restored at the Fermilab property, plus hundreds of acres of woodland, oak savanna, and wetland (Fermilab 2018b). Fermilab participates in Plants of Concern, a rare plant monitoring program organized by the Chicago Botanic Garden. The four species monitored at Fermilab are the savanna blazing star (*Liatris scariosa var. nieuwlandii*), single-flowered broomrape (*Orobancheuniflora*), goldenseal (*Hydrastis canadensis*), and white lady's slipper orchid (*Cypripedium candidum*) (Fermilab 2018b). None of these are found within the PIP-II Project site.

Examples of other rare plant species managed for conservation include blue ash (*Fraxinus quadrangulata*), kingnut hickory (*Carya laciniosa*), and puttyroot orchid (*Aplectrum hyemale*). At Fermilab, state listed plant species are protected as appropriate to aid recovery efforts in Illinois. Fragmented prairie remnants can provide important genetic diversity to communities at the local scale (Fermilab 2018b).

3.2.1.3 Wildlife

The Fermilab property provides suitable habitat for insects, reptiles, amphibians, birds, and mammals. Wildlife species that have been identified at Fermilab include terrestrial mammal species, such as white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), coyotes (*Canis latrans*), red fox (*Vulpes vulpes*), striped skunk (*Mephitis mephitis*), and the southern flying squirrel (*Glaucomys volans*). Other wildlife species include eastern grey tree frog (*Hyla versicolor)* and rusty patched bumble bee (*Bombus affinis*). Prairie habitat occupies 986 acres within the Fermilab property (Fermilab 2018b). Common bird species on-site include mallard (*Anas platyrhynchos*), American goldfinch (*Spinus tristis*), eastern wood pewee (*Contopus virens*), red-winged blackbird (*Agelaius phoeniceus*), yellow-billed cuckoo (*Coccyzus americanus*), great blue heron (*Ardea herodias*), red-eyed vireo (*Vireo olivaceus*), red-tailed hawk (*Buteo jamaicensis*), downy woodpecker (*Picoides pubescens*), northern flicker (*Colaptes auratus*), red-bellied woodpecker (*Melanerpes carolinus*), sandhill cranes (*Antigone canadensis),* and osprey (*Pandion haliaetus*). Smooth green snake (*Opheodrys vernalis*), which is a Chicago Wilderness priority species, were observed on-site in 2015, which was the first record at Fermilab in more than 20 years. The following year, the same individual and two males were captured. Fermilab also has a small herd of American bison (*Bison bison*) that are somewhat domesticated.

3.2.1.4 Fisheries

Illinois Department of Natural Resources (IDNR) conducted surveys of the major ponds and lakes in 1996. The DuPage County Forest Preserve, Openlands, and the Shedd Aquarium performed a stream health survey in 2014. Based on the results of these surveys, no federal listed or state listed fish species were observed; however, several species of common native and game fish were found.

3.2.1.5 Threatened and Endangered Species

The USFWS Information for Planning and Consulting (IPaC) database (USFWS 2018b) was reviewed to identify any federal listed threatened or endangered wildlife species or critical habitat that could potentially be occurring/present within the proposed PIP-II Project site. The Official Species List from the USFWS (USFWS 2018b) is provided as **Appendix B**. Eight federal listed threatened or endangered plant and wildlife species were identified in the USFWS Official Species List, and the federal listed species are described below:

- Rusty-patched bumble bee (RPBB; *Bombus affinis*): There are currently 986 acres of suitable prairie habitat within the Fermilab property (Campbell 2018).
- Northern long-eared bat (*Myotis septentrionalis*): The northern long-eared bat is a federal listed threatened species (USFWS 2018c). There are no hibernacula (mines, caves) in the area, but the

species roosts under the barks of specific types of trees in upland forests during the summer. In 2017, a bat survey was conducted at the Fermilab property using both mist netting and acoustic methods. Six common bat species were identified on-site; however, no northern long-eared bats were observed (DOE 2018). No acoustic data were recorded at the Inner Ring site, and no bats have been observed at the Inner Ring site, suggesting that the PIP-II Project site is not used by bats (Hohoff et al. 2017).

- Eastern prairie fringed orchid (EPFO; *Plantanthera leucophaea*): The EPFO is a federal listed threatened plant species that occurs on moist to wet silt loam or sand prairies and requires full sun for optimal growth and reproduction. Its preferred habitat includes wet prairies and bogs. It occurs within palustrine areas, such as freshwater wetlands, and can even occur in disturbed habitats, such as wet roadside ditches. The PIP-II Project site provides habitat for the EPFO; however, intensive searches for the orchid were conducted on three non-consecutive days in 2015 during the prime blooming period (July 1, July 7, and July 9). No EPFO were identified within the PIP-II Project site. Additionally, this species was not observed during or since the 2016 wetland delineation field exercises.
- In 2017, the USFWS provided a Biological Opinion (BO) that the Fermilab property has a current baseline condition of zero for the EPFO. USFWS concluded that no critical habitat has been designated at the Fermilab property for this species; therefore, none would be affected. In coordination with the USFWS, Fermilab introduced EPFO seed to various locations on the Fermilab property to contribute to the USFWS Recovery Plan for this species. The seeding locations were outside of the PIP-II Project site. If future DOE plans for the Fermilab property change and necessitate adverse impacts to an EPFO population, the USFWS would be contacted to remove or relocate the EPFO plants and the site would return to a baseline condition of zero (Weis 2017).
- Eastern massauga (*Sisturus catenatus*). This rattlesnake is a federal listed threatened reptile. These snakes are found in wet prairies, marshes, and low areas along rivers and lakes, and often use upland habitat adjacent to wet areas during part of the year. These snakes hibernate alone in crayfish burrows, under logs, tree roots, and in small mammal burrows. This rattlesnake has not been observed on the Fermilab property to date and is extremely unlikely to be found (Campbell 2018).
- Hines emerald dragonfly (*Somatochlora hineana*): This is a federal listed endangered insect that lives in calcareous (high in calcium carbonate) spring-fed marshes and sedge meadows overlaying dolomite bedrock. There is no suitable habitat at Fermilab or in the PIP-II Project site for this species, and the species has not been observed on the Fermilab property to date (Campbell 2018).
- Leafy prairie-clover (*Dalea foliosa*): This is a federal listed endangered plant and a perennial wildflower about 1 to 2 feet tall, found in prairie remnants along the Des Plaines River in Illinois, in thin soils over limestone substrate. This species prefers full or partial sunlight (at least one half day of sunlight), moist to slightly dry conditions, and a thin rocky soil. The blooming period is mid- to late summer and lasts 1 to 2 months. The petals of the flowers are medium purple or rose-pink (rarely white), while their sepals and bracts are green-white. Based on the 2018 plant survey, this species has not been identified within the PIP-II Project site. There is no suitable habitat at Fermilab or in the PIP-II Project site for this species (Campbell 2018).
- Meads milkweed (*Asclepias meadii*): This milkweed is a federal listed threatened plant and a long-lived perennial herb of tallgrass prairies that typically requires moderately wet (mesic) to moderately dry (dry mesic) upland tallgrass prairie. Its blooming period is late May and early June. The blooms are composed of a solitary umbrella-like cluster of flowers at the top of the stalk that has 6 to 15 greenish, cream-colored flowers. The young green fruit pods appear by late

June and reach their maximum length of 1.5 to 4 inches by late August or early September. Based on the 2018 plant survey, this species has not been identified within the PIP-II Project site. There is no suitable habitat at Fermilab or in the PIP-II Project site for this species (Campbell 2018).

- Prairie bush-clover (*Lespedeza leptostachya*): This is a federal listed threatened prairie plant found only in the tallgrass prairie. The entire plant has a grayish-silver sheen. The pale pink or cream-colored flowers bloom in mid-July. Based on the 2018 plant survey, this species has not been identified within the PIP-II Project site. No critical habitats under USFWS jurisdiction were identified within the PIP-II Project site and there is no suitable habitat in the PIP-II Project site for this species (Campbell 2018).

The Illinois Natural Heritage Data Center identified that there are known records of the state listed osprey and federal listed RPBB near the PIP-II Project site (**Appendix B**). **Table 3.2-1** provides a listing of federal and state listed threatened or endangered species and critical habitat potentially occurring within the PIP-II Project site. As part of the NEPA process for the Proposed Action, Fermilab consulted with the USFWS pursuant to Section 7 of Endangered Species Act (ESA). Copies of the USFWS consultation letters and e-mails are included in **Appendix B**.

A letter was received from the IDNR on March 29, 2018 following Fermilab's request for information through the Natural Resources Ecological Compliance Assessment Tool (EcoCAT) (IDNR 2018) on state listed endangered, threatened, or rare species within the PIP-II Project site. Fermilab also consulted with the IDNR regarding state listed species. Copies of the IDNR consultation letters and e-mails are included in **Appendix B**.

A follow-up response was sent to IDNR on July 5, 2018 with the results of the most recent osprey nest survey. Based on the 2017 Osprey Survey, there are four osprey nests at Fermilab, as shown on **Figure 3.2-1**. Three of the nests are active and are located 0.25 to 0.45 miles from the PIP-II Project site. The fourth nest is inactive and located approximately 4 miles east of the PIP-II Project site. As of 2017, no osprey nests have been identified within the PIP-II Project site.

Table 3.2-1 Threatened and Endangered Species Potentially Present at the PIP-II Project Site

Scientific Name	Common Name	Status Federal/State	Habitat Description	Potential to Occur in the PIP-II Project site
Birds				
Asio flammeus	Short-eared Owl	SE	Grasslands and open areas with low vegetation. Perch in low trees or on the ground. They nest on the ground, usually where there is enough vegetation to provide cover.	Potential to occur within the PIP-II Project site. Observed annually on the Fermilab property during the winter in the Main Ring and Eola brome fields located 1.5 miles northeast of the PIP-II Project site.
Bartramia longicauda	Upland Sand Piper	SE	Grasslands, including native prairie habitat, but also including some cropland and airports. Nest on the ground.	Not likely to be within the PIP-II Project site. Historically observed in 2002 within the Fermilab property during the summer in North Eola brome fields located 1.5 miles northeast of the PIP-II Project site.
Botaurus lentiginosus	American Bittern	SE	Wetlands, usually less vegetated and shallower than those used by the Least Bittern. Wintering birds avoid areas where water bodies freeze and may forage in dry grasslands. Mainly breed in freshwater marshes where there is tall vegetation.	Potential to occur within the PIP-II Project site. Observed within the Main Ring, but not within the PIP-II boundary. Nests never observed, just single birds passing through.
Calidris canutus rufa	Rufa Red Knot	FT/ST	Intertidal, marine habitat near coastal inlets, estuaries, and bays. Breeds in drier tundra areas. Nests on the ground.	Not likely to be within the PIP-II Project site. Historically observed as a vagrant within the Fermilab property.
Charadrius melodus	Piping Plover	FE/SE	Along the coast in the Northeast and lakeshores, rivers, and alkali wetlands in the northern Great Plains and Great Lakes. They nest in sandy areas where vegetation is more sparse and above the water line. During low tide, they forage on coastal beaches, sandflats, and mudflats.	Not likely to be within the PIP-II Project site. Last observed on the Fermilab property in 2013.
Chlidonias niger	Black Tern	SE	Freshwater marshes in the summer. Tropical coasts in the winter.	Not likely to be within the PIP-II Project site. Observed infrequently flying through the Fermilab property; no evidence of breeding on Fermilab property.
Circus cyaneus	Northern Harrier	SE	Open terrain including marshes, fields, and prairies. Nest on the ground in wetland areas or grasslands.	Potential to occur within the PIP-II Project site. Observed regularly flying through the Fermilab property; winter resident; no evidence of breeding on Fermilab property.

Table 3.2-1 Threatened and Endangered Species Potentially Present at the PIP-II Project Site

Scientific Name	Common Name	Status Federal/State	Habitat Description	Potential to Occur in the PIP-II Project site
Coccyzus erythropthalmus	Black-billed Cuckoo	ST	Woodlands and thickets including aspen, poplar, birch, sugar, maple, hickory, hawthorn and willow. Nest in trees.	Not likely to be within the PIP-II Project site. Breeding has not been observed on the Fermilab property since 2001; uncommonly observed since 2001.
Dendroica cerulea	Cerulean Warbler	ST	Nest in large tracts of deciduous forests with large-diameter trees. Nest in uplands, wet bottomlands, and dry slopes.	Not likely to be within the PIP-II Project site. Not observed on the Fermilab property since 2003.
Egretta caerulea	Little Blue Heron	SE	Wetlands including swamps, marshes, ponds, canals, ditches, and more. Usually nest in small trees or shrubs near water.	Not likely to be within the PIP-II Project site. Historically observed as a vagrant within the Fermilab property.
Egretta thula	Snowy Egret	SE	Marshes, estuaries, tidal channels, shallow bays, mangroves, grassy ponds, temporary pools, and swamps. Nest in colonies where there is thick vegetation in more isolated locations.	Not likely to be within the PIP-II Project site. Not observed on the Fermilab property since 2003.
Gallinula galeata	Common Gallinule	SE	Freshwater and brackish ponds, marshes, and lakes with aquatic vegetation. Will use artificial ponds, sewage lagoons, and stormwater retention ponds. Nest atop aquatic plants at the shoreline or in trees and shrubs.	Not likely to be within the PIP-II Project site. Not observed on the Fermilab property since 1997.
Ixobrychus exilis	Least Bittern	ST	Freshwater or brackish marshes with tall grasses, cattails, and reeds. Nests in tall marsh vegetation.	Potential to be within the PIP-II Project site. Breeding has not been observed on the Fermilab property since 2008, but 2017 was a record year of observations in the east lakes and Main Ring Lake.
Lanius ludovicianus	Loggerhead Shrike	SE	Open woodlands or open land with short vegetation and shrubs or low trees. Often found in agricultural fields, orchards, pastures, and along roadsides with fence lines and utility poles.	Potential to migrate through the PIP-II Project site. Not observed on Fermilab property since 2001.
Nyctanassa violacea	Yellow-crowned Night-Heron	SE	Coastal wetlands, barrier islands, saltmarshes, drainage ditches, mangroves, bottomland forests, swamps, and wet fields, usually with heavy cover nearby. Usually nests in large trees high above ground but can nest close to the ground or water in thickets or mangroves.	Not likely to be within the PIP-II Project site. Not observed on the Fermilab property since 2000.

Table 3.2-1 Threatened and Endangered Species Potentially Present at the PIP-II Project Site

Scientific Name	Common Name	Status Federal/State	Habitat Description	Potential to Occur in the PIP-II Project site
Nycticorax	Black-crowned Night-Heron	SE	Wetlands including marshes, swamps, streams, lakes, ponds, tidal mudflats, canals, agricultural fields, and more. Nest in groves of trees, thickets, or on the ground in locations that prevent predation such as on islands or above the water.	Potential to migrate through the PIP-II Project site. Breeding has not been observed on the Fermilab property since 2001.
Pandion haliaetus	Osprey	SE	Habitat around bodies of water where fish are present. Usually nest in trees but also nest on utility poles.	Regularly observed within the Fermilab property since 2009. There are four known osprey nests at Fermilab, one of which is inactive. The three active nests are located 0.25 to 0.45 miles from the PIP-II Project site (**Figure 3.2-1**).
Phalaropus tricolor	Wilson's Phalarope	SE	Breed in marshes of the Great Plains and intermountain West. Winter in South America. During migration, assemble on salty lakes and coastal marshes. Nests usually on the ground near water, sometimes in marsh plants just above ground.	Not likely to be within the PIP-II Project site. Rare migrant, last seen in 2005.
Rallus elegans	King Rail	SE	Freshwater and brackish marshes, rice fields. Just above water in a patch of vegetation.	Not likely to be within the PIP-II Project site. Last observed in 2006.
Sterna forsteri	Forster's Tern	SE	Freshwater, brackish, or saltwater marshes or the borders of lakes, islands, or streams. Nests in marshes, on top of dense vegetation - often on top of muskrat houses. Sometimes on the ground near marsh.	Not likely to be within the PIP-II Project site. Migrants occasionally observed.
Sterna hirundo	Common Tern	SE	Lakes, ocean, bays, and beaches. Nest on bare ground surrounded by low vegetation or on floating mats of vegetation.	Not likely to be within the PIP-II Project site. Last observed on the Fermilab property in 2000.
Tyto alba	Barn Owl	ST	Woodlands, farms, groves, barns, towns, and cliffs. Usually semi-open country with good foraging habitat. Nests in caves and hollow trees or artificial sites such as barn lofts.	Not likely to be within the PIP-II Project site. Released within barns on the Fermilab property in 2009. No sightings since.
Xanthocephalus	Yellow-headed Blackbird	SE	Wetlands in prairies, mountain meadows, and shallow areas of marshes, ponds, and rivers. Nest in cattails, bulrushes, or reeds.	Not likely to be within the PIP-II Project site. Last observed on the Fermilab property in 1997.

Table 3.2-1 Threatened and Endangered Species Potentially Present at the PIP-II Project Site

Scientific Name	Common Name	Status Federal/State	Habitat Description	Potential to Occur in the PIP-II Project site
Plants				
Asclepias meadii	Mead's milkweed	SE	Tallgrass prairies that typically requires moderately wet (mesic) to moderately dry (dry mesic) upland tallgrass prairie.	Not likely to be within the PIP-II Project site. Not observed on the Fermilab property to date.
Dalea foliosa	Leafy prairie-clover	FE/SE	Found in prairie remnants along the Des Plaines River in Illinois, in thin soils over limestone substrate. Prefer full or partial sunlight (at least one-half day of sunlight), moist to slightly dry conditions, and a thin rocky soil.	Not likely to be within the PIP-II Project site. Not observed on the Fermilab property to date.
Filipendula rubra	Queen-of-the-prairie	ST	Moist black soil prairies, moist sand prairies, moist meadows along rivers in woodland areas, shrubby fens, and wet areas.	Not likely to be present within the PIP-II Project site. Observed in 2016 in the northwest quadrant prairie on the Fermilab property, but far east of the PIP-II Project site.
Lespedeza leptostachya	Prairie bush clover	SE	Tallgrass prairie habitat.	Not likely to be within the PIP-II Project site. Not observed on the Fermilab property to date.
Platanthera leucophaea	Eastern prairie fringed orchid	FT/SE	Occurs in a variety of habitats from mesic prairies to wetlands such as sedge meadows, marsh edges, and bogs. It requires full sun for optimum growth and flowering and a grassy habitat with little or no woody encroachment.	Not observed within the PIP-II Project site. Introduced on the Fermilab property outside of the PIP-II Project site in agreement between USFWS and DOE. Very low o impacts anticipated to occur as a result of the PIP-II Project.
Reptiles				
Emydoidea blandingii	Blanding's turtle	SE	Lakes, ponds and reservoirs, marshes; peatlands; rivers, streams, and adjacent sandy uplands	Not likely to be present in the PIP-II Project site. Last observed on the Fermilab property in 2000 despite survey efforts in 2010 and 2015.
Sistrurus catenatus	Eastern massasauga	SE	Wet prairies, marshes, and low areas along rivers and lakes. Often use upland habitat adjacent to wet areas during part of the year. Hibernates in crayfish burrows, under logs, tree roots, and in small mammal burrows. Hibernates alone.	Not likely to be within the PIP-II Project site. Not observed on the Fermilab property to date.

Table 3.2-1 Threatened and Endangered Species Potentially Present at the PIP-II Project Site

Scientific Name	Common Name	Status Federal/State	Habitat Description	Potential to Occur in the PIP-II Project site
Insects				
Bombus affinis	Rusty-patched bumble-bee	FE	Grasslands and tallgrass prairie habitat. Nesting sites include underground and abandoned rodent cavities or clumps of grasses and undisturbed soil for overwintering queens.	Potential to occur within the PIP-II Project site. Observed within the Fermilab property in 2014 and 2018 ; however, not observed within the PIP-II Project site. Observed regularly in the Main Ring area in 1993.
Somatochlora hineana	Hine's emerald dragonfly	FE	Lives in calcareous (high in calcium carbonate) spring-fed marshes and sedge meadows overlaying dolomite bedrock.	Not likely to be within the PIP-II Project site. Not observed on the Fermilab property to date.
Mammals				
Myotis septentrionalis	Northern long-eared bat	FT/ST	Winter - hibernate in caves and mines. Summer - roost in cavities or crevices of trees. May also roost in caves and mines. Rarely found roosting in structures such as barns or sheds.	Not likely to be within the PIP-II Project site. Not observed on the Fermilab property to date.

Legal Status Codes:
FE = Federal listed as Endangered under the Federal ESA
FT = Federal listed as Threatened under the Federal ESA
SE = State listed as Endangered under the Illinois Endangered Species Act (IESA)
ST = State listed as Threatened under the IESA
* Effective May 19, 2015

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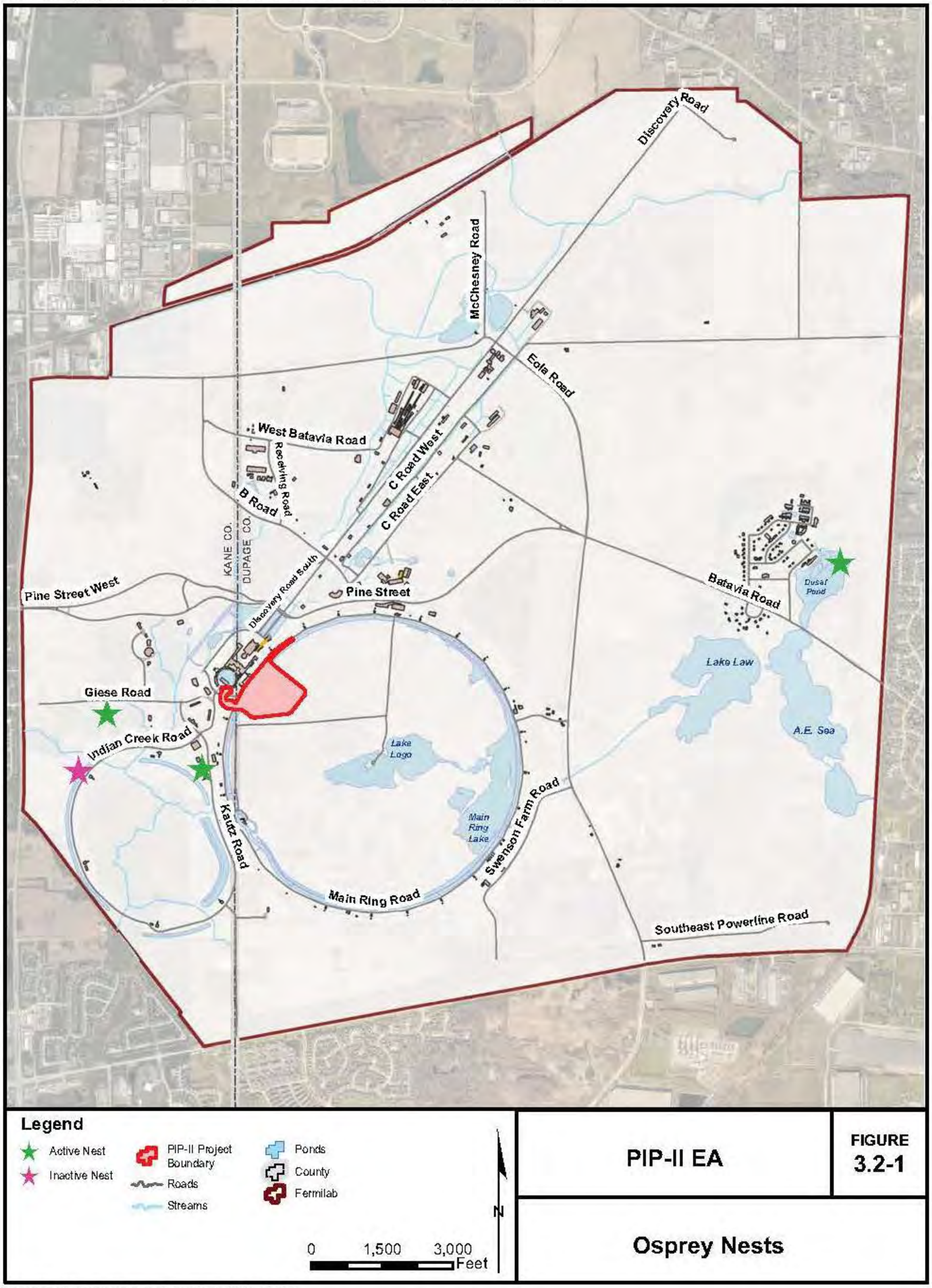

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3.2.2 Environmental Impacts

3.2.2.1 Proposed Action

3.2.2.1.1 Construction

3.2.2.1.1.1 Wetlands and Aquatic Habitat

Figure 2.2-2 provides an overlay of the Proposed Action facilities, construction footprint, and wetlands. The construction footprint includes construction access, staging areas, laydown areas, fill areas, and excavation areas. During construction of the Proposed Action facilities, placement of fill would displace up to 16.9 acres of vegetated wetlands (WBK 2016). Based on the JD issued on July 23, 2018 (USACE 2018), the impacted wetlands are not considered jurisdictional; therefore, they would not be subject to the CWA Section 404 permitting process.

As has been used in the past at Fermilab, construction of the Proposed Action would incorporate BMPs, such as silt fences, waddles, and other soil erosion techniques, to minimize discharge into the cooling water system. This EA documents compliance with the wetland assessment protocol required by DOE (10 CFR § 1022) and EO 11990, *Protection of Wetlands*. Floodplain evaluation requirements are addressed in **Section 3.5, Hydrology and Water Quality**.

3.2.2.1.1.2 Vegetation

The Proposed Action would have both short-term and long-term impacts on upland and non-jurisdictional wetland habitats at Fermilab. EPFO (federal listed as threatened and state listed as endangered) and queen-of-the-prairie bush clover (state listed as threatened) have been identified on the Fermilab property (**Table 3.2-1**); however, these two plant species have not been identified within the PIP-II Project site . Approximately 28 acres of upland prairie habitat would be cleared during construction and approximately 20 mature and dead trees would be removed. Fermilab would minimize impacts on vegetation and tree removal using SEPMs, including reseeding the areas temporarily disturbed during construction.

3.2.2.1.1.3 Wildlife

Impacts to habitat for common wildlife species by vegetation clearing and ground disturbance during construction would be low. The PIP -II Project site likely serves as a local pathway for movement of common wildlife species using the area for water or refuge. Construction could prevent common wildlife species from accessing areas to the south. Construction noise and the increase in human activity would likely deter common wildlife species from entering the construction boundary. Construction materials would be properly stored, and food and trash would be removed at the end of each workday to avoid attracting wildlife to the site.

Impacts would be short-term and limited to the immediate vicinity of the construction activities because wildlife could use open areas to the east and west that are outside the construction boundary. For upland species, this would be a short-term impact, as vegetation would be restored as part of the SEPMs.

Suitable foraging and breeding habitat for birds and raptors exists in the vicinity of the Proposed Action. Removal of vegetation, including scrub vegetation, wetland vegetation, and trees, would reduce the amount of foraging and breeding habitat for common bird species. To comply with the Migratory Bird Treaty Act (MBTA), Fermilab would schedule removal of vegetation outside the typical nesting season (April through August), to the extent practicable. The nearest known raptor nest to PIP-II Project site is an osprey nest approximately 0.25 mile (or 1,320 feet) to the southwest. Active nests would be monitored during construction to avoid destruction of the nests.

During construction, removal of up to 20 mature and dead trees would be removed. Northern long eared bats may use these trees for summer-roosting habitat; however, during 2017 bat surveys there were no signs of northern long-eared bat within the Fermilab property. To minimize potential impacts, tree removal would be scheduled for the winter months, if feasible. Fermilab's SEPMs would minimize impacts on bats to the extent practicable by conducting the initial site preparation, including clearing of trees, outside of seasonal periods of bat activity. Therefore, impacts to the northern long-eared bat would be low and are unlikely.

The RPBB is a federal listed species with the potential to forage within the prairie habitat of the PIP-II Project site. Currently, there are 986 acres of potentially suitable RPBB prairie habitat within the Fermilab property. Of the 28 acres within the PIP-II Project site, the footprint of Proposed Action aboveground facilities would occupy approximately 5 acres for the 40-year life of the Project. The remaining 23 acres would be revegetated.

Overwintering sites for hibernating queens require undisturbed soil or clumps of grasses. Nest locations are likely to be in or near open areas that are not heavily forested and not too wet (i.e., not marsh, shrub wetlands, or wetland forest) and typically within 0.6 mi (1 kilometer [km]) of summer foraging areas (USFWS 2018a). The PIP-II Project site is unlikely to be suitable habitat for overwintering bees. To minimize potential impacts to RPBB, vegetation would be cleared before the bees' active foraging season (mid-March through mid-October); therefore, impacts to the RPBB are not anticipated.

Consultation with the USFWS and IDNR was initiated for the Proposed Action to comply with Section 7 of the ESA, as required for projects that involve federal activities. The USFWS and IDNR consultation letters and e-mails received to date are included as **Appendix B**.

In a letter dated August 1, 2018 (USFWS 2018b), USFWS provided a "No Effect Determination" for the following federal listed species that have the potential to occur within the PIP-II Project site:

- Eastern prairie fringed orchid
- Leafy prairie-clover
- Mead's milkweed
- Prairie bush clover
- Eastern massasauga rattlesnake
- Hine's emerald dragonfly

For the newly listed RPBB, which has been observed on the Fermilab property, USFWS concluded that the PIP-II Project "may affect but is not likely to adversely affect" the RPBB. The Project would implement SEPMs to avoid impacts to suitable bee habitat. Through phone conversations and a follow-up letter e-mailed to the USFWS on July 5, 2018 (DOE 2018),the following SEPMs were outlined to minimize potential impacts to the RPBB. Before construction, approximately 28 acres of prairie vegetation within the PIP-II Project site would be removed through a controlled burn outside of the foraging season (mid-March through mid-October).

After construction is completed, approximately 23 acres would be revegetated, and the footprint of Proposed Action aboveground facilities would occupy approximately 5 acres for the 40-year life of the Project.

Fermilab also provided IDNR with the proposed SEPMs to protect the RPBB as previously described. Based on an e-mail from the IDNR dated August 2, 2018 (IDNR 2018), IDNR's concerns for the RPBB and the osprey have been sufficiently addressed by the USFWS Consultation letter. Copies of correspondence with IDNR are included in **Appendix B**.

For the northern long-eared bat, which has not been observed on the Fermilab property, USFWS requested that Fermilab complete a northern long-eared bat 4(d) Streamlined Consultation Form for the Project. This streamlined form indicates that the Project may affect the northern long-eared bat, but that any resulting incidental take of the bat is not prohibited by the final 4(d) rule. The Project would implement SEPMs to avoid potential impacts to summer roosting bats, including removal of up to 20 trees during the winter months (DOE 2018).

3.2.2.1.1.4 <u>Fisheries and Macroinvertebrates</u>

The Proposed Action would not require stream modifications; therefore, impacts to federal or state protected fish species, aquatic invertebrate species, or their habitats would be very low. There are no creeks or streams within the PIP-II Project site; therefore, no direct impacts to fish and aquatic habitat are anticipated.

An ICW pond may be constructed on the PIP-II Project site to collect cooling water from the Cryogenic Plant Building and sump pump discharges. This pond would occupy approximately 0.25 acre and would extend the cooling water surface area of the existing cooling pond network. The water in this pond would discharge by gravity flow through a control structure to the existing A0 pond, where it would then be routed to the site-wide ICW network.

Stormwater runoff during construction and any groundwater pumped from excavations would be directed to the industrial cooling ponds and would be managed in compliance with the Project-specific SWPPP. Stormwater runoff from Project-related activities would be managed per SEPMs to reduce suspended solids and turbidity, including the Project-specific construction SWPPP. Indirect impacts to fish and aquatic habitat are not anticipated and would be very low.

If dewatering is necessary, pumped groundwater would be collected in Fermilab's existing cooling water ditches and ponds. Fermilab has an existing NPDES permit (IL0026123) authorizing stormwater discharges into surface waters. Fermilab would prepare a dewatering plan and would comply with NPDES permit requirements. Impacts on surface water quality would be short-term and localized, and would not result in long-term impacts on fish or macroinvertebrates.

3.2.2.1.2 Operations

Operations would occur within the 28 acres previously disturbed by construction of the Proposed Action. Of the 28 acres within the PIP-II Project site, the footprint of Proposed Action aboveground facilities would occupy approximately 5 acres for the 40-year life of the Project. The remaining 23 acres would be reseeded. Impacts on biological resources were analyzed for both pulsed and CW-mode operations.

3.2.2.1.2.1 <u>Wetlands and Aquatic Habitat</u>

Operations would occur within the footprint of construction and would not require additional excavation, wetland fill, or vegetation removal. Stormwater runoff from impervious surfaces and any groundwater pumped from excavations would be directed to the industrial cooling ponds and would be managed in compliance with Fermilab's site-wide SWPPP. The potential for impacts of chemical spills would be also be minimized by SEPMs, including Fermilab's existing site-wide SPCC Plan. Operation of the Proposed Action would have very low impacts on wetlands and aquatic habitat.

3.2.2.1.2.2 Vegetation

During operations, Fermilab would conduct long-term maintenance of the re-vegetated areas adjacent to the aboveground facilities, including mowing grassy areas and removing invasive species. Fermilab would also implement SEPMs to minimize erosion, such as maintenance programs to maintain vegetative cover. Impacts on grasslands and other vegetation would be very low.

3.2.2.1.2.3 Wildlife

Operation of the Proposed Action would have very low direct impacts on wildlife. Operations would not likely affect wildlife movement pathways because most activities would occur within the footprint of the new Project facilities, and wildlife movements have already adapted to the previously developed areas on the Fermilab property. Fermilab would reestablish vegetative cover on the areas disturbed during construction. Fermilab would conduct long-term maintenance of the vegetated areas adjacent to the aboveground facilities, including mowing grassy areas and removing invasive species.

Operation of the new proton linear accelerator may result in low-level irradiation of the soil and groundwater adjacent to the accelerator enclosure. The conventional facilities would be designed to incorporate the applicable radiation safety requirements contained in FESHM 11000: Radiation Safety, to reduce exposure to ALARA levels, including shielding labyrinths, exit passageways, and passive shielding. Implementation of these requirements would minimize radiation exposure outside the enclosures and would minimize radioactive air emissions and activation of soil and groundwater. With implementation of the existing established Fermilab policies and procedures, radiological exposure of wildlife would be unlikely.

Fermilab screens for impacts on aquatic and terrestrial biota in compliance with DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2002b). Based on the data collected by Fermilab, radiation exposures of on-site biota are below DOE standards, and the shielding used to minimize radiation doses of biological receptors is effective for existing physics experiments.

Under the Proposed Action, the increased beam intensity would provide for an increase in beam power and result in increased levels of accelerator produced radionuclides, including tritium and sodium-22, at the targets and detectors (air, soil, surface water, and groundwater activation) throughout the accelerator complex and other experiments. Accelerator produced radionuclides have been previously evaluated in other Fermilab EAs for the LBNF/DUNE (DOE 2015), NuMI (DOE 1997) and NO*v*A (DOE 2008) Projects. These were all found to be well within regulatory limits. The PIP-II Project would not change the previous EA evaluations.

In compliance with DOE Orders, Fermilab conducts extensive environmental monitoring of surface water as part of SEPMs, including for tritium concentrations at the NPDES outfalls and at the Fermilab property boundary. Surface water concentrations of tritium at the NPDES outfalls and discharges from the Fermilab property are below DOE surface water standards. Fermilab has also conducted soil and groundwater monitoring, the results of which demonstrate that exposure to beamline radiation from existing Fermilab experiments poses a low risk to wildlife populations and that the SEPMs maintain exposure at below DOE limits (DOE Order 458.1, Change 3; DOE 2013). Accelerator produced radionuclides have been previously evaluated in other Fermilab EAs for the LBNF/DUNE (DOE 2015), NuMI (DOE 1997) and NO*v*A (DOE 2008) Projects which would utilize the increased beam intensity and power from PIP-II. These were all found to be well within regulatory limits. The PIP-II Project would not change the previous EA evaluations. Based on the results of Fermilab's ongoing surface water, soil, and site-wide groundwater monitoring, exposure of plants and animals to tritium in surface water, soil or groundwater would be low.

3.2.2.1.2.4 Fisheries and Macroinvertebrates

The Proposed Action would not require any stream modifications; therefore, operation of the Proposed Action would have very low impacts on fish species, stream macroinvertebrates, or their habitats. Stormwater runoff would be managed through SEPMs, including implementation of Fermilab's existing wildlife and water quality monitoring programs, existing site-wide SWPPP, and compliance with IEPA water quality standards that support beneficial uses such as fish habitat.

3.2.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no new ground disturbances within the PIP-II Project site; therefore, there would be no impact on biological resources from the Proposed Action, including wetlands and aquatic habitat, terrestrial vegetation, protected species, wildlife, or fisheries. Existing research projects and planned projects would continue at Fermilab. Potential impacts on biological resources associated with the planned LBNF/DUNE Project were previously analyzed in the LBNF/DUNE EA (DOE 2015). Impacts included placing clean fill in approximately 5 acres of jurisdictional wetlands as well as Indian Creek; however, these impacts would be offset through purchase of wetland credits or other wetland and stream habitat replication. In addition, the LBNF/DUNE Project would require clearing of approximately 140 acres of upland habitat, including removal of approximately 250 to 300 trees. To minimize biological impacts, Fermilab would continue to implement SEPMs and monitor for ongoing research and planned projects to comply with relevant permits, as well as DOE, federal, and state requirements.

3.3 CULTURAL RESOURCES

This section describes existing cultural, historical, and paleontological resources at Fermilab and the potential environmental impacts of the Proposed Action and No Action Alternative, including excavation and grading. Cultural and historical resources include a broad range of objects, sites, buildings, structures, and districts created or influenced by human use or occupation or recognized in past or current cultural practice. Cultural and historical resources may include traditional resources, sacred sites, or traditional use areas that are important to a community's practices, beliefs, and cultural identity. Cultural resources may have archaeological, architectural, or traditional cultural significance. Architectural resources include standing buildings, bridges, dams, and other structures of historic significance. Paleontological resources are fossilized remains, traces, or imprints of organisms, preserved in or on the Earth's crust, that are of paleontological interest, and that provide information about the history of life on Earth. As described in the below sections, there are no known historic properties or paleontological resources in the PIP-II Project site.

3.3.1 Affected Environment

The federal historic preservation process is established by the National Historic Preservation Act (NHPA), Section 106 NHPA (16 U.S.C. 470[f]). The NHPA also established the National Register of Historic Places (NRHP), the official list of the properties significant in terms of prehistory, history, architecture, or engineering. The NRHP is administered by the National Park Service (NPS), and properties listed in the NRHP may be privately or publicly owned. To meet the evaluation criteria for eligibility to the NRHP, a property should be 50 years of age or older, significant under one or more NRHP evaluation criteria (36 CFR Part 60.4), and retain historic integrity. Younger structures may be eligible for listing in the NRHP if they are of exceptional importance or if they have the potential to gain significance in the future per special NRHP considerations. Properties may be of local, state, or federal significance. Properties listed or eligible or that meet the NRHP evaluation criteria are historic properties according to the NHPA.

3.3.1.1 Cultural Resources

The DOE, as a federal agency, is responsible for compliance with the review process set forth in Section 106. The DOE works closely with Illinois Historic Preservation Agency (IHPA) and the Advisory Council on Historic Preservation (ACHP) to protect the cultural resources at Fermilab.

Comprehensive surveys for prehistoric and historic sites have been conducted within the Fermilab boundaries. A site-wide CRMP was completed and submitted to the IHPA in 2015. IHPA concurred with the findings of the CRMP.

The CRMP incorporates information from a number of these archeological and architectural surveys (Lurie and Bird 2015). The CRMP identifies, maps, and classifies archeological resources found at Fermilab. Based on the CRMP and the archaeological and architectural investigations completed at the facility from 1968 through 2014, there are no historic farmsteads or known cultural resources within the PIP-II Project site that would be eligible for the NRHP.

The NPS defines cultural resources as: *"physical evidence or place of past human activity: site, object, landscape, structure; or a site, structure, landscape, object or natural feature of significance to a group of people traditionally associated with it."* The Fermilab CRMP (Lurie and Bird 2015) summarizes the archaeological and architectural investigations completed at the facility from 1968 through 2014. It identifies and classifies known cultural and historical resources and outlines procedures for addressing cultural and historical resources that may be disturbed during construction. Fermilab cultural and historical records and reports are curated at Fermilab's Environment, Safety, Health, and Quality (ESH&Q) Section and at the Illinois State Museum.

Initial (Phase I) archaeological surveys have been completed for the entire Fermilab property (Lurie and Bird 2015). Those surveys reported 108 prehistoric and historic archaeological sites. Most of these sites (75) have been formally evaluated for their NRHP eligibility, and five sites are eligible to be included in the NRHP. Fermilab has also conducted surveys of all the historic standing buildings and structures on the property. In 1967, all of these buildings and structures were evaluated for their potential historical significance. Subsequently, all but a few buildings and structures that were in relatively good condition were moved to the Fermilab Village for adaptive reuse, primarily as dormitories and laboratories.

Under the terms of the CRMP (Lurie and Bird 2015), any undertaking on the facility that would result in ground disturbance must be evaluated for cultural and historic resources. This review is to be included in the NEPA review process for all proposed undertakings. This evaluation includes defining the extent of the site and conducting an NRHP eligibility evaluation based on current information and criteria. Section 106 requires that impacts on historic properties are avoided or that protective measures (e.g., documentation, recovery) are implemented. Should unanticipated resources be encountered during construction, Fermilab and DOE would stop construction in that area and notify an archaeologist or paleontologist, who would implement the procedures outlined in the Fermilab CRMP. If any of the known resources within the area of the proposed undertaking are potentially eligible for the NRHP or have not been evaluated, Phase II evaluations would be completed.

3.3.1.2 Paleontological Resources

Pleistocene (defined as a period from approximately 2.6 million to 11,700 years ago) fossils have been recovered from sediments throughout Illinois. Taxa identified include Jefferson's ground sloth, American mastodon, woolly mammoth, stag-moose, Harlan's muskox, giant beaver, bison, and flat-headed peccary. Mastodon fossils are common in mire deposits of northeastern Illinois, and stag-moose fossils are most frequently found in wetland deposits. Mastodon fossils have been discovered in multiple locations near Fermilab, including a marsh lake near Batavia, a swamp near Aurora, a bog near Naperville, and on a farm near Wheaton (Anderson 1905). Mapping of surficial geology of the Batavia area indicates that the lake deposits of the Equality Formation are fossil-bearing (Curry 2001). There are no known paleontological resources in the PIP-II Project site; however, based on fossil records for similar areas, paleontological resources could occur within the PIP-II Project site.

Fossils are recognized regionally within the Joliet and Kankakee Formations, and most commonly produce invertebrate fossils such as tabulate coral (*Favosites* sp.) and orthocone nautiloids (Moshier and Greenberg 2011). These formations are exposed extensively in northeastern Illinois and southeastern Wisconsin. The Kankakee Formation also has produced halysitid and rugose corals, stromatoporoids, trilobites, and brachiopods including *Platymerella* sp. The upper Kankakee Formation commonly contains echinoderm (pelmatozoan) fossils. The Brandon Bridge Member of the Joliet Formation contains scarce macrofossils, but remains of trilobites, brachiopods, and orthoconic nautiloids are common. A soft-bodied biota was identified within the Brandon Bridge Member of the Joliet Formation in Wisconsin but is not known to be present in Illinois (Mikulic et al. 1985).

3.3.2 Environmental Impacts

3.3.2.1 Proposed Action

3.3.2.1.1 Construction

Construction would require excavation and fill to install the Proposed Action facilities. The Proposed Action is unlikely to have direct or indirect impacts on cultural resources because there are no known historic properties or cultural resources within the PIP-II Project site. In addition, the entire PIP-II Project site was previously disturbed during past farming activities and during construction of the Main Ring.

In addition to known sites, undocumented and unanticipated cultural and historical resources (including human remains, fossils, and paleontological resources) could be encountered during construction. Should unanticipated resources be encountered during construction, Fermilab and DOE would stop construction in that area and notify an archaeologist or paleontologist, who would implement the procedures outlined in the Fermilab CRMP.

There are no known paleontological resources in the PIP-II Project site; therefore, the Proposed Action is unlikely to have direct or indirect impacts on paleontological resources. Based on fossil records for similar areas elsewhere in the state, Pleistocene mammal fossils (such as mastodon and bison) have been reported and could be encountered during excavations.

In the event of an unanticipated discovery of cultural or paleontological resources, all ground disturbance, including the movement of vehicles and equipment within 100 feet of the discovery, would be stopped, and the stop-work zone would be clearly marked. The discovery would be protected, and an archaeologist or paleontologist would be notified to inspect the discovery and implement the appropriate notifications and treatment procedures. Ground disturbance would not resume in the stop-work zone until authorized by DOE in consultation with IDNR per the Fermilab CRMP.

3.3.2.1.2 Operation

Once constructed, operation of the Proposed Action would involve access to and use of the proposed facilities and service buildings, maintenance, and landscaping. Because these activities would not typically require ground disturbance or excavations, operation of the Proposed Action would have very low impact on cultural or paleontological resources.

3.3.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no excavation, grading, or other new ground disturbances within the PIP-II Project site; therefore, there would be no impacts on historic properties or paleontological resources from the Proposed Action. Fermilab's existing research projects and other planned projects would continue. Activities that require ground disturbance would comply with CRMP requirements.

3.4 HEALTH AND SAFETY

This section describes the potential human health and safety impacts associated with the Proposed Action and No Action Alternative. Health and safety impacts are evaluated in terms of the potential risk to Fermilab workers and nearby residents. The following subsections provide an overview of existing human health and safety hazards at Fermilab and describe how these hazards and risks are minimized by engineering controls and existing safety and environmental health management programs. Potential risks are associated with construction and equipment installation hazards (excavation, use of heavy equipment, falls, exposure to high voltage, material handling, dust, fumes, noise, and the use of hazardous materials), as well as industrial and radiological hazards from operations. The affected environment includes the Proposed Action construction and operational areas, particularly within underground enclosures, where workers would be exposed to components with residual radiation. The affected environment also includes adjacent on-site and off-site areas potentially exposed to radioactive air emissions. The potential risk of traffic accidents is analyzed in **Section 3.7, Transportation**, and potential waste management impacts are addressed in **Section 3.14, Waste Management**.

3.4.1 Affected Environment

Fermilab has existing health and safety programs to protect workers and the public from hazards associated with construction and experimental activities. Fermilab's Integrated Environment, Safety, and Health Management System complies with DOE requirements (10 CFR 851, "Worker Safety and Health Program"). Fermilab follows an ongoing process to plan, implement, evaluate, and improve environmental and safety performance and regulatory compliance. Elements of the Environmental Management System (EMS) are coordinated with Fermilab's ISMS to form a combined ESH&Q Management System. Protection of workers from exposures to common industrial hazards is in accordance with regulations established by the OSHA.

Fermilab's overarching health and safety program is outlined in the FESHM (Fermilab 2016b). The FRCM (Fermilab 2017a) outlines the radiological health and safety procedures in compliance with CFR Title 10, Part 835 (10 CFR 835), "Occupational Radiation Protection." The FESHM and FRCM contain guidelines relevant to Proposed Action construction (e.g., excavation), installation, and operation (e.g., accelerator operations, electrical safety, fire protection, emission control, radiation safety). Future decommissioning (e.g., facility decontamination and decommissioning) is not addressed in this EA.

Subcontractors must comply with contractual performance measures regarding health and safety. Construction Contractors must comply with Fermilab's environmental, safety, and health requirements as SEPMs, and Contractor safety programs must conform to the principles of Fermilab's ISMS, including FESHM 7010: ES&H Program for Construction, 9010: Traffic Safety and OSHA 1926 Construction Safety Standards. Excavations must be carried out in compliance with 29 CFR 1926.650 and FESHM 7030: Excavation.

Fermilab requires that construction Contractors develop and implement Project-specific health and safety plans and complete appropriate site-specific health and safety training. Under the FESHM, a hazard analysis (HA) process must be completed to evaluate the associated hazards and determine how the work can be performed safely. The HA includes identification of hazards, measures to reduce hazards, and expectations for all affected employees. Under OSHA regulations (29 CFR 1904), a work-related injury or illness is "recordable" if it results in days away from work, restricted work, or transfer to another job; medical treatment beyond first aid; loss of consciousness; or death. Total Recordable Cases (TRCs) are work-related injuries or illnesses serious enough to require medical treatment, a hospital visit, or prescription medication. The TRC rate is a normalized expression of 100 employees working full-time for 50 weeks or 1 year (200,000 hours). The rate is calculated as the number of recordable cases divided by the hours worked, and then multiplied by 200,000.

If an injury prevents the employee from performing any or all of his or her duties (i.e., they must be assigned "light duty" or cannot work at all), the injury is classified as a Days Away, Restricted, or Transferred (DART) case. DART cases are a subset of the TRCs. The DART rate is calculated in a manner similar to that of the TRC rate (number of DART cases per total worker hours multiplied by 200,000).

The U. S. Department of Labor, Bureau of Labor Statistics (BLS), Occupational Injury and Illness Data maintain statistics on the TRC and DART rates for the construction industry. Under FESHM 7010: ESH&Q Program for Construction, Fermilab Contractors must show a 3-year safety record equal to or less than 85% of the most current BLS statistics for total construction.

Similar to other industrial settings, current activities at Fermilab typically result in some occupation-related injuries. However, Fermilab's safety record is much better than that of the general industry. Fermilab's 2017 TRC rate for all work activity was 0.91 (Vaziri 2018). In 2017, the DART rate for the previous 365 days at Fermilab was 0.43 (Vaziri 2018). This rate is below the 2016 DART rate of 1.6 for all U.S. workers. The rate of fatal work injuries for U.S. workers in in 2016 was 3.6 per 100,000 full-time equivalent (FTE) workers, an increase from 3.4 in 2015, the highest rate since 2010 (BLS 2017). By comparison, Fermilab has never experienced a fatal injury.

3.4.1.1 Radiation Safety

Fermilab implements an ISMS in accordance with Title 10 CFR Part 835, Occupational Radiation Protection in such a manner that worker and public safety and protection of the environment are given the highest priority. Fermilab is committed, in all its activities, to maintain any safety, health, or environmental risks associated with ionizing radiation or radioactive materials at levels that are ALARA. Fermilab management supports design considerations, work planning, and review of activities in support of the Fermilab ALARA program.

Ionizing radiation is currently produced at Fermilab during normal operations. The accelerated particles, or particle beams, produced in the accelerators are from one source. In addition, some accelerator components become radioactive as a result of operations. Radioactive materials are carefully labeled and controlled by trained personnel.

The biological impacts of radiation exposure vary depending on the type of radiation, the energy of the radiation, the portion of the body exposed, and the exposure duration. The biological effect of radiation is measured in units called rem, a relatively large unit.

The biological effect of radiation is usually reported in millirem (1,000 mrem = 1 rem). As shown in **Table 3.4-1**, data published by the National Council on Radiation Protection and Measurements (NCRP) show that an average member of the U.S. population receives a total dose of ionizing radiation of 624 mrem (0.624 rem) in a year from naturally occurring sources such as terrestrial and cosmic radiation, medical, commercial, and industrial sources (NCRP 2009). In addition, during a one-way flight across the country (New York to Los Angeles), a passenger is likely to receive 2 to 5 mrem of radiation. The radiation from two cross-country flights is about equal to the radiation dose from a single chest x-ray (USEPA 2018b).

Table 3.4-1 Comparison of Annual Average Doses Received by a U.S. Resident from All Sources

Source		Dose (mrem in a year)[a]	Percent (%) of Total
Ubiquitous background	Radon and thoron	228	37
	Space	33	5
	Terrestrial	21	3
	Internal (body)	29	5
	Subtotal	**311**	**50**
Medical	Computed tomography	147	24
	Medical x-ray	76	12
	Nuclear medicine	77	12
	Subtotal	**300**	**48**
Consumer	Construction materials, smoking, air travel, mining, agriculture, fossil fuel combustion	13	2
Other	Occupational	0.5[b]	0.1
	Nuclear fuel cycle	0.005[c]	0.01
	Total	**624**	**100**

Notes:
a To convert millirem to millisieverts,, divide by 100.
b Occupational dose is regulated separately from public dose and is provided here for informational purposes.
c Calculated using 153 person-sieverts from Table 6.1 of the NCRP Report 160 using a 2006 U.S. population of 300 million.
Source: NCRP 2009

Radiation exposure of Fermilab employees, scientific users, and visitors is regulated by DOE 10 CFR 835. Radiological wastes are managed in compliance with DOE Order 435.1, Change 1 (DOE 2007) These requirements are implemented at Fermilab through detailed written policies outlined in the FRCM (Fermilab 2017a). Terms used to describe radiological doses (e.g., equivalent dose, effective dose, and total effective equivalent dose) are defined in 10 CFR 835.

DOE standards limiting radiological doses to members of the public (who are not occupational workers at Fermilab) are subject to DOE Order 458.1 Change 2 (DOE 2013) and supported by DOE-STD-1196-2100 (DOE 2011). DOE limits the primary radiation dose for the public to 100 mrem in a year from activities conducted at Fermilab and other DOE facilities. The amount of exposure members of the public receive during visits to Fermilab is never more than a very small fraction of this dose limit. Radiation dose to the maximally exposed member of the public from airborne radionuclide emissions during the past 20 years was estimated to be well below the USEPA standard of 10 mrem in a year and also much lower than the USEPA's continuous monitoring threshold of 0.1 mrem in a year.

3.4.2 Environmental Impacts

3.4.2.1 Proposed Action

This section describes the potential human health and safety impacts associated with the construction and operation of the Proposed Action. The Proposed Action would comply with relevant federal, state, and local health and safety regulations. Additionally, industrial codes and standards would minimize potential health and safety risks to on-site workers and the public. The PIP-II Integrated ES&H Management Plan (Fermilab 2016b) establishes the framework and expectations for the ES&H program for the PIP-II Project. This plan and its requirements apply to all work carried out by Project staff. Additional documents would be developed to provide more detailed ES&H program requirements and establish implementing procedures to carry out the program elements. A PIP-II Project Construction ES&H Plan and an ES&H Management Plan for Construction would be developed to define additional program requirements that would be implemented by Contractors while working on the PIP-II Project site.

3.4.2.1.1 Construction

Potential hazards during construction would include use of heavy equipment (e.g., forklifts, cranes, and specialized lifting equipment for heavy components); work in confined spaces; work at elevation/falls; electrical hazards associated with exposures to high voltage (utilities); exposure to dust, fumes, and noise; wildfire risks; and handling of hazardous materials (oils, solvents). Use of lifting equipment would comply with established Fermilab standards and procedures. Rigging operations would be performed by properly trained and licensed operators using certified lifting equipment.

To minimize health and safety risks to the public, access to construction areas would be limited to construction workers, Fermilab, and DOE employees who would administer and monitor construction activities. Site security would minimize the risks of unauthorized people accessing the PIP-II Project site. Areas accessible to workers would be routinely monitored, and appropriate signs would be posted.

During construction, the primary potential health and safety risk would be work-related accidents and injuries typical of the construction industry. Workers would be subject to the typical hazards and occupational exposures faced at other industrial construction projects. Potential hazards associated with construction would include excavations; use of heavy earth-moving equipment; work in confined spaces (areas with limited egress); work at elevation/falls; electrical hazards; exposure to dust, fumes, and noise; wildfire risks; material handling; and handling hazardous materials. Hazardous materials used during construction may include paints, epoxies, oils, and lead for construction of shielding. Construction would follow conventional practices for operation of heavy earth-moving equipment. Excavation-related impacts would be limited to the PIP-II Project site within the Fermilab property.

Contractors would perform the excavations and would be required to meet safety qualifications and comply with SEPMs and Fermilab's established health and safety procedures. To minimize potential impacts on workers, the public, and the environment, construction activities would comply with the applicable requirements of OSHA (29 CFR Parts 1910 and 1926), DOE (10 CFR Parts 835 and 851), the FESHM (Fermilab 2016b) and the FRCM (Fermilab 2017a). These regulations and Project-specific plans require such measures as hazard communication, personal protective equipment (PPE), safety training, worker monitoring, hearing protection, fire protection, fall protection, and excavation safety.

No new safety and health programs would be required because the established programs would be implemented. Task-specific HAs would be completed to identify construction hazards and to avoid or minimize them by delineating and establishing construction boundaries and barriers; implementing established Fermilab safety programs and procedures, including engineering and administrative controls and use of appropriate PPE; health and safety training; and conducting routine inspections.

Construction would necessitate decommissioning of any existing Main Ring or Booster Ring equipment before the start of construction. It is possible that some of these materials would be activated at low levels. Before demolition, the structures would be inspected, and in many cases tested, for the presence of any radioactive materials/items, including asbestos. Regulated radioactive material would be segregated before removal by the Contractor. If found, any activated material, along with metals to be recycled, would be segregated and managed in accordance with Fermilab standards and procedures in coordination with the Fermilab Radiological Control Organization.

Fire risk would be minimized through SEPMs by following the fire safety precautions required by the FESHM, as well as OSHA regulations and NFPA 241, "Standard for Safeguarding Construction, Alteration and Demolition Operations." In addition, potential ignition sources would be controlled. For example, smoking would be limited to designated areas, and hot work (e.g., welding) would be controlled through the Fermilab burn permit program.

Facility access and egress would be designed and provided in accordance with applicable NFPA Life Safety Codes and Standards including NFPA 520: "Standard on Subterranean Spaces," which requires adequate egress in the event of an emergency. Facility fire detection and suppression systems, as well as personnel occupancy requirements, would comply with NFPA 101: Life Safety Code. Fire alarm/fire suppression systems would also be designed in accordance with Fermilab engineering standards, which require a hard-wired, zoned, general evacuation fire alarm system.

Electrical hazards would be minimized through engineered controls such as isolation and insulation, combined with Fermilab SEPMs including policies, procedures, and training. Work performed on electrical systems would include controls such as lockout/tagout (LO/TO) procedures. Electrical equipment would be designed, upgraded, installed, and operated in compliance with the National Electrical Code, NFPA 70; OSHA 29 CFR 1910, Subpart S, Electrical; and the Fermilab Electrical Safety Program.

The rate of potential incidents for Project-related injuries can be estimated based on national employer-reported injury, illness, and fatality rates. Based on an average daily workforce over the 7 years of construction with an average of 18 workers, and assuming that each worker would be on the job 2,000 hours per year for 7 years, the Proposed Action would result in an approximate total of 252,000 worker hours. Based on the 2016 national recordable incident rate of 2.9 cases per 200,000 worker hours, an average of four work-related injuries and illnesses may occur during the 7-year construction period (fewer than one per year). Based on the 2016 national fatality rates, no fatalities are likely over the 7 years of construction. During 2017, Fermilab's average incidence rates were 0.91 case of recordable injuries/illnesses and 0.43 DART case per 200,000 worker hours, which are lower than the national rates. Based on Fermilab's average incidence rates, construction would result in approximately one recordable work-related injury or illness and fewer than one (0.53) DART case over the 7-year construction period. The calculated results are an estimate and do not imply that a particular number of accidents, injuries, or fatalities would actually occur.

The Proposed Action construction would be implemented in a manner similar to those of past and present high-energy physics experiments at Fermilab. Controls and protective measures would be designed and implemented to comply with applicable standards, which would reduce the probability of accidents. Potential health and safety impacts would be minimized by implementing SEPMs, including compliance with Fermilab's established health and safety procedures.

3.4.2.1.1.1 Radiation Safety

During construction, workers would not work in radiation exposure areas associated with existing Fermilab facilities and would receive radiation doses no higher than the public under the ALARA program. Under ALARA, Fermilab takes every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical. Some excavation would occur in areas previously exposed to accelerator operations and cooling water, which contains very low levels of radionuclides, including tritium. Based on Fermilab's experience with other similar projects, excavation could result in radiation exposures. To verify that exposures would be at or below regulatory limits, soil would be excavated in compliance with the procedures outlined in the FRCM (Fermilab 2017a), including monitoring of worker exposures and radiation safety oversight. Radiation exposure potential associated with the use of radiography sources or other licensed radioactive material would be managed by the Contractor(s) in accordance with the applicable regulations and the terms of their license(s).

3.4.2.1.2 Operations

Based on the PIP-II PHAR, the primary hazards during operations would include electrical, ionizing radiation inside/outside, cryogenics, and material handling. Based on the experience of other accelerator facilities at Fermilab, the evaluations conducted and Fermilab's commitment to certain design features and safety controls for the Project, it is expected that the health and safety impacts (risk) of foreseeable accidents can be managed at acceptably low levels through the facility design process and control of operations. The Project design incorporated protection measures to reduce potential hazards to no more than minor on-site and negligible off-site impacts to people and the environment during operations (Fermilab 2017d) .

Impacts analyzed for exposure of Fermilab workers to radiation account for both pulsed and CW-mode operations. Radionuclide emissions during operations would be controlled and monitored to verify that radionuclide emissions from all sources were well below DOE requirements, USEPA dose limits, and site-specific Fermilab policy. During operations, occupational hazards would be similar to those associated with research, educational, office, or light industrial workplaces and similar to those analyzed for the NO*v*A Project (DOE 2008) and other Fermilab projects. For specific aspects of operations, Fermilab would prepare task-specific HAs or protocols to identify hazards. During operations, hazards would be minimized by engineering controls included in the design and operational planning and SEPMs, as well as by implementation of established Fermilab protocols. Radiation exposures during operations would be reduced to ALARA and at or below regulatory limits.

Radionuclide generation has been evaluated in the Fermilab EAs for the LBNF/DUNE (DOE 2015), NuMI (DOE 1997) and NO*v*A (DOE 2008) Projects which would utilize the increased beam intensity and power from PIP-II. These were all found to be well within regulatory limits. The PIP-II Project would not change the previous EA evaluations.

Potential hazards during operations would include use of heavy equipment (e.g., forklifts, cranes, and specialized lifting equipment for heavy components); work in confined spaces; work at elevation/falls; electrical hazards associated with exposures to high voltage (utilities); exposure to dust, fumes, and noise;

wildfire risks; and handling of hazardous materials (oils, solvents). Use of lifting equipment would comply with established Fermilab standards and procedures. Rigging operations would be performed by properly trained and licensed operators using certified lifting equipment.

Some workers could be exposed to powerful magnets capable of pulling tools from hands and interfering with the performance of cardiac pacemakers, suture staples, aneurysm clips, artificial joints, and prostheses. Stray static magnetic fields would be measured and mapped, and appropriate warning signs would be posted.

Potential issues associated with the handling of low-level radioactive waste (LLRW) would be minimized by implementing SEPMs, including established programs that comply with 10 CFR 851 and DOE orders. Under these requirements, site inventories would be completed for hazardous chemicals. Standard safety practices would include the use of PPE as appropriate, and spill prevention planning would be implemented as outlined in the FESHM and the Fermilab SPCC Plan.

The Proposed Action would also use cryogens. Fermilab scientists use cryogens extensively for existing experiments. Personnel involved in handling cryogens would take cryogenic safety and ODH training as required under Fermilab SEPMs, including the site's cryogen safety program. In addition, all piping and vessels for storing and conveying cryogens would be designed to comply with FESHM requirements.

Because few new positions would be created for operations, the number of worker hours for the Proposed Action would be similar to those for current conditions; therefore, there would be a very small increase in the potential for injuries/illnesses. With implementation of established Fermilab health and safety standards and controls, health and safety impacts would be low.

3.4.2.1.2.1 Radiation Safety

Operation of the Proposed Action would expose PIP-II workers to low levels of radiation similar to those generated by existing Fermilab experiments. Under normal operations, worker exposures to radiation would be controlled by implementation of Fermilab's established safety procedures requiring that doses are maintained as ALARA and limiting doses to less than 1,500 mrem in a calendar year. The main operational health and safety risk would be the potential for the primary proton beam to partially penetrate the beamline shielding in a short-term excursion that would be immediately terminated by numerous detection devices both to terminate the unplanned radiation exposure and to restore proper facility operation. Thus, the beam radiation would be present only during beam operation and would cease instantly when the beam is turned off. Radiation exposure would be minimized by ALARA design measures and by preparing and implementing operating plans and health and safety plans. ALARA design measures would include encasing the beamline in thick steel and concrete shielding adequate to protect against radiation losses during routine operations, as well as the unlikely accidental loss of control of the beam.

The Fermilab Radiation Safety Interlock System would minimize the potential for accidents involving direct beam exposure. This system has successfully been in use for many years at Fermilab and would protect personnel from direct exposure to the beam; high voltage; and potentially resulting injury, radiation exposure, or death. This system would include access control interlocks, radiation detectors, exclusion area boundary gates, access keys and cores, an emergency shutdown system, an audio warning system, and an electrical safety system. Before enabling the beam, Fermilab operators would also conduct a walkthrough (Search and Secure) of the beam enclosure, per facility-specific search and secure procedures, to ensure that the area is unoccupied. Shielding in accordance with the FRCM (Fermilab

2017a) would minimize radiation exposure outside the enclosures and would minimize radioactive air emissions and activation of soil and groundwater.

The beamline would have systems designed to contain radio-activated air and accidental spills of activated water.

Beamline components would be subject to intense radiation during beam operation and would require regular replacement. Shielding would keep residual radiation sufficiently low to allow maintenance personnel to access the irradiated components. Shielding would be designed to maintain the radiation doses in occupied spaces below 0.25 mrem per hour during beam operation. For areas accessible to the public, shielding would be designed to keep the dose rate below 0.05 mrem per hour.

The beamline would be monitored to identify areas experiencing beam losses. This system would also include monitoring of airborne radiation: radioactive gases generated from beamline operations. Fermilab's radioactive air emissions permit limits off-site exposure to radioactive air to less than 0.1 mrem in a year (40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities"). Fermilab stack-monitoring detectors are connected to the site-wide monitoring network.

Many of the Proposed Action beamline components would be cooled with water. Because the cooling water would be activated by exposure to radiation, this would be a recirculating closed-loop system. The water would be recirculated, depending on the component, for many months or many years until a purge is required. All generators must characterize their waste as required by the low-level waste receiving facility and DOE Manual 435.1-1 Radioactive Waste Management Manual (DOE 1999). Radiological wastes would be handled in compliance with DOE Order 435.1 (DOE 1999). These requirements are implemented at Fermilab through detailed written policies outlined in the FRCM (Fermilab 2017a).

Beamline components would require maintenance and occasional replacement, requiring close work and handling of activated components. Workers conducting maintenance inside the beam enclosure would be subject to higher radiation levels with less frequent exposure. Per the FRCM, the maximum dose allowed for radiation workers is 100 mrem per week. Radiation exposure of Fermilab employees, scientific Users, and visitors is regulated by DOE 10 CFR 835. As with existing Fermilab experiments, exposures under the Proposed Action would remain below DOE regulatory dose equivalent annual limit of 5,000 mrem and the Fermilab administrative annual dose goal for radiation workers of 1,500 mrem.

Collective radiation doses to occupational workers at Fermilab and other DOE facilities are routinely tabulated. The sum of the doses received by all occupational workers during a calendar year is expressed in units of person-rem. Past and planned operations at Fermilab have typically resulted in an average collective dose of about 13 person-rem during calendar years 2012 through 2016. The Proposed Action is not expected to increase this average significantly. Exposures to low levels of ionizing radiation may result in an increase in latent cancer fatalities (LCFs). Because the primary health concern associated with radiation is latent cancers, DOE uses a dose-to-risk conversion factor to estimate potential radiation impacts. The number of radiation-induced LCFs is estimated by multiplying the dose (person-rem) by health risk conversion factors that relate the radiation dose to the potential number of LCFs. These factors are based on comprehensive studies of people historically exposed to large doses of radiation, such as survivors of atomic weapon detonations during World War II. The conversion factor most commonly used in recent assessments is 0.0006 LCF per person-rem of exposure for workers and the public (Interagency Steering Committee on Radiation Standards [ISCORS] 2002). Based on a dose-to-risk conversion factor of 0.0006 fatal cancers per person-rem and the 5-year average of collective dose of about 13 person-rem, the estimated probability of a fatal cancer induced by radiation would be 0.0078 LCF (i.e., less than one chance in 100 that there would be a single LCF among the approximately 1,200 monitored workers). For comparison, the natural lifetime risk of fatal cancer in the U.S. population is approximately 0.2 (two chances in 10) (American Cancer Society 2018).

Fermilab has a long-standing policy of limiting off-site exposures resulting from Fermilab operations to less than 10 mrem in a calendar year. The 5-year average (2012-2016) off-site dose to the general public from penetrating radiation is 0.07 mrem (Fermilab 2017a). The same 5-year average off-site dose to the public from radioactive air is 0.047 mrem. This total off-site dose to the public is a fraction of the Fermilab administrative limit of 10 mrem in a calendar year (Fermilab 2017a). This policy would continue to apply to the Proposed Action.

3.4.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no new occupational or radiological health or safety impacts on workers or the public from the Proposed Action. Existing research projects and other planned activities would continue at Fermilab, along with associated health and safety hazards. Health and safety at Fermilab would continue to be managed in accordance with established programs, policies, and procedures to minimize potential occupational or radiological health or safety impacts on Fermilab workers or the public. Radiation exposures for Fermilab workers would be ALARA and would be below Fermilab and DOE exposure standards (1,500 mrem in a year and 5,000 mrem in a year, respectively). Exposures to the public would be less than the Fermilab administrative limit standard of 10 mrem in a calendar year.

3.5 HYDROLOGY AND WATER QUALITY

This section describes existing hydrologic resources and water quality at Fermilab and evaluates potential environmental impacts on surface and groundwater hydrology and water quality from the Proposed Action and No Action Alternative. The hydrology evaluation presented below is in support of DOE's requirement to complete a floodplain assessment as required by 10 CFR 1022 and related EOs and DOE Orders. The affected environment also includes surface water and groundwater potentially affected by formation of radionuclides, and adjacent surface waters and groundwater potentially affected by runoff and spills.

3.5.1 Affected Environment

3.5.1.1 Surface Water Hydrology

Fermilab is located between the Fox River and the West Branch of the DuPage River, which both flow north-to-south. The Fox River flows into the Illinois River near Ottawa, Illinois. The West Branch of the DuPage River flows along the DuPage-Cook County line to its confluence with the East Branch DuPage River near Naperville and then into the Illinois River near Joliet, Illinois.

Surface water runoff from the Fermilab property drains into three creeks: Kress Creek, Ferry Creek, and Indian Creek. On Fermilab property, surface water drains westward toward the Fox River via Mahoney Creek and Indian Creek; or drains eastward toward the West Branch of the DuPage River via Kress

Creek, an unnamed tributary of the West Branch, or one of two tributaries of Ferry Creek (Lurie and Bird 2015). Kress Creek crosses the northeast corner of the Fermilab property, flowing southeast to the West Branch of the DuPage River. Ferry Creek flows southeast to the West Branch of the DuPage River. Indian Creek flows to the south along the western edge of the Fermilab property and off site at the southwest corner of the property, and then to the Fox River at Aurora, Illinois.

The drainage divide between Ferry Creek Watershed and Indian Creek Watershed is the Main Ring. The on-site drainage areas within the Ferry Creek Watershed total approximately 3,214 acres. The tributary area includes the area within the existing Main Ring, including the Main Ring Lake and a series of cooling water ponds along the perimeter of the Main Ring, as shown on **Figure 2.2-2**. Several Ferry Creek tributaries were dammed to create on-site cooling water ponds (DUSAF Pond, A.E. Sea, Sea of Evanescence, and Lake Law). The Ferry Creek Watershed outlet from the Fermilab property is at the downstream end of the Sea of Evanescence.

The PIP-II Project site is located at the southwest corner of the Fermilab property within the Main Ring and Ferry Creek Watershed. The PIP-II Project site is predominantly flat with very limited topographic relief. Overland flow of stormwater runoff from the PIP-II Project site flows southeast to Ferry Creek. Sump water from the A0 pond flows to Indian Creek.

The existing area within the Main Ring is predominantly flat with very limited topographic relief. Based on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), the PIP-II Project site is not located within the 100-year Special Flood Hazard Area (FEMA 2004), which has a 1% chance of flooding in any given year.

3.5.1.2 Surface Water Quality

Fermilab currently releases minor amounts of regulated pollutants to surface water bodies from stormwater runoff, cooling water, effluents from various on-site construction projects, and pesticide applications. Fermilab monitors the physical and chemical parameters from selected water bodies. Stormwater runoff, as well as cooling water, is currently discharged in accordance with Fermilab's existing NPDES permit (IL0026123). Six outfalls are identified in the permit. Four outfalls discharge to Indian Creek, one outfall discharges to Ferry Creek, and one outfall discharges to Kress Creek. Some of these outfalls typically have little or no flow because much of the impounded surface water is recirculated for cooling and does not continuously leave the Fermilab property.

Fermilab implements an Environmental Monitoring Program (Fermilab 2018c) to provide data on Fermilab's impacts on the surrounding environment, including surface water. Per the existing NPDES permit, the six outfalls are monitored to document compliance with the permit effluent limits for these parameters. During periods of discharge at the outfalls, NPDES permit requires monitoring of temperature, pH, tritium concentrations, and an estimate of flow at all locations. Total residual chlorine is monitored at Indian and Kress Creeks. Discharge Monitoring Reports are submitted monthly to the IEPA, as required by the NPDES permit. The FESHM Chapter 8026, Surface Water Protection, describes regulatory aspects and responsibilities of the surface water program.

Accelerator-produced radionuclides are an expected outcome of operating the planned accelerator complex and is associated with both past and ongoing experiments. Tritium and sodium-22 are the only radionuclides produced in volumes that could potentially affect surface water quality and that warrant long-term monitoring under Fermilab's Environmental Monitoring Program (Fermilab 2018c). Surface water is sampled monthly and analyzed for radionuclides based on their potential for contamination. Monthly data are from measurements taken at the outfalls and Fermilab property boundary locations.

Radionuclide generation has been evaluated in the Fermilab EAs for the LBNF/DUNE (DOE 2015), NuMI (DOE 1997) and NO*v*A (DOE 2008) Projects which would utilize the increased beam intensity and power from PIP-II. These were all found to be well within regulatory limits. The PIP-II Project would not change the previous EA evaluations.

In November 2005, tritium was detected for the first time at the Indian Creek outfall on the southwest corner of the Fermilab property. Increased monitoring began on Ferry Creek in April 2006 following the detection of low levels of tritium in Indian Creek. During droughts, Ferry Creek can be dry at the Fermilab property boundary, and no water samples can be taken. Since that time, Fermilab has instituted additional measures to reduce these tritium concentrations. Tritium was added to the NPDES permit in 2008.

In November 2016, tritium was detected in the outfall discharged to Kress Creek (1.3 pCi/ml). Indian Creek exhibited tritium discharges 11 months of the year in 2016 (highest concentration was 10.8 pCi/ml in June 2016). In December 2016, the Ferry Creek outfall (from A.E. Sea to Sea of Evanescence) yielded the first detectable level of tritium (1.3 pCi/ml). Monitoring for radioactivity in surface water continues to be a primary component of Fermilab's routine environmental surveillance program. Tritium has a half-life of 12.3 years. The levels of tritium in the Fermilab cooling ponds and in Kress Creek, Indian Creek, and Ferry Creek would not pose a health threat to humans or biota because the tritium levels would be well below DOE surface water standards for tritium (1,900 pCi/ml) as defined in 10 CFR 835 (DOE Order 458.1; DOE 2013). In the unlikely event that radioactivity in surface water were to exceed DOE's surface water release criteria of 1,900 pCi/ml, it would be treated as LLRW. LLRW is disposed of in accordance with DOE standards at DOE-approved radioactive waste disposal sites. LLRW is addressed in **Section 3.14, Waste Management**. Water containing tritium concentrations is either reclaimed for use via discharge into Fermilab's ICW System or disposed of as LLRW. All radioactive materials would be shipped in accordance with existing regulations.

Fermilab has numerous on-site sumps that collect and drain water from building footings and from under beamline tunnels and other experimental areas. Water collected by these sumps typically contains low concentrations of radionuclides (primarily tritium) from rainwater leaching radioactive soils. These sumps discharge to on-site ditches and ponds. Fermilab monitors the on-site ponds and creeks and takes steps to keep the levels of tritium ALARA. Tritium concentrations in the ICW ponds are typically well below DOE surface water standards for tritium (1,900 pCi/ml) as defined in 10 CFR 835 (DOE Order 458.1; DOE 2013). Sodium-22 concentrations are typically not detected. The DOE Derived Concentration Technical Standard for sodium-22 is 10 pCi/ml (DOE 2011).

The USEPA defines an impaired waterbody as one where required pollution controls are not sufficient to attain or maintain applicable water quality standards. The IEPA 303(d) list reports Indian Creek as an impaired water body. Chloride, fecal coliform, phosphorus, total suspended solids, sedimentation/siltation, and dissolved oxygen levels currently do not meet water quality standards and are attributed to urban runoff, storm sewer discharge, and sewer overflows. Based on the IEPA 303(d) list, Kress Creek is also impaired based on low dissolved oxygen. Fermilab's discharges do not contribute to the total maximum daily loads (TMDLs) for which Indian Creek and Kress Creek are on the 303(d) list. Based on the IEPA 303(d) list, Ferry Creek is not an impaired water body (IEPA 2018).

Fermilab maintains an on-site piping system for the conveyance of aqueous process wastewater and sanitary effluent, which are directed to sanitary sewers and ultimately discharged to POTWs in Batavia and Warrenville/Naperville. Fermilab has an NPDES pre-treatment permit for process wastewater and sanitary effluent discharges to the Batavia POTW. The permit requires effluent sampling and analysis for tritium and heavy metals, as these are the potential contaminants most likely generated from Fermilab activities. Fermilab's sanitary wastewater discharges comply with the pre-treatment permit, as well as specified radionuclide levels in the DOE Derived Concentration Guide (DOE 2011). Wastewater discharges are controlled by criteria described in FESHM 8025: Wastewater Discharge to Sanitary Sewers.

Monitoring stations, located at the site boundary, sample effluent discharges to the Batavia and Warrenville/Naperville POTWs. The discharges at these locations are a mixture of all effluents contributing to that sanitary sewer system. Fermilab monitors metals and tritium concentrations in the sanitary effluent discharged from the site. Analytical results for metals are compared to municipal discharge limits to track compliance.

Low levels of tritium have been regularly recorded in the effluent discharged to the Batavia POTW since August 2005. No other isotopes have been detected. To date, tritium concentrations in all discharges have been well below DOE Order 458.1 Derived Concentration Standards. The highest tritium level detected in the sanitary sewer water discharged to the Batavia POTW to date is roughly 5 to 10 pCi/ml. This level is below the DOE standard for tritium in sanitary sewers, which is 9,500 pCi/ml. Fermilab's sanitary sewer discharges complied with the pre-treatment permit as well as specified radionuclide levels in the DOE Derived Concentration Guide (DOE 2011).

3.5.1.3 Groundwater Hydrology

Groundwater at Fermilab and the PIP-II Project site is found in three main aquifers: the glacial drift aquifer and the shallow and deep bedrock aquifers. Within the glacial drift aquifer, groundwater is intermittently present within discontinuous silt, sand, and gravel lenses. IEPA considers this groundwater Class II groundwater, which is classified as non-resource groundwater, not for consumption (35 Illinois Administrative Code [IAC], Part 620.21). The IEPA defines Class I groundwater as a non-degradable resource, which is to be highly protected. The IEPA water quality standards are less stringent for Class II groundwater relative to the standards for Class I groundwater (Fermilab 2016b) and FESHM 8011: Groundwater Protection: Excavations and Wells (Fermilab 2018d).

The glacial drift units are 60 to 100 feet thick. Groundwater flow in these deposits is generally downward and slow. The average water table fluctuates seasonally between 5 and 15 feet below ground surface (bgs). The upper portions of the Silurian bedrock are approximately 150 feet thick and have low primary porosity but contain secondary porosity in the form of joints and fractures. This zone of high secondary porosity is referred to here as the shallow bedrock aquifer and is composed primarily of the Upper Bedrock Aquifer per Illinois State Water Survey terminology. The shale-dominated Brainard Formation provides lower confinement of the shallow bedrock aquifer.

The uppermost aquifer in the unconsolidated glacial sediments comprising the Prairie Aquigroup frequently exhibits hydraulic connection with nearby surface water bodies including lakes, ponds, and ditches with constant flow. An intermediate aquifer in the Prairie Aquigroup (approximately 20 to 40 feet bgs) exists in some locations at Fermilab. The depths of these relatively shallow glacial aquifers overlap and have a potential interaction with the majority of Fermilab's subsurface accelerator structures.

The groundwater in the Silurian bedrock aquifer and groundwater within the lower glacial deposits can be hydraulically connected to the bedrock aquifer and are classified as Class I groundwater. The various confining layers effectively insulate the Class I bedrock aquifers from potential surficial radionuclide and chemical contamination due to dilution and radioactive decay during the long periods required for water to percolate downward (Fermilab 2015b).

3.5.1.4 Groundwater Quality

Water quality is regularly monitored at Fermilab for multiple groundwater zones (aquifers), ranging from only several feet deep to more than 400 feet bgs. Fermilab conducts groundwater sampling pursuant to the Fermilab Groundwater Management Plan (Fermilab 2015b) to identify migration of radiological or chemical contamination from beamlines or other experimental areas.

The IEPA defines Class I groundwater as high-quality groundwater suitable for use as drinking water. Class I groundwater is considered a non-degradable resource for which the IEPA water quality standards are highly protective. Class II groundwater is classified as non-resource groundwater and not suitable for consumption. The IEPA water quality standards for Class II groundwater are less stringent relative to the standards for Class I groundwater.

Class II groundwater (non-resource groundwater, not for consumption) at Fermilab can be affected by radiation when the shielding around high-intensity beam loss areas or around the beam targets becomes radioactive (i.e., "activated"). Radionuclides formed by this process can leach into groundwater. Of the leachable radionuclides produced by Fermilab operations, tritium and sodium-22 are the only radionuclides produced in volumes that could potentially affect groundwater quality and that warrant long-term monitoring under Fermilab's Environmental Monitoring Program (Fermilab 2018c).

Low levels of tritium (less than 80 pCi/ml in non-regulated, Class II groundwater) have historically been detected in source-specific wells screened in the glacial tills beneath local experimental areas. The DOE Derived Concentration Technical Standard (DOE 2011) for tritium is 20 pCi/ml. DOE policy on groundwater protection is expressed in DOE Order 458, Radiation Protection of the Public and the Environment. The tritium in these groundwater units has ample time to undergo radioactive decay to levels below detection limits before reaching any Class I groundwater. The USEPA drinking water standard for tritium is 20 pCi/ml; however, Fermilab would comply with the IEPA groundwater standard for non-degradation of Class I groundwater which is <1 pCi/ml. To date, no detectable levels of tritium or accelerator-produced radionuclides have been found in the Class I groundwater of the upper aquifer at Fermilab.

3.5.2 Environmental Impacts

3.5.2.1 Proposed Action

3.5.2.1.1 Construction

3.5.2.1.1.1 Surface Water Hydrology

During construction of the Proposed Action, potential impacts on surface water hydrology would be low. Construction activities would have direct impacts on surface flows and would require stormwater management. Construction would require the excavation of up to 120,000 yd^3 of soil, which could modify surface water flows in the area.

Fermilab and DOE must comply with EO 11988, *Floodplain Management* (May 24, 1977; 42 F.R. 26951) and 10 CFR 1022, which require federal agencies to evaluate the potential impacts of its actions on floodplains. EO 11988 requires federal agencies to comply with flood protection standards, including construction of federal structures and facilities, in accordance with the standards and criteria promulgated under the National Flood Insurance Program, as appropriate for the type of structure or facility. The Proposed Action would not involve activities within a 100-year or 500-year floodplain (FEMA 2004). Very low impacts on floodplains would occur from implementation of the Proposed Action.

3.5.2.1.1.2 Surface Water Quality

The Proposed Action could have potential impacts on surface water quality during excavation, construction of the facilities, and other ground-disturbing activities. Impacts to surface water quality would be low. Multiple ground-disturbing activities would occur under the Proposed Action; including excavation; grading; and construction of surface features such as service buildings, parking lots, staging areas, and access roads. Construction would expose soils to rain and wind erosion during the placement and compaction of the soil before revegetation. Trenching, grading, and stockpiling activities would, if not properly addressed, result in exposing bare soil that could be eroded by wind and rainfall and ultimately transported to Ferry Creek. The resulting sedimentation could degrade water quality, and channel siltation could affect hydraulic capacity and habitat quality; however, this risk is minimized by flat topography and by implementation of SEPMs, including compliance with the Project-specific SWPPP, the Fermilab site-wide SPCC Plan, and the effluent limits of the NPDES Permits.

Construction stormwater NPDES permits are required for areas that occupy more than 1 acre. Fermilab would apply to the IEPA for coverage under the NPDES General Permit for Stormwater Discharges from Construction Site Activities (IL10) by submitting an NOI. The Proposed Action would require preparation of a SWPPP that would conform to “Illinois Urban Manual” standards (NRCS 2002). The SWPPP would describe the construction activity; soil disturbance; and required erosion and sediment controls, stabilization practices, structural controls, post-construction stormwater management, and wastewater treatment requirements. Stormwater and runoff associated with construction projects must follow the requirements outlined in FESHM 8012: Sedimentation and Erosion Control Planning.

Fermilab would be required to develop SWPPPs and to conduct and document regular inspections (Fermilab 2015b). Stormwater would be managed in accordance with the general permit, IEPA regulations, and FESHM 8012: Sedimentation and Erosion Control Planning. Stormwater BMPs would be used to control erosion, minimize degradation of water quality, and comply with relevant stormwater regulations.

Potential impacts on water quality would include minor increases in turbidity in Ferry Creek and downstream waterways. Minor increases in turbidity and sediment load would not be expected to influence the inclusion of Ferry Creek on the IEPA 303(d) impaired water bodies list.

If groundwater pumping is required for dewatering, pumped groundwater would be collected in Fermilab’s existing cooling water ditches and ponds. Fermilab’s existing NPDES permit (IL0026123) authorizes stormwater discharges into cooling waters. Fermilab would prepare a dewatering plan and would comply with NPDES permit requirements.

Water quality impacts would be minimized by preparing and implementing a Project-specific construction SWPPP, implementing Fermilab’s existing stormwater management program, and employing the methods used to control erosion similar to those used during construction of the NuMI (DOE 1997) and NO*v*A (DOE 2008) Projects. These methods would include the installation and maintenance of proper soil erosion barriers around disturbed areas and soil stockpiles as specified in the Illinois Urban Manual (NRCS 2002). The Project-specific SWPPP would require a combination of BMPs, such as silt fences, hay bales, and other measures, to direct stormwater runoff away from wetlands and sensitive resources and to detain water long enough for the sediment to settle before flowing into surface water. Containment measures would be used around the ground disturbance areas to protect slopes and to prevent transport of sediment-laden stormwater into surface waters during storm events.

Construction could also generate minor amounts of oily debris, cement truck washout, paint waste, paint solvent, and minor petroleum-contaminated soils typically resulting from equipment hydraulic line breaks or leaks. Fueling and fuel storage could have potential impacts on water quality and would be managed according to Fermilab's site-wide SPCC Plan. FESHM 8031: Oil Pollution Prevention, outlines the SPCC and secondary containment requirements. The Project-specific construction SWPPP would also outline additional SEPMs and pollution prevention BMPs regarding the proper storage and use of hazardous materials. With implementation of the SWPPP, SPCC Plan, and compliance with the effluent limits of the NPDES permits, impacts from these materials are expected to be low.

3.5.2.1.1.3 Groundwater Hydrology

Construction of the Proposed Action facilities may require excavations to depths below groundwater elevations. Construction within these excavations may require groundwater pumping for dewatering, which would result in some localized groundwater drawdown and short-term and localized impacts on groundwater flows around the Proposed Action facilities, but no large changes in flow direction, elevation, or quantity of groundwater. With implementation of the SWPPP, SPCC Plan and Fermilab SEPMs, impacts to groundwater hydrology would be low.

Fermilab monitors ten groundwater monitoring wells installed near SWMU 12 located south of the PIP-II Project site. One SWMU well (MW-9B) is located north of Holter Road and is a bedrock well (Greer 2018). One of the bedrock monitoring wells (MWS3) was recently abandoned (**Figure 2.2-2**). The SWMU monitoring wells are located outside of the PIP-II Project site; therefore, impacts to wells would be very low.

3.5.2.1.1.4 Groundwater Quality

During construction of the Proposed Action facilities, dewatering may be required to keep the excavation dry for construction workers and equipment. If groundwater pumping is required for dewatering, pumped groundwater would be collected in Fermilab's existing cooling water ditches and ponds. Fermilab's existing NPDES permit (IL0026123) authorizes dewatering and stormwater discharges into cooling water ditches and ponds. Fermilab would prepare a dewatering plan and would comply with NPDES permit requirements.

Groundwater contamination would be minimized by implementation of the Project-specific SPCC Plan; the Fermilab SPCC Plan; and the Project-specific construction SWPPP, including BMPs designed to minimize releases of oil, fuel, solvents, and other construction materials. Impacts to groundwater quality would be low.

3.5.2.1.2 Operations

3.5.2.1.2.1 Surface Water Hydrology

Collected stormwater runoff from the service buildings, adjacent loading and parking areas, and other impervious surfaces would be directed to the cooling ponds and recycled through the ICW system such that the increase in impervious surfaces would not result in an increase in peak stormwater flows. The Proposed Action would comply with existing stormwater regulations and SEPMs to allow percolation of stormwater in detention basins or similar BMPs.

The Proposed Action would not involve activities within a 100-year or 500-year floodplain (FEMA 2004). Thus, no impacts on floodplains would occur during operations.

3.5.2.1.2.2 Surface Water Quality

Stormwater BMPs would be used to protect water quality in Ferry Creek during operations. If groundwater pumping is required for dewatering, pumped groundwater would be collected in Fermilab's existing cooling water ditches from building sumps and ponds.

Impacts on surface water quality were analyzed for both pulsed and CW-mode operations. Generation of accelerator produced radionuclides, including tritium and sodium-22, is a function of beam power. Under the Proposed Project, increased beam intensity and power would result in increased levels of radionuclide generation throughout the accelerator complex and other experiments. Fermilab has developed standard measures to minimize the generation of radionuclides at the source (accelerator target halls) and thus minimize the release of tritium to surface water. Based on Fermilab's experience with other similar projects, tritium concentrations are expected to be several times lower than the drinking water standard for tritium (20 pCi/ml) set by the USEPA Primary Drinking Water Regulations; Radionuclide; Final Rule at 40 CFR 141, Subpart G.

During the Proposed Action operations, surface water radionuclide concentrations would be well below the DOE surface water standard and the USEPA drinking water standard for tritium (20 pCi/ml). For the NO*v*A Project (DOE 2008), Fermilab determined that, even under drought conditions when radionuclides would be most concentrated (Martens 2007), neither tritium nor sodium-22 concentrations would exceed surface water quality standards. Calculations showed that, under drought conditions, tritium concentrations would be approximately 25 to 50 pCi/ml (DOE limit of 1,900 pCi/ml), and sodium-22 concentrations would be below a detection limit of 0.4 pCi/ml (DOE limit of 10 pCi/ml). Accelerator produced radionuclides have been previously evaluated in other Fermilab EAs for the LBNF/DUNE, NuMI and No*v*a Projects which would utilize the increased beam intensity and power from PIP-II. These were all found to be well within regulatory limits. The PIP-II Project would not change the previous EA evaluations.

Vehicle use by maintenance workers and researchers during Proposed Action operations could result in increases in oil and fuel use and increased concentrations of oil and fuel in stormwater runoff from parking lots and roadways if not maintained. However, runoff from all parking lots, access roads, and loading areas would be managed through SEPMs, including BMPs as required by the Fermilab SWPPP. Surface water quality impacts would be low during operation of the Proposed Action.

3.5.2.1.2.3 Groundwater Hydrology

The beamline's underground enclosures would operate in the glacial drift aquifer and surface of the upper bedrock aquifer. Operation of the Proposed Action would not require the use of groundwater; therefore, the Project would have limited and localized impacts on groundwater flow, and overall impacts to groundwater would be very low.

3.5.2.1.2.4 Groundwater Quality

Class II groundwater (non-resource groundwater, not for consumption) at Fermilab may be affected by radiation when the shielding around high-intensity beam loss areas or around the beam targets becomes radioactive (i.e., "activated"). Radionuclides formed by this process can leach into groundwater. Of the leachable radionuclides produced by Fermilab operations, tritium and sodium-22 are the only radionuclides produced in volumes that could potentially affect groundwater quality and that warrant long-term monitoring under Fermilab's Environmental Monitoring Program (Fermilab 2018c).

Consistent with previous Fermilab experiments, the Proposed Action would be designed to minimize impacts to groundwater quality during operations. Similar to other Fermilab projects, soil and water at the interface between the beamline shielding and surrounding soils and groundwater may become activated.

Impacts on groundwater quality were analyzed for both pulsed and CW-mode operations. Groundwater immediately adjacent to the shielding would be collected, drained to a sump, pumped into the ICW system, and recycled for cooling of experimental power sources and components. Activation of groundwater is thus minimized by removing it from any possible radioactivity source.

The Proposed Action by itself would not change the level of radionuclide generation within the current laboratory experimental program. Although the Proposed Project would have the ability to provide more protons than the existing Linac, the existing facility areas would remain limited to the currently approved beam operational limits. Fermilab's existing radiological programs ensure compliance with beam intensity limits. Accelerator produced radionuclides have been previously evaluated in other Fermilab EAs for the LBNF/DUNE, NuMI and No*v*a Projects which would utilize the increased beam intensity and power from PIP-II. These were all found to be well within regulatory limits. The PIP-II Project would not change the previous EA evaluations.

Activated shielding and soils around the beamline would be left in place for the life of the experiment. Groundwater immediately adjacent to the shielding would be collected, drained to a sump, pumped into the ICW system, and recycled for cooling of experimental power sources and components. Activation of groundwater is thus minimized by removing it from any possible radioactivity.

Fermilab would implement existing established Fermilab policies and procedures to minimize the risk of unforeseen events and releases. Should inadvertent spills or releases occur, cleanup would be implemented promptly and effectively to avoid adverse ecological impacts. The Project would comply with the Fermilab tritium monitoring efforts and plan (Fermilab 2017a).

Similar to the LBNF/DUNE (DOE 2015), NuMI (DOE 1997) and NO*v*A (DOE 2008) Projects, the Proposed Action would be designed to maintain Class I groundwater radionuclide concentrations below the Standard Limit of Detections, which for tritium is 1 pCi/ml and 0.04 pCi/ml for sodium-22. Groundwater exposure to radiation generated by the proton beam would be minimized by shielding as described in **Section 2.2.4.3**. Furthermore, the potentially affected groundwater would be part of the glacial drift aquifer, which is not available for consumption as part of a Class 1 groundwater resource. In addition, groundwater at the Fermilab property has very slow seepage velocities, and there are no drinking water wells proximate to the Fermilab property boundary.

Local public drinking water supplies are not derived from this shallow groundwater but rather from the deep aquifer at a minimum of 700 feet bgs. Private wells are generally installed in the shallow bedrock aquifer at 200 feet. The closest municipal water supply well is located approximately 1.4 miles west of Booster Ring Road. Some private wells have tapped groundwater at depths from 25 to 100 feet bgs (IEPA 1998). These drinking water wells are protected by wellhead protection regulations under the Illinois Groundwater Protection Act (IGPA), which provides for well setbacks, land use regulation, groundwater quality standards, and detailed assessment of threatened community wells and their aquifers as necessary.

Building sumps would direct groundwater to the ICW ponds, which are underlain by naturally occurring clay, further minimizing migration of radionuclides to the groundwater. Groundwater that seeps through to the glacial deposits would be unlikely to migrate off site. In addition to the redundant interceptor system and bedrock grouting, Fermilab would evaluate the installation of a monitoring well program adjacent to these structures to allow sampling of the shallow bedrock zones. The number of monitoring wells and their specific locations have not yet been determined and would be identified in the site-specific groundwater monitoring plan based on the site-wide Fermilab Groundwater Monitoring Plan (Fermilab 2015b). The monitoring program encompasses both radionuclides and chemical contaminants. At present, there are numerous monitoring wells adjacent to the proposed PIP-II Project site. Once operations commence, process samples would be used to evaluate whether additional monitoring wells are required for the Proposed Action. The ongoing monitoring program enables baseline data to be established for the site before construction and subsequent operations.

Impacts to groundwater quality would be low because exposure of groundwater to radiation generated by the proton beam would be minimized by shielding as described in **Section 2.2.4.3**. The radionuclides in these groundwater units would have ample time to undergo radioactive decay to levels below detection limits before reaching any Class I waters. The shallow depth, local source, and extremely low migration rates of water through the glacial till would make the probability of tritium reaching Class I groundwater extremely low.

Operation of vehicles and maintenance activities could affect groundwater quality without protective measures in place. However, operation of the Proposed Action would only require chemical use indoors and in small quantities. Further, impacts on groundwater would be minimized through SEPMs and by implementing the Fermilab SPCC and SWPPP, including operational BMP designed to minimize releases of oil, fuel, solvents, and other materials. Impacts to groundwater quality would be low.

3.5.2.2 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be constructed or operated and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no excavation, grading, filling, or other new ground disturbances within the PIP-II Project site; no impervious surfaces would be added; and no additional stormwater would be generated; therefore, there would be no impacts on surface water or groundwater hydrology or water quality from the Proposed Action. Ongoing construction, operations, and other planned projects would continue to result in potential impacts on hydrology and water quality. Fermilab would minimize these impacts by implementing existing water quality controls, including stormwater management and ongoing groundwater monitoring programs; thus, impacts would remain low.

3.6 NOISE AND VIBRATION

This section evaluates potential noise and vibration impacts of the Proposed Action, including construction of the Proposed Action facilities at Fermilab. The affected environment includes areas at Fermilab that would be subject to noise or vibration levels that exceed ambient levels, including areas near the proposed Project.

3.6.1 Affected Environment

3.6.1.1 Existing Noise Conditions

The proposed Project is located on an isolated portion of the western side of the Fermilab property. Existing noise sources in that area include vehicular traffic from Kirk Road to the west and Butterfield Road to the south. Ambient noise levels vary depending on the time of day, weather, and proximity to noise-attenuating features such as trees and topographical changes. Existing Fermilab operations contribute little to existing ambient noise levels at the property line and in surrounding residential areas. The land uses adjacent to Fermilab include residential communities to the west, south, and east, and industrial facilities to the north and south.

The noise receptors in the vicinity of Fermilab are single-family residences located west of Kirk Road and near the southwest corner of the Fermilab property to the west of the Illinois Prairie Path (e.g., Savannah Drive). The residences west of Kirk Road are approximately 1 mile from the Proposed Action aboveground facilities.

Kirk Road is a four-lane road with a high volume of existing automobile and truck traffic. The ambient noise levels along Kirk Road were evaluated in the LBNF/DUNE EA (DOE 2015). Based on the 2015 EA, the ambient noise levels measured at a location approximately 150 feet south of the Giese Road and Kirk Road intersection ranged from 56.2 to 62.2 decibels (db), A-weighted (dBA) equivalent sound level (L_{eq}) during the day (7:00 a.m. to 9:00 p.m.) and 50.7 to 60.5 dBA L_{eq} at night (9:00 p.m. to 7:00 a.m.). This noise level is typical for a commercial area with vehicular traffic. The higher daytime noise levels can be attributed to Kirk Road traffic. Ambient noise levels adjacent to Kirk Road ranged from 62.4 dBA L_{eq} near Pine Street to 67.5 dBA L_{eq} near Giese Road (DOE 2015).

3.6.1.2 Noise Standards

3.6.1.2.1 Federal Standards

USEPA published noise guidelines to protect public health and welfare with an adequate margin of safety (USEPA 1974). These criteria were intended as a guideline for instances where no local, county, or state standard existed. The USEPA set guidelines of L_{dn} 45 dBA indoors and 55 dBA outdoors for residential areas. The day-night average sound level (L_{dn}) is the average noise level over a 24-hour period.

Sound has two physical properties: pressure variation and loudness. Pressure variation is measured in the number of pressure changes (cycles) per second and is referred to as frequency, measured in Hertz (Hz). The higher the frequency (Hz), the higher-pitched the sound. Sound loudness is typically characterized by both sound pressure and sound pressure variation.

The following are examples of noise and associated loudness measured in dBA:

- Library 30 dBA
- Normal Speech 70 dBA (at 3 ft.)
- Garbage Disposal 80 dB (at 3 ft.)
- Gas Lawn Mower 100 dBA (at 30 ft.)

The frequency of pressure contributes a correction to decibel readings. The human ear can hear sounds within a frequency range of 20 Hz to 20,000 Hz. Sounds are most easily heard within a frequency range of 2,500 to 3,000 Hz. An ‘A-weighting’ scale applies a weight to dB levels depending on frequency. This correction to the decibel scale is strongest at the lower and higher levels of sound pressure. Sound loudness is expressed in the following sections as dBA or decibels corrected (A-weighting) for frequency response. To the average human ear, the apparent increase in “loudness” doubles for every 10 dBA increase in noise.

3.6.1.2.2 State Standards

The State of Illinois Administrative Code Title 35, Subtitle H, Chapter I, Part 901, Sound Emission Standards and Limitations for Property Line-Noise-Sources includes noise limits specific to source and receptor land uses (residential [Class A], commercial/[Class B], and agricultural/industrial [Class C]; State of Illinois 2006). Given the on-site and adjoining land uses, the most restrictive noise limitations (source: Class C, receptor Class A) would be applicable to the Proposed Action. **Table 3.6-1** summarizes the applicable requirements, which are defined by octave band. An octave is a range of frequencies whose upper frequency limit is twice that of its lower frequency limit. For example, the 1,000 Hz octave band contains noise energy at all frequencies from 707 to 1414 Hz. A Hz is the unit of frequency or pitch of a sound. One Hz equals one cycle per second (e.g., 1 kHz = 1000 Hz, 2 kHz = 2000 Hz). Section 901.107 (regulatory exceptions) indicates that the equivalent sound levels presented in **Table 3.6-1** do not apply to construction activities because construction noise is typically intermittent and transient.

Table 3.6-1 Illinois Noise Regulation – Sound Pressure Levels (dBA) Emitted to Class A (Residential) from Class C (Industrial)

Scenario	Octave Band Center Frequency (Hz)								
	31.5	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
Daytime Limit (L_{eq}) (7:00am to 10:00pm)	75	74	69	64	58	52	47	43	40
Nighttime Limit (L_{eq}) (10:00pm to 7:00am)	69	67	62	54	47	41	36	32	32

Source: State of Illinois 2006

3.6.1.2.3 Local

The DuPage County regulations concerning noise have adopted by reference pursuant to Illinois Administrative Code Title 35 Subtitle H entitled "Noise," chapter II entitled "Environmental Protection Agency Part 951" and measurement procedures for the enforcement of 35 Illinois Code 900 and 901 (DuPage County 2016).

Kane County's general nuisance noise ordinance prohibits loud and unnecessary noise. Construction that can be heard from a distance of 100 feet or more from the source is prohibited between 9:00 p.m. and 6:00 a.m. on weekdays, and between 9:00 p.m. and 8:00 a.m. on Saturdays and Sundays (Kane County 2008).

The City of Batavia City Code Chapter 4, Section 4-4-6, limits noise sources on industrial properties (City of Batavia 2005). The peak/ maximum noise generated may not exceed the levels listed in **Table 3.6-2** at receiving (receptor) residential property lines.

Table 3.6-2 City of Batavia Maximum Permissible Noise Levels at Residential Property

Industrial Property To:	Daytime Hours (7:00am to 9:00pm)	Nighttime Hours (9:00pm to 7:00am)
Residential property	60 dBA	50 dBA

Chapter 4, Section 4-4-4, Permitted Hours for Construction Activity, prohibits outdoor construction within 1,000 feet of any residential lot on weekdays and Saturdays between 9:00 p.m. and 7:00 a.m. and between 9:00 p.m. and 8:00 a.m. on Sundays (City of Batavia 2005).

3.6.1.3 Vibration Standards

Vibrations caused by construction activities are transmitted via waves in the ground. The energy associated with ground-borne waves generally dissipates with distance from the vibration source. Vibration is an oscillatory motion that can be described in terms of the displacement, velocity, or acceleration. Peak particle velocity (PPV) is defined as the maximum instantaneous positive or negative peak of the vibration signal. PPV is used to assess the potential for damage to buildings and structures and is expressed in inches per second (in/sec); vibration for evaluating human response can also be expressed using PPV. Vibrations of 0.13 in/sec PPV are distinctly perceptible. The potential for structural damage exists at PPVs of 2.0 to 2.5 or higher.

The Federal Transit Administration (FTA) vibration guidelines state that a vibration level of 65 velocity in decibels (VdB) is the threshold of perceptibility for humans, and vibration that exceeds 80 VdB may cause annoying impacts on humans. The threshold for potential cosmetic damage to extremely fragile buildings is 90 VdB. **Table 3.6-3** summarizes FTA's construction vibration damage criteria (FTA 2006).

Table 3.6-3 FTA Construction Damage Criteria

Building Category	PPV* (in/sec)	VdB (Approximate Lv**)
Reinforced concrete, steel, or timber (no plaster)	0.5	102
Engineered concrete and masonry (no plaster)	0.3	98
Non-engineered timber and masonry buildings	0.2	94
Buildings extremely susceptible to vibration damage	0.12	90

Notes:
* PPV = the maximum instantaneous positive or negative peak of the vibration signal
** VdB = Root mean square velocity in decibels re 1 micro-inch/second; Lv = Vibration Velocity Level
Source: FTA 2006

3.6.2 Environmental Impacts

This section evaluates the potential impacts of construction and operational noise and vibration on the environment. Impacts may include general annoyance, interference with speech, and sleep disturbances.

3.6.2.1 Proposed Action

3.6.2.1.1 Construction

Construction of the Proposed Action would require the use of heavy earth-moving equipment, excavators, loaders, and haul trucks, and would normally occur during daytime hours from 7:00 a.m. to 9:00 p.m. Noise-producing activities would include operation of heavy equipment, on-site excavation, transport of construction materials, construction of service buildings, assembly of beamline components, and site preparation and restoration. In addition, Project-related vehicles traveling on Kirk Road and other public roads would generate short-term and intermittent noise. Construction noise levels are rarely steady in nature, but instead fluctuate depending on the numbers and types of equipment in use at any given time. Project-related noise levels would be below the federal, state, and local noise standards.

Noise values for construction equipment were derived from literature sources (e.g., FHWA Construction Noise Handbook [FHWA 2009]). The loudest equipment typically emits noise levels between 73 and 85 dBA at 50 feet, with utilization factors of 20 to 40% (i.e., the percentage of time during which the equipment would be used per day).

Noise levels diminish rapidly with distance from the source. As a general rule, noise decreases by approximately 6 dBA with every doubling of distance from a source (Bell 1982). Therefore, noise levels at various distances from a source can be predicted using this formula. Sound levels that would be generated by typical construction equipment are shown in **Table 3.6-4**. These estimates are conservative because atmospheric adsorption, topography, vegetation, the presence of any natural or man-made barriers, and blocked line of sight may cause additional noise attenuation. Therefore, the sound levels in **Table 3.6-4** are likely to be overestimates for the noise of each source at the distances listed.

Table 3.6-4 Projected Sound Levels of Construction and Development Equipment

Noise Source	Estimated Sound Level (dBA) at Distances from Source					
	50 feet	**100 feet**	**200 feet**	**400 feet**	**800 feet**	**1,600 feet**
Dump Truck	76	70	64	58	52	46
Pneumatic Tool	85	79	73	67	61	55
Grader	83	77	71	65	59	53
Front-End Loader	79	73	67	61	55	49
Excavator	81	75	69	63	57	51
Backhoe	78	72	66	60	54	48
Dozer	82	76	70	64	58	52
Generator	81	75	69	63	57	51

Source: FHWA 2006

The closest off-site sensitive receptors would be the property lines of the residences that occur along the Kirk Road corridor in Batavia and surrounding roadways. Construction-related sound levels experienced by a noise-sensitive receptor near construction activity would be a function of distance. The Proposed Action construction activities would be approximately 1 mile from the nearest off-site sensitive receptors. The distance to the nearest occupied areas and intervening noise-buffering features (e.g., trees, buildings, and berms) are sufficient to attenuate the noise of the heavy equipment to near background levels. Noise levels would also be reduced during construction of the underground facilities because the excavations would attenuate much of the sound.

Noise impacts would be short-term, localized, and limited to the immediate vicinity of the construction activities. Fermilab would communicate with local residents regarding the construction schedule and would announce the start of construction and progress toward completion. Construction would normally be completed during the daytime hours, during which time construction-related noise levels would be exempt from the City of Batavia’s noise code.

Traffic on Kirk Road generates considerable ambient noise. Based on the noise data collected for the LBNF/DUNE Project (DOE 2015), the existing ambient noise levels at adjacent receptors range from 62.4 to 67.5 dBA L_{eq}. Based on current local traffic conditions, the ambient noise levels are anticipated to be similar to the previously measured noise levels. Based on the considerable ambient noise levels, noise levels during construction and installation of the Proposed Action would be well below the threshold for a perceptible or nuisance effect at the property lines of the residences directly across Kirk Road or at the on-site recreational areas, including the Illinois Prairie Path and the nature trail. Construction noise impacts would be low and comparable to existing ambient noise levels at the nearest sensitive receptors.

Construction would generate ground-borne vibration from use of heavy equipment. Potential sources would include excavators and compactors, and drilling support pilings for the buildings. The Proposed

Action would not require blasting. Relative to the LBNF/DUNE Project, the Proposed Action would generate much less noise and no vibration at off-site locations.

3.6.2.1.2 Operations

Noise impacts were analyzed for both pulsed and CW-mode operations. The primary noise sources during the Proposed Action operations would be from outdoor equipment including transformer and chiller units, HVAC units, and ventilation of the service buildings. Chillers and HVAC units would be designed to include quiet equipment and incorporate sound dampening equipment or enclosures, if needed, to maintain noise at below State of Illinois octave band threshold limits.

Trail users would not be able to hear the low operational noise levels associated with the Proposed Action. Potential noise impacts associated with the LBNF/DUNE Project were previously analyzed in the LBNF/DUNE EA (DOE 2015). Based on the 2015 EA, the existing ambient noise levels at adjacent receptors range from 62.4 to 67.5 dBA Leq. The noise levels during the Proposed Action operations are not anticipated to be perceptible above existing ambient noise levels at off-site residences on Kirk Road or on-site recreational areas; therefore, the Proposed Action would have very low impacts on noise levels.

3.6.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no impacts on noise or vibration from the Proposed Action. Existing research projects and other planned projects at Fermilab would continue to generate noise and vibration, as would existing ambient noise sources such as Kirk Road.

Potential noise and vibration impacts associated with the LBNF/DUNE Project were previously analyzed in the LBNF/DUNE EA (DOE 2015). Based on the 2015 EA, the existing ambient noise levels at adjacent receptors range from 62.4 to 67.5 dBA Leq. Noise levels during LBNF construction would increase by approximately 5 decibels directly west of Kirk Road and less than 3 decibels at other locations. A change of 3 dB is just noticeable and a change of 5 dB is clearly noticeable. Noise levels would diminish rapidly at distance because many of the of the underground facilities would be constructed within excavations, which would attenuate much of the sound. In addition, construction would normally be completed during the day and within the day, during which activities (and their associated noise levels) would be exempt from the City of Batavia's noise code. Other Fermilab activities could generate short-term, localized noise impacts.

In addition, vibrations may be noticeable during LBNF blasting activities, but below the level that would cause structural damage during blasting. To minimize noise, Fermilab would conduct blasting only during the day and after public notification. However, because of the distance between LBNF/DUNE and past projects, the distance between the Fermilab central campus and any off-site receptors, intervening features (e.g., trees, buildings, and berms), the substantial ambient noise generated by Kirk Road, and other adjacent land uses, there would be low off-site noise or vibration effects.

3.7 TRANSPORTATION

This section describes the existing transportation infrastructure and traffic volumes, Project-related traffic, and potential impacts on public roadways, including the potential for travel delays or traffic accidents near Fermilab. It quantifies potential impacts on public travel and identifies methods to minimize traffic impacts. The affected environment for Fermilab consists of on-site and off-site roadways that would be used for transportation by workers and to transport materials to and from the Project.

3.7.1 Affected Environment

Fermilab is located approximately 38 miles west of downtown Chicago, Illinois. **Figure 2.2-1** depicts the roadways near and adjacent to Fermilab. Interstate 88 (I-88) is a multi-lane, high-volume route running east-west and located south of the site. State Highway 59 (IL 59) is a principal four- to six-lane north-south arterial located to the east. Kirk Road forms the western boundary of the Fermilab property and becomes Farnsworth Avenue south of IL-56 (Butterfield Road). This four-lane arterial connects to I-88 to the south and IL 38 (Roosevelt Road) to the north. Butterfield Road is a four-lane arterial that runs east-west along the southern boundary of the Fermilab property. At peak periods, commuter traffic is often heavy on all primary routes to and from Fermilab.

There is a network of roadways within the Fermilab property, primarily around the Central District of the Fermilab campus, Wilson Hall, and the accelerator rings. The roads within Fermilab are operated as private roads. Public access is limited to designated recreational and educational areas within the main campus. Other areas are accessible only with a Fermilab or DOE ID badge.

Employees and visitors may enter the Fermilab property through one of three gated entrances. The primary entrance for both employees and visitors is the Main Entrance, located on Pine Street, which is accessed from Kirk Road. The second entrance is East Gate on Batavia Road. Batavia Road is a public access, paved road used primarily for travel within the Fermilab property. The third entrance is located at West Wilson Street and Kirk Road and is open during limited hours, primarily for heavy truck deliveries. Other potential entrances exist at Kautz Road and Eola Road. These entrances are normally gated and locked but can be opened for specific purposes.

The current workforce at Fermilab is approximately 1,780 full- and part-time employees, along with 2,000 visiting scientist users (Riesselmann 2018). The number of users fluctuates because experimenters typically stay at Fermilab for a few weeks and then return to their home institutions. Approximately half of Fermilab's employees are located in Wilson Hall. Users work at various experimental facilities across the site and are not localized in any one area.

In Fiscal Year (FY) 2016, Fermilab had approximately 60,000 visitors (Riesselmann 2018). Many visitors come to see the bison herd, train dogs, and walk the nature trails. Visitors also go to Wilson Hall to attend cultural activities, take self-guided tours, attend middle school and high school group tours, participate in activities at Fermilab's science education center, and conduct business with the Laboratory.

3.7.1.1 Traffic Volume

Table 3.7-1 shows the 2016 annual average daily traffic (AADT) for the primary public travel routes near Fermilab. The existing roadways meet the current needs of area traffic.

Table 3.7-1 2016 Annual Average Daily Traffic in the Fermilab Area

Roadway	Location	Existing AADT	Existing Truck AADT
Kirk Rd (CR 77)	South of Pine St; North of Mesa Ln	36,100*	Not Counted
Kirk Rd	North of Pine St; South of E Wilson St	35,000*	Not Counted
North Farnsworth Ave (CR 77)	South of Butterfield; North of Biltner Rd	30,100*	Not Counted
Butterfield Rd (IL 56)	West of Kirk Rd/Farnsworth Ave	15,700	1,725
Butterfield Rd (IL 56)	West of North Eola Road	18,300**	1,875**
IL 59	North of Butterfield Rd	34,000	3,100
IL 59	South of Butterfield Rd	46,800	9,000

Table 3.7-1 2016 Annual Average Daily Traffic in the Fermilab Area

Roadway	Location	Existing AADT	Existing Truck AADT
Eola Rd (CR 14)	Between Butterfield Rd and Ferry Rd	14,200	Not Counted
East Roosevelt Rd	Between Technology Blvd and McChesney Rd	22,800	2,050
I-88	Between Eola Rd & IL 59	113,900**	12,400**

Notes:
* 2014 AADT ** 2015 AADT
Source: IDOT 2018

3.7.1.2 Traffic Accidents

Based on the Illinois Department of Transportation (IDOT) 2015 Illinois Crash Facts and Statistics, there were a total of 313,316 motor vehicle crashes in the State of Illinois, resulting in a total of 65,744 injuries (IDOT 2017b). Based on the 105.4 billion (105,369,163,823) total vehicle miles driven by all motor vehicles in 2015, the crash and injury rates were 2.97×10^{-06} and 6.24×10^{-07}, respectively (IDOT 2017b). The 2015 vehicle crashes resulted in 914 fatalities; therefore, the death rate was 0.95 per hundred million vehicle miles traveled or 8.67×10^{-09} (IDOT 2017b). These are statewide statistics for all motor vehicles and do not account for the differences in accident rates for commuter vehicles relative to the rates for delivery trucks or tractor trailers.

To reduce the risk to motorists, bicyclists, and pedestrians, Fermilab has adopted, as a minimum, the applicable portions of the State of Illinois Vehicle Code and the *Rules of the Road* publication into its Work Smart Standards as SEPMs. All Fermilab employees are required to take the online *Traffic Safety Awareness* training course per site SEPMs.

An on-site security force enforces traffic safety rules, issues citations, and responds to traffic accidents and emergencies. Construction work, road repairs, and road closures must follow the FHWA's Manual on Uniform Traffic Control Devices (FHWA 2009), which provides standards for measures such as signage, traffic controls, worker safety, and flaggers. It would also comply with Fermilab's ES&H Manual 2060: Work Planning and Hazard Analysis. This policy requires review and revision of traffic safety measures as needed to respond to new or increasing traffic impacts. To minimize potential traffic impacts, Fermilab would implement a traffic safety program as an SEPM. This program is formalized in the FESHM 9010: Traffic Safety, including Safeguards for Construction and Maintenance Activities.

The following safeguards are required SEPMs during construction or maintenance activities that may affect the flow of traffic:

- Signs would be posted indicating road work in progress. Reflective signs and/or flashing lights are required for night visibility.
- Traffic cones would be set up to divert traffic safely away from or through the work area.
- A flag person would be assigned to the area if the work is to be performed in any area where driver visibility is obstructed (e.g., by heavy equipment). The flag person would wear a hard hat, an orange reflective vest, and use an orange flag or hand-held stop/slow sign to direct traffic. In some circumstances, two flag persons may be necessary.
- Fire and security crews would be notified in advance of any work on or near roadways, so they are aware of the temporary road conditions.

For impaired roadways (totally blocked):

- Fire and security crews would be notified at least 3 days in advance so that appropriate notifications and emergency arrangements can be made.
- "Road Closed" and "Detour" signs would be posted. Reflective signs and/or flashing lights are required for night visibility.
- The area would be fully barricaded to prevent inadvertent access.

3.7.2 Environmental Impacts

3.7.2.1 Proposed Action

3.7.2.1.1 Construction

The construction workforce would average approximately 18 workers per day, with a peak workforce of approximately 38 workers per day during construction of the service buildings and beamline. Construction trucks and equipment would enter Fermilab through the Wilson Street gate, and construction workers would enter through the gates at Wilson Street or Pine Street (**Figure 2.2-1**). Fermilab may also open Kautz Road at the Butterfield Road entrance for heavy equipment and large concrete pours (Dixon 2018c). Points of origin for transport of construction-related materials and commuting workers would vary; however, many construction-related vehicles would likely travel primarily on Butterfield Road, Kirk Road, and I-88. Construction traffic typically would occur outside the normal commute peak periods.

On-site roadways that would be directly affected by the Proposed Action construction would include Main Ring Road, which borders the Proposed Action to the north, Kautz Road to the west, and Holter Road to the south. Under the Proposed Action, local roads would be constructed to access the new service buildings. Each of the new service buildings would have parking and staging areas for equipment laydown and soil stockpiling. Construction parking would be temporary, while operations parking would be permanent.

3.7.2.1.1.1 <u>Traffic Volume</u>

During construction of the Proposed Action, traffic volumes would increase slightly on the public roadways near Fermilab. Construction-related vehicular traffic on public roads would include commuting construction workers and trucks delivering construction materials and supplies. Construction-related traffic would be intermittent and would vary over the construction period depending on the activities conducted. The Proposed Action would not require rail or marine transport of construction materials or components.

On average, under the Proposed Action, daily commuting of 18 construction workers (36 round trips per day) would result in an increase in the number of vehicles of less than 1% relative to the existing traffic volumes on the surrounding roads. The increased volume of traffic on public roadways would be limited to the 7-year active construction period. The additional PIP-II-related traffic would result in very few traffic delays because there would be a minimal increase in the number of vehicles traveling on public roadways. Traffic impacts would be minimized by scheduling the arrivals and departures of construction-related workers to avoid peak commute hours. Workers would typically arrive before the morning commute peak period and avoid the evening commute peak.

During construction, traffic volumes would increase on roads within the Fermilab property, including Kautz Road, Main Ring Road, and Holter Road. The Contractor would transport heavy excavation equipment (e.g., front-end loaders) and haul trucks to the PIP-II Project site, prepare and grade the site, and construct access roads. After flatbed trucks arrive to deliver the excavation equipment, construction traffic would consist primarily of commuting workers. The majority of heavy equipment movement for this phase would occur within the Fermilab property.

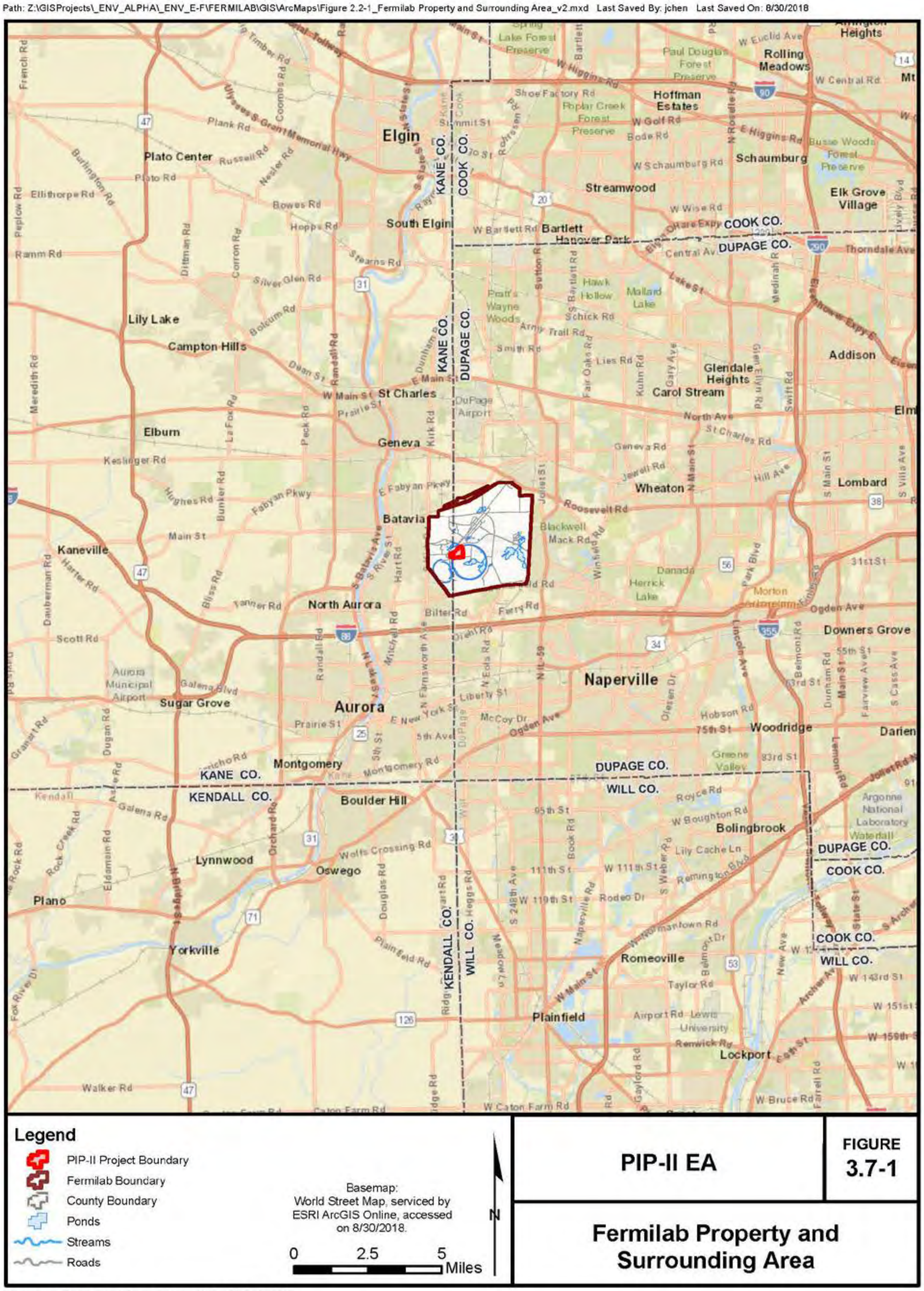
A total of approximately 4,247 truck trips would be required over the 7-year construction period. The peak number of round trip truck trips per day would occur during construction of the Linac complex in the third year of construction. Excavated soil would either be stored at the PIP-II Project site for use as backfill or transported to existing soil stockpiling areas within the Fermilab property. The truck trips for transport of soil would not result in noticeable traffic effects because travel would be limited to on-site roads within the Fermilab property, primarily roads that are not accessible to the public.

Construction of the Proposed Action would cause an increase in the number of vehicles traveling on Kautz Road, Main Ring Road, and Holter Road within the Fermilab property. The Project-related traffic would represent a small increase in the number of vehicles relative to the 2,500 vehicles (employees and visitors) currently traveling to Fermilab daily.

The Proposed Action would not require frequent closure of public or on-site roads; however, short-term road closures may be required. The cranes and other oversize equipment would arrive (and depart) on large flatbed trucks that would be wider than a single lane, would require an escort and flaggers for wide turns and for entering the site, and may require brief road closures or traffic delays.

Construction of the Proposed Action facilities would be completed in approximately 7 years. Over that period, approximately 4,247 truck trips would be required for delivery of materials for the beamline construction. The peak number of trips per day on public roads for these deliveries be approximately seven trucks per day (14 round trip truck trips per day).

Table 3.7-2 shows the estimated Project-related vehicles and the percentage increase in AADT under the Proposed Action for the primary public travel routes near Fermilab relative to existing AADT on public roads near Fermilab (**Figure 3.7-1**). The estimated number of Project-related vehicles is based on the peak number of vehicles (an average of 76 round-trip commuter vehicles and an average of 14 round trip truck deliveries per day). The traffic associated with the peak construction would represent a small increase in the number of vehicles on public roadways in the vicinity of Fermilab. The estimated % traffic increases presented in **Table 3.7-2** are very conservative because they assume that the peak number of construction vehicles would travel the same route each day. These vehicles would actually travel various routes, and no single stretch of road would experience all the worker and truck traffic. Even with a conservation assumption that all construction traffic used the same route, the public roads in the vicinity of Fermilab would experience an increase in average daily traffic of less than 1.0%.



Source: Adapted from Fermilab GIS 2018

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Table 3.7-2 Proposed Action Projected Traffic Increase with Project-related Construction Vehicles

Roadway	Location	Project-Related Vehicles*	Total Projected AADT*	Percent Increase
Kirk Rd (CR 77)	South of Pine St; North of Mesa Ln	90	36,578	0.25
Kirk Rd (CR 77)	North of Pine St; South of E Wilson St	90	17,178	0.26
North Farnsworth Ave (CR 77)	South of Butterfield; North of Biltner Rd	90	15,378	0.30
Butterfield Rd (IL 56)	Between Packford Ln and DuPage Pkwy	90	26,878	0.57
Butterfield Rd (IL 56)	Between Beverly Dr and Ginger Woods Pkwy	90	13,278	0.49
IL 59	North of Butterfield Rd	90	33,078	0.26
IL 59	South of Butterfield Rd	90	30,178	0.19
Eola Rd (CR 14)	Between Ferry Rd and Butterfield Rd	90	30,678	0.63
East Roosevelt Rd (IL 38)	Between Fabyan Pkwy & McChesney Rd	90	31,978	0.39
I-88	Between Eola Rd and IL 59	90	107,678	0.08

Note:
* Assumes peak number of Project-related vehicles (76 commuter vehicles and 14 truck deliveries round trip per day = 90 Project-related vehicles per day during peak construction) and that all Project-related vehicles travel on the listed road.

Source: IDOT 2017a

The construction Contractor and Fermilab would prepare and implement a Project-specific traffic control plan establishing measures such as scheduling the arrivals and departures of construction-related trucks and heavy haul deliveries to avoid peak commute hours to the extent practicable. To minimize traffic delays resulting from vehicles turning left from Butterfield Road into Fermilab, the traffic control plan would outline the truck routes and constrain trucks from making left turns against oncoming traffic, if feasible. Implementation of SEPMs, including preparing and complying with a traffic control plan, would minimize traffic delays and the risk of traffic accidents. Therefore, impacts on public travel would be very low.

On-site traffic impacts would be minimized by following site traffic control procedures, including employing flaggers and posted detours, which would minimize effects on traffic flow and the potential for accidents. Access to the construction areas would be limited to construction workers and Fermilab personnel engaged in the administration or monitoring of construction. Other controls would be implemented as needed to address potential traffic impacts, including minimizing construction vehicle movement on-site during peak rush hours and placing construction staging areas in locations that would minimize construction vehicle traffic on routes traveled by visitors. Overall, public travel impacts on Fermilab private roadways would be minimized by implementing the traffic control measures outlined in the FESHM 9010: Traffic Safety. With implementation of these measures, Fermilab would minimize off-site construction traffic impacts from the Proposed Action.

3.7.2.1.1.2 Traffic Accidents

During construction of the Proposed Action, the potential for traffic accidents would be roughly proportional to the number of Project-related vehicles miles. Although the rate of traffic accidents cannot be definitively predicted, an incremental increase can be estimated based on the historical rates. Numerical estimates of potential accidents were calculated using the number of vehicle miles that would be driven during construction and applying the accident rates per vehicle mile from the IDOT Illinois Crash Facts & Statistics (IDOT 2017b). The calculated result is an estimate of risk and does not imply that a particular number of accidents, injuries, or fatalities would actually happen.

To determine the number of vehicle miles associated with construction under the Proposed Action, a conservative average commute distance of 76 miles per round trip was used to estimate the distance traveled by workers driving to and from Fermilab. This distance is based on a one-way distance of 38 miles between Chicago and Batavia.

Table 3.7-2 provides an estimate of the average daily traffic (number of vehicles) traveling on local roads during peak construction; however, the total vehicle miles over the 7-year construction period were used to estimate the potential number of accidents. Under the Proposed Action, construction would result in approximately 2,721,019 vehicle miles over the 7-year construction period. This estimate assumes one 76-mile round trip per day for an average of 18 workers and 4,247 truck trips travelling one 76-mile round trip each over the 7-year construction period. Based on IDOT-published accident rates, the Proposed Action may potentially result in eight accidents (8.1), two injuries (1.7), and zero (0.02) fatalities over the 7-year construction period. These estimates are approximations based on the available statewide statistics for all motor vehicles, and do not account for the differences in accident rates for commuter vehicles relative to the rates for delivery trucks or tractor trailers, local factors such as traffic safety devices, weather conditions, police enforcement of safety regulations, or shared use of roads and parking areas with pedestrians and bicyclists. The calculated results are an estimate and do not imply that a particular number of accidents, injuries, or fatalities would actually occur.

Project-related trucks traveling within the Fermilab property would adhere to the traffic safety policy outlined in FESHM 9010: Traffic Safety. For construction, this policy requires signage and/or flashing lights, traffic cones, and flaggers to direct trucks where visibility is obstructed. Trucks would also be required to adhere to on-site speed limits. Further, Fermilab would establish one-way transport routes where practicable. On-site roads closed for construction would be barricaded and marked to prevent inadvertent access. Traffic management would be incorporated into the construction contract. Traffic safety is also addressed in **Section 3.4, Health and Safety**.

Construction of the Proposed Action would not involve transport of large volumes of hazardous materials or any radioactive materials or wastes. Transported hazardous materials would include those required for construction such as lubricants and solvents. Risks from routine transport of small volumes of hazardous materials and waste are evaluated in **Section 3.14, Waste Management**.

3.7.2.1.2 Operations

Under the Proposed Action, very few new permanent positions would be added at Fermilab; however, approximately 10 additional researchers could be present on-site at any one given time. Potential impacts on traffic volume and accidents are presented below.

3.7.2.1.2.1 Traffic Volume

During operation of the Proposed Action, the 10 additional researchers (20 round trips per day) would not result in a noticeable increase in traffic volume relative to current operations. Assuming this increase in personnel increases local traffic, the additional vehicles would represent a traffic increase of less than 1% (0.1%) impact on nearby roads. The Project-related vehicles would result in a very slight increase in traffic volume relative to current conditions; therefore, impacts on public travel would be very low.

Operations would slightly increase parking demand. Under the Proposed Action, additional parking areas would be constructed near the new service buildings; therefore, the increased parking demand would not exceed the supply. The increased parking demand would not affect parking in other experimental areas or at Wilson Hall.

3.7.2.1.2.2 Traffic Accidents

Under the Proposed Action, operations would result in 2,500,000 vehicle miles traveled over the 40-year life of the Project. Whereas construction workers may commute from Chicago and associated suburbs,, most of the operations staff would seek housing closer to Fermilab; therefore, this analysis assumes one 25-mile round trip per day for up to 10 workers for 40 years. Based on IDOT-published accident rates for all motor vehicles, the total vehicle miles traveled for operations has the potential to result in seven accidents (7.4), two injuries (1.6), and zero (0.02) fatalities over the 40-year life of the Project. These estimates are approximations based on the available statewide statistics for all motor vehicles, and do not account for the differences in accident rates for commuter vehicles relative to the rates for delivery trucks or tractor trailers, local factors such as traffic safety devices, weather conditions, police enforcement of safety regulations, or shared use of roads and parking areas with pedestrians and bicyclists. The calculated results are an estimate and do not imply that a particular number of accidents, injuries, or fatalities would actually occur.

3.7.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no impacts on traffic volumes or accident rates from the Proposed Action. Existing research projects and other planned projects would continue at the Fermilab property. Traffic impacts associated with the LBNF/DUNE Project were previously analyzed in the LBNF/DUNE EA (DOE 2015), and traffic impacts were projected to be low. Public travel on nearby travel routes, including Kirk Road, Butterfield Road, and I-88, as well as the on-site roads within the Fermilab property, would increase over time in proportion to regional changes in population and development. Traffic associated with ongoing research and planned projects at Fermilab would result in low impacts on traffic volumes and accident rates on public roads and the roads within the Fermilab property.

3.8 AIR QUALITY AND GREENHOUSE GASES

This section evaluates the potential air quality impacts from construction and operation of the Proposed Action at Fermilab. The affected environment for air quality at Fermilab includes DuPage and Kane Counties and the State of Illinois, which has adopted USEPA's National Ambient Air Quality Standards (NAAQS). Emissions of greenhouse gases (GHG) have very small if any localized impacts; therefore, the affected environment in this EA for GHG emissions is the global atmosphere.

3.8.1 Affected Environment

The ambient air quality of an area is generally characterized in terms of whether it complies with NAAQS and State Ambient Air Quality Standards (SAAQS), where applicable. The CAA (42 U.S.C. 7401 et seq.) requires the USEPA to set national standards for emissions that are considered harmful to public health and the environment (criteria pollutants). The NAAQS establish standards to protect the public health and welfare for the following "criteria" pollutants:

- Ozone (O_3)
- Carbon monoxide (CO)
- Sulfur dioxide (SO_2)
- Nitrogen dioxide (NO_2)
- Particulate matter whose particles are less than or equal to (≤) 10 microns [µm] in size (PM_{10})

- Particulate matter whose particles are ≤ 2.5 µm in size ($PM_{2.5}$)
- Lead (Pb).

The levels of criteria pollutants are measured by a network of air monitors located throughout the state. If the concentration of one or more criteria pollutants in a geographic area is found to exceed the regulated or 'threshold' level for one or more of the NAAQS, the area may be classified as a non-attainment area. DuPage and Kane Counties have been designated as moderate non-attainment areas for the 8-hour O_3 standard (2008 standard) (**Table 3.8-1**).

The IEPA created a Registration of Small Sources (ROSS) program that applies to more than 3,000 permitted sources which combined produce less than 1% of the air pollution in the State of Illinois. The program is intended to simplify air regulatory requirements by requiring sources with low emissions to register with the IEPA rather than acquire an air permit. Although the small sources qualifying for this program are not subject to permitting requirements, the sources must still comply with all applicable environmental laws and regulations. The ROSS regulation is documented at 35 I IAC 201.175. Fermilab qualifies as a small emission source under the requirements of the ROSS program per 35 IAC 201.175.

Table 3.8-1 Air Quality Standards Attainment Status for DuPage and Kane County Areas

Parameter		State Standard	Federal Standard	Attainment Status
O_3	1-Hour	--	--	Non-attainment
	8-Hour	0.070 ppm	0.070 ppm	Unclassifiable/Attainment
CO	1-Hour	35 ppm (40 mg/m^3)	35 ppm (40 mg/m^3)	Unclassifiable/Attainment
	8-Hour	9.0 ppm (10 mg/m^3)	9.0 ppm (10 mg/m^3)	Unclassifiable/Attainment
NO_2	1-Hour	0.100 ppm	0.100 ppm	Attainment
	Annual Arithmetic Mean	0.053 ppm (100 µg/m^3)	0.053 ppm (100 µg/m^3)	Attainment
SO_2	1-Hour	75 ppb	75 ppb	Attainment
	3-Hour	0.5 ppm	0.5 ppm	Attainment
	24-Hour	0.14 ppm	--	Unclassifiable
PM_{10}	24-Hour	150 µg/m^3	150 µg/m^3	Unclassifiable/Attainment
$PM_{2.5}$	24-Hour	35 µg/m^3	35 µg/m^3	Unclassifiable/Attainment
	Annual Arithmetic Mean	12 µg/m^3	12 µg/m^3	Attainment
Lead	Rolling 3-Month Avg	0.15 µg/m^3	0.15 µg/m^3	Non-attainment

Notes:
1 -- = no standard available
2 µg/m^3 = micrograms per cubic meter
ppm = parts per million
mg/m^3 = milligrams per cubic meter
ppb = parts per billion
Sources: USEPA 2018a, 35 IAC 243 Subpart B

Potential emissions from typical processes at Fermilab include PM, CO, nitrogen oxides (NO_X), SO_2, volatile organic material (VOM), and Hazardous Air Pollutants (HAPs) in quantities below major source thresholds. **Table 3.8-2** summarizes the estimated actual emissions of Criteria Air Pollutants (CAPs) from the Fermilab property (existing emissions during 2017 operations), including carbon dioxide equivalent (CO_{2e}, an expression of the climate warming potential of GHGs in terms of equivalent amount of carbon dioxide [CO_2]).

Table 3.8-2 Estimated Release of Criteria Air Pollutants at Fermilab for 2017

Emission Unit	Actual Pollutant Emissions (tons per year)						
	PM	**CO**	**NO_x**	**SO_2**	**VOM**	**GHG (as CO_2e)**	**HAP**
CUB Boilers	0.0938	1.0364	1.2338	0.0074	0.0679	1,489.6133	0.0233
Gasohol UST	-	-	-	-	0.0126	-	-
Radionuclide Stacks	-	-	-	-	-	-	-
FCC Generator	0.0258	0.2027	0.8844	0.0147	0.0260	375.1600	-
Cavity Processing Lab	0.0001	-	0.0000	-	-	-	0.0000
Debonding Oven	0.0134	0.0018	0.0021	0.0000	0.0426	2.5318	0.0000
Permitted Sources Total	**0.1330**	**1.2409**	**2.1204**	**0.0222**	**0.1490**	**1,867.3051**	**0.0234**
ROSS LIMITS	**CAP Total (<5 tons per year)**			**3.6654**			
	HAP Total (<0.5 tons per year)			**0.0234**			

Notes:
FY 2017 Annual Emissions Data, Fermilab ROSS.
CO_2e: The total global warming potential of all GHG emissions in terms of carbon dioxide.

Accelerator-produced radionuclides, including tritium and other short-lived radionuclides, are a normal byproduct of facility operations. The highest annual level of tritium emissions Fermilab has recorded since 2002 has been 0.002 millirem. Fermilab's site-wide emissions are below the level (0.1 millirem) at which the USEPA requires constant monitoring. Even though Fermilab's emissions are below that standard, tritium is monitored regularly at Fermilab.

The airborne radionuclides produced at Fermilab are released into the atmosphere through vent stacks to the surface of the Fermilab property. Atmospheric emissions are limited by minimizing the ventilation of the tunnels during beam operations. Ventilation is maximized for personnel access; however, air emissions are still limited by allowing sufficient time for decay after beam shutdown and before accessing. Air from the ventilation stacks is monitored for radionuclide emissions.

The annual radioactivity of typical releases from Fermilab (site-wide) and the highest estimated dose rate at the Fermilab property boundary from these releases are well below both the regulatory limits for the annual release of radionuclides (2,000 Curies/year[Ci/yr], National Emission Standards for Hazardous Air Pollutants [NESHAP] requirement) and the maximum dose at the site boundary (10 mrem/year, 40 CFR 61). Based on Fermilab's 2017 NESHAP report, the total estimated dose rate to maximally exposed individual off-site was 0.0419 mrem.

3.8.1.1 Conformity

USEPA promulgated the General Conformity Rule in November 1993 to implement the conformity provision of Title I, Section 176 (c) (1) of the Federal CAA. The General Conformity regulations apply to any federal action to ensure attainment of the NAAQS and verify that actions do not cause or contribute to new violations of the NAAQS. Each state must prepare and submit a State Implementation Plan (SIP) describing how the state plans to achieve the federal standards by specified dates, depending on the severity of the air quality within the state or air basin. This provision requires that the federal government not engage, support, or provide financial assistance to licensing, permitting, or approving any activity not conforming to an approved SIP.

A conformity analysis is required if the generation of air emissions would exceed conformity threshold levels for pollutants designated as non-attainment or maintenance for the NAAQS. The *de minimis* levels for conformity of each criteria pollutant in non-attainment in this air basin are presented in **Table 3.8-3**.

Table 3.8-3 General Conformity *de minimis* Level

Pollutant	*de minimis* Level (tons/year)
O_3 (NO_x)*	100
O_3 (VOC)*	100

Notes:
* O_3 is a gas formed when volatile organic carbon compounds (VOCs) and NO_x undergo photochemical reactions in the presence of sunlight. For this analysis, these two precursors were evaluated as surrogates for O_3. The *de minimis* values for non-attainment areas were used.

3.8.1.2 Greenhouse Gases

GHGs contribute to the greenhouse effect, which is the process by which terrestrial radiation is absorbed by gases in the atmosphere, warming the Earth's surface and atmosphere. According to the Intergovernmental Panel on Climate Change (IPCC), the atmospheric concentrations of the GHGs CO_2, methane (CH_4), and nitrous oxide (N_2O) have all increased since 1750 due to human activity. In 2011, the concentrations of these gases were 391 ppm, 1,803 parts per billion (ppb), and 324 ppb, and exceeded pre-industrial levels by approximately 40%, 150%, and 20%, respectively (IPCC 2014). In addition, the concentrations of these gases now exceed the highest concentrations recorded in air samples taken from polar ice formed during the past 800,000 years. The mean rates of increase in atmospheric concentrations over the past century are, with very high confidence, unprecedented in the last 22,000 years (IPCC 2014). Concentrations of GHGs other than CO_2 are reported in units of metric tons of CO_2 equivalent, where impacts from each GHG are converted to equivalent impacts of CO_2.

The federal government has taken a number of steps to reduce GHG emissions, conserve energy, reduce demand, and promote development of renewable energy sources and technologies. Fermilab has developed site-specific sustainability goals, and the Proposed Action would be consistent with Fermilab's current goals for construction and operation activities. Fermilab is registered with the Clean Fuel Fleet Program; one of several programs the IEPA has implemented to help improve air quality in the Chicago ozone non-attainment area.

3.8.2 Environmental Impacts

3.8.2.1 Proposed Action

3.8.2.1.1 Construction

During construction, various gasoline- and/or diesel-powered vehicles, excavation equipment, cranes, and other heavy equipment would be used for excavation, backfilling, material movement, and other activities. Construction activities would produce particulate emissions from earth-moving activities and from fugitive emissions generated by traffic on paved and unpaved areas. Construction activities would also produce criteria pollutant emissions from combustion of fuel used in construction equipment, supply delivery trucks, and passenger vehicles. Construction activities associated with the Proposed Action would occur over a period of approximately 7 years and would include construction of the enclosures, service buildings, beamline, and utilities.

Under the Proposed Action, construction would generate particulate emissions from dust and combustion emissions from construction equipment and vehicles, including various gasoline- and/or diesel-powered vehicles, excavation equipment, cranes, and other heavy machinery. Construction would generate both attainment and non-attainment pollutants; however, emissions would be minimized by SEPMs, short-term and localized, and would not exceed the general conformity *de minimis* threshold (100 tons) for non-attainment pollutants (e.g., O_3 precursors such as NO_x) and VOCs. Air emissions from excavation, soil stockpiling, and construction activities would be minimized by implementing SEPMs, including erosion and dust control BMPs.

Construction activities would also include the construction or upgrade of local access roads to the service buildings. Particulate emissions would result from supply truck deliveries, earth moving for soil stockpiling and earthwork, and use of construction equipment in disturbed areas. Specific activities that would contribute to fugitive particulate air emissions would include excavation, stockpiling, and placement of approximately 120,000 yd^3 of soil (Dixon 2018b).

The information and assumptions used to calculate construction emissions, including construction activities and the approximate types and quantity of construction equipment that would be used for each type of construction activity, are documented in **Appendix C**. Construction activities would be performed during a 5-day workweek; therefore, emissions were calculated assuming 5 days per week. Emissions from construction were estimated using USEPA's AP-42 emission factors or as otherwise noted in **Appendix C**.

Table 3.8-4 presents the resulting emissions calculations for each year of construction. Construction activities would generate emissions for area attainment and non-attainment pollutants. However, air emissions would be short-term and localized and would not lead to long-term impacts on air quality. Proposed Action construction emissions, when compared with the *de minimis* thresholds for the conformity regulations, would not exceed the general conformity *de minimis* threshold (100 tons) for non-attainment pollutants (O_3 precursors: NO_x and VOC) during years of heavy construction (2020 to 2026). Internal installation would continue for approximately 3 to 4 years subsequent to the heavy construction phase, which would require use of passenger vehicles for worker commutes. Emissions during this phase of construction would be very low. Diesel equipment would also emit small quantities of HAPs. Emissions from architectural coatings and other chemicals used in the building process would also be very low.

Air pollution emissions from excavation, soil stockpiling, and construction activities would be minimized using SEPMs including erosion and dust control BMPs such as water sprays and surfactants, minimization of disturbed soil area, soil stabilization and re-vegetation, and administrative controls such as sequencing and scheduling. Emissions from other construction activities, such as vehicle traffic and equipment operation, would be minimized by the dust control practices listed above, where applicable, and by proper maintenance of equipment and use of low-sulfur diesel fuels. Projected annual air emissions would not require additional air permitting.

Emissions during construction activities would be below the *de minimis* thresholds for the conformity regulations and would not exceed the general conformity *de minimis* threshold (100 tons) for non-attainment pollutants (O_3 precursors: NO_x and VOC).

In addition to criteria pollutants, CO_2 emissions would result from the combustion of fuel used to operate construction, passenger, and supply vehicles, and construction equipment and is considered a GHG. Direct GHGs emissions are defined as emissions from sources owned or controlled by the reporting entity and include emissions from all construction activities. Indirect GHG emissions are a consequence of the activities of the reporting entity but occur at sources owned or controlled by another entity and include emissions generated by commuting workers and purchased electricity for operations. Both direct and indirect potential GHG missions were quantified for construction and operations at Fermilab and are presented in **Table 3.8-4**.

The Proposed Action would result in short-term increased emissions of GHG during construction. The increase in GHG generated from the Proposed Action would be very low compared to those being released worldwide. The Proposed Action would have a low impact on the level of GHG overall. Over the life of the Project, local climate changes would be minimal and are not anticipated to result in changes to local floodplains. The Proposed Action would have a low impact on climate change locally both now and in the future.

3.8.2.1.2 Operations

Air quality impacts were analyzed for both pulsed and CW-mode operations. Criteria pollutants and GHG emissions would be generated during operations by natural gas combustion for space and water heating, and from fuel combustion for researcher commuting. The Proposed Action would result in a small increase in continuous emissions of criteria pollutants and GHGs from the use of natural gas for heating of approximately 85,420 square feet of floor space. Because of the small increase in staff during operations, emissions of criteria pollutants and GHGs related to water heating are expected to be very low.

During operations, a permanent 250-kilowatt diesel generator would supply emergency power for the Proposed Action for the life of the Project. Based on IEPA guidance, the emissions calculations were based on 500 hours per year, if needed for emergency power. No other operational air emission sources are anticipated as part of this Project. Although the Proposed Action would increase energy consumption, its operation would minimize the net increase by using renewable energy, installing meters, employee training, and continuing to purchase Renewable Energy Certificates (RECs).

Purchased electricity needed to operate the facility is estimated at approximately 6 MW and would be required for operation of the beam, lighting, and equipment. Electricity consumption would result in an indirect increase in criteria pollutants that would occur at the energy generation facility.

Table 3.8-4 presents the criteria pollutant and GHG emissions, including the total CO_2 emissions for both the construction and operation periods at Fermilab. GHG emissions from purchased power are included in **Table 3.8-4**. Fermilab completed a climate change vulnerabilities screening, which helped identify those assets and systems most vulnerable to the region’s most likely climate impacts. The increase in criteria pollutant emissions during facility operations would be less than 1 ton per year of any criteria pollutant, therefore conforming to the state’s SIP.

The Proposed Action would result in increased GHG emissions for the life of the project. The increase in GHG generated from the Proposed Action would be very low compared to those being released worldwide. The Proposed Action would have a low impact on the level of GHG overall. The Proposed Action would have a low impact on climate change locally both now and in the future.

Proposed Action emissions during operations would be below the *de minimis* thresholds for the conformity regulations and would not exceed the general conformity *de minimis* threshold (100 tons) for non-attainment pollutants (O_3 precursors: NO_x and VOC). Fermilab would continue to qualify as a small emission source under the requirements of the ROSS program per 35 IAC 201.175.

The potential release of hazardous air emissions from the operation of the Proposed Action and existing operations could include radionuclides. Under normal conditions, some of the radionuclides produced by the operation of the Fermilab accelerator could become airborne in the form of radioactive gases and tritiated water vapor and enter the atmosphere through three mechanisms: 1) ventilation of air from the underground facility; 2) evaporation of tritiated water; and 3) evaporation from the Fermilab ponds.

Table 3.8-4 Estimated Construction and Operations Emissions for the Proposed Action

	Emissions (short tons/year)						CO_2e Emissions (metric tons/year)		
Year	**CO**	**NO_X**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**VOC**	**Direct**	**Indirect**	**Total**
Proposed Action Construction									
2019/2020	25.77	37.28	12.10	4.65	11.61	3.96	6,895	2,348	9,243
2021	23.55	33.79	11.18	4.36	10.53	3.63	6,252	2,319	8,572
2022	19.25	26.20	11.01	3.40	8.14	3.07	4,843	2,309	7,152
2023	23.91	38.81	11.07	4.33	12.18	3.91	7,250	2,308	9,558
2024	21.68	34.50	10.46	3.97	10.83	3.58	6,446	2,337	8,784
2025	20.29	33.61	9.84	3.85	10.60	3.48	6,303	2,329	8,632
2026	13.78	15.07	7.47	2.34	4.64	2.10	2,740	2,329	5,068
Maximum Proposed Action Construction Emissions	25.77	38.81	12.10	4.65	12.18	3.96	7,250	2,348	9,558
Proposed Action Operational Period									
Worker Vehicle Fuel	1.96E-01	1.68E-02	5.30E-03	3.51E-03	5.91E-04	2.47E-02	0	55	55
Electricity Generation	--	--	--	--	--	--	0	54,046	54,046
Space Heating	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	0	0
2026 - 2066	1.96E-01	1.68E-02	5.30E-03	3.51E-03	5.91E-04	2.47E-02	0	54,101	54,101

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Potential releases of HAPs from operations could include radionuclides; however, these emissions would be controlled and monitored and would be well below regulatory limits. Fermilab's radioactive air emissions permit limits off-site exposure to radioactive air to less than 0.1 mrem in a year (40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities"). Fermilab stack-monitoring detectors are connected to the site-wide monitoring network. Radionuclide emissions during operations would be controlled and monitored to verify that radionuclide emissions from all sources are well below DOE requirements, Fermilab discharge permit limits, USEPA dose limits, and site-specific Fermilab policy levels (**Section 3.4, Health and Safety**).

3.8.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no impacts on air quality or GHGs from the Proposed Action. Ongoing research and planned projects would continue to generate air emissions and GHG at Fermilab; however, these emissions were previously evaluated and determined to have low potential impacts on air quality (DOE 2015). Emissions would continue to be controlled and monitored and would be well below regulatory limits. The No Action Alternative would not be expected to have any additional impacts on the NAAQS.

3.9 VISUAL RESOURCES

This section describes the visual setting at Fermilab and evaluates the potential visual impacts of the Proposed Action and No Action Alternative. The affected environment includes on-site and off-site areas from which the Proposed Action facilities would be visible to residents and motorists on the surrounding public roads.

3.9.1 Affected Environment

Fermilab is located on the boundary between eastern Kane and western DuPage Counties in an area of mixed residential, commercial, and agricultural land use. The predominant adjacent public roadway is Kirk Road, which is located between Fermilab's western boundary and residential communities to the west. The characteristic landscape within and around the Proposed Action construction area is predominantly natural and rural in character, with Fermilab experimental facilities mixed in, including roadways connecting the facilities and a number of cooling ponds.

Fermilab is located on a flat landscape between the Fox and DuPage Rivers. The existing landscape does not contain unique landforms, and the vegetation patterns of wetlands, forested wetlands, agricultural lands, and grasslands are common to the region. The natural areas on the Fermilab property include wetlands, restored tallgrass prairie habitat, and Indian Creek. On-site recreational areas include an interpretive nature trail near the Lederman Science Center and the Illinois Prairie Path, a 62-mile-long trail used for hiking and biking that passes through the southwest corner of the Fermilab property. The western portion of Fermilab is primarily composed of experimental facilities devoted to high-energy physics research, which have been present since Fermilab was established in the 1960s. Several of Fermilab's facilities are visible in the area including the main entrance at Kirk Road and Pine Street, the Main Injector, and Fermilab's main office building, Wilson Hall. This 16-story office building is a highly visible landmark at Fermilab and is the most dominant visual element in the landscape, particularly from Kirk Road.

3.9.2 Environmental Impacts

3.9.2.1 Proposed Action

3.9.2.1.1 Construction

The Proposed Action construction activities would not be visible from Kirk Road or other off-site locations because the construction area would be approximately 1 mile from the nearest residences and roadways, and would be screened from view by the surrounding facilities or trees. In addition, the Proposed Action construction activities would not be visible from on-site recreational areas. The Proposed Action facilities would be constructed near existing Fermilab buildings with Wilson Hall in the background.

Construction would require removal of approximately 20 mature and dead trees, operation of construction equipment, and the presence of temporary construction trailers. Short-term, localized impacts on the visual character of the landscape would result from removal of vegetation, including trees, and exposure of soils of contrasting color and texture during excavation, grading, and building the Proposed Action facilities. These impacts would occur intermittently over the construction period as soil is excavated and stockpiled, and the area is restored. Visual impacts would be short-term and localized. Construction would not occur at night; therefore, would not require overnight lighting other than security lighting.

Fermilab would implement standard SEPMs to minimize visual impacts, including revegetation of disturbed areas, developing Project-specific architectural styles for the new buildings, and directing outdoor lighting downward. The architectural style of the new buildings would reflect and harmonize with the existing buildings at Fermilab. Overall, the visual impacts of Project-related construction activities would be low.

3.9.2.1.2 Operations

The Proposed Action aboveground facilities would not be visible from Kirk Road or other off-site locations because the Project would be approximately 1 mile from the nearest residences and roadways and would be screened from view by the surrounding facilities or trees. In addition, the Proposed Action aboveground facilities would not be visible from the Illinois Prairie Path or the nature trail; therefore, there would be very low impacts on the quality of the recreational experience for users of the on-site recreational areas. In addition, some of the facilities would be hidden underground and would not be visible on the Fermilab property.

The Proposed Action facilities would not be visible from off-site locations, the Illinois Prairie Path or the interpretive nature trail. The Proposed Action would be visible to visitors traveling along the east side of Wilson Hall and from the observation areas that overlook the PIP-II Project site and Main Ring. The surface buildings would be landscaped comparable to the existing buildings at Fermilab. On-site views of the Proposed Action facilities would include other man-made features, including other existing Fermilab buildings, with Wilson Hall in the background.

Fermilab would implement standard SEPMs to minimize visual impacts, including revegetation, developing Project-specific architectural styles for the new buildings, and directing outdoor lighting downward. The disturbed areas would be revegetated to minimize the contrast with adjacent grassy areas, trees, agricultural fields, and restored prairie. The architectural style of the new buildings would reflect and be harmonious with the existing buildings at Fermilab. Impact to visual resources would be very low during operations.

3.9.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no impacts on the quality of the recreational experience for users of the Illinois Prairie Path or the interpretive nature trail from the Proposed Action. Existing Fermilab facilities, such as the Pine Street entrance, the MI buildings and ponds, and Wilson Hall (a prominent Fermilab feature), would remain visible from on-site and off-site locations. Other planned activities and surface structures, such as those associated with the LBNF/DUNE Project, would still have the potential to be visible at times from off-site locations and from points along Kirk Road during construction and operations. However, as described in the LBNF/DUNE EA (DOE 2015), visual impacts would be low.

3.10 GEOLOGY AND SOILS

This section describes the existing geological and soils environment, including surface conditions and subsurface bedrock. It then describes the potential environmental impacts of the Proposed Action, including the excavations required in soils and rock to construct the proposed facilities and the No Action Alternative. The affected environment for geology and soils impacts includes areas that would be excavated, graded, or filled as well as adjacent areas potentially subject to erosion and sedimentation.

3.10.1 Affected Environment

3.10.1.1 Geology

Fermilab is situated between the Marengo and Valparaiso Morainic Systems, in the Bloomington Ridged Plain of the Great Lakes Section of the Central Lowland Province (NRCS 2003). The regional topography was formed by a series of glacial advances and retreats, primarily during the Woodfordian Substage (22,000 to 12,500 years before present [B.P.]) of the Wisconsinan Glaciation. The area has nearly all the features associated with glaciated areas including kames, kame terraces, eskers, and a large number of glacial lakes, many of which are now drained. Fermilab's topography is predominantly flat with local topographic relief of generally less than 50 feet. Ponds and wet areas have formed in some small depressions. Surface elevations at the proposed construction area range from approximately 732 to 741 feet above mean sea level (amsl).

Fermilab's surface consists of silts, clays, and alluvial deposits to depths of up to 20 feet bgs (Curry 2001). These deposits are generally unconsolidated and overlie overconsolidated subglacial till deposits. This deposit is the Yorkville Till Member of the Lemont Formation (Curry 2001). A sand and gravel glacial outwash deposit known as the Henry Formation is discontinuously present at the base of the till.

Glacial deposits at Fermilab unconformably overlie early Silurian (443 to 417 million years ago [Ma]) bedrock. Bedrock outcrop exposures in the Fermilab area are rare, except in quarries (e.g., North Aurora and Elmhurst) and river bluffs. The closest bedrock outcrop is approximately 1.2 miles to the west along the Fox River (Curry 2001).

3.10.1.2 Soils

The soils of DuPage County were derived from parent materials that were directly or indirectly impacted by the Wisconsin glaciation. The parent materials for the soils in DuPage County include glacial till, glacial outwash, loess (or silty material), lacustrine sediments, organic deposits, alluvium, and bedrock. Glacial till is non-stratified drift transported and deposited directly by glacial ice and is a compact mixture of gravel, sand, silt, and clay (NRCS 1999).

The soil survey data for the U.S. Department of Agriculture (USDA) Soil Survey Geographic Database (SSURGO) indicates that the PIP-II Project site includes soil units Wauconda Silt Loam, 0 to 2% slopes (697A) and Drummer Silty Clay Loam, 0 to 2% slopes (Hydric) (152A). Hydric soils are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. These areas typically support wetlands. Hydric soil indicators persist in the soil during both wet and dry periods (WBK 2016).

Soil limitations were assessed using the DuPage County Soil Survey (NRCS 1999), as well as interpreted soil properties (Soil Survey Staff [SSS] 2017). Based on the high clay content of the somewhat poorly drained site soils and moist soil conditions resulting from a shallow water table, the risk of wind erosion is low to moderate when the vegetative cover is removed. Site soils are moderately susceptible to water erosion; however, this risk is minimized by flat topography. Wauconda Silt Loam and Drummer Silty Clay Loam soils in the Fermilab property are NRCS-classified Prime Farmland, if drained (NRCS 1999); however, the soils within the PIP-II Project site are not currently cultivated. Approximately 2,200 acres of the Fermilab property are currently licensed for crop production.

3.10.1.3 Seismic

Fermilab is located in a region of the central mid-continent that is tectonically stable and exhibits very low seismic risk. The closest known earthquake zones capable of producing substantial ground motion are located several hundred miles to the south of Fermilab. The Fermilab area does not have known active faults. In 2008, the United States Geological Survey (USGS) produced updated seismic hazard maps for the conterminous United States, including peak ground acceleration (PGA) and spectral accelerations for a range of return periods and exceedance probabilities (Peterson et al. 2008). The predicted PGA value for the Fermilab area for a seismic event with a return period of approximately 2,500 years or less (2% probability of occurring in 50 years) would be approximately 0.06g (with *g* equal to acceleration due to gravity) (Peterson et al. 2008). The predicted PGA would correspond to less than 2.0 on the Richter Scale, which likely would not be felt at Fermilab (Wald et al. 1999).

3.10.2 Environmental Impacts

3.10.2.1 Proposed Action

3.10.2.1.1 Construction

The Proposed Action would affect soils during excavation, soil stockpiling and placement of soils for construction of the Project facilities. Environmental impacts would include removal of soil within the footprint of facility construction and related soil functions (e.g., support plant growth), soil compaction adjacent to excavation and stockpile areas from frequent vehicle traffic, increased potential for erosion, and loss of soil productivity during stockpiling.

During construction of the Proposed Action, up to 120,000 yd^3 of soil would be removed; however, topsoil would be preserved to the extent practicable and reused to restore the site and other areas. Geological resources (i.e., rock) would not be affected because no excavation of bedrock is anticipated to be required.

The top layers of soil excavated from this area would be moved to a soil stockpiling area on the east side of the PIP-II Project site as shown on **Figure 2.2-2**. Before construction of the Tevatron Project in the 1970s, the soils within the PIP-II Project site (Wauconda Silt Loam and Drummer Silty Clay Loam) were NRCS-classified Prime Farmland, if drained (NRCS 1999). No crops have been cultivated in the PIP-II Project site for many years. Because the PIP-II Project site is not currently used for crop production, the loss of soil functions would not represent a direct impact on farming operations or regional agricultural productivity. Other short-term impacts on soils would include a very localized increased risk of erosion from excavation and grading and from around soil stockpiles. The Project soils are moderately susceptible to water erosion; however, this risk of impacting surrounding areas (e.g., surface waters) is minimized by flat topography. Fermilab would comply with SEPMs as well as the NPDES permit and would develop and implement a SWPPP. SEPMs to minimize soil erosion would include diverting runoff from exposed soil surfaces, revegetating disturbed areas, and implementing other measures to collect and filter runoff (e.g., sedimentation basins, sediment/silt fences). Compacted soils in heavy traffic areas would be revitalized via decompaction techniques such as tilling and regrading followed by mulching and reseeding.

Fermilab would apply to the IEPA for coverage under the NPDES General Permit for Stormwater Discharges from Construction Site Activities (IL10) by submitting a NOI. The Proposed Action would require preparation of a SWPPP that would conform to "Illinois Urban Manual" standards (NRCS 2002). The SWPPP would describe the construction activity; soil disturbance; and required erosion and sediment controls, stabilization practices, structural controls, post-construction stormwater management, and wastewater treatment requirements. It would also outline a maintenance plan and required BMP inspections and reporting. The certified SWPPP would be available on-site for inspection by the IEPA, NRCS, and the local community. All SWPPPs are also available online at the IEPA web site.

3.10.2.1.2 Operation

During operations, the Proposed Action would have little or no direct impacts on geology or soils. Ongoing grounds maintenance, including mowing and soil erosion control, would be conducted in accordance with the Fermilab SWPPP. Operations would not require excavation or grading. The vegetation surrounding the new facilities would be maintained per SEPMs to minimize soil erosion.

Impacts on soils were analyzed for both pulsed and CW-mode operations. The Project would be designed with thick shielding for radiation and other engineering controls to minimize contact of soils with irradiated materials. Operations would have very low impacts on soils and bedrock.

3.10.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no impacts on geology or soils from the Proposed Action. Ongoing research and planned projects requiring excavation or grading would continue at Fermilab. During these activities, Fermilab would implement SEPMs, including erosion control and site restoration, to minimize soil impacts.

3.11 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

This section provides baseline data on population, ethnicity, employment, income, housing, and the local economy near Fermilab and evaluates the potential socioeconomic impacts of the Proposed Action and No Action Alternative, including the potential for adverse human health or environmental impacts that could disproportionately affect a minority or low-income population. The affected environment includes the municipalities and communities surrounding Fermilab that could potentially be affected by socioeconomic factors, such as an influx of workers, increased demand for housing, construction spending, or disproportionate impacts on minority or low-income populations.

This analysis complies with EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, dated February 11, 1994. This EO directs each federal agency to "make achieving environmental justice (EJ) part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental impacts of its programs, policies, and activities on minority populations and low-income populations in the United States."

DOE's *Environmental Justice Strategy* (DOE 2017) and Five Year Implementation Plan (2008) demonstrate DOE's commitment to comply with EO 12898. Using BMPs, the DOE continues to seek new ways to implement and advance the overall EJ goals identified in EO 12898. The federal Interagency Working Group on Environmental Justice (EJ IWG) plays a central role in creating healthy and sustainable communities by bringing together the federal family to address critical EJ issues. USEPA defines EJ as: "The fair treatment and meaningful involvement of all people-regardless of race, color, national origin, or income-with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." The EJ IWG responsibilities and authority to act on EJ issues are established by EO 12898, with two accompanying documents: 1) the 2011 Memorandum of Understanding on Environmental Justice and Executive Order 12898 and 2) the Charter for the Interagency Working Group on Environmental Justice (EJ IWG 2011). The EJ IWG Framework for Collaboration Fiscal Years 2016 - 2018 provides additional guidance (EJ IWG 2016).

3.11.1 Affected Environment

Fermilab is located in eastern Kane County and western DuPage County, west of the greater Chicago metropolitan area. The area covered by analysis includes the entirety of Kane and DuPage Counties and the cities that border the Fermilab property, including the Cities of Batavia, West Chicago, Warrenville, Aurora, and North Aurora.

3.11.1.1 Population, Race, and Ethnicity

As shown in **Table 3.11-1**, the demographics of DuPage County are similar to those of the state as a whole. The percentage of the population of Kane County that identifies as Hispanic is larger than those in DuPage County or the state.

Table 3.11-1 Estimated 2017 Population and Demographics of the Area

Municipality Name	Total Population	White, alone (%)	Black or African American, alone (%)	American Indian/ Alaskan Native, alone (%)	Asian, alone (%)	Native Hawaiian or Other Pacific Islander, alone (%)	Two or More Races (%)	Hispanic or Latino (%)	White alone, not Hispanic or Latino ,(%)
United States	325,719,178	76.6	13.4	1.3	5.8	0.2	2.7	18.1	60.7
State of Illinois	12,802,023	77.1	14.6	0.6	5.7	0.1	2.0	17.3	61.3
Chicago	2,716,450	48.7	30.9	0.3	6.1	0.0	2.5	29.1	32.3
DuPage County	930,128	80.3	5.2	0.4	12.1	0.1	2.0	14.4	67.0
Kane County	534,667	86.6	6.0	1.0	4.3	0.1	1.9	32.1	56.9
Batavia	26,563	91.0	2.6	0.1	1.2	0.0	2.6	7.5	87.0
West Chicago	27,182	81.3	2.0	0.1	6.8	0.0	2.3	52.0	39.0
Warrenville	13,269	81.2	4.1	0.0	6.4	0.0	3.8	18.5	67.2
Aurora	200,965	56.5	10.2	0.4	7.7	0.1	2.7	42.7	37.7
North Aurora	18,245	77.5	6.2	0.7	5.9	0.1	2.8	14.8	71.0

Source: U.S. Census Bureau 2018

3.11.1.2 Minority Populations

The percentage of minority populations in Kane and DuPage Counties and the cities that border Fermilab does not exceed 50%. Those people identifying themselves as Hispanic or Latino may be of any race, so they are also included in applicable race categories Because some persons identifying themselves as Hispanic and Latino are double-counted in the percentages listed for other race categories in **Table 3.11-1**, the data in the table may sum to greater than 100%. DuPage County, Kane County, Batavia, West Chicago, and Aurora have smaller percentages of minority populations relative to the state and national averages.

3.11.1.3 Income

Median household income and per capita income data for 2012 through 2016 (in 2016 dollars) are presented in **Table 3.11-2**. The median household incomes for the cities that border Fermilab are higher than those for the State of Illinois and the U.S. Generally, per capita incomes for the communities in the vicinity of Fermilab are also higher than those for the State of Illinois and the U.S.

Table 3.11-2 2012 to 2016 Median and Per Capita Household Incomes in the Area

Locality	Median Household Income	Per Capita Income	Persons in Poverty
United States	$55,322	$29,829	12.7%
State of Illinois	$59,196	$31,502	13.0%
Chicago	$50,434	$30,847	21.7%
DuPage County	$81,521	$40,547	7.0%
Kane County	$71,602	$31,774	10.5%
Batavia	$89,932	$42,110	12.7%
West Chicago	$71,520	$26,102	10.4%
Warrenville	$80,686	$34,371	7.6%
Aurora	$63,967	$26,989	14.0%
North Aurora	$81,826	$36,182	6.1%

Source: U.S. Census Bureau 2018

3.11.1.4 Housing

From 2012 to 2016, the median value of owner-occupied housing units in DuPage County was reported at $283,500, and $215,800 in Kane County (U.S. Census Bureau 2018); these are higher than the state and national medians, which are $174,800 and $184,700, respectively. Housing is available in both counties, with housing unit vacancy rates ranging from 5.4 to 6.4% and a rental property vacancy rate of approximately 2%.

3.11.1.5 Industrial Sectors

The economies of DuPage and Kane Counties are generally typical of suburbs of large cities. Similar to other suburban areas in the region, the professional, scientific, and technical services; educational, health care, social services, and retail industrial sectors play large roles in the local economy. Manufacturing also accounts for a large number of jobs.

Fermilab's current workforce consists of approximately 1,780 full- and part-time employees, as well as approximately 2,000 scientist users who are involved in experiments at Fermilab (Riesselmann 2018). Many of these individuals associated with Fermilab visit the area for short periods and usually seek accommodations off-site in the local area.

3.11.1.6 Low Income Populations

In 2016, approximately 12.7% of the U.S. population and 13.0% of Illinois' population were living below the poverty line. In DuPage and Kane Counties, approximately 7.0 and 10.5%, respectively, of the population were below the poverty line. Incomes in the cities in the vicinity of Fermilab are higher than the poverty thresholds (U.S. Department of Health and Human Services 2018), as well as the average U.S. and state incomes (U.S. Census Bureau 2018). The cities surrounding Fermilab are neither low-income nor disproportionately minority communities.

3.11.2 Environmental Impacts

3.11.2.1 Proposed Action

3.11.2.1.1 Construction

3.11.2.1.1.1 Socioeconomics

The Proposed Action would require relatively few construction workers; therefore, it would not increase the costs of labor in the region. Construction would require an average of approximately 18 workers and a peak of approximately 38 construction workers per day. Given the size of the locally available labor pool, the Proposed Action would be unlikely to result in worker in-migration; therefore, the Proposed Action would have very low, if any, impacts on the population, demographics, or local housing demand in the Fermilab area.

The total DOE-approved cost range for the PIP-II Project is $653 to $928 million (Bihary 2018) for the excavations, utilities, and surface and subsurface buildings, with a construction period of 7 years. Total construction costs are anticipated to be approximately $168.4 million, and annual construction spending would peak at $33.2 million for site preparation (Dixon 2017). The average non-residential building construction worker in the Chicago area earns $41,770 (BLS 2018). The average annual income for all occupations in DuPage County is $50,4343 (U.S. Census Bureau 2017). The Project-related jobs would result in very low impacts on the local employment rate because construction workers generally move from one project to another. The number of additional site personnel and Contractors required for construction activities associated with the Project would have a marginally positive and temporary effect on the local and regional economy, the local construction industry and associated industries.

The Proposed Action also entails the development and installation of technical systems that would either be fabricated outside the area and then assembled and installed by existing Fermilab staff or fabricated, assembled, and installed by existing Fermilab staff. In either case, no additional economic benefit would be realized in the Fermilab area from the development and installation of technical systems.

3.11.2.1.1.2 Environmental Justice

In accordance with DOE's Environmental Justice Strategy (DOE 2017), DOE's NEPA process would provide residents, including the minority populations, with access to information regarding the selected alternative. The DOE would announce via letters to various stakeholders, publish a press release and an advertisement in local newspapers, and would set up a website to notify the public of the availability of the PIP-II Draft EA for comment. Potential impacts from the Proposed Action would be low, including increased traffic, noise, and dust during construction. Most impacts would occur along the Kirk Road corridor in Batavia, which is the closest off-site location to the Proposed Action. The cities surrounding Fermilab are neither low-income nor disproportionately minority communities; therefore, the Proposed Action construction would not disproportionately impact minority or low-income communities.

3.11.2.1.2 Operations

3.11.2.1.2.1 Socioeconomics

The Proposed Action would contribute to ongoing activities at Fermilab that may stimulate additional tourism and visitor spending with a net positive economic benefits to the local economy. In addition, the Proposed Action operations may require off-site support services from workers with higher end salaries, which may contribute to consumer spending. Few additional new permanent positions would be created at Fermilab. Therefore, there would be minimal direct or induced economic impacts generated from the earning and spending of new employees or on the local housing market. Some sectors of the local economy would experience a small, beneficial effect resulting from spending by researchers visiting the site, primarily in the areas immediately surrounding Fermilab.

Economic impacts from operation of the Proposed Action would be relatively small and would represent a marginally positive effect on the local and regional economy, including a continuation of existing economic benefits generated from operations at Fermilab. The low staffing level for the experiment operation phase and the finite limit to the experiment duration indicates that local and regional economy would not increase appreciably.

3.11.2.1.2.2 Environmental Justice

The cities that border Fermilab are neither low-income nor disproportionately minority communities; therefore, the Proposed Action operation would not have disproportionately high and adverse human health or environmental effects on low-income communities or minority populations.

3.11.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no socioeconomics impacts, including no impacts on population, demographics, local housing demand, and no beneficial economic impacts on the local construction industry and associated industries from the Proposed Action. Ongoing research and planned projects would continue at Fermilab. The residences closest to the Proposed Action occur along the Kirk Road corridor in Batavia. As described in the LBNF/DUNE EA (DOE 2015), the cities that border Fermilab are neither low-income nor disproportionately minority communities; therefore, existing and future experiments would not have disproportionately high and adverse human health or environmental effects on low-income communities or minority populations.

3.12 SUSTAINABILITY

This section evaluates the consistency of the Proposed Action and No Action Alternative with federal, DOE, and site-specific sustainability policies and practices. The affected environment is the compliance environment at Fermilab as well as air, energy, water, and other limited resources needed for the Proposed Action.

3.12.1 Affected Environment

Fermilab is committed to an environmentally sound and sustainable future. This includes designing, locating, constructing, maintaining and operating its facilities in an energy-efficient and sustainable manner consistent with Fermilab's mission and goals.

As a federal facility, Fermilab manages a sustainability program consistent with current federal EOs and DOE directives, including EO 13834, *Efficient Federal Operations*, dated March 17, 2018, EO 13783, *Promoting Energy Independence and Economic Growth*, dated March 28, 2017, and DOE Order 436.1, *Departmental Sustainability*. EO 13834 directs federal agencies to manage their buildings, vehicles, and overall operations to optimize energy and environmental performance, reduce waste, and cut costs. DOE Order 436.1 requires that DOE facilities carry out their missions in a sustainable manner, in accordance with the DOE's Strategic Sustainability Performance Plan (SSPP). DOE is developing a 2018 *Sustainability Implementation Plan* to implement the requirements of EO 13834. The previous sustainability EOs have been revoked.

In 2010, Fermilab developed its first Site Sustainability Plan (SSP). Since then, the Fermilab SSP has been updated annually with new goals and progress. The current Fermilab SSP (Fermilab 2018e) outlines the laboratory's progress towards achieving sustainability goals and establishes goals for energy efficiency, waste reduction, sustainable acquisition, GHG reduction, water use efficiency, and recycling. To achieve these goals, DOE sites must increase energy efficiencies, reduce fleet petroleum consumption, conserve water, and reduce waste. In addition, Fermilab's environmental management system is maintained in compliance with International Standard Organization (ISO) 14001 requirements.

Fermilab optimizes reduced fossil fuel usage in new building designs, per Energy Independence and Security Act (EISA) Section 433, through fuel substitution, assessing renewable energy opportunities, greater equipment efficiencies, and controls strategies. Fermilab is registered with the Clean Fuel Fleet Program, one of several programs the IEPA has implemented to help improve air quality in the Chicago ozone non-attainment area.

Fermilab has incorporated a number of sustainable practices and programs, including restoration of prairie, forest and wetland conservation, and water quality protection. Other sustainable programs focus on biodiversity, land management, composting, and water conservation. Since 2008, Fermilab has greatly reduced GHG emissions and waste production, including through a site-wide recycling program. The site's ICW system minimizes the use of potable water by capturing, retaining, and recycling rainwater. Further, no treated potable water is used for landscaping or agriculture.

Accelerator science inherently uses large amounts of energy. However, the laboratory strives to improve energy efficiency. During FY 2011, Fermilab installed a high-efficiency boiler and numerous lighting retrofits. Fermilab has focused on energy efficiency, including simplicity and economy of design, for buildings and through upgrades consistent with DOE's SSPP. Fermilab also purchases RECs to offset GHG emissions. The purchase of RECs implies an actual reduction of GHG emissions nationwide assuming that these purchases reduce the cost of producing renewable energy.

In FY 2017, Fermilab achieved success in meeting the laboratory's sustainability goals. The following accomplishments are notable examples of sustainability progress that support Fermilab's ability to deliver on its mission.

- Fermilab's Sustainability Management Team was re-chartered and now includes Sustainability Goal Owners to build expertise in developing and delivering projects to meet Fermilab's sustainability goals.
- Fermilab used an Illinois public sector retro-commissioning & energy assessment program to complete four retro-commissioning and energy audit projects yielding a list of energy conservation measures that saved 9,124 MWh and 94,034 therms annually.

- Modernization of Fermilab's ICW system backbone through a Science Laboratories Infrastructure (SLI) project was substantially complete in FY 2017. More than 4 miles of new and replacement pipe infrastructure would significantly improve the reliability and efficiency of the ICW system.
- The Sustainability Management Team oversaw efforts to maximize waste diversion and communicate a message of environmental stewardship by deploying and monitoring three-bin landfill/recycling/compost waste container groups at the Fermilab 50th anniversary public open house.
- Fermilab fleet management staff began using vehicle telematics to track and analyze fleet vehicle use and trip characteristic data.
- Fermilab installed its first two electric vehicle charging stations which would enable the charging of both fleet and personal employee vehicles. Employees pay for the electricity to charge personal vehicles per the new "Employee Electric Vehicle Charging" policy and procedure.
- Four new High Performance Sustainable Buildings (HPSB) were added to Fermilab's portfolio, more than doubling the laboratory's inventory of HPSB facilities in a single year.
- For the seventh year in a row, the Fermilab Grid Computing Center was awarded Energy Star status for its superior energy performance.
- Fermilab completed a climate change vulnerabilities screening which helped identify those assets and systems most vulnerable to the region's most likely climate impacts.

Fermilab has developed an FY 2018 SSP with the following goals applicable to the Proposed Action (Fermilab 2018e):

- Reduce direct and indirect GHG emissions;
- Reduce facility energy use;
- Increase the number of HPSBs to comply with the Guiding Principles;
- Conserve water to reduce potable use;
- Reduce industrial, landscaping and agricultural water use;
- Manage waste for waste reduction and pollution prevention, divert non-hazardous solid waste and divert construction and demolition materials debris;
- Manage fleet to decrease fleet petroleum use, reduce per-mile GHG emissions, and increase alternative fuel use;
- Increase renewable energy use as a percentage of overall facility electricity use;
- Increase use of renewable energy for overall facility electric and thermal energy use;
- Increase % of new contract actions meeting sustainable acquisition requirements;
- Procure environmentally sustainable electronics, including power management features on eligible computers, and implement the use of duplex printing; and
- Dispose of electronics through government programs and certified recyclers.

3.12.2 Environmental Impacts

3.12.2.1 Proposed Action

3.12.2.1.1 Construction

Fermilab is committed to designing, locating, constructing, maintaining, and operating its facilities in an energy-efficient and sustainable manner to achieve a balance that would realize maximum attainable reuse and recycling of depletable resources in an economically viable manner and consistent with Fermilab's mission and goals. The Proposed Action would comply with the current federal EOs, DOE directives, and the Fermilab SSP.

The construction phase of the Proposed Action would be consistent with the goals outlined in the current federal EOs, DOE directive, Fermilab's current SSP (Fermilab 2018e), which would be updated to comply with the new EOs, and *Implementation of Guiding Principles for Sustainable Federal Building Requirements for the PIP-II Conventional Facilities at Fermilab* (Fermilab 2017b). These two Fermilab documents were developed under EO 13693, which has since been revoked. The guidelines in these two documents would be followed until an updated SSP is developed for Fermilab, at which time the new requirements would supplant those of EO 13693.

3.12.2.1.2 Operations

As part of the conceptual design development, the Proposed Action conventional facilities team developed a variety of sustainability goals and objectives based on the facility type and intended use. These goals are summarized in the following subsections.

3.12.2.1.2.1 Employ Integrated Design Principles

Sustainable Locations: The integrated Project team considered the environmental impact and balanced that potential impact against the overall Project goals and objectives when siting the Proposed Action conventional facilities. The considerations included access to adjacent existing utilities, roadways, shared parking, as well as walking distances to the facilities in Wilson Hall.

Integrated Design: The integrated Project team developed performance goals for the Proposed Action conventional facilities.

- The PIP-II Project site is adjacent to a restored prairie. Site restoration and landscaping choices would be designed with the input of Fermilab subject matter experts including plant selection, pollinator habitat, and wildfire management strategies.
- Fermilab currently has two electric vehicle charging stations. During the design phase, the Project team would seek input from Fermilab to determine if the PIP-II Project site would be appropriate for the addition of an electric charging station.

Commissioning: The Proposed Action would include initial commissioning of the building systems to optimize and verify performance. The plan for the initial commissioning would be developed during the design phase and implemented during the construction phase by an independent commissioning agent. Recommissioning would be the responsibility of Fermilab following the policies and procedures of the Facilities Engineering Services Section.

3.12.2.1.2.2 Optimize Energy Performance

Energy Efficiency: The integrated Project team would employ design strategies that reduce energy loads including the use of energy-efficient products where applicable.

Renewable and Clean Energy: The Proposed Action is located on the Fermilab property and relies on Fermilab Energy Manager procurement of energy and RECs.

Metering: The Project would install meters for the following systems (if used):

- Electric meters at the incoming building service;
- Natural gas meter located at the incoming service; and
- Chilled water British thermal unit (BTU) meter located at the supply point at the existing Central Utility Building.

3.12.2.1.2.3 Protect and Conserve Water

Indoor Water Use: The integrated Project team would design the Proposed Action conventional facilities to meet American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 189.1-2014 sections 6.3.2, 6.4.2, and 6.4.3, or current comparable ASHRAE standards.

Water-efficient Products: The design of the Proposed Action conventional facilities would incorporate water-efficient fixtures.

Water Meters: The design would include the following:

- DWS meter located at the incoming building service; and
- ICW at the incoming building service.

Cooling Towers: The use of cooling towers would be investigated during the detailed and final design phase and, if needed, would be optimized.

Single-pass Cooling: The conceptual design does not anticipate single-pass cooling.

Outdoor Water Use: Fermilab policy does not allow the use of potable water for landscaping. The site restoration and landscaping plan would be developed with input from Fermilab experts to ensure that native, non-invasive, drought-tolerant, and low-maintenance plants are established where appropriate.

Alternate Water: The conceptual design for the Proposed Action conventional facilities does not anticipate the use of alternate water. This would be revisited during the detailed and final design phases and implemented if determined to be cost-effective.

Stormwater Management: The Proposed Action conventional facilities would comply with EISA Section 438 Storm Water Runoff Requirements for Federal Development Projects.

3.12.2.1.2.4 Enhance Indoor Environmental Quality

Ventilation and Thermal Comfort: For those portions of the conventional facilities in regularly occupied spaces, the design would be based on current ASHRAE Standard 55 Thermal Environmental Conditions for Human Occupancy as well as ASHRAE Standard 62.1 or 62.2 Ventilation for Acceptable Indoor Air Quality.

Daylighting and Lighting Controls: The design of the Proposed Action conventional facilities would maximize reasonable opportunities for daylighting, automatic dimming controls or accessible manual controls, task lighting, and shade/glare control in regularly occupied spaces.

Indoor Air Quality:

- Radon: Previous experience at Fermilab indicates that radon is not an issue.
- Moisture Control: During the detailed and final design phases, the integrated Project team would establish and implement a moisture control strategy to prevent damage to equipment, minimize mold contamination, and reduce health risks from excess moisture.
- Low-Emitting Materials: The integrated Project team would investigate and specify appropriate low-emitting materials for building construction and operations.
- Indoor Air Quality During Construction: The Subcontractor documents would include necessary protocols to protect indoor air quality during construction.
- Environmental Smoking Control: The Project would comply with Fermilab policies and regulations for smoking control including prohibiting smoking within buildings and within 25 feet of entrances, operable windows, and ventilation intakes.
- Integrated Pest Management: The Project would comply with FESHM chapter 8042, Integrated Pest Management.
- Occupant Health and Wellness: During detailed and final design, the integrated Project team would investigate and implement reasonable opportunities for voluntary increased physical movement of building occupants including making stairwells an option for circulation, active workstations, and accommodations for bicycles. The conventional facilities would include access to potable water, daylight, and exterior views in normally occupied spaces.

3.12.2.1.2.5 Reduce the Environmental Impact of Materials

Material Content and Performance: During the detailed and final design phases, the Project team would investigate and specify, where applicable, construction materials and building supplies that have a lesser or reduced effect on human health and the environment.

- Recycled Content and Comprehensive Procurement Guidelines: Where applicable and cost-effective, the Project would specify and install products that meet Resource Conservation and Recovery Act (RCRA) section 6002.
- Bio Based Content: Where applicable and cost-effective, the Project would specify and install products that meet Farm Security and Rural Investment Act (FSRIA) section 9002.
- Ozone-depleting and High Global Warming Potential (GWP) Chemicals: During detailed and final design, the Project team would investigate and specify products to avoid ozone-depleting compounds and high GWP chemicals.

Waste Diversion and Materials Management: The Project goal for recycling is to comply with FESHM Chapter 8022, Recycling, Waste Minimization, and Pollution Prevention. The Project team would incorporate appropriate space and equipment for collection, storage, and staging of recyclable content. The Project goal for construction debris is to divert at least 50% of construction and demolition debris from landfills.

3.12.2.1.2.6 Assess and Consider Climate Change Risks

Mission Criticality: Fermilab is the DOE's single-purpose particle physics and accelerator laboratory. Fermilab's vision is to lead the world in neutrino science research with particle accelerators. The Proposed Action would have the potential to support all experiments using beams at Fermilab due to its role as the front end of the accelerator complex and is therefore considered critical to the mission of the laboratory in the coming decades.

Floodplain Considerations: The Proposed Action conventional facilities goal would be to avoid long- and short- term adverse impacts to existing floodplains where practicable.

Facility Design: The Proposed Action conventional facilities goal would be to investigate and incorporate cost-effective and reasonable cost resilience measures to address predicted climate conditions over the anticipated 40-year life of the Project. The Proposed Action would increase energy consumption; however, the Project would minimize the net increase by using renewable energy, installing meters, employee training, and continuing to purchase RECs.

3.12.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no impacts on the use of energy or water, or generation of GHG or waste materials from the Proposed Action. As analyzed in the LBNF/DUNE EA (DOE 2015), existing research projects and other planned projects at Fermilab would continue to use energy and water, generate air emissions and GHGs, and generate and dispose of waste materials in a manner consistent with the current federal EOs, DOE directives, and the updated Fermilab SSP.

3.13 UTILITIES

This section describes existing utilities at Fermilab and the potential impacts of the Proposed Action and No Action Alternative on municipal utilities. The affected environment includes local power, water, and wastewater utilities, which would serve the Proposed Action.

3.13.1 Affected Environment

Electrical power is supplied to Fermilab through the northern Illinois bulk power transmission system operated by a local investor-owned utility. The site interconnects with the bulk transmission system at two locations. Fermilab is serviced by 345 kV service connections at two interconnections. Fermilab takes power from the interconnections and delivers it along Fermilab-owned and operated transmission lines to the KRS and MSS electrical substations where the power is transformed to 13.8 kV for site-wide distribution. Fermilab maintains two separate types of power systems: pulsed power and conventional power. The pulsed power loads used by accelerator facilities are large and are of the wrong type for the conventional facilities equipment; thus, the systems are separate. In 2017, Fermilab’s electricity usage was approximately 279,647 megawatt-hours (MWh; Meiland 2018).

Fermilab’s drinking water is provided through a community water system from the City of Warrenville. Fermilab’s domestic water demand in 2017 was approximately 32 million gallons (Meiland 2018).

Fermilab maintains an on-site piping system for the conveyance of aqueous process wastewater and sanitary effluent. Wastewaters and sanitary effluent are directed to sanitary sewers and ultimately discharged to POTWs in Batavia and Warrenville/Naperville. In calendar year 2017, Fermilab's total sewer discharge was approximately 32.7 million gallons (Meiland 2018).

3.13.2 Environmental Impacts

3.13.2.1 Proposed Action

3.13.2.1.1 Construction

The Proposed Action would include decommissioning any existing Main Ring or Booster Ring equipment before the start of construction. Demolition and site work for extension of utilities to the Project would require shutoffs for local gas, power, communication, and domestic water services for removal and capping. Impacts would include short-term interruptions in utility services to some adjacent facilities.

The Proposed Action would require utility construction and relocation. Construction would require limited power, potable water, water for dust control, wastewater treatment, and natural gas. Power demand for construction would be short-term and would be limited to lighting construction trailers, operating small tools, and powering ventilation and pumps. The increased power, water, and other utility requirements of the Proposed Action would be within the capacity of electricity and water suppliers.

The Proposed Action would require relatively few construction workers; therefore, it would have low impacts on the capacity of the municipal water supply or wastewater treatment utilities. Construction would require an average of approximately 18 workers and a peak of approximately 38 construction workers per day. The water and waste treatment facilities in Batavia have sufficient existing treatment capacity such that the Proposed Action would not create a level of additional demand that would require the expansion of any off-site utilities.

3.13.2.1.2 Operations

Energy consumption impacts were analyzed for both pulsed and CW-mode operations. Electrical power for the Project would be included in bulk power purchased by DOE for overall operations at Fermilab. In addition, a permanent 250-kilowatt diesel generator would supply emergency power for the Proposed Action non-Linac support facilities.

In 2026, Fermilab's projected power demand (without PIP-II) would be approximately 60 to 70 MW (DOE 2015). The total estimated power requirements for the Proposed Action SC Linac operating in the PM and the Beam Transfer Line to the booster would be approximately 6 MW (Fermilab 2015c) beginning in approximately 2026, including HVAC and lighting. Superconducting materials carry zero electrical resistance, so current sails through them effortlessly. By taking advantage of superconducting components, accelerators minimize the amount of power they draw from the power grid, channeling more of it to the beam. Beams thus achieve higher energies at less cost than in normal-conducting accelerators, such as Fermilab's current Linac.

The capacity of the power provider's existing system would be designed to accommodate other large power users, including industrial and commercial customers such as O'Hare International Airport. The power load required for the 40 years of operation is not anticipated to exceed power or distribution system capacity of the local power providers or require off-site upgrades to existing generation or distribution systems. Closure of other experiments and the continuation of energy conservation measures at Fermilab would result in an overall reduction in operational power usage over time.

The Proposed Action would also require expanded utilities for operations, including potable water, wastewater treatment, and natural gas. Under implementation of the Proposed Action, the potable water requirements would be limited to the restrooms and would be within the capacity of the City of Warrenville community water system. Wastewater would be discharged to the Batavia and Warrenville sewer systems and would be within the projected capacity of those systems for treatment and discharge.

The Proposed Action would require few additional Fermilab employees for operations. Therefore, it would have low impacts on the capacity of the municipal water supply or wastewater treatment utilities. The water and waste treatment facilities in Batavia have sufficient existing water supply and wastewater treatment capacity such that the utility needs of the Proposed Action would not create a level of additional demand that would require the expansion of any off-site utilities or cause induced growth.

Natural gas is provided by Nicor under a supply contract with the Defense Energy Supply Center. Gas would be easily accessible to the Proposed Action from the CUB and would be used to heat approximately 85,400 square feet of floor space for the Proposed Action facilities. Given the increased natural gas supply nationwide, the natural gas required by the Proposed Action operations would be within Nicor’s capacity.

The Proposed Action would increase energy consumption; however, the Project would minimize the net increase by complying with the energy efficiency measures outlined in the SSP, which would be updated in accordance with current EOs (e.g., using renewable energy, installing meters, and employee training) and continuing to purchase RECs. The Proposed Action would comply with EO 13834, Efficient Federal Operations; DOE Order 436.1, Departmental Sustainability; as well as the Fermilab SSP goals of energy efficiency and water use efficiency. The Proposed Action would not create a level of additional demand that would require the expansion of any off-site utilities or cause induced growth.

3.13.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities, and no project-specific power and other utility upgrades would be completed; therefore, there would be no impacts on the use of energy, water, or other utilities from the Proposed Action. The No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. Ongoing research and planned projects would require expanded utility services, with power and water provided by local utilities. These impacts were previously evaluated in the LBNF/DUNE EA (DOE 2015) and determined to be within the capacities of local providers. Fermilab would continue to operate existing experiments, pursue energy efficiency and other sustainability goals outlined in Fermilab’s current and future updates to the SSP.

3.14 WASTE MANAGEMENT

This section describes existing waste generation and management at Fermilab and the potential environmental impacts of the Proposed Action and No Action Alternative on waste management practices and facilities. The affected environment includes the waste management compliance environment and programs at Fermilab, as well as on-site and off-site waste management and disposal facilities.

3.14.1 Affected Environment

Current operations at Fermilab generate non-hazardous and hazardous wastes, including chemical and radiological wastes. Fermilab manages waste in compliance with applicable regulations including the RCRA; the Toxic Substances Control Act (TSCA); the Superfund Amendments and Reauthorization Act (SARA); the CAA; CWA; the Safe Drinking Water (SDWA) Act; and other applicable federal and state regulations. Fermilab's waste management program also complies with DOE Orders and IEPA regulations. DOE Orders include DOE Manual 435.1-1 (Radioactive Waste Management) (DOE 1999), DOE Order 460.1A (Packaging and Transportation Safety) (DOE 1996), and DOE Order 460.2A (Departmental Materials Transportation and Packaging Management) (DOE 2004b). These requirements flow down to Fermilab's plans and procedures, such as the Fermilab ES&H Manual and the FRCM.

Fermilab has implemented approved programs and plans regarding proper waste packaging, transportation, disposal, and reuse/recycling. The Fermilab plans and programs include:

- Radioactive Waste Management Program
- Waste Management Plan
- LLRW Certification Program
- SPCC Plan
- SWPPP
- Emergency Response Plan
- Integrated ESH&Q Management Plan

Table 3.14-1 shows the volumes of various waste categories managed in 2017 by the Fermilab Hazard Control Technology Team.

Table 3.14-1 Waste Volumes Managed by Fermilab - 2017

Waste Type	Volume (cubic meters)	Volume (cubic yards)
Non-Routine Hazardous Waste (RCRA + TSCA)	46.8	61.2
Routine Hazardous Waste (RCRA + TSCA)	21.6	28.3
Non-Routine Non-Hazardous Special Waste	81.0	106.0
Routine Non-Hazardous Special Waste	159.8	209.0
Radioactive Waste (DOE regulated)	160.5	209.9

Source: Fermilab 2017c

Fermilab continues to make progress minimizing waste and reducing pollution. In FY 2016, Fermilab generated 957 metric tons of municipal type waste. Fermilab recycled 683 tons (71%) of material through a combination of office/residential type recycling, and the recycling of scrap metals, wood, tires, and other materials. Two hundred and fifty-four tons (27%) were sent to a landfill. This amount does not include electronics (Fermilab 2017c).

Non-hazardous waste includes municipal landfill waste, construction waste, and industrial waste that is specially packaged and identified for disposal. These wastes are from laboratory and remediation operations, such as soils containing petroleum hydrocarbons and polychlorinated biphenyls (PCBs). Waste materials leaving the site are screened for radiation before pickup and again before off-site transport to a licensed disposal facility. All radioactive materials are shipped in accordance with existing regulations.

Fermilab has an extensive waste minimization program that includes recycling to collect a variety of waste material including white office paper, mixed office paper, cardboard, plastic, glass, metal containers, scrap metal, electronic components, laser printer cartridges, batteries, fluorescent lamps, non-PCB ballasts, oil, and construction debris. Receptacles are placed in appropriate locations to collect these materials.

Fermilab regularly handles, stores, and uses hazardous materials as part of ongoing experimental programs and daily operations. These hazardous materials include solvents, corrosives, acids, adhesives, paints and epoxies, metals, and radioactive materials. Fermilab hazardous waste procedures include characterization, packaging, marking, labeling, and hazard communication.

Fermilab maintains a permit under RCRA to manage the proper storage, disposal, or reclamation of hazardous waste. Fermilab does not treat or dispose of any regulated wastes on-site. All wastes are properly disposed though licensed waste handling, transport, or disposal facilities. An annual Hazardous Waste Report is transmitted to IEPA, and radioactive waste summaries are provided to DOE Fermi Site Office. Fermilab employees handling and packaging hazardous waste are trained in accordance with DOE procedures and RCRA requirements. Radioactive waste is not governed under RCRA and is managed in compliance with DOE requirements.

Each Fermilab waste generator is responsible for waste characterization and packaging in compliance with DOE Order 460.1C for hazardous waste packaging and transportation (DOE 2010). Fermilab reduces waste and prevents pollution through process change and substitution, material reuse and recycling, using control technologies, and proper disposal if other more sustainable options cannot be implemented.

Fermilab discharges sanitary wastewater to the Batavia and Warrenville/Naperville sewer systems and POTWs. In calendar year 2017, Fermilab's total sewer discharge was approximately 32.7 million gallons (Mieland 2018). Fermilab has an NPDES pre-treatment permit for process discharges to the Batavia POTW. Fermilab's sanitary wastewater discharges complied with the pre-treatment permit, as well as specified radionuclide levels in DOE Derived Concentration Guide (DOE 2011).

Fermilab monitors the tritium concentrations in the sanitary effluent discharged from the site to the municipal wastewater treatment plants (WWTPs) of Batavia and Warrenville/Naperville. Low concentrations of tritium are regularly recorded in the discharge to Batavia. To date, the highest level detected in the sanitary sewer water discharged to the City of Batavia is roughly 10.5 pCi/ml. This level is well below the DOE standard for tritium in sanitary sewers, which is 9,500 pCi/ml.

Sanitary sewer wastewater treated in Batavia's wastewater treatment facility is discharged into the Fox River. While there is no treatment that removes tritium from water, the low levels of tritium measured in the Fermilab sanitary sewers are diluted to undetectable levels by the time they reach the Fox River. The amount of tritium that Fermilab adds to the Fox River is less than that added naturally by rainwater.

Fermilab generates LLRW and mixed waste from routine operations, maintenance, and experiments at its high-energy physics research program. Fermilab generates radioactive experimental components after they are exposed to beam radiation. Radioactive waste includes waste materials contaminated with radionuclides or activated by exposure to prompt radiation.

Materials with detectable radioactivity are retained for reuse on-site, disposed as radioactive waste, or as both a hazardous and radioactive waste. Property exposed to radioactivity is surveyed as required by 10 CFR 835 for contamination before removal from Fermilab. Radioactive waste is packaged, marked, labeled, and transported in accordance with DOE Orders and U.S. Department of Transportation (USDOT) requirements. Fermilab generated approximately 210 yd^3 of radioactive waste in 2017 as shown in **Table 3.14-1**.

Water containing tritium concentrations is either reclaimed for use via discharge into Fermilab's ICW System or disposed of as LLRW. Water disposed of as LLRW is done in accordance with DOE standards at DOE-approved radioactive waste disposal sites.

3.14.1.1 Pre-Existing Contamination

The SWMUs at Fermilab are areas where historical hazardous waste storage or disposal may have caused contamination to soil or groundwater. The existing SWMU 12, CUB Pipe and Clay Tile Field, is located approximately 750 feet southeast of the PIP-II Project boundary as shown on **Figure 3.14-1**. SWMU 12 was used as a leach field to dispose of wastewater containing chloride and metals. Remediation was conducted for SWMU 12, and all contaminated soil and gravel was removed and disposed of properly off site. Fermilab is conducting a groundwater monitoring program for glacial till and bedrock wells located at SWMU 12 in accordance with Fermilab's RCRA permit issued by IEPA.

Drainage is overland to the southeast to Lake Logo. Semi-annually, Fermilab continues to sample ten groundwater monitoring wells installed near SWMU 12. These wells are monitored for chloride and lead. Disturbances of the soils within SWMU 12 are prohibited without ESH&Q approval and appropriate stormwater protections. One SWMU well (MW-9B) is located north of Holter Road and is a bedrock well (Greer 2018). Bedrock well MWS3 was recently abandoned (**Figure 2.2-2**).

3.14.2 Environmental Impacts

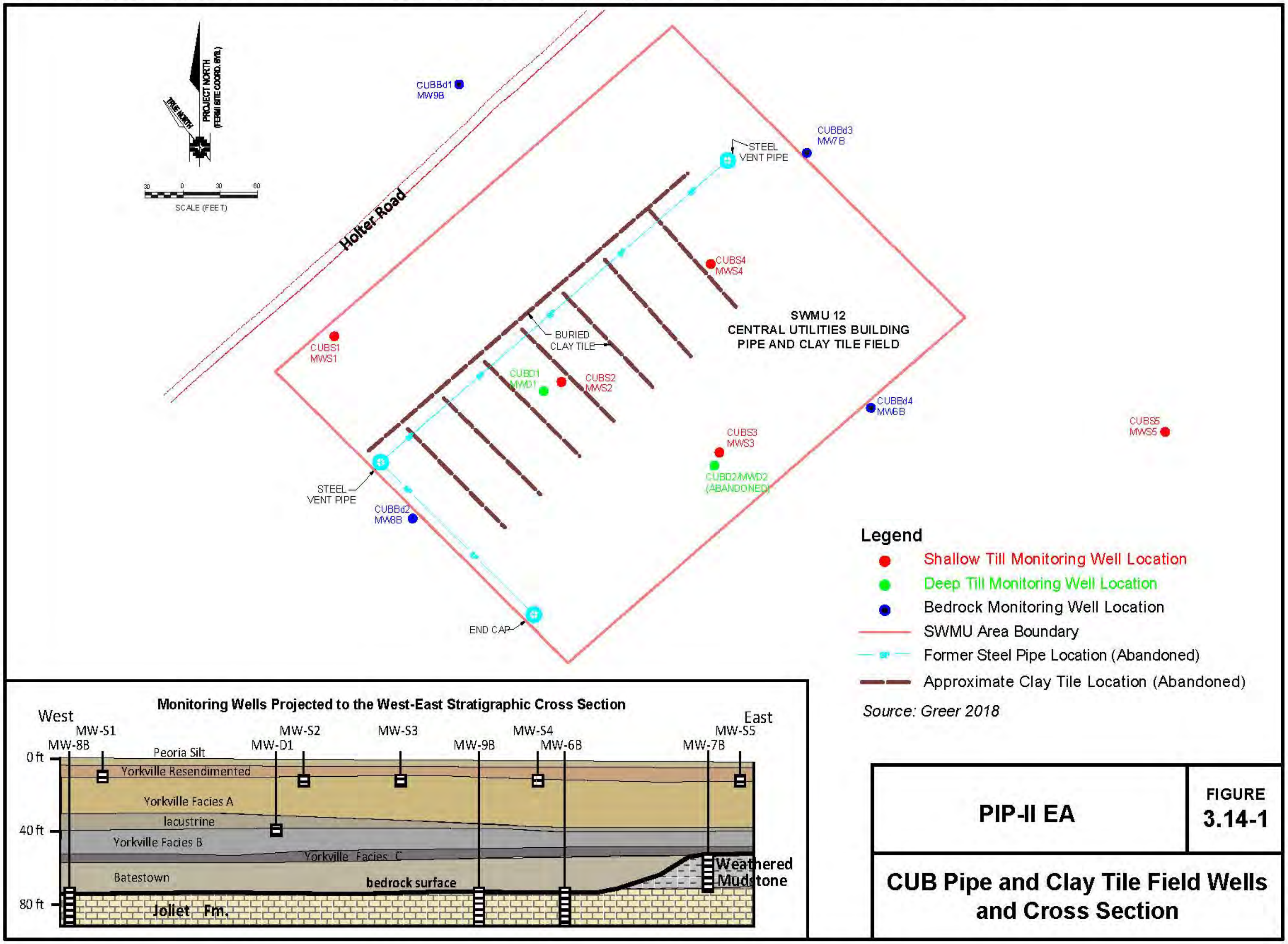
3.14.2.1 Proposed Action

3.14.2.1.1 Construction

Construction of the Proposed Action would generate non-hazardous waste and relatively small quantities of regulated waste. Non-hazardous wastes generated by construction would consist of construction debris and sanitary waste. The total volume of waste generated and disposed of at Fermilab would be reduced by Fermilab's active minimization program. Construction of the experimental facilities and service buildings and site excavation would generate approximately 20,000 yd^3 of construction debris, which would largely be recycled. A small volume of regulated waste would also be generated. Regulated waste would be properly disposed of via processing or recycling at a licensed off-site facility.

General refuse from the Proposed Action would be discarded into dumpsters located at the Project. Wastes placed in dumpsters would be collected by a commercial waste hauler and transported to the hauler's processing facility, where recyclable materials would be removed, and the remainder disposed of in a permitted off-site landfill. The remaining organic waste would be transported for disposal in a permitted off-site sanitary landfill.

Path: Z:\GISProjects_ENV_ALPHA_ENV_E-F\FERMILAB\AdobeIllustrator\AI\PIP_II_EA\Fermi_PIP_II_Fig3.14-1_CUB Pipe and Clay Tile Field Wells and Cross Section.ai Last Saved By: JChen Last Saved On: 05/03/2018



PIP-II EA

FIGURE 3.14-1

CUB Pipe and Clay Tile Field Wells and Cross Section

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Construction of the Proposed Action would require the excavation of up to 120,000 yd^3 of soil. Excavated material would be stored on-site or reused as fill. Excavated soils would not be expected to contain radionuclides. The SWMU 12 remediation areas are beyond the limits of the PIP-II Project site and would not be disturbed or affected by any construction associated with the Proposed Action.

During active construction, the Proposed Action would generate an increased amount of municipal and construction/demolition solid wastes relative to current conditions. The additional quantities of wastes would be well within the existing capacity of the Fermilab waste system, would not adversely affect waste disposal handling capacity or facilities, and would not require construction of new facilities on-site or off-site to accommodate the increased amount of construction waste. Contractor specifications would require compliance with federal, state, and local requirements and with Fermilab policies regarding waste management. Fermilab would follow strict Standard Operating Procedures (SOPs) for managing and minimizing wastes including reuse/recycling. Once construction is complete, waste generation of this nature would decrease. Impacts to waste management would be low.

Construction of the Proposed Action would generate small quantities of petroleum waste. The quantities generated would increase relative to current conditions but would be well within the existing capacity of the Fermilab waste system. These wastes would be generated by construction equipment maintenance such as routine changes of hydraulic hoses and fittings to minimize ruptures and fluid releases. Some inadvertent mechanical failures, vehicle mishaps, or fluid releases would require minor cleanup. Other wastes would include oily rags used during equipment maintenance and cleanup of residual hydraulic fluids and fuels, adhesives, paint, and solvents. Wastes would be packaged, marked, and labeled for transport in accordance with DOE Orders and USDOT requirements. Construction wastes would be disposed of in accordance with DOE requirements and would meet disposal facility Waste Acceptance Criteria (WAC). Based on Fermilab construction experience, **Table 3.14-2** provides the estimated waste volumes that would be generated during construction of the Proposed Action.

Table 3.14-2 Estimated Construction Waste Volumes

Hazardous Waste	Volume[1]	Disposal Method
Oily Rags	1,000 gallons (3,800L)	Incineration
Spent Solvents	100 gallons (380L)	Incineration
Epoxy Paint	50 gallons (189L)	>50% Recycle or Incineration
Hydraulic Fluid (spills)	200 gallons (757L)	Incineration
Fuel (spills)	50 gallons (189L)	Incineration
Used Motor Oil and Lubricants	2,000 gallons (7,570L)	100% Recycle or Incineration

Source: Dixon 2018d

The Proposed Action would include decommissioning any existing Main Ring or Booster Ring equipment before the start of construction. The work would consist primarily of the demolition, removal, and recycling of various building materials. Demolition debris would include reinforced concrete, perimeter drain tile, and excavated materials. Decommissioning would be conducted by Fermilab personnel in accordance with established Fermilab policies and procedures. The Contractor would be required to dispose of all construction and demolition waste with a recycling vendor and obtain a report on the amounts of each material recycled for submittal to Fermilab.

It is possible that some of the demolition wastes would be activated at low levels. Before demolition, the structures would be inspected, and in some cases tested, for the presence of any regulated waste materials/items, including asbestos. Regulated waste would be segregated before removal by the

Contractor. If found, any activated material, along with metals to be recycled, would be segregated and managed in accordance with Fermilab standards and procedures in coordination with the Fermilab Radiological Control Organization.

In summary, construction would increase the amount of wastes generated and subsequent waste handling and disposal; however, Contractor specifications require compliance with federal, state, and local requirements and with existing Fermilab policies. The minimal quantities of regulated waste streams generated would not adversely affect off-site disposal facilities, nor would the Proposed Action require modification of existing on-site waste handling facilities. The waste streams generated would not adversely affect facility disposal capacity, would not require development of new procedures, and would not require modification of the existing disposal facilities or new facilities. Waste would be managed following Fermilab's existing SOPs for storage, recycling, and disposal.

The SWMU 12 remediation areas are located beyond the limits of the PIP-II Project site; therefore, SWMU 12 would not be affected by the Proposed Action. The SWMU monitoring wells would also not be affected by the Project (Greer 2018).

3.14.2.1.2 Operations

During operations, the Proposed Project would generate non-hazardous, hazardous, and radioactive waste at amounts similar to those of past and present activities at Fermilab experiments. Waste management impacts were analyzed for both pulsed and CW-mode operations. Composition of these waste streams would be very similar to those generated by other past and present facilities at Fermilab, including the Tevatron, NuMI and NO*v*A Projects, and would be handled in accordance with Fermilab's approved plans and procedures as previously described. The Proposed Action would not generate new waste streams that would require development of new procedures or new facilities and the impacts would be low.

Small quantities of hazardous materials would be used during operations, including solvents, oil, epoxies, paint, and lead shielding. The quantities of hazardous wastes generated would increase relative to current conditions but would be within Fermilab's existing waste management system capacity. Some hazardous materials may be recycled, such as unused or useable solvents, paints, and lead shielding. Hazardous materials that cannot be recycled/reused would be disposed of in accordance with approved plans and procedures in a safe and compliant manner. Because operations would generate a minimal quantity of hazardous waste, no new on-site or off-site facilities would be needed.

Waste-related hazards from the Project include the potential for releasing waste materials (oils, solvents, chemicals and radioactive material) to the environment, injury of personnel, and a possible reactive or explosive event. Typical initiators would be transportation accidents, incompatible materials, insufficient packaging/labeling, failure of the packaging, and a natural phenomenon (Fermilab 2017d). Operations would generate radioactive waste, including activated shielding components (e.g., steel, concrete) and activated experimental components (e.g., magnets). Small amounts of soil and water at the interface between the beamline shielding and surrounding soils and groundwater may become slightly radioactive. Activated shielding and soils around the beamline would be left in place for the life of the experiment. However, any shielding or components activated as a result of a beamline mis-steering accident would be surveyed and stored underground in a shielded compartment until final disposal in compliance with DOE Orders. Groundwater immediately adjacent to the shielding would be collected, drained to a sump, pumped into the ICW system, and recycled for cooling of experimental power sources and components. Activation of groundwater would be minimized by removing it from any possible radioactivity source.

Groundwater collected from sumps would be directed to the cooling ponds and recycled through the ICW system. Groundwater released from the site would be discharged in compliance with Fermilab's existing NPDES permit. Based on monitoring results, tritium levels in the surface waters at the Fermilab boundary are several times less than the USEPA drinking water standard. These radioactive waste streams and radionuclides would be managed the same as those previously and currently generated by similar Fermilab research projects, including the Tevatron, No*v*A, and NuMI Projects.

Materials exposed to radioactivity and potentially activated would be surveyed before removal from Radiologically Controlled Areas. Radiological surveys would be performed by qualified radiological control technicians and documented before releasing these materials for disposal or reuse in accordance with approved DOE procedures, and shipped in accordance with USDOT requirements. For example, filters or filtrates containing radioactive constituents would be characterized and packaged for compliant disposal as required by the approved disposal facility's WAC.

Overall, impacts from radioactive waste would be low during operations and minimized by design measures and engineering controls (shielding and beamline design), site security, safety procedures in place, accident procedures to isolate hot components, surveying components to determine disposal/reuse procedures, and on-site management of collected groundwater.

3.14.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no impacts on waste generation or management from the Proposed Action, including packaging, transportation, or waste disposal. Existing operations would continue to generate and dispose of the types and quantities of waste similar to current conditions. Construction and operation of planned future projects would generate additional non-hazardous, hazardous, and radioactive wastes; however, solid waste volumes would be well within Fermilab's existing waste disposal handling capacity and would not require construction of new facilities on-site or off-site (DOE 2015).

3.15 ACCIDENT ANALYSIS

This section presents the DOE-required evaluation of potential environmental effects of "reasonably foreseeable accidents" and malevolent acts at Fermilab under implementation of the Proposed Action and No Action Alternative. In addition to the incidents analyzed in this section, an analysis of the potential for vehicular accidents is provided in **Section 3.7, Transportation,** and potential impacts on public and worker health and safety are assessed in **Section 3.4, Health and Safety**.

3.15.1 Affected Environment

The NEPA accident analysis focuses on the highest-consequence credible accident in terms of human or environmental impact, such as an accident involving multiple casualties or a release of a toxic chemical to a wetland or waterway requiring a rapid response. DOE regards incidents with a risk in the range of 1 in 1 million to 1 in 10 million as "reasonably foreseeable" (DOE 2002a). Accident analysis also includes the results of an intentional destructive or terrorist act (DOE 2006). The results of the accident impact analysis provide information to facilitate the decision process regarding the possible (as opposed to the expected) impacts from choosing a given course of action.

Accident risk is based on two main factors: probability of occurrence and magnitude of consequence. Accident types may include occasional accidents (risk of 1 in 100 to 1 in 10,000) such as trips and falls, remote accidents (probability of 1 in 10,000 to 1 in 1,000,000) such as a tank rupture, and improbable accidents (probability of less than 1 in 1,000,000) such as a plane crash. The following subsections analyze these kinds of events.

The affected environment for accidents and malevolent acts would be the area directly and indirectly affected by a reasonably foreseeable incident that would be the highest-consequence credible accident. For this analysis, the affected environment would be contained to the area within the underground enclosures that could be affected by a beam mis-steering event and outdoor areas along cryogen delivery routes potentially affected by a trucking accident and release of liquid argon (Lar) or liquid nitrogen (LN).

3.15.2 Environmental Impacts

3.15.2.1 Proposed Action

As part of the design process, a range of potential accident scenarios was considered to ensure that the Project would have adequate protections in place to minimize potential impacts. Accident conditions (including radiological conditions) are being analyzed as part of the development of a conceptual design, which is ongoing. These analyses continually evolve as the design effort progresses to ensure that all credible hazards are evaluated and appropriate controls would be included in the design to safeguard the public, Fermilab workers, the environment and the PIP-II mission.

The PIP-II Preliminary Hazard Analysis Report (PHAR), Document V2, was issued September 5, 2017 and approved on September 7, 2017 (Fermilab 2017d). The PHAR accounts for the numerous hazards that would likely be present during construction and operation of the Proposed Action. The PHAR analyzed the risk categories for each of 16 risk potential hazard types. The Project design incorporated protection measures to reduce potential hazards. With implementation of the design protection measures, eight of the risk categories were reduced to “Low or below,” six risk categories remained at a “Moderate” level, and no risk categories remained at the “High” level. The risk categories remaining at moderate levels were construction, electrical, cryogenics, ionizing radiation inside/outside, and material handling. The Project design incorporated protection measures to reduce potential hazards to no more than minor on-site and negligible off-site impacts to people and the environment during construction and operations (Fermilab 2017d).

3.15.2.1.1 Construction

During construction, the primary potential health and safety risk would be work-related accidents and injuries typical of the construction industry. Based on the PHAR, construction of the Proposed Action would potentially result in hazards identified as low risk, such as non-routine accidents, fires, hazardous materials release, and natural disasters such as tornados (Fermilab 2017d). These types of events have a higher probability of occurring but would be routinely addressed by safety and response programs and plans.

Fermilab would implement SEPMs, such as preparing and implementing construction health and safety plans pursuant to the Fermilab Integrated Safety Management Systems (ISMS), DOE requirements (e.g., 10 CFR 851, Worker Safety and Health Program), Occupational Safety and Health Administration (OSHA) 29 CFR Parts 1910 and 1926, American Conference of Governmental Industrial Hygienists (AGCIH) silica requirements, and pertinent building codes (e.g., National Electrical Code).

Fire risk would be minimized through SEPMs by following the fire safety precautions required by the FESHM, as well as OSHA regulations and NFPA 241, “Standard for Safeguarding Construction, Alteration and Demolition Operations." In addition, potential ignition sources would be controlled during construction. For example, smoking would be limited to designated areas, and hot work (e.g., welding) would be controlled through the Fermilab burn permit program. Facility fire detection and suppression systems, as well as personnel occupancy requirements, would comply with NFPA 101: Life Safety Code. Fire alarm/fire suppression systems would also be designed in accordance with Fermilab engineering standards, which require a hard-wired, zoned, general evacuation fire alarm system.

The Proposed Action would include decommissioning any existing Main Ring or Booster Ring equipment before the start of construction. The work would consist primarily of the demolition, removal, and recycling of various building materials. It is possible that some of these materials would be activated at low levels. If found, any activated material, along with metals to be recycled, would be segregated and managed in accordance with Fermilab standards and procedures in coordination with the Fermilab Radiological Control Organization. The Contractor would be required to dispose of all construction and demolition waste with a recycling vendor and obtain a report on the amounts of each material recycled for submittal to Fermilab.

There would be very low potential for accidents associated with ionizing radiation because beam operation would not have started. Some excavation would occur in areas previously exposed to accelerator operations and cooling water, which contains very low levels of radionuclides, including tritium. If present, activated materials would be managed in accordance with Fermilab standards and procedures in coordination with the Fermilab Radiological Control Organization. Based on Fermilab's experience with other similar projects, excavation could result in radiation exposures. During construction, workers would not work in radiation exposure areas associated with existing Fermilab facilities and would receive radiation doses no higher than the public under the ALARA program. Under ALARA, Fermilab takes every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical. To verify that exposures would be at or below regulatory limits, soil would be excavated in compliance with the procedures outlined in the FRCM (Fermilab 2017a), including monitoring of worker exposures and radiation safety oversight. Radiation exposure potential associated with the use of radiography sources or other licensed radioactive material would be managed by the Contractor(s) in accordance with the applicable regulations and the terms of their license(s).

Intentional destructive actions would not result in the types of concerns that would arise for construction requiring large volumes of hazardous or radioactive materials. The Proposed Action would not use these types of materials. Rather, the potential impacts of an act of sabotage could include a fire or explosion involving fuel or explosives stored at the Project. However, the quantities of these materials would be limited.

Any intentional destructive act would be deterred by site security and would have little effect on surrounding residential areas because construction would occur primarily away from adjacent roads and neighborhoods, or in a relatively inaccessible site location. Therefore, intentional destructive acts during construction would have an uncertain but low probability and limited impacts because of the isolated nature of the construction.

During construction, PIP-II would comply with operational SEPMs outlined in the FRCM and 10 CFR 835, Occupational Radiation Protection such that worker and public radiation doses would comply with the FESHM, DOE standards, and Fermilab policy. Other SEPMs would include worker training and badging, including cryogen safety training. With implementation of Fermilab's existing safety programs, there is no major reasonably foreseeable accident scenario arising from construction, such as a major fire or structural failure, with severe impacts.

3.15.2.1.2 Operations

Based on the PIP-II PHAR, the primary hazards during operations would include electrical, ionizing radiation inside/outside, cryogenics, and material handling. The design and operational controls included in the Project design are intended to provide a robust level of protection against these postulated events and provide protection for the public, Fermilab workers, and the environment. Based on the experience of other accelerator facilities at Fermilab, the evaluations conducted and Fermilab's commitment to certain design features and safety controls for the Project, it is expected that the health and safety impacts (risk) of foreseeable accidents can be managed at acceptably low levels through the facility design process and control of operations. The Project design incorporated protection measures to reduce potential hazards to no more than minor on-site and negligible off-site impacts to people and the environment during operations (Fermilab 2017d).

The accident analysis for operations accounts for both pulsed and CW-mode operations. During operations, PIP-II would comply with operational SEPMs outlined in the FRCM and 10 CFR 835, Occupational Radiation Protection. The Proposed Action facilities would be designed with sufficient shielding and operated such that worker and public radiation doses would comply with the FESHM, DOE standards, and Fermilab policy. Other SEPMs would include worker training and badging, as well as cryogen safety training. Potential accident scenarios for electrical, ionizing radiation, cryogenic release, and material handling are analyzed in the following subsections consistent with DOE regulations.

3.15.2.1.2.1 Electrical

Electrical systems throughout the facilities would include high voltages, high currents, and high levels of stored energy. Much of the equipment that would be in use has been designed and built for a specific purpose and is not commonly found in other industrial facilities. Although workplace experience with this equipment has been very good from both safety and operational perspectives, a program has been established to review all equipment that is not labeled by a Nationally Recognized Testing Lab (Fermilab 2017d).

The PIP-II facilities would have both emergency and standby power systems. The emergency power system would include support of fire detection/alarm systems, exit signage, emergency lights, and elevator car lighting, and two-way Fermilab Fire Department communication systems. The standby power systems would support critical systems including elevators, air handling systems, sump pumps, and shaft cranes. The design would follow the NFPA 110 Standard for Emergency and Standby Power Systems. The risk of electrical accidents would be minimized through engineered controls, such as isolation and insulation, combined with Fermilab SEPMs including policies, procedures, and training. Work performed on electrical systems would include controls such as lockout/tagout (LO/TO) procedures. Electrical equipment would be designed, upgraded, installed, and operated in compliance with the National Electrical Code, NFPA 70; OSHA 29 CFR 1910, Subpart S, Electrical; and the Fermilab Electrical Safety Program. With implementation of Fermilab standard procedures, the probability of electrical accidents is low.

3.15.2.1.2.2 Ionizing Radiation

The beamline would be designed, constructed, and operated to minimize the probability of damage. Loss of control of the beam during operations, as a result of human error or mechanical failure, could cause substantial damage to components within just a few beam pulses. Under an assumed reasonably foreseeable scenario where there is a potential for an accidental beam loss, such an incident would result in component heating and damage, groundwater activation, and radiation concerns outside the beamline enclosure. In addition, magnet temperatures would rise rapidly and would effectively destroy or even melt the components. Although not expected, this type of event would result in several adverse impacts including additional radiation exposure of workers involved in activities within the enclosure to isolate and replace the damaged component. Many of the components weigh several tons, and handling would result in additional risk of injury. Component replacement would require many hours of exposure to activated components.

Although radionuclides would not include transuranic isotopes and would be of relatively short half-lives, potential health impacts of radiation exposure under an assumed reasonably foreseeable accident scenario could include latent cancers and related fatalities. Under such a scenario, facility operations would be affected because replacement of damaged components would require an operational shutdown. Although workers routinely manage irradiated components, under this scenario, workers involved in responding to the accident could be exposed for the additional time required to move hot or damaged components to temporary storage in a concrete-shielded cell until they could be moved to a long-term storage facility. Hazards to workers would be managed by limiting the acute exposure time to individuals, based on dose measurements, to verify that administrative radiation limits for workers were not exceeded. Public exposure would be very low because the damaged components would be contained within the underground enclosures.

As described above for construction, intentionally destructive, malevolent, or terrorist actions would not result in the types of concerns that would arise at facilities that store large volumes of hazardous or radioactive materials. Instead, the impacts of an act of sabotage or terrorism could include beam loss and activation or damage of components, resulting in the same environmental impacts described above for a beam loss accident. Specifically, replacement of damaged components would require many hours of close work to move damaged components along with potential for other injuries and accidents inherent with responding to a low-incidence event.

An intentionally destructive act, such as a terrorist attack or sabotage, would have a low probability of success. Such an event would have to overcome several existing preventive measures. The probability of such an attack would be minimized by site security. The maximum reasonably foreseeable scenario would be a fire or explosion that would disperse radioactive material, potentially resulting in on-site and off-site exposure. Such an incident would have a low probability of occurring. The emergency response to contain and reduce the severity of environmental exposure would be immediate and robust with coordination among a number of agencies, including implementation of the Fermilab Comprehensive Emergency Management Plan. Further, the probability of releasing radioactive materials is remote, as any activated material would be underground shielded by steel and concrete, and less vulnerable to fire or explosion than surface infrastructure.

Operational incidents would be minimized by shielding and safety procedures; however, mis-steering of the beam and failure of safety systems caused by an accident or malevolent act would result in irradiation of beamline components, potentially resulting in severe damage. Repairing the facility would create short- and long-term exposure risks to workers involved in entering the beam enclosure and replacing irradiated or damaged components. In this event, workers would isolate the damaged component and would be exposed to activated components over short periods as required to move the damaged component to a concrete-shielded cell. Hazards to workers would be managed by limiting the exposure time to individuals, based on dose measurements, to verify that administrative radiation limits for workers would not be exceeded. Public exposure would be very low because the damaged components would be contained within the underground enclosures.

3.15.2.1.2.3 Cryogen Release

The Proposed Action would employ substantial volumes of LAr and liquid nitrogen LN cryogens. Based on the PIP-II PHAR, cryogenic hazards at PIP-II would include the potential for oxygen deficient atmospheres due to catastrophic failure of the cryogenic systems, thermal (cold burn) hazards from cryogenic components, and pressure hazards (Fermilab 2017d). Initiators could include the failure/rupture of cryogenic systems from overpressure, failure of insulating vacuum jackets, mechanical damage/failure, deficient maintenance, or improper procedures.

A cryogen leak at the underground detector or the associated piping would release LAr or LN, which would rapidly change states to a gas, displace oxygen, and result in a possible ODH situation that would be dangerous to personnel. The consequences of the leak or spill depends on many factors including pressure, size of the leak, the location of the leak, and location of surrounding personnel. A leak or spill in a confined space could result in an oxygen deficient atmosphere and cause asphyxiation. In open areas a leak or spill would result in temporary zones of oxygen depletion. In the event of an inadvertent cryogen release, controls are addressed in the PHAR (Fermilab 2017d).

Accidents involving a tanker truck deliveries of cryogens could result in a release of LAr or LN to the environment. Such a release would result in a rapid phase change from liquid to gas. Under such a circumstance , the gas would be heavier than air and would locally displace oxygen. Significance of the displacement of oxygen would be dependent on many factors such as size of the leak, ambient pressure and temperature, wind direction, and the location of the public or Fermilab workers.

Leak of a cryogen from a truck would be most likely to occur through puncture-type opening due to the design of the cryogen tanker trucks. The resulting spill would not be an instantaneous release but a release (leak) over time. A leak would necessitate emergency response by trained personnel, the creation of a safe zone in which people would be evacuated outside a specified radius dependent on the size of the leak and weather conditions, warnings to residents, and possible attempts to stop the leak by trained responders. Otherwise, the leak would not be considered an environmental hazard because the evolved gas is non-toxic. For reference, representative Safety Data Sheets (SDS) for LAr and LN can be obtained through http://www.us.airliquide.com/en/sds.html.

The compressed gas tanker truck accident statistics are not publicly available due to liability and competitive concerns. Incidental references to compressed gas transportation suggest that accident frequency is very low due to driver training and administrative controls (e.g., inspections, route selection, speed limits) and spills of cryogens are even less common due to the conservative design of transport tanker trucks. The period between years 1994 and 2003 attributes fewer than 100 injuries per year due to exposure to a USDOT-regulated material (of which LAr and LN are a subset) in highway crashes (Traffic Research Board 2005). Normal transportation of DOT-regulated materials by large trucks represents a very low accident potential for public health effects.

Many safeguards would be present to prevent a tanker truck leak. Bulk cryogenic trailers consist of two nested tanks that form a thermos bottle-like insulating vessel. The inner tank would be stainless steel or aluminum. The outer tank would be stainless steel or carbon steel. The space between the two tanks would be evacuated and filled with an insulating material. The double-layered metal tanks and structural supports would make the overall tank system highly resistant to physical damage. Cryogenic gas transport safety and tanker truck design is overseen by the Federal Motor Carrier Safety Administration according to USDOT requirements. Drivers would be selected carefully and undergo extensive training regarding material hazards, emergency response, safe driving, and tanker truck safety.

In the unlikely event of a cryogen release on the Fermilab property, emergency response would be carried out by the Fermilab Fire Department and the Fermilab SPCC team. These responders would be trained in advance to safely and appropriately manage a cryogen release. The probability of cryogenics-related accidents would be low.

3.15.2.1.2.4 Material Handling

Materials with detectable radioactivity are retained for reuse on-site, disposed as radioactive waste, or as both a hazardous and radioactive waste. Materials exposed to radioactivity and potentially activated would be surveyed as required by 10 CFR 835 for contamination before removal from Radiologically Controlled Areas. Radioactive waste is packaged, marked, labeled, and transported in accordance with DOE Orders and USDOT requirements.

The potential for accidents associated with material handling would be minimized by design measures and engineering controls (shielding and beamline design), site security, safety procedures in place, accident procedures to isolate hot components, surveying components to determine disposal/reuse procedures, and on-site management of collected groundwater. Overall, the probability of accidents associated with handling of radioactive waste would be low during operations.

3.15.2.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no impacts on potential accident risks from the Proposed Action. Ongoing research and planned projects at Fermilab would continue to have a potential for accidents and malevolent acts. Based on the accident analysis in the LBNF/DUNE EA (DOE 2015), the probability of accidents or malevolent acts with the potential to affect human health or the environment would be low. Fermilab would continue to implement operational SEPMs outlined in the FRCM and 10 CFR 835, Occupational Radiation Protection and worker safety training, including cryogen safety training.

3.16 CUMULATIVE IMPACTS

This section assesses the potential cumulative impacts associated with the Proposed Action and No Action Alternative. CEQ regulations also require an assessment of cumulative impact of the No Action Alternative as a baseline.

The cumulative impact analysis is based on consideration of past, present, and reasonably foreseeable future projects that could, based on their locations or types of impacts, result in cumulative impacts when considered together with the Proposed Action or No Action Alternative. Cumulative impacts result from the incremental impacts of the action when added to other projects regardless of what agency or person undertakes the action. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time (40 CFR 1508.7).

Projects included for the cumulative impact analysis were identified by reviewing recent planning documents, internet searches, and contacts with local and state officials. This effort did not identify commercial or industrial developments, electricity generation or transmission projects, or major highway improvements with the potential to contribute to cumulative impacts of the Proposed Action. Therefore, with the exception of the cumulative impact assessment for air quality, the geographic boundary for the cumulative impact analysis focused on projects associated with Fermilab and adjacent public roadways.

Table 3.16-1 lists past (constructed and now operating) projects, projects currently under construction, and future projects that would overlap with the construction and/or operation of the Proposed Action. The list focuses on the last 10 years and in some instances has contravening or offsetting impacts with current projects. The table provides a brief description, the project location, and approximate construction schedule.

Table 3.16-1 Projects with Potential for Cumulative Impacts with Proposed Action – Fermilab

Project	Project Description	Location	Construction Schedule
NuMI Off-axis ν_e Appearance (NOνA)	Fermilab experiment to study neutrino transformations	Fermilab	2012 -2014 (Complete)
Micro Booster Neutrino Experiment (MicroBooNE)	Fermilab experiment to test detector technologies. Includes the Liquid Argon Test Facility	Fermilab	2013 - 2015 (Complete)
Main Injector Neutrino Oscillation Search (MINOS)	Fermilab experiment to examine neutrino oscillation	Fermilab	2013 Complete
Muon g-2 and Mu2e	Fermilab muon experiments using part of the Tevatron accelerator complex	Fermilab	2013 - 2017
Main Injector Experiment with νs on As (MINERvA)	Fermilab experiment to study the reaction of neutrinos with carbon, iron, and lead	Fermilab	2006 – 2010 (Complete)
Illinois Accelerator Research Center (IARC)	Office complex (83,000 square feet) to promote collaboration between Fermilab, Argonne, DOE, universities, and industry	Fermilab	2012 - 2013 (Complete)
Short Baseline Neutrino Program	Fermilab experiment to study neutrino oscillation over short distances entirely on Fermilab property	Fermilab	2015 - 2018
Butterfield Road (Kane County)	Butterfield Road widening project	South boundary of Fermilab	2012 - 2013 (Complete)
Kirk Road (Kane County)	Kirk Road intersection improvements	Western boundary of Fermilab	2012 - 2013 (Complete)
Integrated Engineering Research Center	New building near Wilson Hall	Fermilab	2019 - 2022
LBNF/DUNE	Upgrade of Fermilab proton accelerator complex to deliver additional beam power for Fermilab neutrino experiments	Fermilab	2018 - 2030
Main Ring Building Demolitions	Demolishing legacy Main Ring Buildings	Fermilab	2019 - 2025
CUB Addition	Expansion to existing building to provide additional chilled/hot/LCW water systems	Fermilab	2020 - 2022
General Fermilab Plant Projects	Various operations, routine maintenance and improvements with very low or no environmental impact	Various	Various and On-going

3.16.1 Proposed Action

The cumulative impacts associated with the Proposed Action were evaluated in view of past, present, and reasonably foreseeable projects, which were primarily existing and planned projects at Fermilab. The timing of construction of the LBNF/DUNE Project would overlap with construction of the Proposed Action.

In general, the Proposed Action would have very low cumulative impacts on land use and recreation, biological resources and jurisdictional wetlands, cultural and paleontological resources, surface and groundwater hydrology and water quality, noise and vibration, traffic, air quality and GHGs, visual resources, geology and soils, socioeconomics and environmental justice, sustainability, utilities, waste disposal, and the probability of accidents or intentional destructive acts. The Proposed Action would have potential cumulative impacts on worker radiation exposure and surface and groundwater quality; however, Fermilab would comply with a stringent health and safety program and use design measures and Project-specific SEPMs and BMPs to minimize exposure; therefore, cumulative impacts would be low. Cumulative impacts would be minimized through implementation of Fermilab's existing environmental health and safety regulatory programs, sustainability guidelines, SEPMs, BMPs and compliance with relevant federal, state and local laws and requirements. Considered together with other Fermilab and adjacent transportation projects, the Proposed Action is anticipated to result in low cumulative impacts.

3.16.1.1 Land Use and Recreation

Neither the Proposed Action nor any of the past, present, or reasonably foreseeable projects listed in **Table 3.16-1** would result in adverse impacts on land use or recreational activities at Fermilab. The Proposed Action would occur on Fermilab property and would have very low impacts on off-site land uses and on-site recreation. Similarly, all past, present, and future Fermilab projects would occur on Fermilab property and would be focused on physics research. Transportation projects on the roads adjacent to Fermilab have been consistent with adjacent commercial and residential land uses. The Proposed Action, other planned Fermilab projects, and off-site projects would implement SEPMs to reduce indirect impacts, including noise, dust, and visual impacts. Therefore, cumulative impacts on land use or recreation would be low.

3.16.1.2 Biological Resources

The USACE issued a JD on July 23, 2018 (**Appendix B**) verifying that wetlands on the PIP-II Project site are not considered jurisdictional; therefore, they would not be subject to the CWA Section 404 permitting process and no WOUS would be affected by the Proposed Action. Other past and ongoing Fermilab projects, such as the Main Injector, NuMI, NO*v*A and LBNF/DUNE Projects, have resulted in filling on-site wetlands. The LBNF/DUNE Project would include permanent impacts on 5 acres of jurisdictional wetlands as well as Indian Creek; however, these impacts would be offset through purchase of wetland credits or other wetland and stream habitat replication (DOE 2015).

Under implementation of the Proposed Action, approximately 28 acres of prairie habitat would be cleared during construction, and the footprint of Proposed Action aboveground facilities would be approximately 4 acres for the 40-year life of the Project. The remaining 23 acres would be revegetated.

Early Fermilab projects likely affected biological resources, but these impacts have been addressed over decades through on-site environmental programs to preserve and protect resources, including wetlands, prairie, wildlife, and agricultural lands. Potential impacts on biological resources associated with the planned LBNF/DUNE Project were previously analyzed in the LBNF/DUNE EA (DOE 2015). The LBNF/DUNE Project would include clearing of approximately 140 acres of upland habitat at Fermilab, including removal of approximately 250 to 300 trees.

In a letter dated August 1, 2018 (**Appendix B**), the USFWS concurred with Fermilab's request for a "No Effect Determination" for the six federal listed plant and animal species that have the potential to occur within the PIP-II Project site:

- Eastern prairie fringed orchid
- Leafy prairie-clover
- Mead's milkweed
- Prairie bush clover
- Eastern massasauga rattlesnake
- Hine's emerald dragonfly

For the newly federal listed RPBB with the potential to be foraging within the prairie habitat of the both the PIP-II and LBNF Project sites, USFWS concluded that both the PIP-II Project and the LBNF Project "may affect but are not likely to adversely affect" the RPBB. Both projects would implement measures to avoid impacts to suitable bee habitat based on the USFWS Conservation Guidance 2018 (USFWS 2018a), including clearing vegetation before the bee's active foraging season (mid-March through mid-October). The PIP-II Project site is not likely to serve as suitable habitat for overwintering sites for hibernating queen bees because the site is too wet. In addition, approximately 986 acres of restored native prairie vegetation at Fermilab would not be disturbed. Cumulative impacts on the RPBB resulting from the Proposed Action would be low.

For the northern long-eared bat, which has not been observed on the Fermilab property, USFWS requested that Fermilab complete a Northern Long-eared Bat 4(d) Streamlined Consultation Form for both the PIP-II Project and the LBNF Project. This streamlined form indicates that the PIP-II Project may affect the northern long-eared bat, but that any resulting incidental take of the bat is not prohibited by the final 4(d) rule. Both projects would implement SEPMs to avoid potential impacts to summer roosting bats, including removal of trees during the winter months.

There are no osprey nests on the PIP-Project site(**Figure 3.2-1**). IDNR concerns for the RPBB and the osprey have been sufficiently addressed by the USFWS Consultation letter.

3.16.1.3 Cultural Resources

There are no known historic properties or paleontological resources in the PIP-II Project site; therefore, the Proposed Action is not likely to affect cultural resources during construction. Should unanticipated cultural resources be encountered during construction, Fermilab and DOE would stop construction in that area and notify an archaeologist or paleontologist, who would implement the procedures outlined in the Fermilab CRMP. During operation, the Proposed Action would not require excavation; therefore, they would have no cumulative impacts on cultural resources. Other projects at Fermilab have had minimal impacts on cultural resources. Similarly, past Fermilab projects have not affected paleontological resources; however, important fossils have been found in the region. Any archaeological or fossil discoveries associated with the Proposed Action or other planned Fermilab projects would be addressed by engaging a qualified archaeologist or paleontologist and, with minimization measures in place in accordance with the CRMP, the resulting cumulative impacts would be low.

3.16.1.4 Health and Safety

The Proposed Action could impact worker health and safety during construction and operations in the event of an industrial accident or exposure to radiation from irradiated beamline components. However, these risks would be comparable to the potential impacts of all the high-energy physics experiments constructed and operated at Fermilab over the last four decades. The Proposed Action by itself would not change the level of radionuclide generation within the current laboratory experimental program. Although the Proposed Project would have the ability to provide more protons than the existing Linac, the existing facility areas would remain limited to the currently approved beam operational limits. Fermilab's existing radiological programs ensure compliance with beam intensity limits. Accelerator produced radionuclides have been previously evaluated in other Fermilab EAs for the LBNF/DUNE (DOE 2015), NuMI (DOE 1997) and Nova (DOE 2008) Projects which would utilize the increased beam intensity and power from PIP-II. These were all found to be well within regulatory limits. The PIP-II Project would not change the previous EA evaluations.

Potential risks of injury and radiation exposures would be minimized through existing Fermilab programs, which include extensive worker training and badging. Per Fermilab policy and DOE Orders, radiation exposures would be reduced to ALARA. When considered together with other Fermilab activities, there would be a very low increase in the number of workers relative to historical workforce trends. With implementation of shielding and other established Fermilab health and safety and radiological control procedures, cumulative health and safety impacts would be low.

3.16.1.5 Hydrology and Water Quality

Past and ongoing Fermilab experiments, as well as adjacent projects to improve Butterfield Road and Kirk Road, have created impervious surfaces, with a potential for the increased stormwater runoff to affect water quality and add to flooding impacts, such as those that occur on Indian Creek. To minimize stormwater impacts, local municipalities have developed stormwater control programs requiring stormwater detention. New impervious surfaces would comply with stormwater detention requirements. Increased runoff volume would be addressed through existing stormwater programs and would not increase the peak runoff rate. Current and future development projects, including the other planned Fermilab projects, would be required to control stormwater runoff.

The PIP-II Project site has very limited topographic relief. The Proposed Action would not involve activities within a 100-year or 500-year floodplain (FEMA 2004). The Proposed Action would have very low impacts on floodplains or flooding in the vicinity of the PIP-II Project site. Cumulative impacts to surface water hydrology would be low.

The Proposed Action may require dewatering of excavations and may generate pumped groundwater from dewatering excavations during construction; however, this water would be conveyed to the ICW ponds. Dewatering would have short-term, localized groundwater drawdown impacts from pumping during construction. Because ongoing and planned Fermilab projects would have similar localized impacts on groundwater hydrology that would not overlap, there would be low cumulative impacts on groundwater hydrology. The Proposed Action would have only minor risks of contamination that would be minimized through implementation of SEPMs, BMPs to prevent leaks and spills, and according to procedures presented in Project-specific SWPPP and SPCC Plan. Past and planned projects at Fermilab, such as the LBNF/DUNE (DOE 2015), NuMI (DOE 1997), and NO*v*A (DOE 2008) Projects, use similar measures to minimize the potential for spills to avoid impacts on groundwater quality. There would be low cumulative impacts on on-site or off-site groundwater quality.

Stormwater runoff would have the potential to affect water quality in Ferry Creek; however, stormwater would be managed through existing stormwater programs and in compliance with Fermilab's NPDES permit so that best uses of Ferry Creek and criteria are maintained. Past Fermilab projects, as well as projects currently under construction, generate stormwater runoff addressed by BMPs. Operational water is stored and reused in the ICW system. Therefore, given compliance with the Fermilab SWPPP and Project-specific SWPPP and stormwater controls, cumulative impacts to surface water quality and designated uses would be low.

The Proposed Action by itself would not change the level of radionuclide generation within the current laboratory experimental program. Although the Proposed Project would have the ability to provide more protons than the existing Linac, the existing facility areas would remain limited to the currently approved beam operational limits. Fermilab's existing radiological programs ensure compliance with beam intensity limits. Accelerator produced radionuclides have been previously evaluated in other Fermilab EAs for the LBNF/DUNE, NuMI and Nova Projects which would utilize the increased beam intensity and power from PIP-II. These were all found to be well within regulatory limits. The PIP-II Project would not change the previous EA evaluations.

Experiments at Fermilab have the potential to introduce tritium to cooling water and shallow groundwater, and the Proposed Action would potentially represent a cumulative impact should concentrations in groundwater increase above existing background levels. The analysis in the LBNF/DUNE EA found that for 2.3 MW operations (DOE 2015), accelerator produced radionuclides were all within regulatory limits. The ponds would minimize cumulative impacts on groundwater by isolating surface water. Implementation with Fermilab's existing stormwater management policies and practices, as well as Fermilab's existing NPDES would minimize the total amounts of tritium in water. Currently, the tritium levels are low (<80 pCi/ml) and localized in shallow groundwater (i.e., Class 2). Class 2 groundwater migrates at a very low rate to Class 1 waters. Levels of tritium in surface water around Fermilab are regularly monitored and are several times less than the drinking water standard. Fermilab would continue to follow the existing procedures and the Groundwater Monitoring Plan (Fermilab 2015b) to track tritium concentrations and groundwater flow directions. Given the design of beamline components, which would be built specifically to keep water segregated from radioactive sources, the tritium contribution by the Proposed Action would be very low, and cumulative impacts to groundwater hydrology and water quality would be low.

3.16.1.6 Noise and Vibration

During construction, the Proposed Action would generate noise and vibration from the use of excavators, heavy equipment, and Project-related vehicles. To minimize noise impacts, Fermilab would conduct construction activities only during the day. In addition, the underground facilities would be constructed within excavations that would attenuate much of the sound. The Proposed Action is approximately 1 mile from the nearest off-site sensitive receptors and residences along Kirk Road. Noise levels would diminish rapidly with distance. Based on the distance between the PIP-II Project site and off-site receptors, intervening noise-buffering features (e.g., trees, buildings, and berms), and the ambient noise generated by Kirk Road and adjacent land uses, the Proposed Action noise levels would not be noticeable at the nearest off-site sensitive receptors.

Other Fermilab activities would generate short-term, localized noise and vibration impacts. Potential impacts on noise and vibration associated with the planned LBNF/DUNE Project were previously analyzed in the LBNF/DUNE EA (DOE 2015). During construction of the LBNF/DUNE Project, noise levels would increase by approximately 5 dBA above existing ambient conditions at residences directly across Kirk Road, which would be noticeable, but would not exceed state or local noise limits. During blasting for the LBNF/DUNE Project, vibrations may be noticeable at residences near Kirk Road, but vibrations would be below the level that would cause structural damage. The Proposed Action would not require blasting; therefore, there would be no off-site cumulative vibration impacts associated with the Proposed Action.

If construction proceeds as currently envisioned, construction of the LBNF/DUNE Project would occur concurrent with the Proposed Action construction for several years and would result in additional short-term, localized noise impacts. Combined noise levels would not exceed state or local noise limits at the closest off-site sensitive receptors; therefore, cumulative noise and vibration impacts would be low.

3.16.1.7 Transportation

The Proposed Action would result in a very low (<1%) increase in the volume of traffic on the state and county road systems relative to current conditions. Increases in traffic associated with the Proposed Action would be consistent with historical workforce trends. The Proposed Action would result in very low increases in traffic volume and a commensurate very low (less than 1%) increase in the number of accidents and injuries on public roadways. If construction proceeds as currently envisioned, construction of the LBNF/Dune Project would occur concurrent with the Proposed Action construction for several years. Potential impacts on transportation resources associated with the planned LBNF/DUNE Project were previously analyzed in the LBNF/DUNE EA (DOE 2015). During the years in which construction of the Proposed Project overlaps with construction of the LBNF/DUNE Project, the combined traffic impacts would be short-term and consistent with historical workforce traffic trends. Traffic impacts from the Proposed Action and other Fermilab construction projects would be minimized by routing construction traffic to the site's construction entrance at Kautz Road and avoiding large deliveries during peak traffic hours. Traffic SEPMs would include implementing a traffic control plan, worker training, posting speed limits, regularly inspecting construction vehicles, and posting signage. Cumulative impacts to traffic volume and commensurate potential for accidents and injuries on public roads would be very low.

3.16.1.8 Air Quality and GHG

Each state must meet federal air quality standards by specific deadlines, and the plan for meeting these standards is outlined in the state's SIP. To determine whether the Proposed Action would be aligned with the state SIP, the EA includes a conformity analysis, as well as an analysis of potential cumulative impacts in the air basin.

Criteria pollutant emissions estimated for the Proposed Action would be slightly above Conformity Analysis *de minimis* levels for NO_x during the sixth and seventh years of construction but would be offset through purchase of emissions credits and would be low during operations. Similarly, if construction proceeds as currently envisioned, construction of the LBNF/DUNE Project (DOE 2015) would occur concurrent with the Proposed Action construction for several years and would result in additional NO_x emissions that would require purchase of offset credits.

Potential impacts on air quality and GHGs associated with the planned LBNF/DUNE Project were previously analyzed in the LBNF/DUNE EA (DOE 2015). DuPage County is non-attainment for O_3 and $PM_{2.5}$; however, the Proposed Action, when considered together with other planned Fermilab projects, would not delay attainment for these criteria pollutant. Radionuclide emissions during operations would be controlled and monitored to verify that radionuclide emissions from all sources were well below DOE requirements, Fermilab air permit limits, USEPA dose limits, and site-specific Fermilab policy. During the years in which construction of the Proposed Project overlaps with construction of the LBNF/DUNE Project, the cumulative air quality impacts would be low.

The potential cumulative impacts of GHG emissions would result from the aggregated emissions at Fermilab, as well as regional, national, and global GHG emissions. The Proposed Action and all other Fermilab projects would comply with the goals set forth in Fermilab's SSP, which would be updated to comply with the new EOs, including GHG emissions reduction. With implementation of the federal government's measures to reduce GHGs, cumulative GHG impacts from past present and reasonably foreseeable activities at Fermilab would be low.

3.16.1.9 Visual Resources

The Proposed Action would be located east of Wilson Hall within the Main Ring and would not be visible from off-site locations or recreational areas. Other planned Fermilab projects would include surface facilities visible from off-site locations. Most of the other Fermilab features in the same viewshed have been present for many years, including surface facilities constructed as part of MINOS, NuMI, NOvA, and Muon Campus Projects. Cumulative impacts to visual resources would be very low.

3.16.1.10 Geology and Soils

With implementation of erosion control BMPs, the Proposed Action would have very low impacts on geologic resources and low short-term impacts on soil erosion from grading and vegetation removal during construction. Other past and present Fermilab projects have resulted in similar short-term impacts on geology and soils from grading and tunneling that have been addressed through BMPs, such as preservation of topsoil and site restoration. Other planned projects at Fermilab, as well as future off-site transportation improvements, would be subject to engineering design and geotechnical measures as required by state regulations and local building codes, as well as erosion control BMPs. Considered together with other Fermilab and adjacent transportation projects, cumulative impact on geologic resources and soils would be low.

3.16.1.11 Socioeconomics and Environmental Justice

Construction and operation of the Proposed Action would have marginally positive economic benefits on the local and regional economy resulting from construction-related spending, worker salaries, and the purchase of goods and services from area merchants and specialty vendors. Based on the analyses in the LBNF/DUNE EA (DOE 2015), construction and operation of past and current Fermilab projects have not adversely affected, disproportionately or otherwise, low-income or minority communities. The Proposed Action and other planned projects, together with ongoing Fermilab projects and local development, would likely result in marginally positive cumulative, local economic benefits from continued experimental activity and spending of visiting scientists.

3.16.1.12 Sustainability

Experiments at Fermilab, by their very nature, require large amounts of electrical energy, which results in indirect generation of GHGs. The Proposed Action, as well as ongoing and other planned Fermilab projects, would comply with the goals set forth in Fermilab's current SSP, which would be updated to comply with the new EOs, including GHG emissions reduction, energy conservation, water conservation, pollution prevention, sustainable acquisition, and innovation. Overall, Fermilab and individual projects would consider site-wide goals including environmental restoration (e.g., wetlands, prairie) and recycling.

The incorporation of operational efficiency measures in energy use and conservation, along with waste minimization and pollution prevention, is part of Fermilab's normal daily operations and corporate culture. An essential feature of the Fermilab SSP is the purchase of RECs to offset the increased electrical energy use, which minimizes environmental impacts. Therefore, the Proposed Action, considered together with other cumulative activities, would not detract from achieving the goals of the SSP, and cumulative impacts to sustainability would be low.

3.16.1.13 Utilities

Construction of the Proposed Action would require utility construction and short-term interruptions in service to nearby facilities. Interruptions would be limited to Fermilab and would occur primarily within the vicinities of the substation and roadways. The increased power, gas, water, and other utility requirements of the Proposed Action and other planned projects at Fermilab would be within the capacity of power, gas, and water suppliers and the POTWs existing treatment capacity, such that the Proposed Action would not create a level of additional demand that would require the expansion or modification of off-site utilities or result in induced growth. Therefore, the Proposed Action, considered together with other cumulative activities, would have low cumulative impacts on local utilities.

3.16.1.14 Waste Management

The Proposed Action would generate nominal amounts of non-hazardous, hazardous, and radioactive waste in the form of construction wastes/debris (e.g., wood, packaging) and oily waste. Similarly, other projects at Fermilab, together with the Proposed Action, including those currently operating and under construction and other planned projects, would produce similar wastes throughout their lifecycles. These waste streams would be very similar to those generated by other past and ongoing projects at Fermilab, and would be handled in accordance with Fermilab's approved plans and procedures. These impacts would be minimized through implementation of Fermilab's existing waste management programs. In compliance with Fermilab policies, state and local regulations, DOE Orders, and federal EOs, much of this waste would be reused or recycled, reducing waste management impacts. The Proposed Action would not generate new waste streams that would require development of new procedures or new facilities. Therefore, the Proposed Action, considered together with other cumulative activities, would have a low cumulative impact on waste management.

3.16.1.15 Accident Analysis

Based on the PIP-II Preliminary Hazard Analysis Report, the Proposed Action design incorporated protection measures to reduce potential hazards to no more than minor on-site and negligible off-site impacts to people and the environment during construction and operations (Fermilab 2017d). Because of design measures and existing safety programs, there is no reasonably foreseeable "major" accident scenario arising from construction of the Proposed Action or an intentional destructive act. Therefore, the Proposed Action, considered together with other cumulative activities, would have a low cumulative probability for accidents or malevolent acts with the potential to affect human health or the environment.

3.16.2 No Action Alternative

Under the No Action Alternative, Fermilab would not construct or operate the Proposed Action facilities and the No Action Alternative would not meet the long-term mission need goals of the DOE-SC and Fermilab. There would be no cumulative impacts from the Proposed Action. Other past, present, and reasonably foreseeable future projects and activities, as well as off-site projects, would have cumulative impacts that would be minimized by compliance with existing regulatory programs and standard BMPs. Potential cumulative impacts associated with the LBNF/DUNE Project were previously analyzed (DOE 2015). Based on the 2015 EA, the LBNF/DUNE Project would result in low cumulative impacts on land use, cultural resources, health and safety, hydrology and water quality, off-site noise and vibration, traffic, air quality, off-site visual, geology and soils, socioeconomics, sustainability, utilities, and waste disposal. The LBNF/DUNE Project would include permanent impacts on 5 acres of jurisdictional wetlands as well as Indian Creek; however, these impacts would be offset through purchase of wetland credits or wetland and stream habitat replication. Cumulative impacts would be minimized through implementation of Fermilab's existing environmental and health and safety regulations and SEPMs, which would include measures such as revegetation, dust and erosion control, reducing GHG emissions, and adherence to a stringent health and safety program. Under the No Action Alternative, past, present, and reasonably foreseeable future projects are anticipated to result in low cumulative impacts.

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4 AGENCIES AND INDIVIDUALS CONTACTED

This section summarizes federal, state, and local agency consultation and coordination regarding the Proposed Action. The related correspondence is included in **Appendix B**.

4.1 FEDERAL AGENCIES

U.S. Army Corps of Engineers, Chicago District
U.S. Fish and Wildlife Service

4.2 STATE AGENCIES

Illinois Environmental Protection Agency
Illinois Department of Natural Resources
Illinois Emergency Management Agency (IEMA)

4.3 LOCAL GOVERNMENT ORGANIZATIONS

DuPage County
Kane County
City of Batavia

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U.S. Fish and Wildlife Service (USFWS). 2018a. Guidance Conservation Management Guidelines for the Rusty Patched Bumble Bee (*Bombus affinis*). [Web Page]. Located at https://www.fws.gov/midwest/Endangered/insects/rpbb/pdf/ConservationGuidanceRPBBv1_27Feb2018.pdf. February 27, 2018. Accessed: June 14, 2018.

USFWS. 2018b. Letter RE: Concurrence of list of threatened and endangered species that may occur in proposed project location, and/or may be affected by proposed project. Chicago Ecological Services Office. March 22. 3pp.

USFWS 2018c. Letter RE: Concurrence with determinations that the proposed PIP-II and LBNF/DUNE Projects may affect, but are not likely to adversely affect the RPBB. August 1 3pp.Valishev, A. 2013. Safety at Fermilab. June 25, 2013. [Web Page]. Located at https://indico.fnal.gov/materialDisplay.py?contribId=7&materialId=slides&confId=7019. Accessed: April 24, 2018.

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APPENDIX A

PIP-II Fact Sheet

Proton Improvement Plan II

Fermilab's Proton Improvement Plan II will generate the world's most powerful high-energy neutrino beam for the international Deep Underground Neutrino Experiment and position Fermilab as the world leader in accelerator-based neutrino research.

This architectural rendering shows the buildings that will house the new PIP-II accelerators.

Abundant neutrinos, powerful protons

The PIP-II project is an essential upgrade of Fermilab's particle accelerator complex. The upgrade will enable Fermilab's accelerators to generate an unprecedented stream of neutrinos—subtle, subatomic particles that could hold the key to understanding the universe's evolution—by creating the world's most intense high-energy neutrino beams.

This capability positions Fermilab to be the world leader in accelerator-based neutrino research. It enables the scientific program for the international, Fermilab-hosted Deep Underground Neutrino Experiment (DUNE) and Long-Baseline Neutrino Facility (LBNF).

The key to PIP-II is power. When the PIP-II project is complete, Fermilab will be able to generate proton beams greater than 1 megawatt—60 percent higher than current capabilities. These powerful beams of protons will in turn create intense beams of neutrinos. Future PIP-II upgrades will triple the lab's current beam power.

PIP-II's high-intensity proton beams will provide a flexible platform for the long-term future of the Fermilab accelerator complex and the U.S. accelerator-based particle physics program.

An international project

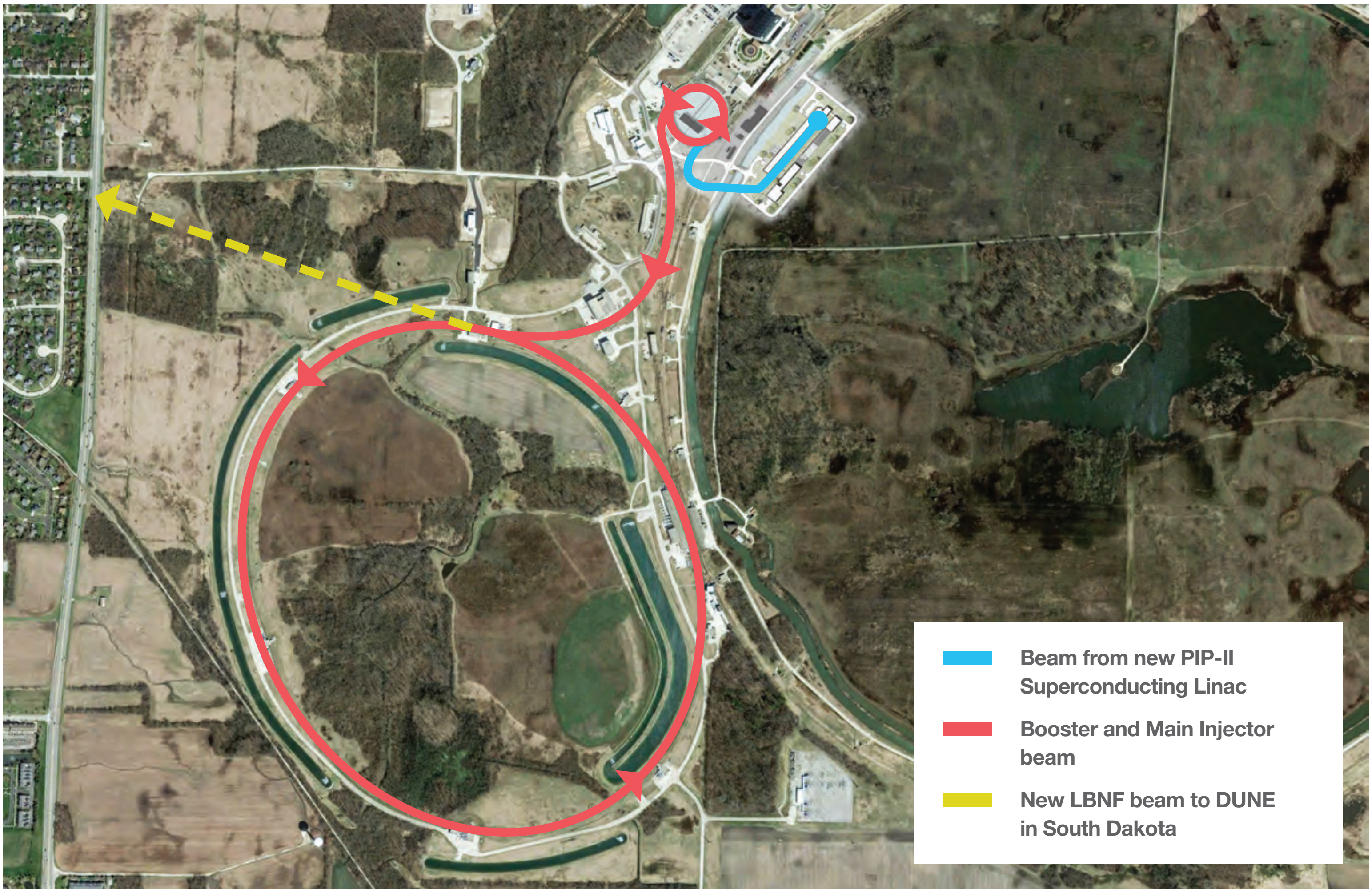
PIP-II is the first particle accelerator on U.S. soil built with significant contributions from international partners. Institutions in India, France, Italy and the UK are expected to contribute to the project, bringing specific expertise in accelerator technologies and established track records in contributing to international accelerator projects.

PIP-II will maximize Fermilab's scientific potential by incorporating a unique first section for the lab's accelerator chain. This will allow scientists to customize beam parameters for multiple experiments operating simultaneously.

PIP-II and superconducting technology

Fermilab is a pioneer in the use of superconducting technology for particle acceleration, and PIP-II will use this forefront technology to accelerate protons efficiently. The project draws on Fermilab's world-class expertise in this research area, helping to raise the performance of the next generation of accelerators.

PIP-II's addition of a new superconducting accelerator to the laboratory's accelerator chain, together with the refurbishment of the lab's existing accelerators, will result in a cutting-edge accelerator complex, providing flexibility to send intense beams to multiple experiments, including LBNF/DUNE, over many decades.



The PIP-II project will supply powerful neutrino beams for the LBNF/DUNE experiment.

Neutrinos for LBNF/DUNE

The neutrinos generated by the powerful PIP-II-enabled accelerator complex will travel to the first of two DUNE particles detectors, located on the Fermilab site, and then continue to travel 800 miles (1,300 kilometers) through Earth's mantle to a second, much larger detector located a mile underground at the Sanford Underground Research Facility in Lead, South Dakota. Scientists will compare the data from the two detectors to understand how neutrinos change as they travel over long distances.

Benefits of PIP-II

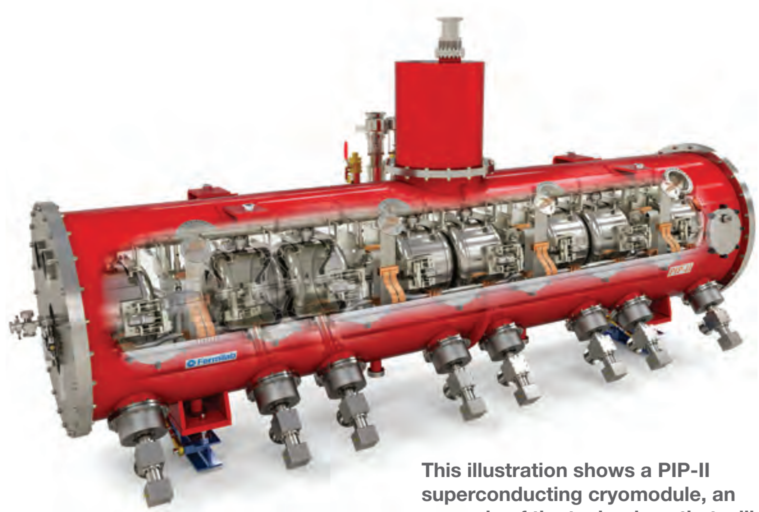
The development of PIP-II, LBNF and DUNE will have a multimillion dollar economic impact in Illinois and South Dakota, according to a recent study by Anderson Economic Group.

In addition, institutions from across the United States and around the globe contribute to these projects. The opportunity to build and test components for PIP-II also has multiplying effects for international collaborators, who will gain expertise in accelerator technology that can be applied in their home countries.

Scientists and engineers are developing the superconducting accelerator technology in PIP-II not only for fundamental science, but also for applications in industry, national security, medicine, computing and the environment.

Time to power up

The design for PIP-II is expected to be finalized in 2019. The PIP-II project is expected to be completed in the mid-2020s.



This illustration shows a PIP-II superconducting cryomodule, an example of the technology that will enable the Fermilab accelerator complex to generate powerful particle beams.

APPENDIX B

PIP-II Correspondence

From:	Hersemann, Rick
To:	kristopher_lah@fws.gov
Cc:	shawn_citron@fws.gov; cathy_pollack@fws.gov; louise_clemency@fws.gov; Kubiak, Kimberly J CIV USARMY CELRC (US); Teri L Dykhuis (dykhuis@fnal.gov); Eric Korzeniowski; "Katie Swanson"; Kate Sienkiewicz (kateps@fnal.gov); Bridget K Iverson; Michels, Martha (FNAL); Ryan E. Campbell (ryancamp@fnal.gov); hamernik@fnal.gov; Bihary, Adam; Carolan, Pepin; Scott, John; Bollinger, Mark; Weis, Michael; McKown, Michelle; Cloutier, Kathryn; Chapin, Allison
Subject:	PIP-II Project USFWS Consultation
Date:	Thursday, July 5, 2018 3:39:45 PM
Attachments:	PIP-II USFWS Consultation Memo 07052018.docx PIP II-LBNF Maps.zip

Mr. Lah,

On behalf of Fermi National Accelerator Laboratory (Fermilab), Ms. Allison Chapin, Arcadis Project Ecologist, contacted you via telephone on May 1, 2018 to discuss the proposed Proton Improvement Plan (PIP-II) Project at Fermilab. Based on the information you requested during this telephone conversation, we are providing the following information to assist with USFWS consultation for the Rusty-patched bumble bee (*Bombus affinis*):

PIP-II Project:

- Total acreage of project site = 27.7 acres
- Acreage temporarily affected during construction = 27.7 acres
- Acreage displaced long-term by the footprint of the aboveground project facilities = 4.4 acres
- Acreage of suitable prairie habitat within the project sites and Fermilab property that will not be impacted by the PIP-II Project = 981.3 acres
- Acreage to be reseeded (restoration) with the IDOT-approved seed mix = 23.3 acres
- The attached zip file contains a map of the PIP-II Project site as well as a map of the high potential zones for the Rusty-patched bumble bee at Fermilab

Additionally, Fermilab has a separate project, the Long Baseline Neutrino Facility and Deep Underground Neutrino Experiment (LBNF/DUNE) Project. For the LBNF/DUNE Project, an Environmental Assessment (EA) was completed in 2015; however, at that time the Rusty-patched bumble bee was not assessed because it was not yet a federal- or state-listed species. To facilitate USFWS' review of cumulative impacts for both projects, Fermilab is also providing the following information for the LBNF portion of that project:

LBNF/DUNE Project:

- Total acreage of project site (LBNF portion) = 140 acres
- Acreage temporarily affected during construction = 80 acres
- Acreage displaced long-term by the footprint of the aboveground project facilities = 5.3 acres
- Acreage of suitable prairie habitat within the project sites and Fermilab property that will not be impacted by the LBNF Project = 980.4 acres
- Acreage to be reseeded (restoration) with the IDOT-approved seed mix = 55 acres
- The attached zip file contains a map of the LBNF Construction & Stockpile Areas, a map of the LBNF Developed & Restored Areas, a map with the location of an Osprey nest within the LBNF footprint, and a map of the high potential zones for the Rusty-patched bumble bee at Fermilab

Based on your conversation with Ms. Chapin, we understand that you planned to forward the acreage details to Shawn Cirton (copied on this email). After Mr. Cirton's review of the project information, please advise DOE and Fermilab on next steps and whether we could add an effects analysis for the Rusty-patched bumble bee to the PIP-II EA that we are currently preparing.

Additionally, we reviewed USFWS' Information for Planning and Consulting (IPaC) database to identify species potentially present within the PIP-II Project site. We prepared the attached memo to provide additional information for each of the species with the potential to occur within the PIP-II Project site.

To avoid or minimize potential impacts birds, bats and bumble bees during construction, Fermilab would schedule removal of vegetation outside the typical nesting, foraging and roosting season for the birds, bats and bumble bee. Based on the information in the attached memo and with implementation of Fermilab's standard environmental protection measures, we conclude that the PIP-II Project is not likely to adversely affect the Eastern prairie fringed orchid, Leafy prairie clover, Mead's milkweed, Prairie bush clover, Northern long-eared bat, Eastern massasauga, Hine's emerald dragonfly, or the Rusty-patched bumble bee. We request concurrence from USFWS that the proposed Project is not likely to adversely affect the species with the potential to occur within the PIP-II Project site.

Please let us know if you need additional information or have questions.

Thanks,

Rick Hersemann
NEPA Compliance Officer
U.S. Department of Energy
Fermi Site Office
P.O. Box 2000
Batavia, IL 60510
Phone: (630) 840-4122
rick.hersemann@science.doe.gov

From:	Hersemann, Rick
To:	Hayes, Bradley
Cc:	Teri L Dykhuis (dykhuis@fnal.gov); Scott, John; Cloutier, Kathryn; Chapin, Allison; Bihary, Adam
Subject:	RE: Questions on EcoCAT 1809073
Date:	Thursday, March 29, 2018 8:53:07 AM
Attachments:	PIP-II Figures.docx

Mr. Hayes:

I have attached a couple figures that show the footprint of the proposed PIP-II project. The PIP-II footprint is mainly located on restored prairie that was formerly agricultural land. There will be ground disturbance for construction of the buildings, roads, utilities, and beam lines as shown on the figures. Most of the footprint is on restored prairie but there could be a few dead ash trees removed on the southwest part of the footprint. Let me know if you have further questions.

Thanks

Rick Hersemann
NEPA Compliance Officer
U.S. Department of Energy
Fermi Site Office
P.O. Box 2000
Batavia, IL 60510
Phone: (630) 840-4122
Fax: (630) 840-3285
rick.hersemann@science.doe.gov

From: Hayes, Bradley [mailto:Bradley.Hayes@illinois.gov]
Sent: Friday, March 23, 2018 10:58 AM
To: Hersemann, Rick <Rick.Hersemann@science.doe.gov>
Subject: Questions on EcoCAT 1809073

Mr. Hersemann,

I have begun the review of the EcoCAT you submitted (1809073 FERMI PIP-II) and I have a few questions. Will this project require tree removal or ground disturbance? If so are there any plans showing the extent or ground disturbance or was a tree survey done indicating the species and size of trees removed?
Thanks,
Brad

Brad Hayes
Resource Planner
Impact Assessment Section
Illinois Department of Natural Resources
One Natural Resources Way

Springfield, IL 62702
Email: Bradley.Hayes@illinois.gov
Phone: (217) 782-0031

Department of Energy
Fermi Site Office
Post Office Box 2000
Batavia, Illinois 60510

September 13, 2017

Mr. Alec Messina
Director
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Dear Mr. Messina:

SUBJECT: NOTIFICATION TO PREPARE AN ENVIRONMENTAL ASSESSMENT FOR THE PROTON IMPROVEMENT PLAN II (PIP-II) PROJECT AT FERMI NATIONAL ACCELERATOR LABORATORY, BATAVIA, ILLINOIS

This letter is to inform you that the Department of Energy (DOE) Fermi Site Office (FSO) intends to commence the National Environmental Policy Act (NEPA) process and prepare an Environmental Assessment (EA) on the proposed Proton Improvement Plan II (PIP-II) project at the Fermi National Accelerator Laboratory (Fermilab), in Batavia, Illinois. The PIP-II project would encompass a number of improvements and additions to the Fermilab accelerator complex with the goal of providing proton beam power capability of 1.4 megawatts (MW).

The PIP-II project is necessary to implement the vision articulated in the May 2014 report from the Particle Physics Projects Prioritization Panel (P5) and in the Mission Need Statement issued for PIP-II by the DOE Office of Science, both of which highlight the opportunity for the U.S. to host a world-leading long baseline neutrino program of intensity frontier research. The PIP-II project would deliver beam to the Long Baseline Neutrino Facility (LBNF) at Fermilab. The project would also support the long-term development of a broad multi-MW program at Fermilab as future resources become available.

We intend to send you a draft EA for your comment prior to DOE approval and prior to making any decision based upon it (i.e., issuing a "Finding of No Significant Impact" or deciding to prepare an environmental impact statement). Our current project schedule suggests that this will occur in middle to late 2018.

Should you have any questions about the NEPA process, please feel free to contact our NEPA Compliance Officer, Rick Hersemann, at (630) 840-4122 or via email at

rick.hersemann@science.doe.gov. If you have any questions about the PIP-II project itself you should contact our Federal Project Director, Adam Bihary, at (630) 840-2130 or via email at adam.bihary@science.doe.gov.

Sincerely,

Michael J. Weis
Site Manager

cc: N. Lockyer, Fermilab
J. Lykken, Fermilab
T. Meyer, Fermilab
M. Michels, Fermilab
T. Dykhuis, Fermilab
S. Holmes, Fermilab
P. Derwent, Fermilab

Department of Energy
Fermi Site Office
Post Office Box 2000
Batavia, Illinois 60510

September 13, 2017

Mr. Joseph Klinger
Assistant Director
Illinois Emergency Management Agency
2200 South Dirksen Parkway
Springfield, IL 62703

Dear Mr. Klinger:

SUBJECT: NOTIFICATION TO PREPARE AN ENVIRONMENTAL ASSESSMENT FOR THE PROTON IMPROVEMENT PLAN II (PIP-II) PROJECT AT FERMI NATIONAL ACCELERATOR LABORATORY, BATAVIA, ILLINOIS

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Sincerely,

Michael J. Weis
Site Manager

cc: N. Lockyer, Fermilab
J. Lykken, Fermilab
T. Meyer, Fermilab
M. Michels, Fermilab
T. Dykhuis, Fermilab
S. Holmes, Fermilab
P. Derwent, Fermilab

Department of Energy
Fermi Site Office
Post Office Box 2000
Batavia, Illinois 60510

September 13, 2017

Mr. Wayne Rosenthal
Director
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL 62702-1271

Dear Mr. Rosenthal:

SUBJECT: NOTIFICATION TO PREPARE AN ENVIRONMENTAL ASSESSMENT FOR THE PROTON IMPROVEMENT PLAN II (PIP-II) PROJECT AT FERMI NATIONAL ACCELERATOR LABORATORY, BATAVIA, ILLINOIS

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Sincerely,

Michael J. Weis
Site Manager

cc: N. Lockyer, Fermilab
J. Lykken, Fermilab
T. Meyer, Fermilab
M. Michels, Fermilab
T. Dykhuis, Fermilab
S. Holmes, Fermilab
P. Derwent, Fermilab

TELEPHONE LOG

☒ Outgoing Call ☐ Incoming Call

Date: 5/1/18 Project: Fermilab PIP-II EA Project No: CO002306.0001

Arcadis Employee:

Name: Allison Chapin

Office Location: Chicago

Contact:

Name: Andrew Horton Title: Conservation Planning

Organization: U.S. Fish and Wildlife Service Phone: 952-252-0092 x208

Address/Location: Ecological Services Field Office
4101 American Boulevard East
Bloomington, MN 55425

RE: Rusty-patched bumblebee surveys at Fermilab

Items Discussed:

Allison Chapin discussed the Fermilab project with Andrew Horton, the results of the threatened and endangered species search for the site and the potential for the rusty-patched bumblebee to be present onsite. Allison was directed to the Twin Cities office by Ryan Campbell, as the lead office addressing the newly listed Rusty-patched bumblebee.
Allison mentioned that the rusty-patched bumblebee has been observed onsite, but not within the project area and asked Andrew if specific surveys should be completed in the project area to determine presence/absence. Andrew did not think that was necessary at this time. He indicated that proving absence would be difficult knowing that the have been observed onsite in the past. Andrew recommended that Allison contact the local Chicago office to begin consultation on this species.

Action to be taken:

- Allison was directed to call Kristopher Lay, Chicago USFWS.

From:	Hersemann, Rick
To:	Cloutier, Kathryn
Cc:	Teri L Dykhuis (dykhuis@fnal.gov); Eric Korzeniowski
Subject:	FW: IDNR Fermilab PIP-II Project USFWS Consultation
Date:	Wednesday, August 22, 2018 2:07:03 PM

Resending

From: Hersemann, Rick
Sent: Thursday, August 02, 2018 11:27 AM
To: Teri L Dykhuis (dykhuis@fnal.gov) <dykhuis@fnal.gov>; Ryan E. Campbell (ryancamp@fnal.gov) <ryancamp@fnal.gov>; 'Martha E. Michels' (martha@fnal.gov) <martha@fnal.gov>; Bridget K Iverson <iverson@fnal.gov>; Eric Korzeniowski <etkorzen@fnal.gov>; 'Katie Swanson' <kswanson@fnal.gov>; Kate Sienkiewicz (kateps@fnal.gov) <kateps@fnal.gov>; 'hamernik@fnal.gov' <hamernik@fnal.gov>; Bihary, Adam <Adam.Bihary@Science.doe.gov>; McKown, Michelle <Michelle.McKown@science.doe.gov>; Scott, John <John.Scott@Science.doe.gov>; Bollinger, Mark <Mark.Bollinger@science.doe.gov>; Weis, Michael <Michael.Weis@science.doe.gov>; 'Cloutier, Kathryn' <Kathryn.Cloutier@arcadis.com>; Chapin, Allison <Allison.Chapin@arcadis.com>; 'Lia Merminga' <merminga@fnal.gov>
Subject: IDNR Fermilab PIP-II Project USFWS Consultation

Illinois Department of Natural Resources (IDNR) concerns for the Rusty-patched bumble bee and the Osprey have been sufficiently addressed by the USFWS Consultation letter. Looks like this wraps up our consultations with IDNR and USFWS.

Rick Hersemann
NEPA Compliance Officer
U.S. Department of Energy
Fermi Site Office
P.O. Box 2000
Batavia, IL 60510
Phone: (630) 840-4122
rick.hersemann@science.doe.gov

From: Hayes, Bradley [mailto:Bradley.Hayes@illinois.gov]
Sent: Thursday, August 02, 2018 9:38 AM
To: Hersemann, Rick <Rick.Hersemann@science.doe.gov>
Subject: RE: Fermilab PIP-II Project USFWS Consultation

Rick,
That addresses my concerns sufficiently. I will make a note this information in our record.
Thanks,
Brad

From: Hersemann, Rick [mailto:Rick.Hersemann@science.doe.gov]

Sent: Thursday, August 2, 2018 8:43 AM
To: Hayes, Bradley <Bradley.Hayes@illinois.gov>
Cc: Teri L Dykhuis (dykhuis@fnal.gov) <dykhuis@fnal.gov>; Ryan E. Campbell (ryancamp@fnal.gov) <ryancamp@fnal.gov>; Michels, Martha (FNAL) <martha@fnal.gov>; Bridget K Iverson <iverson@fnal.gov>; Eric Korzeniowski <etkorzen@fnal.gov>; 'Katie Swanson' <kswanson@fnal.gov>; Kate Sienkiewicz (kateps@fnal.gov) <kateps@fnal.gov>; hamernik@fnal.gov; Bihary, Adam <Adam.Bihary@Science.doe.gov>; McKown, Michelle <Michelle.McKown@science.doe.gov>; Scott, John <John.Scott@Science.doe.gov>; Bollinger, Mark <Mark.Bollinger@science.doe.gov>; Weis, Michael <Michael.Weis@science.doe.gov>; Cloutier, Kathryn <Kathryn.Cloutier@arcadis.com>; Chapin, Allison <Allison.Chapin@arcadis.com>; Lia Merminga <merminga@fnal.gov>
Subject: [External] Fermilab PIP-II Project USFWS Consultation

Mr. Hayes,

As a follow-up to your 3/29/2018 letter and my 7/5/2018 email I am forwarding the attached USFWS Consultation for the PIP-II Project at Fermilab. Hopefully the USFWS letter addresses your concerns regarding the potential for the Rusty-patched bumble bee to be present in the PIP-II Project area. Also, I have attached an updated map showing the Osprey nests located at Fermilab in relationship to the PIP-II Project area. Fermilab will utilize best management practices to minimize any potential impacts to these species. Let me know if you have any questions or need additional information.

Thanks

Rick Hersemann
NEPA Compliance Officer
U.S. Department of Energy
Fermi Site Office
P.O. Box 2000
Batavia, IL 60510
Phone: (630) 840-4122
rick.hersemann@science.doe.gov

From: Pollack, Cathy [mailto:cathy_pollack@fws.gov]
Sent: Wednesday, August 01, 2018 1:17 PM
To: Hersemann, Rick <Rick.Hersemann@science.doe.gov>
Subject: Re: [EXTERNAL] PIP-II Project USFWS Consultation

Hi Rick,

Our (FWS) response is attached. Let me know if you have any questions.

I've also attached the Streamlined Consultation Form for Federal Agencies regarding the northern long eared bat (which I mention in our response letter). Let me know if you have any questions in filling this out. If not, fill it out, sign it, keep it with your project files, and then send me a copy.

Cathy

Cathy Pollack
U.S. Fish & Wildlife Service
Chicago Ecological Services Office
230 South Dearborn Street, Suite 2938
Chicago, IL 60604
847-608-3101

On Thu, Jul 5, 2018 at 4:37 PM, Hersemann, Rick <Rick.Hersemann@science.doe.gov> wrote:

> Mr. Lah,
>
> On behalf of Fermi National Accelerator Laboratory (Fermilab), Ms. Allison Chapin, Arcadis Project Ecologist, contacted you via telephone on May 1, 2018 to discuss the proposed Proton Improvement Plan (PIP-II) Project at Fermilab. Based on the information you requested during this telephone conversation, we are providing the following information to assist with USFWS consultation for the Rusty-patched bumble bee (*Bombus affinis*):
>
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>
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> LBNF/DUNE Project:
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Based on your conversation with Ms. Chapin, we understand that you planned to forward the acreage details to Shawn Cirton (copied on this email). After Mr. Cirton's review of the project information, please advise DOE and Fermilab on next steps and whether we could add an effects analysis for the Rusty-patched bumble bee to the PIP-II EA that we are currently preparing.

Additionally, we reviewed USFWS' Information for Planning and Consulting (IPaC) database to identify species potentially present within the PIP-II Project site. We prepared the attached memo to provide additional information for each of the species with the potential to occur within the PIP-II Project site.

To avoid or minimize potential impacts birds, bats and bumble bees during construction, Fermilab would schedule removal of vegetation outside the typical nesting, foraging and roosting season for the birds, bats and bumble bee. Based on the information in the attached memo and with implementation of Fermilab's standard environmental protection measures, we conclude that the PIP-II Project is not likely to adversely affect the Eastern prairie fringed orchid, Leafy prairie clover, Mead's milkweed, Prairie bush clover, Northern long-eared bat, Eastern massasauga, Hine's emerald dragonfly, or the Rusty-patched bumble bee. We request concurrence from USFWS that the proposed Project is not likely to adversely affect the species with the potential to occur within the PIP-II Project site.

Please let us know if you need additional information or have questions.

Thanks,

Rick Hersemann
NEPA Compliance Officer
U.S. Department of Energy
Fermi Site Office
P.O. Box 2000
Batavia, IL 60510
Phone: (630) 840-4122
rick.hersemann@science.doe.gov

From: Teri L Dykhuis
To: Cloutier, Kathryn; Chapin, Allison
Subject: FW: Questions on EcoCAT 1809073
Date: Tuesday, March 27, 2018 9:18:34 AM

Please find below the response received from the IDNR.

Teri

From: Hayes, Bradley [mailto:Bradley.Hayes@illinois.gov]
Sent: Friday, March 23, 2018 10:58 AM
To: Hersemann, Rick <Rick.Hersemann@science.doe.gov>
Subject: Questions on EcoCAT 1809073

Mr. Hersemann,

I have begun the review of the EcoCAT you submitted (1809073 FERMI PIP-II) and I have a few questions. Will this project require tree removal or ground disturbance? If so are there any plans showing the extent or ground disturbance or was a tree survey done indicating the species and size of trees removed?
Thanks,
Brad

Brad Hayes
Resource Planner
Impact Assessment Section
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL 62702
Email: Bradley.Hayes@illinois.gov
Phone: (217) 782-0031

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

Illinois Department of
Natural Resources

One Natural Resources Way Springfield, Illinois 62702-1271
www.dnr.illinois.gov

Bruce Rauner, Governor
Wayne A. Rosenthal, Director

March 29, 2018

Mr. Rick Hersemann
Fermi Site Office, P.O. Box 2000
Kirk Road and Pine Street
Batavia, IL 60510

RE: Fermilab PIP-II
Endangered Species Consultation Program
EcoCAT Review # 1809113

Dear Mr. Hersemann:

The Department has received your submission for this project for the purposes of consultation pursuant to the *Illinois Endangered Species Protection Act* [520 ILCS 10/11], the *Illinois Natural Areas Preservation Act* [525 ILCS 30/17], and Title 17 *Illinois Administrative Code* Part 1075. Additionally, the Department may offer advice and recommendations for species covered under the *Fish & Aquatic Life Code* [515 ILCS 5, *et seq.*]; the *Illinois Wildlife Code* [520 ILCS 5, *et seq.*]; and the *Herptiles-Herps Act* [510 ILCS 69].

The proposed action consists of an Environmental Assessment for the Proton Improvement Plan (PIP-II) Project at Fermilab, which will include the construction of buildings, roads, utilities, and beam lines.

EcoCAT indicates a record of the **rusty-patched bumble bee (*Bombus affinis*)**, which was federally-listed as endangered on March 21, 2017, in the vicinity of the project area. In accordance with State law, it was automatically placed on the *Illinois Endangered Species List*. Given the bumble bee may be present in this area and that the bees nests underground, there is a chance the project could disturb a nest. Before any disturbance of the site, the Department suggest a field visit be performed by a qualified individual (biologist, entomologist, or others who have been trained accordingly) to look for rusty-patched bumble bee nests sites. This is not the only species of bee in the area, so a positive ID of the rusty-patched bumble bee is needed before coordination with the Department would need to be initiated. **If** the bee is discovered, the Department also recommends consultation with the US Fish & Wildlife Service regarding potential liability which may result from excavation.

The Department recommends the project proponent review the USFWS rusty-patched bumble bee website: https://www.fws.gov/midwest/endangered/insects/rpbb/index.html This site offers life history and bee surveyor/researcher information.

EcoCAT has indicated records for the state-listed **osprey (*Pandion haliaetus*)** in the vicinity of the project. This species nests are a large heap of sticks and driftwood built in forks of trees, utility poles, or artificial platforms. A survey for osprey nests should be conducted before tree removal to avoid potential impacts to breeding birds. If an osprey nests is identified, it should be documented, and results of the survey should be forwarded to the Department for a final determination of impacts.

Given the above recommendations are adopted, the Department has determined that impacts are unlikely. Please notify the Department if the project will be modified to include these recommendations.

Consultation on the part of the Department is closed, unless U.S. Department of Energy/Fermi National Accelerator Laboratory desires additional information or advice related to this proposal. Consultation for Part 1075 is valid for two years unless new information becomes available which was not previously considered; the proposed action is modified; or additional species, essential habitat, or Natural Areas are identified in the vicinity. If the action has not been implemented within two years of the date of this letter, or any of the above listed conditions develop, a new consultation is necessary.

The natural resource review reflects the information existing in the Illinois Natural Heritage Database at the time of the project submittal, and should not be regarded as a final statement on the project being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are unexpectedly encountered during the project's implementation, the applicant must comply with the applicable statutes and regulations.

Please contact me with any questions about this review.

Sincerely,

Bradley Hayes

Bradley Hayes
Resource Planner
Impact Assessment Section
Department of Natural Resources
(217) 787-0031
bradley.hayes@illinois.gov

Applicant: Allison Chapin
Contact: Allison Chapin
Address: 200 S. Michigan Ave
Suite 2000
Chicago, IL 60604

IDNR Project Number: 1808644
Date: 03/09/2018

Project: PIP-II Fermilab
Address: Kirk Road, Batavia

Description: Environmental Assessment for the Proton Improvement Plan (PIP)-II at Fermilab National Accelerator Laboratory.

Natural Resource Review Results

This project was submitted for information only. It is not a consultation under Part 1075.

The Illinois Natural Heritage Database shows the following protected resources may be in the vicinity of the project location:

Fermilab INAI Site
Osprey *(Pandion haliaetus)*
Osprey *(Pandion haliaetus)*
Rusty-Patched Bumble-Bee *(Bombus affinis)*
Upland Sandpiper *(Bartramia longicauda)*

Location

The applicant is responsible for the accuracy of the location submitted for the project.

County: DuPage	*County:* Kane
Township, Range, Section:	*Township, Range, Section:*
39N, 9E, 30	, ,
, ,	39N, 8E, 25

IL Department of Natural Resources Contact
Impact Assessment Section
217-785-5500
Division of Ecosystems & Environment

Disclaimer

The Illinois Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of natural resources in Illinois. This review reflects the information existing in the Database at the time of this inquiry, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, compliance with applicable statutes and regulations is required.

Terms of Use

By using this website, you acknowledge that you have read and agree to these terms. These terms may be revised by IDNR as necessary. If you continue to use the EcoCAT application after we post changes to these terms, it will mean that you accept such changes. If at any time you do not accept the Terms of Use, you may not continue to use the website.

1. The IDNR EcoCAT website was developed so that units of local government, state agencies and the public could request information or begin natural resource consultations on-line for the Illinois Endangered Species Protection Act, Illinois Natural Areas Preservation Act, and Illinois Interagency Wetland Policy Act. EcoCAT uses databases, Geographic Information System mapping, and a set of programmed decision rules to determine if proposed actions are in the vicinity of protected natural resources. By indicating your agreement to the Terms of Use for this application, you warrant that you will not use this web site for any other purpose.

2. Unauthorized attempts to upload, download, or change information on this website are strictly prohibited and may be punishable under the Computer Fraud and Abuse Act of 1986 and/or the National Information Infrastructure Protection Act.

3. IDNR reserves the right to enhance, modify, alter, or suspend the website at any time without notice, or to terminate or restrict access.

Security

EcoCAT operates on a state of Illinois computer system. We may use software to monitor traffic and to identify unauthorized attempts to upload, download, or change information, to cause harm or otherwise to damage this site. Unauthorized attempts to upload, download, or change information on this server is strictly prohibited by law.

Unauthorized use, tampering with or modification of this system, including supporting hardware or software, may subject the violator to criminal and civil penalties. In the event of unauthorized intrusion, all relevant information regarding possible violation of law may be provided to law enforcement officials.

Privacy

EcoCAT generates a public record subject to disclosure under the Freedom of Information Act. Otherwise, IDNR uses the information submitted to EcoCAT solely for internal tracking purposes.

EcoCAT
Ecological Compliance Assessment Tool

Applicant:	U.S. Department of Energy/Fermi National Accelerator Laboratory	*IDNR Project Number:*	1809113
Contact:	Rick Hersemann	*Date:*	03/23/2018
Address:	Fermi Site Office, P.O. Box 2000 Kirk Road and Pine Street Batavia, IL 60510	*Alternate Number:*	1808644

Project: Fermilab PIP-II
Address: Kirk Road and Pine Street, Batavia

Description: Environmental Assessment for the Proton Improvement Plan (PIP-II) at Fermilab National Accelerator Laboratory.

Natural Resource Review Results

Consultation for Endangered Species Protection and Natural Areas Preservation (Part 1075)

The Illinois Natural Heritage Database shows the following protected resources may be in the vicinity of the project location:

Fermilab INAI Site
Osprey *(Pandion haliaetus)*
Osprey *(Pandion haliaetus)*
Rusty-Patched Bumble-Bee *(Bombus affinis)*
Upland Sandpiper *(Bartramia longicauda)*

An IDNR staff member will evaluate this information and contact you to request additional information or to terminate consultation if adverse effects are unlikely.

Location

The applicant is responsible for the accuracy of the location submitted for the project.

County: DuPage	*County:* Kane
Township, Range, Section: 39N, 9E, 30 , ,	*Township, Range, Section:* , , 39N, 8E, 25

IL Department of Natural Resources Contact
Bradley Hayes
217-785-5500
Division of Ecosystems & Environment

Government Jurisdiction
Department of Energy
Rick Hersemann
Fermi Site Office, P.O. Box 2000
Kirk Road and Pine Street
Batavia, Illinois 60510

Disclaimer

The Illinois Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of natural resources in Illinois. This review reflects the information existing in the Database at the time of this inquiry, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, compliance with applicable statutes and regulations is required.

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EcoCAT
Ecological Compliance Assessment Tool

EcoCAT Receipt

Project Code 1809113

APPLICANT	DATE
U.S. Department of Energy/Fermi National Accelerator Laboratory Allison Chapin 2924 W. Berteau Ave. 1 Chicago, IL 60618	3/23/2018

DESCRIPTION	FEE	CONVENIENCE FEE	TOTAL PAID
EcoCAT Consultation	$ 500.00	$ 11.75	$ 511.75

TOTAL PAID $ 511.75

Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL 62702
217-785-5500
dnr.ecocat@illinois.gov

TELEPHONE LOG

☒ Outgoing Call ☐ Incoming Call

Date: 5/1/18 Project: Fermilab PIP-II EA Project No: CO002306.0001

Arcadis Employee:

Name: Allison Chapin

Office Location: Chicago

Contact:

Name: Kristopher Lah Title: Endangered Species Biologist

Organization: U.S. Fish and Wildlife Service Phone: 312-216-4735

Address/Location: Chicago Illinois Field Office
230 South Dearborn St., Suite 2938 Chicago, IL 60604

RE: Rusty-patched bumblebee surveys at Fermilab

Items Discussed:

Allison Chapin discussed the Fermilab project with Kristopher Lay, the results of the threatened and endangered species search for the site and the potential for the Rusty-patched bumblebee to be present onsite. Kristopher was familiar with the Fermilab site and has worked with Ryan Campbell on various initiatives.

Allison mentioned that the Rusty-patched bumblebee has been observed onsite, but not within the project area and asked Kris if specific surveys should be completed in the project area to determine presence/absence. Kris did not think that was necessary at this time. He indicated that proving absence would be difficult knowing that the have been observed onsite in the past. Additionally, he did not recommend nest surveys, he mentioned they are very difficult to find and only 2-3 have been located thus far.

Kris recommended Fermilab assume presence is likely, the project may affect/not likely to adversely affect the rusty-patched bumblebee.

Action to be taken:

Kris requested an email sent to him and Shawn Cirton (Federal activities lead) with the following information:

- Total acreage of project area
- Total acreage of habitat permanently impacted
- Total acreage of habitat temporarily impacted
- How the area will be restored following work

- Total acreage of available habitat on the site that will not be impacted

Kris mentioned that we Fermilab may be able to write an effects analysis into the EA to get ahead of our Sec 7 consultation process. Following receipt of our email with the acreage information, he said he would discuss with Shawn Cirton and get back to us. He anticipated mitigation would only be in the form in “self-mitigating” onsite through the restored prairie habitat and the work Fermilab is currently doing to preserve ecological species.

DEPARTMENT OF THE ARMY

CHICAGO DISTRICT, CORPS OF ENGINEERS
231 SOUTH LASALLE STREET
CHICAGO, ILLINOIS 60604-1437

REPLY TO
ATTENTION OF:

July 20, 2018

Technical Services Division
Regulatory Branch
LRC-2014-00775

SUBJECT: Jurisdictional Determination for the Fermi Lab Property in Batavia, Kane & DuPage Counties, Illinois (Latitude 41.83921, Longitude -88.26705)

Michael Weis
US Department of Energy
PO Box 2000
Batavia, Illinois 60510

Dear Mr. Weis:

This is in response to your request that the U.S. Army Corps of Engineers complete a jurisdictional determination for the above-referenced site submitted on your behalf by WBK Engineering, LLC. The subject project has been assigned number LRC-2014-00775. Please reference this number in all future correspondence concerning this project.

Following a review of the information you submitted, this office has determined that the subject property contains "waters of the United States".

Indian Creek, Kress Creek, Ferry Creek, Giese Tributary, Kress Creek Transfer Ditch, MI Tributary, North Ditch, Pine Tributary, Shull's Hole Tributary, Swan Tributary, West Tributary, Knauz Road Tributary, Dusaf Pond Tributary, Wetst Ditch, The Channel, Unnamed 20, Unnamed Tributary 23, Unnamed 25, Unnmaed 29, Unnamed Tributary 31, Unnamed 32, Unnamed Tributary 33, Unnamed 34,, Unnamed Tributary 45, Unnamed 46, Unnamed 48, Unnamed Tributary 50, Lab 6 Pond, Nepese Pond, Dusaf Pond, A.E. Sea, Sea of Evanescence, Shull's Hole, Shull's Hole Tributary, Farmed Wetlands (AF, AZ, BI, BJ, BK, BO, C & S), Wetland S, MI Wetland North, MI Wetland South, Wetlands (N05, N09, N10, N11 N12, N15, N17, N23, N25, N36, N37, N38, N39. N40, N45, N46, N47, N48, N73, N103, N104 & N109), Pine St Wetland 1, Pine St Wetland 3, Lake Logo, Main Ring Lake, Eola Wetland 1, Eola Wetland 2, Eola Wetland 3 have been determined to be under the jurisdiction of this office and therefore, subject to Federal regulation (75 Total Waters).

Farmed Wetlands (A, AA, AB, AC, AD, AE, AG, AH, AI, AJ, AK, AL, AM, AN, AO, AP, AQ, AR, AS, AT, AU, AV, AW, AX, AY, B, BA, BB, BC, BD, BE, BF, BG, BI, BL, BM, BN, BP, BQ, BR, BS, BT, BU, D, DD, E, F, G, H, I, J, K, L, M, N, O, P, T, U, V, W, X, Y & Z), Wetlands (N01, N02, N06, N07, N13, N14, N18, N20, N21, N51, N52, N54, N55, N56, N57, N58, N59, N60, N61, N62, N63, N64, N65, N66, N67, N68, N69, N70, N71, N72, N74, N77, N78, N79, N80, N81, N82, N83, N90, N91, N93, N96, N97, N98, N99, N100, N101, N102, N105, N106, N107, N108 & N110), PIP2 Wetlands (1, 2, 3, 4 & 5), , Eola Wetland 4, Eola Wetland 5, Eola Wetland 6, Wetland T, Buffalo Drainage Wetland, Pine St. Wetland 2, and MI Pond have been determined to be isolated and therefore not subject to Federal regulation. Please be informed that this office does not concur with the boundaries of waters not under the jurisdiction of this office (129 Total Waters).

Lake Law, Swan Lake, Goldfish Pond, Retention Pond, Andy's Pond, Casey's Pond, Bulrush Pond, Buffalo Drainage Pond, Kidney Pond, Booster Pond, Center Reflecting Pond, East Reflecting Pond, Andy's Pond Bypass Ditch, Casey's Pond Bypass Ditch, Casey's Pond East Ditch, Meson Ditch, West Meson Ditch, East Meson Ditch, Proton Ditch, Babbling Brook, Eola Ditch 1, Eola Ditch 2, Ponds (A, B, C, D, E, F, G & H), Ponds (1, 2, 3, 4, 5, 6, 7, 8(a), 8(b), 9(a), 9(b), 10, 11, 12(a), 12(b), 12(c), 12(d), 13, 14(a), 14(b), 14(c), 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26(a), 26(b) & 27), Wetlands (N03, N04, N08, N16, N19, N22, N24, N28, N29, N42, N43, N44, N49, N75, N76, N84, N85, N86, N87, N88, N89, N94 & N95), Unnamed (2, 3, 4, 6, 7, 11, 12, 14, 15, 17, 18, 19, 22, 26, 31, 33, 37, 41, 42, 43, 44 and 51) and Unnamed Tributary 24 are water features Exempt from Federal regulation. Please be informed that this office does not concur with the boundaries of waters not subject to Federal regulation (111 Total Waters).

Although this determination provides a notification of the presence of waters of the U.S., this determination does not finalize the wetland boundary. In the event an application is submitted for work within jurisdictional areas, wetland delineation will need to be prepared and submitted to this office.

For a detailed description of our determination please refer to the enclosed decision document. This determination covers only your project as depicted in the Wetland Delineation Exhibit EX JD dated 07/05/2018, prepared by WBK Engineering, LLC.

This determination is valid for a period of five (5) years from the date of the letter, unless new information warrants revision of the determination before the expiration date or a District Commander has identified, after public notice and comment, that specific geographic areas with rapidly changing environmental conditions merit re-verification on a more frequent basis.

This letter is considered an approved jurisdictional determination for your subject site. If you object to this determination, you may appeal, according to 33 CFR Part 331. Enclosed you will find a Notification of Appeal Process (NAP) fact sheet and a Request for Appeal (RFA) form. If you request to appeal the above determination, you must submit a completed RFA form to the Great Lakes/Ohio River Division Office at the following address:

Jacob Siegrist
Regulatory Appeals Review Officer
US Army Corps of Engineers
Great Lakes and Ohio River Division
550 Main Street, Room 10524
Cincinnati, Ohio 45202-3222
Phone: (513) 684-2699 Fax: (513) 684-2460

In order to be accepted, your RFA must be complete, meet the criteria for appeal and be received by the Division Office within sixty (60) days of the date of the NAP. If you concur with the determination in this letter, submittal of the RFA form to the Division office is not necessary.

This determination has been conducted to identify the limits of the Corps Clean Water Act jurisdiction for the particular site identified in this request. This determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985, as amended. If you or your tenant are USDA program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service prior to starting work.

It is your responsibility to obtain any required state, county, or local approvals for impacts to wetland areas not under the Department of the Army jurisdiction. In Kane County, please note that isolated non-waters of the United States not under the jurisdiction of the U.S. Army Corps of Commanders are regulated by the Kane County Stormwater Ordinance. For projects in incorporated areas of Kane County, contact the certified community for information related to the ordinance. For projects in unincorporated areas of Kane County, contact the Kane County Department of Environmental Management at (630) 208-3179. For projects located in DuPage County, please contact the DuPage County Department of Environmental Concerns at (630) 682-6724.

Pursuant to Section 404 of the Clean Water Act, the U.S. Army Corps of Engineers regulates the discharge of dredged or fill material into waters of the United States, including wetlands. A Department of the Army permit is required for any proposed work involving the discharge of dredged or fill material within the jurisdiction of this office. To initiate the permit process, please submit a joint permit application form along with detailed plans of the proposed work. Information concerning our program, including the application form and an application checklist, can be found at and downloaded from our website:
http://www.lrc.usace.army.mil/Missions/Regulatory.aspx

If you have any questions, please contact Mr. Michael J. Machalek of my staff by telephone at (312) 846-5534 or email at Mike.J.Machalek@usace.army.mil.

Sincerely,

MCLAURIN.DIEDRA.L.1230340362

Digitally signed by MCLAURIN.DIEDRA.L.1230340362
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=MCLAURIN.DIEDRA.L.1230340362
Date: 2018.07.20 17:24:45 -05'00'

Diedra L. McLaurin
Team Leader, West Section
Regulatory Branch

Enclosures

Copy Furnished w/out Enclosures

U.S. Environmental Protection Agency (Wendy Melgin)
DuPage County Stormwater Management (Jenna Fahey)
Kane County Division of Environmental Management (Jodie Wolnik)
WBK Engineering, LLC (Natalie Paver)

NOTIFICATION OF ADMINISTRATIVE APPEAL OPTIONS AND PROCESS AND REQUEST FOR APPEAL

Applicant: Michael Weis, US Department of Energy	File Number: LRC-2014-00775	Date: July 20, 2018

	Attached is:	See Section below
	INITIAL PROFFERED PERMIT (Standard Permit or Letter of Permission)	A
	PROFFERED PERMIT (Standard Permit or Letter of Permission)	B
	PERMIT DENIAL	C
X	APPROVED JURISDICTIONAL DETERMINATION	D
	PRELIMINARY JURISDICTIONAL DETERMINATION	E

SECTION I - The following identifies your rights and options regarding an administrative appeal of the above decision. Additional information may be found at http://www.usace.army.mil/CECW/Pages/reg_materials.aspx or Corps regulations at 33 CFR Part 331.

A. INITIAL PROFFERED PERMIT: You may accept or object to the permit.

- ACCEPT: If you received a Standard Permit or a Letter of Permission (LOP), you may sign the permit document and return it to the district commander for final authorization. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- OBJECT: If you object to the permit (Standard or LOP) because of certain terms and conditions therein, you may request that the permit be modified accordingly. You must complete Section II of this form and return the form to the district commander. Your objections must be received by the district commander within 60 days of the date of this notice, or you will forfeit your right to appeal the permit in the future. Upon receipt of your letter, the district commander will evaluate your objections and may: (a) modify the permit to address all of your concerns, (b) modify the permit to address some of your objections, or (c) not modify the permit having determined that the permit should be issued as previously written. After evaluating your objections, the district commander will send you a proffered permit for your reconsideration, as indicated in Section B below.

B. PROFFERED PERMIT: You may accept or appeal the permit

- ACCEPT: If you received a Standard Permit or a Letter of Permission (LOP), you may sign the permit document and return it to the district commander for final authorization. Your signature on the Standard Permit or acceptance of the LOP means that you accept the permit in its entirety, and waive all rights to appeal the permit, including its terms and conditions, and approved jurisdictional determinations associated with the permit.
- APPEAL: If you choose to decline the proffered permit (Standard or LOP) because of certain terms and conditions therein, you may appeal the declined permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division commander. This form must be received by the division commander within 60 days of the date of this notice.

C. PERMIT DENIAL: You may appeal the denial of a permit under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division commander. This form must be received by the division commander within 60 days of the date of this notice.

D. APPROVED JURISDICTIONAL DETERMINATION: You may accept or appeal the approved JD or provide new information.

- ACCEPT: You do not need to notify the Corps to accept an approved JD. Failure to notify the Corps within 60 days of the date of this notice, means that you accept the approved JD in its entirety, and waive all rights to appeal the approved JD.
- APPEAL: If you disagree with the approved JD, you may appeal the approved JD under the Corps of Engineers Administrative Appeal Process by completing Section II of this form and sending the form to the division commander. This form must be received by the division commander within 60 days of the date of this notice.

E. PRELIMINARY JURISDICTIONAL DETERMINATION: You do not need to respond to the Corps regarding the preliminary JD. The Preliminary JD is not appealable. If you wish, you may request an approved JD (which may be appealed), by contacting the Corps district for further instruction. Also you may provide new information for further consideration by the Corps to reevaluate the JD.

SECTION II - REQUEST FOR APPEAL or OBJECTIONS TO AN INITIAL PROFFERED PERMIT

REASONS FOR APPEAL OR OBJECTIONS: (Describe your reasons for appealing the decision or your objections to an initial proffered permit in clear concise statements. You may attach additional information to this form to clarify where your reasons or objections are addressed in the administrative record.)

ADDITIONAL INFORMATION: The appeal is limited to a review of the administrative record, the Corps memorandum for the record of the appeal conference or meeting, and any supplemental information that the review officer has determined is needed to clarify the administrative record. Neither the appellant nor the Corps may add new information or analyses to the record. However, you may provide additional information to clarify the location of information that is already in the administrative record.

POINT OF CONTACT FOR QUESTIONS OR INFORMATION:

If you have questions regarding this decision and/or the appeal process you may contact:

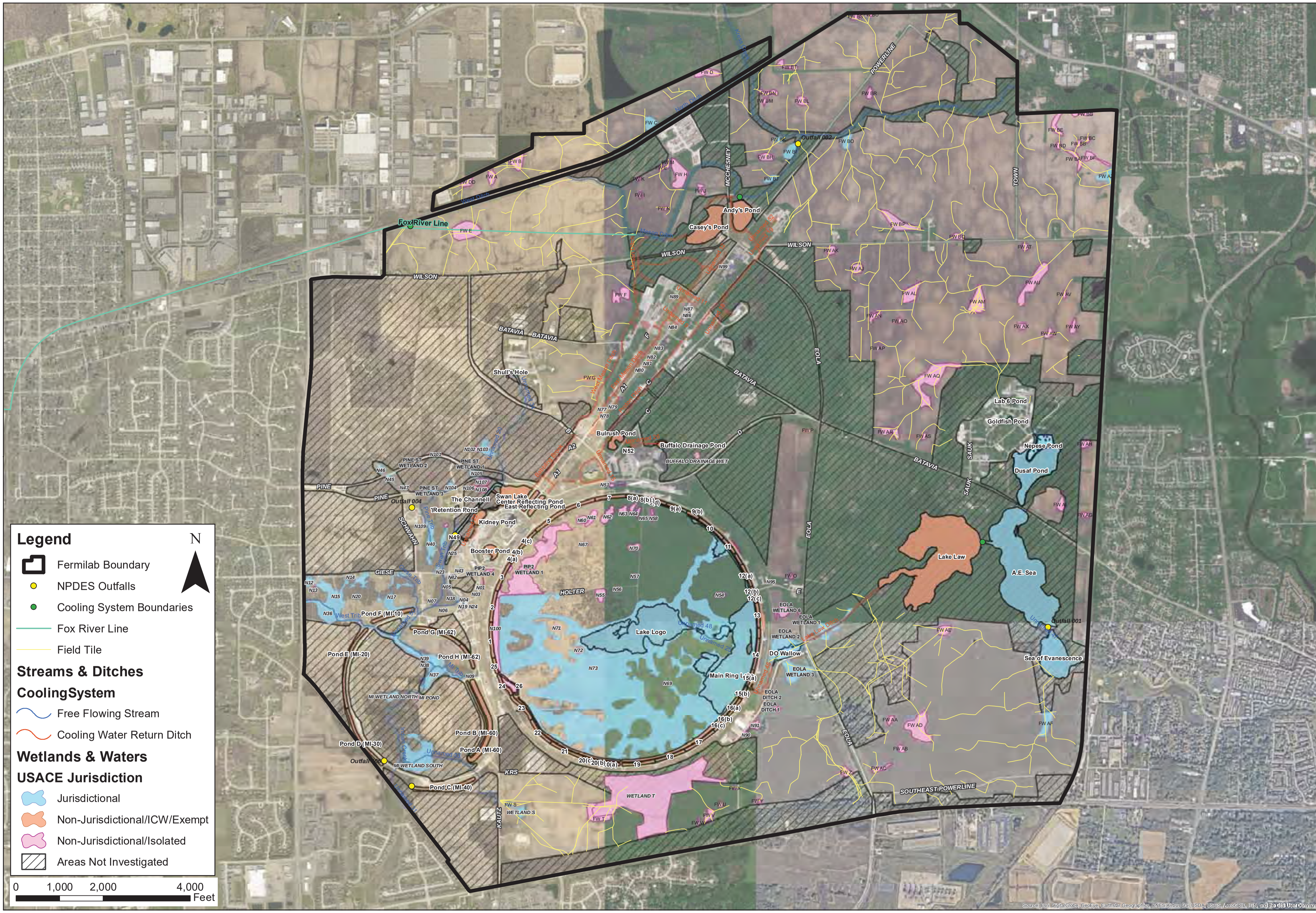
Regulatory Branch
Chicago District Corps of Engineers
231 South LaSalle Street, Suite 1500
Chicago, IL 60604-1437
Phone: (312) 846-5530
Fax: (312) 353-4110

If you only have questions regarding the appeal process you may also contact:

Jacob Siegrist
Regulatory Appeals Review Officer
US Army Corps of Engineers
Great Lakes and Ohio River Division
550 Main Street, Room 10524
Cincinnati, Ohio 45202-3222
Phone: (513) 684-2699 Fax: (513) 684-2460

RIGHT OF ENTRY: Your signature below grants the right of entry to Corps of Commanders personnel, and any government consultants, to conduct investigations of the project site during the course of the appeal process. You will be provided a 15-day notice of any site investigation, and will have the opportunity to participate in all site investigations.

Signature of appellant or agent.	Date:	Telephone number:



TITLE: FERMILAB SWAMP

JURISDICTIONAL DETERMINATION
WETLANDS & WATERS

DSGN.	NMP
DWN.	EAM
CHKD.	NMP
SCALE:	1" = 1,000'
	EX-JD150215_02.mxd

NO.	DATE	NATURE OF REVISION

CLIENT:
FERMI NATIONAL
ACCELERATOR LABORATORY
KIRK AND PINE STREET
P.O. BOX 500
BATAVIA, IL 60510

WBK ENGINEERING, LLC
116 WEST MAIN STREET, SUITE 201
ST. CHARLES, ILLINOIS 60174
(630) 443-7755

PROJECT NO. 150215
DATE 07/05/2018
SHEET 1 OF 1

EX JD

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): July 2, 2018

B. DISTRICT OFFICE, FILE NAME, AND NUMBER: Chicago District, Fermi-Lab, LRC-2014-775

C. PROJECT LOCATION AND BACKGROUND INFORMATION: North of Rt. 56, East of Kirk Road
State: Illinois County/parish/borough: **DuPage** City: Batavia
Center coordinates of site (lat/long in degree decimal format): Lat. 41.83921°N, Long. -88.26705° W.
Universal Transverse Mercator: Zone 16
Name of nearest waterbody: Indian Creek, Kress Creek & Ferry Creek
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: **Fox River**
Name of watershed or Hydrologic Unit Code (HUC): **Upper Fox (07120006)**
☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):
☒ Office (Desk) Determination. Date: May 7, 2018
☒ Field Determination. Date(s): May 12, 2017, June 9, 2017, August 21, 2017

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are no** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

2. Non-regulated waters/wetlands (check if applicable):[1]
☒ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: **Farmed Wetlanda A, AA, AB, AC, AD, AE, AG, AH, AI, AJ, AK, AL, AM, AN, AO, AP, AQ, AR, AS, AT, AU, AV, AW, AX, AY, B, BA, BB, BC, BD, BE, BF, BG, BH, BL, BM, BN, BP, BQ, BR, BS, BT, BU, D, DD, E, F, G, H, I, J, K, L, M, N, O, P, T, U, V, W, X, Y & Z (64 wetlands totalling 90.77 acres), are all shallow isolated farmed wetland depressions with no outlet or connection to any flowing water of the U.S. Wetland T (47.21 acres), is a large isolated emergent wetland surrounded by farming, and ponds and evaporates, and has no outlet or connection to any flowing water of the U.S. Eola Wetlands 4, 5 & 6 (1.58 acres) are all localized isolated wetland poekets surrounded by farming, and have no outlet or connection to any flowing water of the U.S. The M.I. Pond (0.16 acre) was excavated out of hydric soil as an overflow/storage pond, but is not connected to the creek. Wetlands N51, N52, N74, N77, N78, N79, N80, N81, N82, N83 (9 wetlands totalling 2.15 acres) are connected to the closed circular cooling pond and ditch system associated with Casey's Pond, and therefore isolated. Wetlands N01, N02, N06, N07, N13, N14, N18, N20, N21, N52, N54, N55, N56, N57, N58, N59, N60, N61, N62, N63, N64, N65, N66, N67, N68, N69, N70, N71, N72, N90, N91, N93, N96, N97, N98, N99, N100, N101, N102, N105, N106, N107, N108 and N110 (43 wetlands totalling 16.78 acres) are all depressional isolated wetland pockets with no outlet or connection to any flowing water of the U.S. Pine St Wetland 2 (0.01 acre) formed near a culvert under a road that does not connect to anything, so is isolated. The Buffalo Drainage Wetland (0.49 acre) is a depressional wetland pocket that dries up in the summer in the middle of buffalo pasture, and has no outlet or connection to any flowing water of the U.S. PIP2 Wetlands 1, 2, 3, 4 & 5 (13.87 acres)are all isolated depressional wetlands with no outlet or connection to any flowing water of the U.S. [140 wetlands totalling 173.04 acres)**.

SECTION III: CWA ANALYSIS

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[2]
☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.

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[1] Supporting documentation is presented in Section III.F.
[2] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.***

☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: **.**
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):

- ☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
- ☒ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
  - ☒ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
- ☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: **.**
- ☐ Other: (explain, if not covered above): **.**

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):

- ☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
- ☐ Lakes/ponds: acres.
- ☐ Other non-wetland waters: acres. List type of aquatic resource: .
- ☒ Wetlands: 180.69 acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):

- ☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
- ☐ Lakes/ponds: acres.
- ☐ Other non-wetland waters: acres. List type of aquatic resource: .
- ☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):

- ☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: WBK Engineering Fermi-Lab Wetland Exhibits.
- ☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  - ☐ Office concurs with data sheets/delineation report.
  - ☐ Office does not concur with data sheets/delineation report.
- ☐ Data sheets prepared by the Corps: .
- ☐ Corps navigable waters' study: .
- ☒ U.S. Geological Survey Hydrologic Atlas: Aurora North HA 70, 1963, .
  - ☐ USGS NHD data.
  - ☒ USGS 8 and 12 digit HUC maps.
- ☒ U.S. Geological Survey map(s). Cite scale & quad name: Aurora North 7.5", 1993, Pick List, Pick List, Pick List, .
- ☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Soil Survey of DuPage County, Illinois (1999).
- ☒ National wetlands inventory map(s). Cite name: Aurora North, .
- ☒ State/Local wetland inventory map(s): DuPage County ADID, Pick List, .
- ☒ FEMA/FIRM maps: .
- ☐ 100-year Floodplain Elevation is: (National Geodetic Vertical Datum of 1929)
- ☒ Photographs: ☒ Aerial (Name & Date): .
  or ☐ Other (Name & Date): .
- ☐ Previous determination(s). File no. and date of response letter: .
- ☐ Applicable/supporting case law: .
- ☐ Applicable/supporting scientific literature: .
- ☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: Multiple site visits to walk the farmed wetlands, and then the others.

- ☒ Area(s) are geographically isolated. All these wetlands are closed isolated depressions..
- ☒ Area(s) do not have a hydrologic nexus. .
- ☒ Area(s) do not have an ecological nexus. .
- ☒ Area(s) do not have evidence of a subsurface flow connection to a jurisdictional water. .
- ☒ Area(s) do not have evidence of surface overland sheet flow. .
- ☒ Area(s) are not located within the flood plain. .

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): June 27, 2018

B. DISTRICT OFFICE, FILE NAME, AND NUMBER: Chicago District, FermiLab, LRC-2014-775

C. PROJECT LOCATION AND BACKGROUND INFORMATION: NE of Rt. 56 and Kirk Road
State: Illinois County/parish/borough: **DuPage** City: Batavia
Center coordinates of site (lat/long in degree decimal format): Lat. 41.83921°N, Long. -88.26705° W.
Universal Transverse Mercator: Zone 16
Name of nearest waterbody: Kress Creek
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: **Des Plaines River**
Name of watershed or Hydrologic Unit Code (HUC): **Des Plaines (07120004)**
☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):
☒ Office (Desk) Determination. Date: June 11, 2018
☒ Field Determination. Date(s): May 12, 2017, June 9, 2017 & August 21, 2017

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]
☐ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: Defined in People of State of Ill. ex rel. Scott v. Hoffman, No. P-CIV-76-45, slip op. at 7 (S.D.Ill. Jan. 20, 1979).

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
   ☐ TNWs, including territorial seas
   ☐ Wetlands adjacent to TNWs
   ☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
   ☒ Non-RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
   ☒ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
   ☐ Impoundments of jurisdictional waters
   ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
   Non-wetland waters: 2650 linear feet: 8 width (ft) and/or acres.
   Wetlands: 257.30 acres.

   c. **Limits (boundaries) of jurisdiction** based on: **Not established at this time.**
   Elevation of established OHWM (if known): .

2. **Non-regulated waters/wetlands (check if applicable):**[3]
   ☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: .

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: **Pick List**.

   Summarize rationale supporting determination: As defined in People of State of Ill. ex rel. Scott v. Hoffman, No. P-CIV-76-45, slip op. at 7 (S.D.Ill. Jan. 20, 1979).

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": .

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) General Area Conditions:
   Watershed size: 934048 **acres**
   Drainage area: 836673 **acres**
   Average annual rainfall: 37.97 inches
   Average annual snowfall: 33.5 inches

   (ii) Physical Characteristics:
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☒ Tributary flows through **2** tributaries before entering TNW.

   Project waters are **30 (or more)** river miles from TNW.
   Project waters are **1 (or less)** river miles from RPW.
   Project waters are **20-25** aerial (straight) miles from TNW.
   Project waters are **1 (or less)** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: Kress Creek flow into the West Branch DuPage River, which joins with the DuPage River, which flows into the Des Plaines River.

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[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

Tributary stream order, if known: 1.

(b) General Tributary Characteristics (check all that apply):

Tributary is: ☐ Natural
☒ Artificial (man-made). Explain: Old drain tile excavated into open ditch, then widened and expanded over the years.
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: 8 feet
Average depth: 1 feet
Average side slopes: **3:1** .

Primary tributary substrate composition (check all that apply):

☒ Silts ☐ Sands ☐ Concrete
☐ Cobbles ☐ Gravel ☒ Muck
☐ Bedrock ☐ Vegetation. Type/% cover:
☐ Other. Explain: .

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: Tributary is stable.
Presence of run/riffle/pool complexes. Explain: Absent.
Tributary geometry: **Relatively straight**
Tributary gradient (approximate average slope): 1 %

(c) Flow:
Tributary provides for: **Seasonal flow**
Estimate average number of flow events in review area/year: **20 (or greater)**
Describe flow regime: Tributary flows most of growing season, then little or no flow over winter.
Other information on duration and volume: Flow is based on water usage in main ring of Fermi Lab.

Surface flow is: **Discrete and confined.** Characteristics: Defined bed & bank.

Subsurface flow: **No**. Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☒ Bed and banks
☐ OHWM[6] (check all indicators that apply):
☐ clear, natural line impressed on the bank ☐ the presence of litter and debris
☐ changes in the character of soil ☐ destruction of terrestrial vegetation
☐ shelving ☐ the presence of wrack line
☐ vegetation matted down, bent, or absent ☐ sediment sorting
☐ leaf litter disturbed or washed away ☐ scour
☐ sediment deposition ☐ multiple observed or predicted flow events
☐ water staining ☐ abrupt change in plant community
☐ other (list):
☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by: ☐ Mean High Water Mark indicated by:
☐ oil or scum line along shore objects ☐ survey to available datum;
☐ fine shell or debris deposits (foreshore) ☐ physical markings;
☐ physical markings/characteristics ☐ vegetation lines/changes in vegetation types.
☐ tidal gauges
☐ other (list):

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: Water is slightly cloudy.
Identify specific pollutants, if known: Sedimentation; farm pesticides and fertilizers.

[6]A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7]Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):

☐ Riparian corridor. Characteristics (type, average width): .

☐ Wetland fringe. Characteristics: .

☐ Habitat for:

- ☐ Federally Listed species. Explain findings: .
- ☐ Fish/spawn areas. Explain findings: .
- ☐ Other environmentally-sensitive species. Explain findings: .
- ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:

Properties:

Wetland size: 257.3 acres

Wetland type. Explain: Mix of forested, emergent and open water.

Wetland quality. Explain: Moderate.

Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:

Flow is: **Perennial flow**. Explain: Wetlands and lakes are directly connected to tributary which flows during most of growing season.

Surface flow is**: Overland sheetflow**

Characteristics: Main wetlands and ponds inside of main ring are drained by the tributary to Kress Creek.

Subsurface flow: **No**. Explain findings: .

☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:

☒ Directly abutting

☐ Not directly abutting

- ☐ Discrete wetland hydrologic connection. Explain: .
- ☐ Ecological connection. Explain: .
- ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW

Project wetlands are **30 (or more)** river miles from TNW.

Project waters are **20-25** aerial (straight) miles from TNW.

Flow is from: **Wetland to navigable waters.**

Estimate approximate location of wetland as within the **50 - 100-year** floodplain.

(ii) Chemical Characteristics:

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: Wetlands are a mix of quality, and water is clear.

Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):

☐ Riparian buffer. Characteristics (type, average width): .

☐ Vegetation type/percent cover. Explain: .

☒ Habitat for:

- ☐ Federally Listed species. Explain findings: .
- ☐ Fish/spawn areas. Explain findings: .
- ☐ Other environmentally-sensitive species. Explain findings: .
- ☒ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **6**

Approximately (257.30) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Name/ID	Directly abuts? (Y/N)	Size (in acres)	Name/ID	Directly abuts? (Y/N)	Size (in acres)
Lake Logo	Y	20.54	Main Ring Lake	Y	42.97
N73	Y	181.35	Eola Wetland 1	Y	2.43
Eola Wetland 2	Y	6.33	Eola Wetland 3	Y	3.68

Summarize overall biological, chemical and physical functions being performed: These wetlands are adjacent and contiguous to the tributary to Kress Creek, which has seasonal relative permanent flow, and exhibits a surface water connection to a traditional navigable waterway. This surface water connection demonstrates the ability of the tributary to carry pollutants, flood waters, nutrients and organic carbon to the TNW. The adjacent wetlands have the ability to reduce the amount of pollutants and floodwaters reaching the TNW. The headwater wetland is receiving a percentage of its water from groundwater and from runoff from the surrounding uplands before it flows into Des Plaines River. Wetlands such as these provide stormwater storage, habitat, sediment/toxicant retention and nutrient removal/transformation. .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: The decrease of sedimentation, pollutants, flooding, nutrients and habitat provided by the subject wetland provides a positive effect to the downstream relatively permanent waters and traditional navigable waters. The wetland alone, and in combination with other area wetlands, significantly affect the chemical, physical and biological integrity of the Des Plaines River. Stomwater storage provided by the subject wetlands affect the frequency and extent of downstream flooding, decreasing flood peaks in the Des Plaines River, and in turn impacting navigation and downstream bank erosion and sedimentation. The sediment and pollutant/toxicant retention provided by the subject wetland has a direct positive effect on the Des Plaines River in regards to navigation and aquatic food webs that are not adapted to thrive in sediment-choked environments. These factors contribute to the finding of a significant nexus between the on-site wetland and the TNW.

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☐ TNWs: linear feet width (ft), Or, acres.
   ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .
   ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

   Provide estimates for jurisdictional waters in the review area (check all that apply):
   ☐ Tributary waters: linear feet width (ft).
   ☐ Other non-wetland waters: acres.
   Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
   ☒ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional waters within the review area (check all that apply):
   ☒ Tributary waters: **2650** linear feet **8** width (ft).
   ☐ Other non-wetland waters: acres.
   Identify type(s) of waters: **.**

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
   ☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: **.**

   ☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
   ☒ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional wetlands in the review area: **257.30** acres.

7. **Impoundments of jurisdictional waters.[9]**
   As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
   ☐ Demonstrate that impoundment was created from "waters of the U.S.," or
   ☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
   ☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

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[8]See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

- ☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
- ☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
- ☐ which are or could be used for industrial purposes by industries in interstate commerce.
- ☐ Interstate isolated waters. Explain: .
- ☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

[10] Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.*

Provide estimates for jurisdictional waters in the review area (check all that apply):

- ☐ Tributary waters: linear feet width (ft).
- ☐ Other non-wetland waters: acres.
  - Identify type(s) of waters: .
- ☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):

- ☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
- ☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
  - ☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
- ☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
- ☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):

- ☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
- ☐ Lakes/ponds: acres.
- ☐ Other non-wetland waters: acres. List type of aquatic resource: .
- ☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):

- ☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
- ☐ Lakes/ponds: acres.
- ☐ Other non-wetland waters: acres. List type of aquatic resource: .
- ☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):

- ☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: WBK Engineering GIS Wetland Exhibits.
- ☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  - ☐ Office concurs with data sheets/delineation report.
  - ☐ Office does not concur with data sheets/delineation report.
- ☐ Data sheets prepared by the Corps: .
- ☐ Corps navigable waters' study: .
- ☒ U.S. Geological Survey Hydrologic Atlas: Aurora North HA 70, 1963, .
  - ☐ USGS NHD data.
  - ☒ USGS 8 and 12 digit HUC maps.
- ☒ U.S. Geological Survey map(s). Cite scale & quad name: Aurora North 7.5", 1993, Pick List, Pick List, Pick List, .
- ☒ USDA Natural Resources Conservation Service Soil Survey. Citation: NRCS Web Soil Survey.
- ☒ National wetlands inventory map(s). Cite name: Aurora North, .
- ☒ State/Local wetland inventory map(s): DuPage County ADID, Pick List, .
- ☐ FEMA/FIRM maps: .
- ☐ 100-year Floodplain Elevation is: (National Geodetic Vertical Datum of 1929)
- ☒ Photographs: ☒ Aerial (Name & Date): 1939-2014.
  - or ☐ Other (Name & Date): .
- ☐ Previous determination(s). File no. and date of response letter: .
- ☐ Applicable/supporting case law: People of State of Ill. ex rel. Scott v. Hoffman, No. P-CIV-76-45, (S.D.Ill. Jan. 20, 1979)
- ☐ Applicable/supporting scientific literature: .
- ☒ Other information (please specify): Multiple site visits, as well as conversations with Fermi-Lab staff and USEPA.

B. ADDITIONAL COMMENTS TO SUPPORT JD: Lakes and wetlands fed water to cool system, and drain out to Kress Creek most of the summer, then drawn down in winter with little or no outflow; but mostly connected during growing season, and therefore exhibit a Significant Nexus connection.

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): June 28, 2018

B. DISTRICT OFFICE, FILE NAME, AND NUMBER: Chicago District, Fermi Lab, LRC-2014-775

C. PROJECT LOCATION AND BACKGROUND INFORMATION: NE of Rt. 56 and Kirk Road
State: Illinois County/parish/borough: **Kane** City: Batavia
Center coordinates of site (lat/long in degree decimal format): Lat. 41.83921°N, Long. -88.26705° W.
Universal Transverse Mercator: Zone 16
Name of nearest waterbody: Indian Creek
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: **Fox River**
Name of watershed or Hydrologic Unit Code (HUC): **Upper Fox (07120006)**
☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):
☒ Office (Desk) Determination. Date: June 11, 2018
☒ Field Determination. Date(s): May 12, 2017, June 9, 2017 & August 21, 2017

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]
☐ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: Defined in People of State of Ill. ex rel. Scott v. Hoffman, No. P-CIV-76-45, slip op. at 7 (S.D.Ill. Jan. 20, 1979).

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
   ☐ TNWs, including territorial seas
   ☐ Wetlands adjacent to TNWs
   ☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
   ☒ Non-RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
   ☒ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
   ☐ Impoundments of jurisdictional waters
   ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
   Non-wetland waters: 500 linear feet: 1 width (ft) and/or acres.
   Wetlands: 1.37 acres.

   c. **Limits (boundaries) of jurisdiction** based on: **Not established at this time.**
   Elevation of established OHWM (if known): .

2. **Non-regulated waters/wetlands (check if applicable):**[3]
   ☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: .

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: **Pick List**.

   Summarize rationale supporting determination: As defined in People of State of Ill. ex rel. Scott v. Hoffman, No. P-CIV-76-45, slip op. at 7 (S.D.Ill. Jan. 20, 1979).

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": .

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) General Area Conditions:
   Watershed size: 1008237 **acres**
   Drainage area: 393887 **acres**
   Average annual rainfall: 38.31 inches
   Average annual snowfall: 30.8 inches

   (ii) Physical Characteristics:
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☒ Tributary flows through **1** tributaries before entering TNW.

   Project waters are **5-10** river miles from TNW.
   Project waters are **1 (or less)** river miles from RPW.
   Project waters are **5-10** aerial (straight) miles from TNW.
   Project waters are **1 (or less)** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: Unnamed Tributary flows into Indian Creek, which is a direct tributary of the Fox River.
   Tributary stream order, if known: 2.

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[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):

Tributary is: ☒ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: 1-2 feet
Average depth: 0.5 feet
Average side slopes: **4:1 (or greater).**

Primary tributary substrate composition (check all that apply):
☒ Silts ☐ Sands ☐ Concrete
☐ Cobbles ☐ Gravel ☐ Muck
☐ Bedrock ☐ Vegetation. Type/% cover:
☐ Other. Explain: .

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: Very stable due to low flows.
Presence of run/riffle/pool complexes. Explain: Absent.
Tributary geometry: **Relatively straight**
Tributary gradient (approximate average slope): 1 %

(c) Flow:

Tributary provides for: **Intermittent but not seasonal flow**
Estimate average number of flow events in review area/year: **20 (or greater)**
Describe flow regime: Tributary fed by subsurface drain tile outlet, so flows during and after rain events.
Other information on duration and volume: .

Surface flow is: **Discrete and confined.** Characteristics: Defined flow path to Indian Creek.

Subsurface flow: **No**. Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☒ Bed and banks
☐ OHWM[6] (check all indicators that apply):
☐ clear, natural line impressed on the bank ☐ the presence of litter and debris
☐ changes in the character of soil ☐ destruction of terrestrial vegetation
☐ shelving ☐ the presence of wrack line
☐ vegetation matted down, bent, or absent ☐ sediment sorting
☐ leaf litter disturbed or washed away ☐ scour
☐ sediment deposition ☐ multiple observed or predicted flow events
☐ water staining ☐ abrupt change in plant community
☐ other (list):
☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by: ☐ Mean High Water Mark indicated by:
☐ oil or scum line along shore objects ☐ survey to available datum;
☐ fine shell or debris deposits (foreshore) ☐ physical markings;
☐ physical markings/characteristics ☐ vegetation lines/changes in vegetation types.
☐ tidal gauges
☐ other (list):

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: Water is clear.
Identify specific pollutants, if known: Unknown.

[6]A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7]Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):

☐ Riparian corridor. Characteristics (type, average width): .
☐ Wetland fringe. Characteristics: .
☐ Habitat for:
  ☐ Federally Listed species. Explain findings: .
  ☐ Fish/spawn areas. Explain findings: .
  ☐ Other environmentally-sensitive species. Explain findings: .
  ☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:

(a) General Wetland Characteristics:
Properties:
Wetland size: 1.37 acres
Wetland type. Explain: Emergent.
Wetland quality. Explain: Low-Moderate.
Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:
Flow is: **Intermittent flow**. Explain: Wetlands bisected by unnamed tributary, so contribute flow when it rains.

Surface flow is**: Overland sheetflow**
Characteristics: .

Subsurface flow: **Unknown**. Explain findings: .
☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:
☒ Directly abutting
☐ Not directly abutting
  ☐ Discrete wetland hydrologic connection. Explain: .
  ☐ Ecological connection. Explain: .
  ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW
Project wetlands are **5-10** river miles from TNW.
Project waters are **5-10** aerial (straight) miles from TNW.
Flow is from: **Wetland to navigable waters.**
Estimate approximate location of wetland as within the **50 - 100-year** floodplain.

(ii) Chemical Characteristics:

Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: Water is clear; located in old field area.
Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):

☐ Riparian buffer. Characteristics (type, average width): .
☐ Vegetation type/percent cover. Explain: .
☐ Habitat for:
  ☐ Federally Listed species. Explain findings: .
  ☐ Fish/spawn areas. Explain findings: .
  ☐ Other environmentally-sensitive species. Explain findings: .
  ☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)

All wetland(s) being considered in the cumulative analysis: **3**
Approximately (1.37) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Name/ID	Directly abuts? (Y/N)	Size (in acres)	Name/ID	Directly abuts? (Y/N)	Size (in acres)
N45	Y	0.21	N46	Y	0.65
N47	Y	0.51			

Summarize overall biological, chemical and physical functions being performed: These three wetlands directly abut the tributary to Indian Creek, which has intermittent flow driven mainly by subsurface tile discharge, and exhibits a surface water connection to a traditional navigable waterway. This surface water connection demonstrates the ability of the tributary to carry pollutants, flood waters, nutrients and organic carbon to the TNW. The adjacent wetlands have the ability to reduce the amount of pollutants and floodwaters reaching the TNW. The headwater wetland is receiving a percentage of its water from groundwater and from runoff from the surrounding uplands before it flows into Fox River. Wetlands such as these provide stormwater storage, habitat, sediment/toxicant retention and nutrient removal/transformation..

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: The decrease of sedimentation, pollutants, flooding, nutrients and habitat provided by the subject wetland provides a positive effect to the downstream relatively permanent waters and traditional navigable waters. These wetlands alone, and in combination with other area wetlands, significantly affect the chemical, physical and biological integrity of the Fox River. Stomwater storage provided by the subject wetlands affect the frequency and extent of downstream flooding, decreasing flood peaks in the Fox River, and in turn impacting navigation and downstream bank erosion and sedimentation. The sediment and pollutant/toxicant retention provided by the subject wetland has a direct positive effect on the Fox River in regards to navigation and aquatic food webs that are not adapted to thrive in sediment-choked environments. These factors contribute to the finding of a significant nexus between the on-site wetland and the TNW.

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☐ TNWs: linear feet width (ft), Or, acres.
   ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .
   ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

   Provide estimates for jurisdictional waters in the review area (check all that apply):
   ☐ Tributary waters: linear feet width (ft).
   ☐ Other non-wetland waters: acres.
   Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
   ☒ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional waters within the review area (check all that apply):
   ☒ Tributary waters: **1000** linear feet **1-2** width (ft).
   ☐ Other non-wetland waters: acres.
   Identify type(s) of waters: **.**

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
   ☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: **.**

   ☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
   ☒ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional wetlands in the review area: **1.37** acres.

7. **Impoundments of jurisdictional waters.[9]**
   As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
   ☐ Demonstrate that impoundment was created from "waters of the U.S.," or
   ☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
   ☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

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[8]See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

---

[10] Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.*

Provide estimates for jurisdictional waters in the review area (check all that apply):

- ☐ Tributary waters: linear feet width (ft).
- ☐ Other non-wetland waters: acres.
  - Identify type(s) of waters: .
- ☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):

- ☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
- ☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
  - ☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
- ☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
- ☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):

- ☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
- ☐ Lakes/ponds: acres.
- ☐ Other non-wetland waters: acres. List type of aquatic resource: .
- ☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):

- ☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
- ☐ Lakes/ponds: acres.
- ☐ Other non-wetland waters: acres. List type of aquatic resource: .
- ☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):

- ☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: WBK Engineering GIS Wetland Exhibits.
- ☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  - ☐ Office concurs with data sheets/delineation report.
  - ☐ Office does not concur with data sheets/delineation report.
- ☐ Data sheets prepared by the Corps: .
- ☐ Corps navigable waters' study: .
- ☒ U.S. Geological Survey Hydrologic Atlas:Aurora North HA 70, 1963, .
  - ☐ USGS NHD data.
  - ☒ USGS 8 and 12 digit HUC maps.
- ☒ U.S. Geological Survey map(s). Cite scale & quad name: Aurora North 7.5", 1993, Pick List, Pick List, .
- ☒ USDA Natural Resources Conservation Service Soil Survey. Citation: NRCS Web Soil Survey.
- ☒ National wetlands inventory map(s). Cite name: Aurora North, .
- ☒ State/Local wetland inventory map(s): Kane County ADID, Pick List, .
- ☐ FEMA/FIRM maps: .
- ☐ 100-year Floodplain Elevation is: (National Geodetic Vertical Datum of 1929)
- ☒ Photographs: ☒ Aerial (Name & Date): 1939-2014.
  - or ☐ Other (Name & Date): .
- ☐ Previous determination(s). File no. and date of response letter: .
- ☐ Applicable/supporting case law: People of State of Ill. ex rel. Scott v. Hoffman, No. P-CIV-76-45, (S.D.Ill. Jan. 20, 1979)
- ☐ Applicable/supporting scientific literature: .
- ☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: Multiple site visits where some form of flow was observed throughout various times during the growing season; and walking the connection to Indian Creek.

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): May 29, 2018

B. DISTRICT OFFICE, FILE NAME, AND NUMBER: Chicago District, Fermi-Lab, LRC-2014-775

C. PROJECT LOCATION AND BACKGROUND INFORMATION: North of Rt. 56, East of Kirk Road
State: Illinois County/parish/borough: **DuPage** City: Batavia
Center coordinates of site (lat/long in degree decimal format): Lat. 41.83921°N, Long. -88.26705° W.
Universal Transverse Mercator: Zone 16
Name of nearest waterbody: Indian Creek, Kress Creek & Ferry Creek
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: **Fox River**
Name of watershed or Hydrologic Unit Code (HUC): **Upper Fox (07120006)**
☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):
☒ Office (Desk) Determination. Date: May 7, 2018
☒ Field Determination. Date(s): May 12, 2017, June 9, 2017 & August 21, 2017

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are no** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

2. Non-regulated waters/wetlands (check if applicable):[1]
☒ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain: **Goldfish Pond is a small (0.34 acre) detention basin constructed for the small set of homes. The Retention Pond ().27 acres) is a stormwater basin constructed in uplands, and is exempt. Eola Ditch 1 & Eola Ditch 2 are constructed drainage ditches, and therefore are exempt. Lake Law was constructed/excavated in upland soils for use as a cooling pond for the particle ring on the lab, and therefore is an exempt water feature. Ponds A thru H (17.59 acres) are cooling ponds excavated over theinitial accelerator ring for experiments, and are therefore exempt. Ponds 1, 2, 3, 4, 5, 6, 7, 8(a), 8(b), 9(a), 9(b), 10, 11, 12(a), 12(b), 12(c), 12(d), 13, 14(a), 14(b), 14(c), 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26(a), 26(b) & 27 (30.61 acres), are all constructed cooling ponds over the main ring, and are therefore exempt. Wetlands N03, N04, N08, N16, N19, N22, N24, N28, N29, N42, N43, N44, N49, N94 & N95 (0.66 acres) are all exempt roadside ditches. All the ponds and ditches associated with Andy's Pond and Casey's Pond were contructed as surface water cooling systems where water is pumped from Casey's Pond to several buildings, then discharged into Bulrush Pond and ditches to Andy's Pond, and back to Casey's Pond. This includes Andy's Pond, Casey's Pond, Andy's Pond Bypass Ditch, Casey's Pond East Ditch, Casey's Pond Bypass Ditch, Meson Ditch, West Meson Ditch, East Meson Ditch, Proton Ditch, Bulrush Pond, Buffalo Drainage Pond, Unnamed 2, Unnamed 3, Unnamed 4, Unnamed 6, Unnamed 7, Unnamed 11, Unnamed 12, Unnamed 15, Unnamed 17, Unnamed 18, Unnamed 19, Unnamed 26, Unnamed 31, Unnamed 33, Unnamed 41, Unnamed 42, Unnamed 43, Unnamed 44, Unnamed 51, N75, N76, N84, N85, N86, N87, N88 & N89 (20 acres). Unnamed Tributary 24 is a ditch cut through upland to connect roadside drainage to Indian Creek, and therefore is exempt. Unnamed 14, Unnamed 37 and Babbling Brook are all excavated upland roadside ditches, and therefore exempt. The Center Reflecting Pond and East Reflecting Pond (2.45 acres) are exempt ornamental bodies of water. Booster Pond (1.62 acres) is a constructed cooling pond lined with concrete, which is pumped into a pipe that drains down Unnamed 22, and into Kidney Pond (1.52 acres), which drains into Swan Lake (6.55 acres), all of which were excavated in uplands soils for cooling water purposes, which makes them exempt water features..**

[1] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):

- ☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
- ☐ Other: (explain, if not covered above): .

SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):

- ☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: WBK Engineering Fermi-Lab Wetland Exhibits.
- ☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  - ☐ Office concurs with data sheets/delineation report.
  - ☐ Office does not concur with data sheets/delineation report.
- ☐ Data sheets prepared by the Corps: .
- ☐ Corps navigable waters' study: .
- ☒ U.S. Geological Survey Hydrologic Atlas: Aurora North HA 70, 1963, .
  - ☐ USGS NHD data.
  - ☒ USGS 8 and 12 digit HUC maps.
- ☒ U.S. Geological Survey map(s). Cite scale & quad name: Aurora North 7.5", 1993, Pick List, Pick List, Pick List, .
- ☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Soil Survey of DuPage County, Illinois (1999).
- ☒ National wetlands inventory map(s). Cite name: Aurora North, .
- ☒ State/Local wetland inventory map(s): DuPage County ADID, Pick List, .
- ☒ FEMA/FIRM maps: .
- ☐ 100-year Floodplain Elevation is: (National Geodetic Vertical Datum of 1929)
- ☒ Photographs: ☒ Aerial (Name & Date): .
  or ☐ Other (Name & Date): .
- ☐ Previous determination(s). File no. and date of response letter: .
- ☐ Applicable/supporting case law: .
- ☐ Applicable/supporting scientific literature: .
- ☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: Site visits on May 12, 2017, June 9, 2017 and August 21, 2017.

- ☒ Areas are ditches (check all that apply): .
  - ☐ Non-tidal drainage and irrigation ditches excavated on dry land (51 FR 41217, Nov. 13, 1986). .
  - ☒ Ditches (including roadside ditches) excavated wholly in and draining only uplands and that do not carry a relatively permanent flow of water (USACE JD Form Instructional Guidebook 5/30/2007). .
  - ☐ Ditches that do not have a relatively permanent flow into waters of the U.S. or between two (or more) waters of the U.S. (USACE JD Form Instructional Guidebook 5/30/2007). .

- ☒ Area(s) are artificial waters created in upland or dry land: .
  - ☐ Artificially irrigated areas which would revert to upland if the irrigation ceased (51 FR 41217, Nov. 13, 1986). .
  - ☒ Artificial lakes or ponds created by excavating and/or diking dry land to collect and retain water and which are used exclusively for such purposes as stock watering, irrigation, settling basins, or rice growing (51 FR 41217, Nov. 13, 1986). .
  - ☒ Artificial reflecting or swimming pools or other small ornamental bodies of water created by excavating and/or diking dry land to retain water for primarily aesthetic reasons (51 FR 41217, Nov. 13, 1986). .
  - ☐ Waterfilled depressions created in dry land incidental to construction activity and pits excavated in dry land for the purpose of obtaining fill, sand, or gravel unless and until the construction or excavation operation is abandoned and the resulting body of water meets the definition of waters of the United States (51 FR 41217, Nov. 13, 1986). .
  - ☒ Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of the Clean Water Act (other than cooling ponds as defined in 40 CFR 423.11(m) which also meet criteria of this definition) (33 CFR 328.3 (a)). .

- ☐ Area(s) are swales (USACE JD Form Instructional Guidebook 5/30/2007). .
- ☐ Area(s) are erosional features (including gullies) (USACE JD Form Instructional Guidebook 5/30/2007). .
- ☐ Area(s) are prior converted cropland (33 CFR 328.3(a)(8)). .
- ☐ Area(s) are uplands. .
- ☐ Other: .

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD): May 29, 2018

B. DISTRICT OFFICE, FILE NAME, AND NUMBER: Chicago District, Fermi-Lab, LRC-2014-775

C. PROJECT LOCATION AND BACKGROUND INFORMATION: North of Rt. 56, East of Kirk Road
State: Illinois County/parish/borough: **DuPage** City: Batavia
Center coordinates of site (lat/long in degree decimal format): Lat. 41.83921°N, Long. -88.26705° W.
Universal Transverse Mercator: Zone 16
Name of nearest waterbody: Indian Creek, Kress Creek & Ferry Creek
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: **Fox River**
Name of watershed or Hydrologic Unit Code (HUC): **Upper Fox (07120006)**
☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):
☒ Office (Desk) Determination. Date: May 7, 2018
☒ Field Determination. Date(s): May 12, 2017, June 9, 2017 & August 21, 2017

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]
☐ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain: Defined in People of State of Ill. ex rel. Scott v. Hoffman, No. P-CIV-76-45, slip op. at 7 (S.D.Ill. Jan. 20, 1979).

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
   ☐ TNWs, including territorial seas
   ☐ Wetlands adjacent to TNWs
   ☒ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
   ☒ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
   Non-wetland waters: 48850 linear feet: 1-20 width (ft) and/or acres.
   Wetlands: 135.69 acres.

   c. **Limits (boundaries) of jurisdiction** based on: **Not established at this time.**
   Elevation of established OHWM (if known): .

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: **Pick List**.
   Summarize rationale supporting determination: As defined in People of State of Ill. ex rel. Scott v. Hoffman, No. P-CIV-76-45, slip op. at 7 (S.D.Ill. Jan. 20, 1979).

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": .

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).

D. **DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):**

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☐ TNWs: linear feet width (ft), Or, acres.
   ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   ☒ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: Indian Creek, Kress Creek, and Ferry Creek (off-site) are all mapped blue-line streams on the USGS Maps, and have year-round flow. Giese Tributary, Kress Creek Transfer Ditch, MI Tributary, North Ditch, Pine Tributary, Shull's Hole Tributary, Swan Tributary, West Tributary, Knauz Road Tributary, Dusaf Pond Tributary, Wetst Ditch, The Channel, Unnamed 20, Unnamed Tributary 23, Unnamed 25, Unnmaed 29, Unnamed Tributary 31, Unnamed 32, Unnamed Tributary 33, Unnamed 34, Unnamed Tributary 45, Unnamed 46, Unnamed 48 & Unnamed Tributary 50 all exhibit year-round flow (26 Waters). .
   ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

   Provide estimates for jurisdictional waters in the review area (check all that apply):
   ☐ Tributary waters: linear feet width (ft).
   ☐ Other non-wetland waters: acres.
   Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☒ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
   ☒ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: **Lab 6 Pond, Nepese Pond, Dusaf Pond, A.E. Sea and Sea of Evanescence are all in-stream ponds on Ferry Creek, and have no separation. Shull's Hole appears to be spring fed, and is drained by Shull's Hole Tributary ultimately to Indian Creek. Farmed Wetland AF is connected to, and part of the Sea or Evanescence, so abuts Ferry Creek. Farmed Wetland AZ abuts an off-site tributary under the RR Tracks to the east that flows to Kress Creek. Farmed Wetlands BI, BJ, BK & BO all abut Kress Creek. Farmed Wetland C abuts Kress Creek. Farmed Wetland S & Wetland S complex drains via a tributary directly into Indian Creek. MI Wetland North & MI Wetland South each directly abut Indian Creek. Wetland N05 is connected to Unnamed 45 via a pipe under a berm. Wetland N09 directly abuts and is bisected by the MI Tributary. Wetlands N10 & N11 directly abut and are bisected by Unnamed 45. Wetland N12, N15 & N36 all directly abut the West Tributary. N37, N38 & N39 all abut Unnamed 50. Wetland N17 abuts the Giese Tributary. Wetlands N23 & N25 abut Swan Tributary. Wetland N40 is bisected by Pine Tributary; and N48 drains into and abuts Pine Tributary. Wetlands N45, N46 & N47 are in a string of wetlands bisected by a western branch of Pine Tributary. Wetland N103 drains into and abuts Unnamed 20. Wetland N104 drains inot and abuts Pine Tributary. Wetland N109 directly abuts Pine Tributary. Pine St Wetland 1 starts with tile outlet water and flows into The Channel. Pine St Wetland 3 abuts Pine Tributary (40 Wetlands).**

   ☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

   Provide acreage estimates for jurisdictional wetlands in the review area: **135.69** acres.

SECTION IV: DATA SOURCES.

A. **SUPPORTING DATA. Data reviewed for JD (check all that apply -** checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
   ☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: WBK Engineering JD Map Exhibits.
   ☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
      ☐ Office concurs with data sheets/delineation report.
      ☐ Office does not concur with data sheets/delineation report.
   ☐ Data sheets prepared by the Corps: .
   ☐ Corps navigable waters' study: .
   ☒ U.S. Geological Survey Hydrologic Atlas: Aurora North HA 70, 1963, .
      ☐ USGS NHD data.
      ☒ USGS 8 and 12 digit HUC maps.
   ☒ U.S. Geological Survey map(s). Cite scale & quad name: Aurora North 7.5", 1993, Pick List, Pick List, Pick List, .
   ☒ USDA Natural Resources Conservation Service Soil Survey. Citation: Soil Survey of DuPage County, Illinois (1999).
   ☒ National wetlands inventory map(s). Cite name: Aurora North, .
   ☒ State/Local wetland inventory map(s): DuPage County ADID, Pick List, .

☒ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodetic Vertical Datum of 1929)
☒ Photographs: ☒ Aerial (Name & Date): .
or ☐ Other (Name & Date): .
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: People of State of Ill. ex rel. Scott v. Hoffman, No. P-CIV-76-45, (S.D.Ill. Jan. 20, 1979)
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: Multiple site visits to walk all wetlands and drainages..

Northern Long-Eared Bat 4(d) Rule Streamlined Consultation Form

Federal agencies should use this form for the optional streamlined consultation framework for the northern long-eared bat (NLEB). This framework allows federal agencies to rely upon the U.S. Fish and Wildlife Service's (USFWS) January 5, 2016, intra-Service Programmatic Biological Opinion (BO) on the final 4(d) rule for the NLEB for section 7(a)(2) compliance by: (1) notifying the USFWS that an action agency will use the streamlined framework; (2) describing the project with sufficient detail to support the required determination; and (3) enabling the USFWS to track effects and determine if reinitiation of consultation is required per 50 CFR 402.16.

This form is not necessary if an agency determines that a proposed action will have no effect to the NLEB or if the USFWS has concurred in writing with an agency's determination that a proposed action may affect, but is not likely to adversely affect the NLEB (i.e., the standard informal consultation process). Actions that may cause prohibited incidental take require separate formal consultation. Providing this information does not address section 7(a)(2) compliance for any other listed species.

Information to Determine 4(d) Rule Compliance:	YES	NO
1. Does the project occur wholly outside of the WNS Zone[1]?	☐	☒
2. Have you contacted the appropriate agency[2] to determine if your project is near known hibernacula or maternity roost trees?	☒	☐
3. Could the project disturb hibernating NLEBs in a known hibernaculum?	☐	☒
4. Could the project alter the entrance or interior environment of a known hibernaculum?	☐	☒
5. Does the project remove any trees within 0.25 miles of a known hibernaculum at any time of year?	☐	☒
6. Would the project cut or destroy known occupied maternity roost trees, or any other trees within a 150-foot radius from the maternity roost tree from June 1 through July 31.	☐	☒

You are eligible to use this form if you have answered yes to question #1 **or** yes to question #2 **and** no to questions 3, 4, 5 and 6. The remainder of the form will be used by the USFWS to track our assumptions in the BO.

Agency and Applicant[3] (Name, Email, Phone No.): U.S. Department of Energy, Fermi Site Office, Rick Hersemann, rick.hersemann@science.doe.gov, (630) 840-4122

Project Name: Proton Improvement Plan II (PIP-II)

Project Location (include coordinates if known): Fermilab, Batavia, IL 60510; Township 39 North, Range 9 East, Section 30.

Basic Project Description (provide narrative below or attach additional information): The PIP-II Project will construct and operate a new linear accelerator located inside the Main Ring located at Fermilab. The project will construct aboveground and belowground facilities located in a 27.7 acre footprint that contains existing prairie habitat with about 20 mature and dead trees. Prairie will be burned in March and trees will be removed in winter or during the non-roosting months.

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[1] http://www.fws.gov/midwest/endangered/mammals/nleb/pdf/WNSZone.pdf
[2] See http://www.fws.gov/midwest/endangered/mammals/nleb/nhisites.html
[3] If applicable - only needed for federal actions with applicants (e.g., for a permit, etc.) who are party to the consultation.

General Project Information	YES	NO
Does the project occur within 0.25 miles of a known hibernaculum?	☐	☒
Does the project occur within 150 feet of a known maternity roost tree?	☐	☒
Does the project include forest conversion[4]? (if yes, report acreage below)	☐	☒
Estimated total acres of forest conversion		
If known, estimated acres[5] of forest conversion from April 1 to October 31		
If known, estimated acres of forest conversion from June 1 to July 31[6]		
Does the project include timber harvest? (if yes, report acreage below)	☐	☒
Estimated total acres of timber harvest		
If known, estimated acres of timber harvest from April 1 to October 31		
If known, estimated acres of timber harvest from June 1 to July 31		
Does the project include prescribed fire? (if yes, report acreage below)	☒	☐
Estimated total acres of prescribed fire: 27.5 acres from November 1 to April 1		
If known, estimated acres of prescribed fire from April 1 to October 31	0	
If known, estimated acres of prescribed fire from June 1 to July 31	0	
Does the project install new wind turbines? (if yes, report capacity in MW below)	☐	☒
Estimated wind capacity (MW)		

Agency Determination:

By signing this form, the action agency determines that this project may affect the NLEB, but that any resulting incidental take of the NLEB is not prohibited by the final 4(d) rule.

If the USFWS does not respond within 30 days from submittal of this form, the action agency may presume that its determination is informed by the best available information and that its project responsibilities under 7(a)(2) with respect to the NLEB are fulfilled through the USFWS January 5, 2016, Programmatic BO. The action agency will update this determination annually for multi-year activities.

The action agency understands that the USFWS presumes that all activities are implemented as described herein. The action agency will promptly report any departures from the described activities to the appropriate USFWS Field Office. The action agency will provide the appropriate USFWS Field Office with the results of any surveys conducted for the NLEB. Involved parties will promptly notify the appropriate USFWS Field Office upon finding a dead, injured, or sick NLEB.

Signature: Rick Hersemann

Date Submitted: 8/8/2018

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[4] Any activity that temporarily or permanently removes suitable forested habitat, including, but not limited to, tree removal from development, energy production and transmission, mining, agriculture, etc. (see page 48 of the BO).

[5] If the project removes less than 10 trees and the acreage is unknown, report the acreage as less than 0.1 acre.

[6] If the activity includes tree clearing in June and July, also include those acreage in April to October.

United States Department of the Interior

US FISH AND WILDLIFE SERVICE REGION 3
Chicago Ecological Services Field Office
230 South Dearborn Street, Suite 2938
Chicago, IL 60604
Phone: (312) 216-4722

IN REPLY REFER TO:
FWS/AES-CIFO/2018-I-0357

August 1, 2018

Mr. Rick Hersemann
U.S. Department of Energy
Fermi National Accelerator Laboratory
Fermi Site Office
P.O. Box 2000
Batavia, Illinois 60510

Dear Mr. Hersemann:

This letter responds to your e-mailed letter dated July 5, 2018, requesting our concurrence with your federal threatened and endangered species effects determination for the proposed Proton Improvement Plan (PIP-II) Project at Fermi National Accelerator Laboratory (Fermilab). The Department of Energy (DOE) is currently preparing an Environmental Assessment for the PIP-II Project under the National Environmental Policy Act. This proposed project is located in Kane and DuPage Counties in Batavia, Illinois.

You have also provided information on the Long Baseline Neutrino Facility and Deep Underground Neutrino Experiment (LBNF/DUNE) Project where an Environmental Assessment was completed in 2015 prior to the listing (March 2018) of the rusty patched bumble bee (*Bombus affinis*), which has been documented on Fermilab grounds.

Additional information regarding these two projects and federal listed species were discussed during a phone conversation between Ms. Cathy Pollack, of my staff, and yourself, on or about July 12, 2018, and on July 31, 2018.

The proposed PIP-II project involves the construction of underground enclosures and surface facilities located inside the existing Main Ring berm adjacent to the existing Transfer Hall and Booster Ring Facilities on the Fermilab property. This proposed project would affect vegetation, including the removal of ~20 trees. This project will temporarily impact 27.7 acres of prairie habitat during construction. Permanent impacts for aboveground facilities will total 4.4 acres. The remaining 23.3 acres will be restored with an IDOT approved seed mix.

The U.S. Fish and Wildlife Service's IPaC project planning tool identified the following eight species as having the potential to occur within the PIP-II Project area:

- Eastern prairie fringed orchid (*Platanthera leucophaea*)
- Leafy prairie-clover (*Dalea foliosa*)
- Mead's milkweed (*Asclepias meadii)*
- Prairie bush clover (*Lespedeza leptostachya*)
- Northern Long-eared Bat (*Myotis septentrionalis*)
- Eastern massasauga (*Sistrurus catenatus*)
- Hine's emerald dragonfly (*Somatochlora hineana)*
- Rusty-patched bumble bee (*Bombus affinis*)

You have concluded that the proposed PIP-II project is not likely to adversely affect these eight species and have asked for our concurrence.

Fermilab employs an onsite ecologist who conducts annual ecological surveys and keeps records of all observed species within the Fermilab property. Intensive searches for the **eastern prairie fringed orchid** were conducted in 2015 and 2016 on non-consecutive days during the bloom period (June 28 through July 11). This species was not observed and has not been observed onsite to date. In 2017 and in coordination with the U.S. Fish & Wildlife Service, Fermilab introduced seed of the eastern prairie fringed orchid into suitable habitat in various locations on Fermilab grounds, however these locations were outside of the PIP-II Project area. For these reasons, a no effect determination for the eastern prairie fringed orchid is appropriate.

Suitable habitat to support the **leafy prairie clover** (*Dalea foliosa*), **eastern massasauga rattlesnake** (*Sistrurus catenatus*), and the **Hine's emerald dragonfly** (*Somatochlora hineana*), does not exist onsite at Fermilab therefore a no effect determination for these species is appropriate.

Extensive annual plant surveys conducted by Fermilab's onsite ecologist have not located **Mead's milkweed** (*Asclepias meadii*) or **prairie bush clover** (L*espedeza leptostachya*) on Fermilab property, therefore a no effect determination is appropriate for these species.

Addressing the **northern long eared bat** (*Myotis septentrionalis*), you indicate that a bat survey was conducted (in 2017) at the Fermilab property using both mist netting and acoustic surveys with survey results indicating no bats observed at the PIP-II Project site. Because approximately 20 mature and dead trees will be removed and to insure minimal risk to the northern long eared bat, tree removal will be scheduled for the winter months. For the northern long eared bat it is appropriate to use the Fish and Wildlife Service's streamlined consultation form (attached).

The **rusty-patched bumble bee** has been observed on Fermilab property. Although this species has not been observed within the PIP-II Project site, it could potentially occur within this site. To minimize potential impacts to this species, prairie vegetation within the PIP-II Project area will be removed through a controlled burn outside of the foraging season (winter). In addition, Fermilab has ~980 acres of suitable prairie habitat that will not be impacted by the proposed project. For these reasons you have concluded that the project is not likely to adversely affect the rusty patched bumble bee.

The Long Baseline Neutrino Facility and Deep Underground Neutrino Experiment (LBNF/DUNE) Project has not yet been initiated on Fermilab grounds, however an Environmental Assessment was completed in 2015 prior to the listing (March 2018) of the rusty patched bumblebee (*Bombus affinis*). In order to avoid effects from this project to this newly listed species you have indicated that prairie vegetation would also be removed through a controlled burn outside of the bee foraging season (winter).

Based on the information and conservation measures described above, we agree that incidental take of the bumble bee from both project activities (PIP-II Project and LBNF/DUNE) is unlikely, and therefore, we concur with your determinations that the proposed PIP-II Project and the LBNF/DUNE project may affect, but are not likely to adversely affect, the rusty patched bumble bee.

This letter provides comment under the authority of the Endangered Species Act of 1973 (82 Stat. 884, as amended. If you have any questions, please contact Ms. Cathy Pollack at 847-608-3101.

Sincerely,

Louise Clemency

Louise Clemency
Field Supervisor

IPaC Information for Planning and Consultation **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

DuPage and Kane counties, Illinois

Local office

Chicago Ecological Service Field Office

(312) 216-4720

U.s. Fish And Wildlife Service Chicago Ecological Services Office
230 South Dearborn St., Suite 2938
Chicago, IL 60604-1507

http://www.fws.gov/midwest/endangered/section7/s7process/7a2process.html

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species

[1] are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service.

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Northern Long-eared Bat Myotis septentrionalis No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9045	Threatened

Reptiles

NAME	STATUS
Eastern Massasauga (=rattlesnake) Sistrurus catenatus No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2202	Threatened

Insects

NAME	STATUS
Hine's Emerald Dragonfly Somatochlora hineana There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/7877	Endangered
Rusty Patched Bumble Bee Bombus affinis No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9383	Endangered

Flowering Plants

NAME	STATUS
Eastern Prairie Fringed Orchid Platanthera leucophaea This species only needs to be considered if the following condition applies: • Follow the guidance provided at https://www.fws.gov/midwest/endangered/section7/s7process/plants/epfos7guide.html No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/601	Threatened
Leafy Prairie-clover Dalea foliosa No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5498	Endangered
Mead's Milkweed Asclepias meadii No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/8204	Threatened
Prairie Bush-clover Lespedeza leptostachya No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4458	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act

[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see maps of where birders and the general public have sighted birds in and around your project area, visit E-bird tools such as the E-bird data mapping tool (search for the name of a bird on your list to see specific locations where that bird has been reported to occur within your project area over a certain timeframe) and the E-bird Explore Data Tool (perform a query to see a list of all birds sighted in your county or region and within a certain timeframe). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)
American Bittern Botaurus lentiginosus This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/6582	Breeds Apr 1 to Aug 31
American Golden-plover Pluvialis dominica This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Oct 15 to Aug 31
Black Rail Laterallus jamaicensis This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/7717	Breeds Mar 1 to Sep 15
Black-billed Cuckoo Coccyzus erythropthalmus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9399	Breeds May 15 to Oct 10
Bobolink Dolichonyx oryzivorus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Jul 31
Buff-breasted Sandpiper Calidris subruficollis This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9488	Breeds elsewhere

Cerulean Warbler Dendroica cerulea — Breeds Apr 21 to Jul 20
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/2974

Eastern Whip-poor-will Antrostomus vociferus — Breeds May 1 to Aug 20
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Golden Eagle Aquila chrysaetos — Breeds elsewhere
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Henslow's Sparrow Ammodramus henslowii — Breeds May 1 to Aug 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3941

Hudsonian Godwit Limosa haemastica — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Kentucky Warbler Oporornis formosus — Breeds Apr 20 to Aug 20
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

King Rail Rallus elegans — Breeds May 1 to Sep 5
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/8936

Least Bittern Ixobrychus exilis — Breeds Aug 16 to Oct 31
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/6175

Lesser Yellowlegs Tringa flavipes — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9679

Prothonotary Warbler Protonotaria citrea — Breeds Apr 1 to Jul 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Red-headed Woodpecker Melanerpes erythrocephalus Breeds May 10 to Sep 10
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Rusty Blackbird Euphagus carolinus Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Semipalmated Sandpiper Calidris pusilla Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Short-billed Dowitcher Limnodromus griseus Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9480

Smith's Longspur Calcarius pictus Breeds elsewhere
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Wood Thrush Hylocichla mustelina Breeds May 10 to Aug 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds.

Probability of Presence ( )

Each green bar represents the bird's relative probability of presence in your project's counties during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week

of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

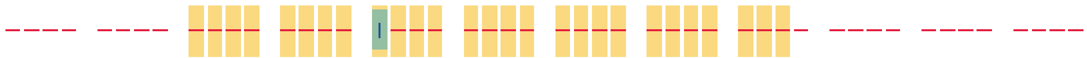
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the counties of your project area. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

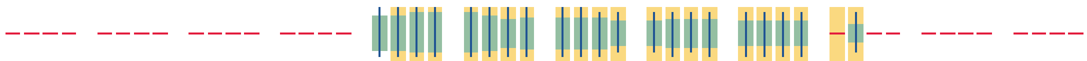
Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information.

Black Rail



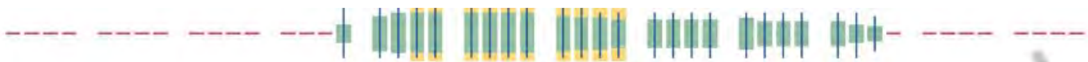
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Black-billed Cuckoo



BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Bobolink



BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Buff-breasted Sandpiper

BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Cerulean Warbler

BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

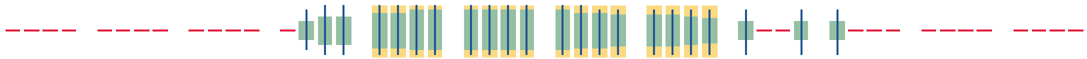
Eastern Whip-poor-will

BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Golden Eagle

Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

Henslow's Sparrow
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

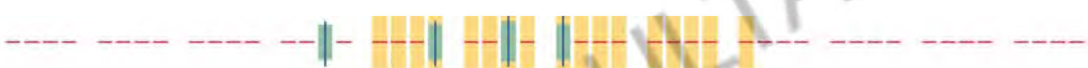


Hudsonian Godwit
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

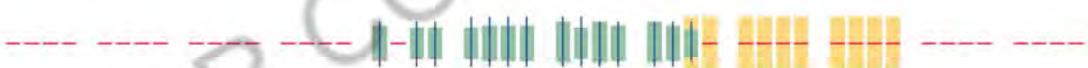
SPECIES JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Kentucky Warbler
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

King Rail
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

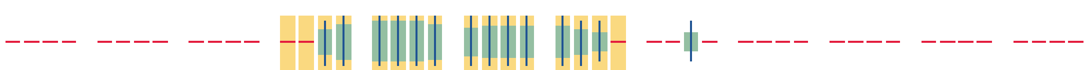


Least Bittern
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

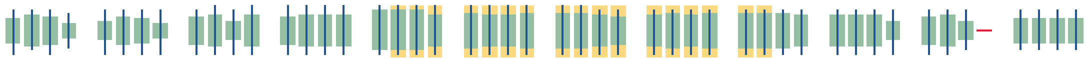


Lesser Yellowlegs
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

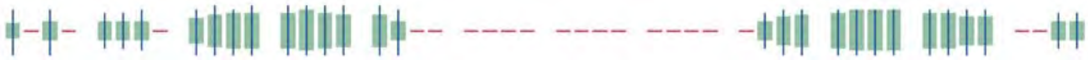
Prothonotary Warbler
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Red-headed Woodpecker
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Rusty Blackbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

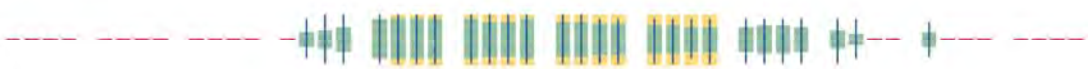


Semipalmated Sandpiper
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Short-billed Dowitcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Smith's Longspur
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Wood Thrush
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the counties which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the E-bird Explore Data Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird entry on your migratory bird species list indicates a breeding season, it is probable that the bird breeds in your project's counties at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review.

Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the BGEPA should such impacts occur.

Facilities

Wildlife refuges and fish hatcheries

REFUGE AND FISH HATCHERY INFORMATION IS NOT AVAILABLE AT THIS TIME

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

This location overlaps the following wetlands:

FRESHWATER EMERGENT WETLAND
- PEMCh

FRESHWATER FORESTED/SHRUB WETLAND
- PFO1Ch

LAKE
- L1UBGx

A full description for each wetland code can be found at the National Wetlands Inventory website: https://ecos.fws.gov/ipac/wetlands/decoder

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chicago Ecological Service Field Office
U.s. Fish And Wildlife Service Chicago Ecological Services Office
230 South Dearborn St., Suite 2938
Chicago, IL 60604-1507
Phone: (312) 216-4720 Fax:
http://www.fws.gov/midwest/endangered/section7/s7process/7a2process.html

In Reply Refer To: March 22, 2018
Consultation Code: 03E13000-2018-SLI-0168
Event Code: 03E13000-2018-E-00453
Project Name: Fermilab PIP-II Project

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

To Whom It May Concern:

To Whom It May Concern:

The attached species list identifies any federally threatened, endangered, proposed and candidate species that may occur within the boundary of your proposed project or may be affected by your proposed project. The list also includes designated critical habitat if present within your proposed project area or affected by your project. This list is provided to you as the initial step of the consultation process required under section 7(c) of the Endangered Species Act, also referred to as Section 7 Consultation.

Please note! For all **wind energy projects** and **projects that include installing towers that use guy wires or are over 200 feet in height**, please contact this field office directly for assistance, even if no federally listed plants, animals or critical habitat are present within your proposed project or may be affected by your proposed project.

For all other projects, continue the Section 7 Consultation process by going to our Section 7 Technical Assistance website at http://www.fws.gov/midwest/endangered/section7/s7process/index.html. If you are familiar with this website, you may want to go to Step 2 of the Section 7 Consultation process at http://www.fws.gov/midwest/endangered/section7/s7process/step2.html.

Under 50 CFR 402.12(e) (the regulations that implement Section 7 of the Endangered Species Act) the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally. You may verify the list by visiting the ECOS-IPaC website http://ecos.fws.gov/ipac/ at regular intervals during project planning and implementation and completing the same process you used to receive the attached list. As an alternative, you may contact this Ecological Services Field Office for updates.

Although no longer protected under the Endangered Species Act, be aware that bald eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), as are golden eagles. Projects affecting these species may require measures to avoid harming eagles or may require a permit. If your project is near an eagle nest or winter roost area, see our Eagle Permits website at http://www.fws.gov/midwest/midwestbird/EaglePermits/index.html to help you determine if you can avoid impacting eagles or if a permit may be necessary.

We appreciate your concern for threatened and endangered species. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Chicago Ecological Service Field Office
U.s. Fish And Wildlife Service Chicago Ecological Services Office
230 South Dearborn St., Suite 2938
Chicago, IL 60604-1507
(312) 216-4720

Project Summary

Consultation Code: 03E13000-2018-SLI-0168

Event Code: 03E13000-2018-E-00453

Project Name: Fermilab PIP-II Project

Project Type: Department of Energy Operations

Project Description: Species list requested for an Environmental Assessment for the Proton Improvement Plan II (PIP-II). The PIP-II project will encompass a number of improvement and additions to the Fermilab accelerator complex. Note, the site owners have coordinated with the USFWS to introduce the Eastern prairie fringed orchid to the site with an agreed baseline of 0.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/41.83694959783854N88.25767786699237W

Counties: DuPage, IL | Kane, IL

Endangered Species Act Species

There is a total of 8 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 1 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Reptiles

NAME	STATUS
Eastern Massasauga (=rattlesnake) *Sistrurus catenatus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2202	Threatened

Insects

NAME	STATUS
Hine's Emerald Dragonfly *Somatochlora hineana* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7877	Endangered
Rusty Patched Bumble Bee *Bombus affinis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9383	Endangered

Flowering Plants

NAME	STATUS
Eastern Prairie Fringed Orchid *Platanthera leucophaea* No critical habitat has been designated for this species. This species only needs to be considered under the following conditions: ▪ Follow the guidance provided at https://www.fws.gov/midwest/endangered/section7/s7process/plants/epfos7guide.html Species profile: https://ecos.fws.gov/ecp/species/601 Species survey guidelines: https://ecos.fws.gov/ipac/guideline/survey/population/984/office/31131.pdf	Threatened
Leafy Prairie-clover *Dalea foliosa* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5498	Endangered
Mead's Milkweed *Asclepias meadii* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8204	Threatened
Prairie Bush-clover *Lespedeza leptostachya* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4458	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

APPENDIX C

PIP-II Air Emissions Calculations

Table C-1 Summary of Annual Emissions for Fermilab Project

Year	Emissions (short tons/year)						CO_2e Emissions (metric tons/year)		
	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC	Direct	Indirect	Total
Proposed Action Construction									
2020	25.93	37.74	12.12	4.68	11.76	3.99	6,984	2,348	9,332
2021	23.71	34.25	11.21	4.38	10.68	3.66	6,341	2,319	8,661
2022	19.41	26.66	11.04	3.42	8.29	3.10	4,932	2,309	7,241
2023	24.07	39.27	11.10	4.36	12.33	3.94	7,339	2,308	9,647
2024	21.84	34.96	10.49	3.99	10.98	3.61	6,535	2,337	8,873
2025	20.44	34.07	9.87	3.88	10.75	3.51	6,392	2,329	8,720
2026	13.94	15.53	7.50	2.37	4.79	2.13	2,829	2,329	5,157
Max Proposed Action Construction Emissions	25.93	39.27	12.12	4.68	12.33	3.99	7,339	2,348	9,647
Proposed Action Operational Period									
Worker Vehicle Fuel	1.96E-01	1.68E-02	5.30E-03	3.51E-03	5.91E-04	2.47E-02	0	55	55
Electricity Generation	--	--	--	--	--	--	0	54,046	54,046
Space Heating	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	0	0
2026 - 2066	1.96E-01	1.68E-02	5.30E-03	3.51E-03	5.91E-04	2.47E-02	0	54,101	54,101

Table C-2 Project Schedule

Activity / Parameter / Equipment			Units	Calendar 2020												2020 Total
				Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20	
1	**Surface**		**--**													--
	A.)	**Site Preparation**	**--**													--
			--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
	B.)	**Cryo Plant Building**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	C.)	**Utility Plant Building**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	D.)	**Linac Complex**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	E.)	**Booster Connection**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--

Notes:

Schedule represents range of months during which each activity may occur based on information provided by Fermilab. Project infrastructure activities are assumed to occur from 2017 through the end of the project.

Table C-2 Project Schedule

Activity / Parameter / Equipment			Units	Calendar 2021												2021 Total
				Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	
1	**Surface**		**--**													--
	A.)	**Site Preparation**	**--**													--
			--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
	B.)	**Cryo Plant Building**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	C.)	**Utility Plant Building**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	D.)	**Linac Complex**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	E.)	**Booster Connection**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--

Notes:
Schedule represents range of months during which each activity may occur based on information provided by Fermilab. Project infrastructure activities are assumed to occur from 2017 through the end of the project.

Table C-2 Project Schedule

		Activity / Parameter / Equipment	Units	Calendar 2022												2022 Total
				Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	
1	**Surface**		--													--
	A.)	**Site Preparation**	--													--
			--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
	B.)	**Cryo Plant Building**	--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	C.)	**Utility Plant Building**	--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	D.)	**Linac Complex**	--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	E.)	**Booster Connection**	--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--

Notes:

Schedule represents range of months during which each activity may occur based on information provided by Fermilab. Project infrastructure activities are assumed to occur from 2017 through the end of the project.

Table C-2 Project Schedule

Activity / Parameter / Equipment			Units	Calendar 2023												2023 Total
				Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	
1	**Surface**		**--**													--
	A.)	**Site Preparation**	**--**													--
			--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
	B.)	**Cryo Plant Building**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	C.)	**Utility Plant Building**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	D.)	**Linac Complex**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	E.)	**Booster Connection**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--

Notes:

Schedule represents range of months during which each activity may occur based on information provided by Fermilab. Project infrastructure activities are assumed to occur from 2017 through the end of the project.

Table C-2 Project Schedule

		Activity / Parameter / Equipment	Units	Calendar 2024												2024 Total
				Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24	Dec-24	
1	**Surface**		--													--
	A.)	**Site Preparation**	--													--
			--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
	B.)	**Cryo Plant Building**	--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	C.)	**Utility Plant Building**	--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	D.)	**Linac Complex**	--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	E.)	**Booster Connection**	--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--

Notes:
Schedule represents range of months during which each activity may occur based on information provided by Fermilab. Project infrastructure activities are assumed to occur from 2017 through the end of the project.

Table C-2 Project Schedule

		Activity / Parameter / Equipment	Units	Calendar 2025												2025 Total
				Jan-25	Feb-25	Mar-25	Apr-25	May-25	Jun-25	Jul-25	Aug-25	Sep-25	Oct-25	Nov-25	Dec-25	
1	**Surface**		--													--
	A.)	**Site Preparation**	--													--
			--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
	B.)	**Cryo Plant Building**	--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	C.)	**Utility Plant Building**	--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	D.)	**Linac Complex**	--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	E.)	**Booster Connection**	--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--

Notes:
Schedule represents range of months during which each activity may occur based on information provided by Fermilab. Project infrastructure activities are assumed to occur from 2017 through the end of the project.

Table C-2 Project Schedule

		Activity / Parameter / Equipment	Units	Calendar 2026												2026 Total
				Jan-26	Feb-26	Mar-26	Apr-26	May-26	Jun-26	Jul-26	Aug-26	Sep-26	Oct-26	Nov-26	Dec-26	
1	**Surface**		**--**													--
	A.)	**Site Preparation**	**--**													--
			--													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
	B.)	**Cryo Plant Building**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	C.)	**Utility Plant Building**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	D.)	**Linac Complex**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--
	E.)	**Booster Connection**	**--**													--
		Civil/Site	--													--
		Excavation	--													--
		Structural	--													--
		MEP	--													--

Notes:

Schedule represents range of months during which each activity may occur based on information provided by Fermilab. Project infrastructure activities are assumed to occur from 2017 through the end of the project.

Table C-3 General Schedule Assumptions

Parameter	Units	Calendar 2020												2020 Total
Max Days in Month	day/mo	31	29	31	30	31	30	31	31	30	31	30	31	--
Days Without Construction[a]	day/mo	8	8	8	8	10	8	8	10	8	9	9	8	--
Days of Construction	day/mo	23	21	23	22	21	22	23	21	22	22	21	23	--
Max Construction Hours in Month[b]	hr/mo	184	168	184	176	168	176	184	168	176	176	168	184	--

Notes:

a Represents construction activities would be performed during a 5-day work week, emissions were calculated assuming five days per week. For months with no planned construction, the days without construction equal the max days in month. While up to 10 holidays are planned, time has not been subtracted by month.

b Equipment was assumed to operate for 8 hours per day of construction.

8 hrs/day

Table C-3 General Schedule Assumptions

Parameter	Units	Calendar 2021												2021 Total
Max Days in Month	day/mo	31	28	31	30	31	30	31	31	30	31	30	31	--
Days Without Construction[a]	day/mo	10	8	8	8	10	8	9	9	8	10	8	8	--
Days of Construction	day/mo	21	20	23	22	21	22	22	22	22	21	22	23	--
Max Construction Hours in Month[b]	hr/mo	168	160	184	176	168	176	176	176	176	168	176	184	--

Notes:

a Represents construction activities would be performed during a 5-day work week, emissions were calculated assuming five days per week. For months with no planned construction, the days without construction equal the max days in month. While up to 10 holidays are planned, time has not been subtracted by month.

b Equipment was assumed to operate for 8 hours per day of construction.

8 hrs/day

Table C-3 General Schedule Assumptions

Parameter	Units	Calendar 2022												2022 Total
Max Days in Month	day/mo	31	28	31	30	31	30	31	31	30	31	30	31	--
Days Without Construction[a]	day/mo	10	8	8	9	9	8	10	8	8	10	8	9	--
Days of Construction	day/mo	21	20	23	21	22	22	21	23	22	21	22	22	--
Max Construction Hours in Month[b]	hr/mo	168	160	184	168	176	176	168	184	176	168	176	176	--

Notes:

a Represents construction activities would be performed during a 5-day work week, emissions were calculated assuming five days per week. For months with no planned construction, the days without construction equal the max days in month. While up to 10 holidays are planned, time has not been subtracted by month.

b Equipment was assumed to operate for 8 hours per day of construction.
8 hrs/day

Table C-3 General Schedule Assumptions

Parameter	Units	Calendar 2023												2023 Total
Max Days in Month	day/mo	31	28	31	30	31	30	31	31	30	31	30	31	--
Days Without Construction[a]	day/mo	9	8	8	10	8	8	10	8	9	9	8	10	--
Days of Construction	day/mo	22	20	23	20	23	22	21	23	21	22	22	21	--
Max Construction Hours in Month[b]	hr/mo	176	160	184	160	184	176	168	184	168	176	176	168	--

Notes:

a Represents construction activities would be performed during a 5-day work week, emissions were calculated assuming five days per week. For months with no planned construction, the days without construction equal the max days in month. While up to 10 holidays are planned, time has not been subtracted by month.

b Equipment was assumed to operate for 8 hours per day of construction.

8 hrs/day

Table C-3 General Schedule Assumptions

Parameter	Units	Calendar 2024												2024 Total
Max Days in Month	day/mo	31	29	31	30	31	30	31	31	30	31	30	31	--
Days Without Construction[a]	day/mo	8	8	10	8	8	10	8	9	9	8	9	9	--
Days of Construction	day/mo	23	21	21	22	23	20	23	22	21	23	21	22	--
Max Construction Hours in Month[b]	hr/mo	184	168	168	176	184	160	184	176	168	184	168	176	--

Notes:

a Represents construction activities would be performed during a 5-day work week, emissions were calculated assuming five days per week. For months with no planned construction, the days without construction equal the max days in month. While up to 10 holidays are planned, time has not been subtracted by month.

b Equipment was assumed to operate for 8 hours per day of construction.
8 hrs/day

Table C-3 General Schedule Assumptions

Parameter	Units	Calendar 2025												2025 Total
Max Days in Month	day/mo	31	28	31	30	31	30	31	31	30	31	30	31	--
Days Without Construction[a]	day/mo	8	8	10	8	9	9	8	10	8	8	10	8	--
Days of Construction	day/mo	23	20	21	22	22	21	23	21	22	23	20	23	--
Max Construction Hours in Month[b]	hr/mo	184	160	168	176	176	168	184	168	176	184	160	184	--

Notes:

a Represents construction activities would be performed during a 5-day work week, emissions were calculated assuming five days per week. For months with no planned construction, the days without construction equal the max days in month. While up to 10 holidays are planned, time has not been subtracted by month.

b Equipment was assumed to operate for 8 hours per day of construction.

8 hrs/day

Table C-3 General Schedule Assumptions

Parameter	Units	Calendar 2026												2026 Total
Max Days in Month	day/mo	31	28	31	30	31	30	31	31	30	31	30	31	--
Days Without Construction[a]	day/mo	9	8	9	8	10	8	8	10	8	9	9	8	--
Days of Construction	day/mo	22	20	22	22	21	22	23	21	22	22	21	23	--
Max Construction Hours in Month[b]	hr/mo	176	160	176	176	168	176	184	168	176	176	168	184	--

Notes:

a Represents construction activities would be performed during a 5-day work week, emissions were calculated assuming five days per week. For months with no planned construction, the days without construction equal the max days in month. While up to 10 holidays are planned, time has not been subtracted by month.

b Equipment was assumed to operate for 8 hours per day of construction.

8 hrs/day

Table C-4 Types of Activities for Proposed Action[a]

Activity	Units	Calendar 2020												2020 Total
Site Preparation	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	--
Cryo Plant	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--
Utility Plant Building	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Linac Complex	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Booster Connection	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Soil Movement	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--

Notes:

a Based on project schedule in Table F1-2 above.

Table C-4 Types of Activities for Proposed Action[a]

Activity	Units	Calendar 2021												2021 Total
Site Preparation	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	--
Cryo Plant	--	Y	Y	Y	N	N	N	N	N	N	N	N	N	--
Utility Plant Building	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Linac Complex	--	N	N	N	N	N	N	N	N	N	Y	Y	Y	--
Booster Connection	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Soil Movement	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--

Notes:

a Based on project schedule in Table F1-2 above.

Table C-4 Types of Activities for Proposed Action[a]

Activity	Units	Calendar 2022												2022 Total
Site Preparation	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Cryo Plant	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Utility Plant Building	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Linac Complex	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--
Booster Connection	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Soil Movement	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--

Notes:

a Based on project schedule in Table F1-2 above.

Table C-4 Types of Activities for Proposed Action[a]

Activity	Units	Calendar 2023												2023 Total
Site Preparation	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Cryo Plant	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Utility Plant Building	--	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	--
Linac Complex	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--
Booster Connection	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Soil Movement	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--

Notes:

a Based on project schedule in Table F1-2 above.

Table C-4 Types of Activities for Proposed Action[a]

Activity	Units	Calendar 2024												2024 Total
Site Preparation	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Cryo Plant	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Utility Plant Building	--	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	--
Linac Complex	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--
Booster Connection	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Soil Movement	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--

Notes:

a Based on project schedule in Table F1-2 above.

Table C-4 Types of Activities for Proposed Action[a]

Activity	Units	Calendar 2025												2025 Total
Site Preparation	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Cryo Plant	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Utility Plant Building	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Linac Complex	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--
Booster Connection	--	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	--
Soil Movement	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--

Notes:

a Based on project schedule in Table F1-2 above.

Table C-4 Types of Activities for Proposed Action[a]

Activity	Units	Calendar 2026												2026 Total
Site Preparation	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Cryo Plant	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Utility Plant Building	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Linac Complex	--	N	N	N	N	N	N	N	N	N	N	N	N	--
Booster Connection	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--
Soil Movement	--	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	--

Notes:

a Based on project schedule in Table F1-2 above.

Table C-5 Construction Equipment Hours of Operation for Proposed Action[a]

Equipment	Units	Calendar 2020												2020 Total
Bulldozers	hr/mo/unit	184	168	184	176	168	176	184	168	176	35.2	33.6	36.8	**1,690**
Backhoes	hr/mo/unit	184	168	184	176	168	176	184	168	176	35.2	33.6	36.8	**1,690**
Bobcats	hr/mo/unit	174.8	159.6	174.8	167.2	159.6	167.2	174.8	159.6	167.2	35.2	33.6	36.8	**1,610**
Rollers/Compactors	hr/mo/unit	110.4	100.8	110.4	105.6	100.8	105.6	110.4	100.8	105.6	17.6	16.8	18.4	**1,003**
Scrapers (Pans)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	hr/mo/unit	110.4	100.8	110.4	105.6	100.8	105.6	110.4	100.8	105.6	17.6	16.8	18.4	**1,003**
Water Trucks	hr/mo/unit	73.6	67.2	73.6	70.4	67.2	70.4	73.6	67.2	70.4	17.6	16.8	18.4	**686**
Asphalt Paver	hr/mo/unit	36.8	33.6	36.8	35.2	33.6	35.2	36.8	33.6	35.2	17.6	16.8	18.4	**370**
Gradall	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	hr/mo/unit	92	84	92	88	84	88	92	84	88	44	42	46	**924**
Dewatering Pumps	hr/mo/unit	184	168	184	176	168	176	184	168	176	88	84	92	**1,848**
Soil Dump Trucks[b]	hr/mo total	50	50	50	50	50	50	50	50	50	50	50	50	**594**

Notes:

a Based on max construction hours per month and equipment utilization factors in Table X-14.

b Soil dump truck operating hours calculated based on amounts of soil to be moved provided in Table F1-10 and the following parameters:

15 cubic yards/trip
3 miles/trip
10 miles/hr

Table C-5 Construction Equipment Hours of Operation for l

Equipment	Units	Calendar 2021												2021 Total
Bulldozers	hr/mo/unit	168	160	184	176	168	176	176	176	176	42	44	46	**1,692**
Backhoes	hr/mo/unit	168	160	184	176	168	176	176	176	176	84	88	92	**1,824**
Bobcats	hr/mo/unit	159.6	152	174.8	132	126	132	132	132	132	42	44	46	**1,404**
Rollers/Compactors	hr/mo/unit	100.8	96	110.4	88	84	88	88	88	88	16.8	17.6	18.4	**884**
Scrapers (Pans)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	hr/mo/unit	100.8	96	110.4	88	84	88	88	88	88	16.8	17.6	18.4	**884**
Water Trucks	hr/mo/unit	67.2	64	73.6	52.8	50.4	52.8	52.8	52.8	52.8	16.8	17.6	18.4	**572**
Asphalt Paver	hr/mo/unit	33.6	32	36.8	17.6	16.8	17.6	17.6	17.6	17.6	16.8	17.6	18.4	**260**
Gradall	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	hr/mo/unit	84	80	92	44	42	44	44	44	44	126	132	138	**914**
Dewatering Pumps	hr/mo/unit	168	160	184	88	84	88	88	88	88	84	88	92	**1,300**
Soil Dump Trucks[b]	hr/mo total	39	39	39	39	39	39	39	39	39	39	39	39	**464**

Notes:

a Based on max construction hours per month and equipment utilization factors in Table X-14.

b Soil dump truck operating hours calculated based on amounts of soil to be moved provided in Table F1-10 and the following parameters:

15 cubic yards/trip
3 miles/trip
10 miles/hr

Table C-5 Construction Equipment Hours of Operation for l

Equipment	Units	Calendar 2022												2022 Total
Bulldozers	hr/mo/unit	42	40	46	42	44	44	42	46	44	42	44	44	**520**
Backhoes	hr/mo/unit	84	80	92	84	88	88	84	92	88	84	88	88	**1,040**
Bobcats	hr/mo/unit	42	40	46	42	44	44	42	46	44	42	44	44	**520**
Rollers/Compactors	hr/mo/unit	16.8	16	18.4	16.8	17.6	17.6	16.8	18.4	17.6	16.8	17.6	17.6	**208**
Scrapers (Pans)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	hr/mo/unit	16.8	16	18.4	16.8	17.6	17.6	16.8	18.4	17.6	16.8	17.6	17.6	**208**
Water Trucks	hr/mo/unit	16.8	16	18.4	16.8	17.6	17.6	16.8	18.4	17.6	16.8	17.6	17.6	**208**
Asphalt Paver	hr/mo/unit	16.8	16	18.4	16.8	17.6	17.6	16.8	18.4	17.6	16.8	17.6	17.6	**208**
Gradall	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	hr/mo/unit	126	120	138	126	132	132	126	138	132	126	132	132	**1,560**
Dewatering Pumps	hr/mo/unit	84	80	92	84	88	88	84	92	88	84	88	88	**1,040**
Soil Dump Trucks[b]	hr/mo total	67	67	67	67	67	67	67	67	67	67	67	67	**807**

Notes:

a Based on max construction hours per month and equipment utilization factors in Table X-14.

b Soil dump truck operating hours calculated based on amounts of soil to be moved provided in Table F1-10 and the following parameters:

15 cubic yards/trip
3 miles/trip
10 miles/hr

Table C-5 Construction Equipment Hours of Operation for l

Equipment	Units	Calendar 2023												2023 Total
Bulldozers	hr/mo/unit	44	40	46	80	92	88	84	92	84	88	88	84	**910**
Backhoes	hr/mo/unit	88	80	92	120	138	132	126	138	126	132	132	126	**1,430**
Bobcats	hr/mo/unit	44	40	46	160	184	176	168	184	168	176	176	168	**1,690**
Rollers/Compactors	hr/mo/unit	17.6	16	18.4	32	36.8	35.2	33.6	36.8	33.6	35.2	35.2	33.6	**364**
Scrapers (Pans)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	hr/mo/unit	17.6	16	18.4	56	64.4	61.6	58.8	64.4	58.8	61.6	61.6	58.8	**598**
Water Trucks	hr/mo/unit	17.6	16	18.4	32	36.8	35.2	33.6	36.8	33.6	35.2	35.2	33.6	**364**
Asphalt Paver	hr/mo/unit	17.6	16	18.4	32	36.8	35.2	33.6	36.8	33.6	35.2	35.2	33.6	**364**
Gradall	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	hr/mo/unit	132	120	138	160	184	176	168	184	168	176	176	168	**1,950**
Dewatering Pumps	hr/mo/unit	88	80	92	160	184	176	168	184	168	176	176	168	**1,820**
Soil Dump Trucks[b]	hr/mo total	36	36	36	36	36	36	36	36	36	36	36	36	**434**

Notes:

a Based on max construction hours per month and equipment utilization factors in Table X-14.

b Soil dump truck operating hours calculated based on amounts of soil to be moved provided in Table F1-10 and the following parameters:

15 cubic yards/trip
3 miles/trip
10 miles/hr

Table C-5 Construction Equipment Hours of Operation for l

Equipment	Units	Calendar 2024												2024 Total
Bulldozers	hr/mo/unit	92	84	84	88	92	80	46	44	42	46	42	44	**784**
Backhoes	hr/mo/unit	138	126	126	132	138	120	92	88	84	92	84	88	**1,308**
Bobcats	hr/mo/unit	184	168	168	176	184	160	46	44	42	46	42	44	**1,304**
Rollers/Compactors	hr/mo/unit	36.8	33.6	33.6	35.2	36.8	32	18.4	17.6	16.8	18.4	16.8	17.6	**314**
Scrapers (Pans)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	hr/mo/unit	64.4	58.8	58.8	61.6	64.4	56	18.4	17.6	16.8	18.4	16.8	17.6	**470**
Water Trucks	hr/mo/unit	36.8	33.6	33.6	35.2	36.8	32	18.4	17.6	16.8	18.4	16.8	17.6	**314**
Asphalt Paver	hr/mo/unit	36.8	33.6	33.6	35.2	36.8	32	18.4	17.6	16.8	18.4	16.8	17.6	**314**
Gradall	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	hr/mo/unit	184	168	168	176	184	160	138	132	126	138	126	132	**1,832**
Dewatering Pumps	hr/mo/unit	184	168	168	176	184	160	92	88	84	92	84	88	**1,568**
Soil Dump Trucks[b]	hr/mo total	34	34	34	34	34	34	34	34	34	34	34	34	**404**

Notes:

a Based on max construction hours per month and equipment utilization factors in Table X-14.

b Soil dump truck operating hours calculated based on amounts of soil to be moved provided in Table F1-10 and the following parameters:

15 cubic yards/trip
3 miles/trip
10 miles/hr

Table C-5 Construction Equipment Hours of Operation for l

Equipment	Units	Calendar 2025												2025 Total
Bulldozers	hr/mo/unit	46	40	42	44	44	84	92	84	88	92	80	92	**828**
Backhoes	hr/mo/unit	92	80	84	88	88	126	138	126	132	138	120	138	**1,350**
Bobcats	hr/mo/unit	46	40	42	44	44	84	92	84	88	92	80	92	**828**
Rollers/Compactors	hr/mo/unit	18.4	16	16.8	17.6	17.6	33.6	36.8	33.6	35.2	36.8	32	36.8	**331**
Scrapers (Pans)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	hr/mo/unit	18.4	16	16.8	17.6	17.6	33.6	36.8	33.6	35.2	36.8	32	36.8	**331**
Water Trucks	hr/mo/unit	18.4	16	16.8	17.6	17.6	33.6	36.8	33.6	35.2	36.8	32	36.8	**331**
Asphalt Paver	hr/mo/unit	18.4	16	16.8	17.6	17.6	33.6	36.8	33.6	35.2	36.8	32	36.8	**331**
Gradall	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	hr/mo/unit	138	120	126	132	132	168	184	168	176	184	160	184	**1,872**
Dewatering Pumps	hr/mo/unit	92	80	84	88	88	168	184	168	176	184	160	184	**1,656**
Soil Dump Trucks[b]	hr/mo total	25	25	25	25	25	25	25	25	25	25	25	25	**296**

Notes:

a Based on max construction hours per month and equipment utilization factors in Table X-14.

b Soil dump truck operating hours calculated based on amounts of soil to be moved provided in Table F1-10 and the following parameters:

15 cubic yards/trip
3 miles/trip
10 miles/hr

Table C-5 Construction Equipment Hours of Operation for l

Equipment	Units	Calendar 2026												2026 Total
Bulldozers	hr/mo/unit	44	40	44	44	42	44	46	42	44	44	42	46	**522**
Backhoes	hr/mo/unit	44	40	44	44	42	44	46	42	44	44	42	46	**522**
Bobcats	hr/mo/unit	44	40	44	44	42	44	46	42	44	44	42	46	**522**
Rollers/Compactors	hr/mo/unit	17.6	16	17.6	17.6	16.8	17.6	18.4	16.8	17.6	17.6	16.8	18.4	**209**
Scrapers (Pans)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	hr/mo/unit	17.6	16	17.6	17.6	16.8	17.6	18.4	16.8	17.6	17.6	16.8	18.4	**209**
Water Trucks	hr/mo/unit	17.6	16	17.6	17.6	16.8	17.6	18.4	16.8	17.6	17.6	16.8	18.4	**209**
Asphalt Paver	hr/mo/unit	17.6	16	17.6	17.6	16.8	17.6	18.4	16.8	17.6	17.6	16.8	18.4	**209**
Gradall	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	hr/mo/unit	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	hr/mo/unit	44	40	44	44	42	44	46	42	44	44	42	46	**522**
Dewatering Pumps	hr/mo/unit	88	80	88	88	84	88	92	84	88	88	84	92	**1,044**
Soil Dump Trucks[b]	hr/mo total	25	25	25	25	25	25	25	25	25	25	25	25	**296**

Notes:

a Based on max construction hours per month and equipment utilization factors in Table X-14.

b Soil dump truck operating hours calculated based on amounts of soil to be moved provided in Table F1-10 and the following parameters:

15 cubic yards/trip
3 miles/trip
10 miles/hr

Table C-6 Construction Equipment Horsepower Hours for Proposed Action[a]

Equipment	Units	Calendar 2020												2020 Total
Bulldozers	bhp/mo total	228,160	208,320	228,160	218,240	208,320	218,240	228,160	208,320	218,240	43,648	41,664	45,632	**2,095,104**
Backhoes	bhp/mo total	120,336	109,872	120,336	115,104	109,872	115,104	120,336	109,872	115,104	23,021	21,974	24,067	**1,104,998**
Bobcats	bhp/mo total	131,100	119,700	131,100	125,400	119,700	125,400	131,100	119,700	125,400	26,400	25,200	27,600	**1,207,800**
Rollers/Compactors	bhp/mo total	138,000	126,000	138,000	132,000	126,000	132,000	138,000	126,000	132,000	22,000	21,000	23,000	**1,254,000**
Scrapers (Pans)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	bhp/mo total	131,155	119,750	131,155	125,453	119,750	125,453	131,155	119,750	125,453	20,909	19,958	21,859	**1,191,802**
Water Trucks	bhp/mo total	48,576	44,352	48,576	46,464	44,352	46,464	48,576	44,352	46,464	11,616	11,088	12,144	**453,024**
Asphalt Paver	bhp/mo total	6,403	5,846	6,403	6,125	5,846	6,125	6,403	5,846	6,125	3,062	2,923	3,202	**64,310**
Gradall	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	bhp/mo total	296,700	270,900	296,700	283,800	270,900	283,800	296,700	270,900	283,800	141,900	135,450	148,350	**2,979,900**
Dewatering Pumps	bhp/mo total	216,384	197,568	216,384	206,976	197,568	206,976	216,384	197,568	206,976	103,488	98,784	108,192	**2,173,248**
Soil Dump Trucks[b]	bhp/mo total	22,381	22,381	22,381	22,381	22,381	22,381	22,381	22,381	22,381	22,381	22,381	22,381	**268,569**

Notes:

a Based on hours of operation per unit in Table F1-5 above and number of units and unit capacity in Table F1-9.

b Soil dump truck horsepower-hour totals based on total hours of operation in Table F1-5 above and unit capacity in Table F1-9.

Table C-6 Construction Equipment Horsepower Hours for P

Equipment	Units	Calendar 2021												2021 Total
Bulldozers	bhp/mo total	208,320	198,400	228,160	218,240	208,320	218,240	218,240	218,240	218,240	52,080	54,560	57,040	**2,098,080**
Backhoes	bhp/mo total	109,872	104,640	120,336	115,104	109,872	115,104	115,104	115,104	115,104	54,936	57,552	60,168	**1,192,896**
Bobcats	bhp/mo total	119,700	114,000	131,100	99,000	94,500	99,000	99,000	99,000	99,000	31,500	33,000	34,500	**1,053,300**
Rollers/Compactors	bhp/mo total	126,000	120,000	138,000	110,000	105,000	110,000	110,000	110,000	110,000	21,000	22,000	23,000	**1,105,000**
Scrapers (Pans)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	bhp/mo total	119,750	114,048	131,155	104,544	99,792	104,544	104,544	104,544	104,544	19,958	20,909	21,859	**1,050,192**
Water Trucks	bhp/mo total	44,352	42,240	48,576	34,848	33,264	34,848	34,848	34,848	34,848	11,088	11,616	12,144	**377,520**
Asphalt Paver	bhp/mo total	5,846	5,568	6,403	3,062	2,923	3,062	3,062	3,062	3,062	2,923	3,062	3,202	**45,240**
Gradall	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	bhp/mo total	270,900	258,000	296,700	141,900	135,450	141,900	141,900	141,900	141,900	406,350	425,700	445,050	**2,947,650**
Dewatering Pumps	bhp/mo total	197,568	188,160	216,384	103,488	98,784	103,488	103,488	103,488	103,488	98,784	103,488	108,192	**1,528,800**
Soil Dump Trucks[b]	bhp/mo total	17,462	17,462	17,462	17,462	17,462	17,462	17,462	17,462	17,462	17,462	17,462	17,462	**209,547**

Notes:

a Based on hours of operation per unit in Table F1-5 above and number of units and unit capacity in Table F1-9.

b Soil dump truck horsepower-hour totals based on total hours of operation in Table F1-5 above and unit capacity in Table F1-9.

Table C-6 Construction Equipment Horsepower Hours for P

Equipment	Units	Calendar 2022												2022 Total
Bulldozers	bhp/mo total	52,080	49,600	57,040	52,080	54,560	54,560	52,080	57,040	54,560	52,080	54,560	54,560	**644,800**
Backhoes	bhp/mo total	54,936	52,320	60,168	54,936	57,552	57,552	54,936	60,168	57,552	54,936	57,552	57,552	**680,160**
Bobcats	bhp/mo total	31,500	30,000	34,500	31,500	33,000	33,000	31,500	34,500	33,000	31,500	33,000	33,000	**390,000**
Rollers/Compactors	bhp/mo total	21,000	20,000	23,000	21,000	22,000	22,000	21,000	23,000	22,000	21,000	22,000	22,000	**260,000**
Scrapers (Pans)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	bhp/mo total	19,958	19,008	21,859	19,958	20,909	20,909	19,958	21,859	20,909	19,958	20,909	20,909	**247,104**
Water Trucks	bhp/mo total	11,088	10,560	12,144	11,088	11,616	11,616	11,088	12,144	11,616	11,088	11,616	11,616	**137,280**
Asphalt Paver	bhp/mo total	2,923	2,784	3,202	2,923	3,062	3,062	2,923	3,202	3,062	2,923	3,062	3,062	**36,192**
Gradall	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	bhp/mo total	406,350	387,000	445,050	406,350	425,700	425,700	406,350	445,050	425,700	406,350	425,700	425,700	**5,031,000**
Dewatering Pumps	bhp/mo total	98,784	94,080	108,192	98,784	103,488	103,488	98,784	108,192	103,488	98,784	103,488	103,488	**1,223,040**
Soil Dump Trucks[b]	bhp/mo total	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	30,413	**364,954**

Notes:

a Based on hours of operation per unit in Table F1-5 above and number of units and unit capacity in Table F1-9.

b Soil dump truck horsepower-hour totals based on total hours of operation in Table F1-5 above and unit capacity in Table F1-9.

Table C-6 Construction Equipment Horsepower Hours for P

Equipment	Units	Calendar 2023												2023 Total
Bulldozers	bhp/mo total	54,560	49,600	57,040	99,200	114,080	109,120	104,160	114,080	104,160	109,120	109,120	104,160	**1,128,400**
Backhoes	bhp/mo total	57,552	52,320	60,168	78,480	90,252	86,328	82,404	90,252	82,404	86,328	86,328	82,404	**935,220**
Bobcats	bhp/mo total	33,000	30,000	34,500	120,000	138,000	132,000	126,000	138,000	126,000	132,000	132,000	126,000	**1,267,500**
Rollers/Compactors	bhp/mo total	22,000	20,000	23,000	40,000	46,000	44,000	42,000	46,000	42,000	44,000	44,000	42,000	**455,000**
Scrapers (Pans)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	bhp/mo total	20,909	19,008	21,859	66,528	76,507	73,181	69,854	76,507	69,854	73,181	73,181	69,854	**710,424**
Water Trucks	bhp/mo total	11,616	10,560	12,144	21,120	24,288	23,232	22,176	24,288	22,176	23,232	23,232	22,176	**240,240**
Asphalt Paver	bhp/mo total	3,062	2,784	3,202	5,568	6,403	6,125	5,846	6,403	5,846	6,125	6,125	5,846	**63,336**
Gradall	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	bhp/mo total	425,700	387,000	445,050	516,000	593,400	567,600	541,800	593,400	541,800	567,600	567,600	541,800	**6,288,750**
Dewatering Pumps	bhp/mo total	103,488	94,080	108,192	188,160	216,384	206,976	197,568	216,384	197,568	206,976	206,976	197,568	**2,140,320**
Soil Dump Trucks[b]	bhp/mo total	16,330	16,330	16,330	16,330	16,330	16,330	16,330	16,330	16,330	16,330	16,330	16,330	**195,960**

Notes:

a Based on hours of operation per unit in Table F1-5 above and number of units and unit capacity in Table F1-9.

b Soil dump truck horsepower-hour totals based on total hours of operation in Table F1-5 above and unit capacity in Table F1-9.

Table C-6 Construction Equipment Horsepower Hours for P

Equipment	Units	Calendar 2024												2024 Total
Bulldozers	bhp/mo total	114,080	104,160	104,160	109,120	114,080	99,200	57,040	54,560	52,080	57,040	52,080	54,560	**972,160**
Backhoes	bhp/mo total	90,252	82,404	82,404	86,328	90,252	78,480	60,168	57,552	54,936	60,168	54,936	57,552	**855,432**
Bobcats	bhp/mo total	138,000	126,000	126,000	132,000	138,000	120,000	34,500	33,000	31,500	34,500	31,500	33,000	**978,000**
Rollers/Compactors	bhp/mo total	46,000	42,000	42,000	44,000	46,000	40,000	23,000	22,000	21,000	23,000	21,000	22,000	**392,000**
Scrapers (Pans)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	bhp/mo total	76,507	69,854	69,854	73,181	76,507	66,528	21,859	20,909	19,958	21,859	19,958	20,909	**557,885**
Water Trucks	bhp/mo total	24,288	22,176	22,176	23,232	24,288	21,120	12,144	11,616	11,088	12,144	11,088	11,616	**206,976**
Asphalt Paver	bhp/mo total	6,403	5,846	5,846	6,125	6,403	5,568	3,202	3,062	2,923	3,202	2,923	3,062	**54,566**
Gradall	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	bhp/mo total	593,400	541,800	541,800	567,600	593,400	516,000	445,050	425,700	406,350	445,050	406,350	425,700	**5,908,200**
Dewatering Pumps	bhp/mo total	216,384	197,568	197,568	206,976	216,384	188,160	108,192	103,488	98,784	108,192	98,784	103,488	**1,843,968**
Soil Dump Trucks[b]	bhp/mo total	15,206	15,206	15,206	15,206	15,206	15,206	15,206	15,206	15,206	15,206	15,206	15,206	**182,472**

Notes:

a Based on hours of operation per unit in Table F1-5 above and number of units and unit capacity in Table F1-9.

b Soil dump truck horsepower-hour totals based on total hours of operation in Table F1-5 above and unit capacity in Table F1-9.

Table C-6 Construction Equipment Horsepower Hours for P

Equipment	Units	Calendar 2025												2025 Total
Bulldozers	bhp/mo total	57,040	49,600	52,080	54,560	54,560	104,160	114,080	104,160	109,120	114,080	99,200	114,080	**1,026,720**
Backhoes	bhp/mo total	60,168	52,320	54,936	57,552	57,552	82,404	90,252	82,404	86,328	90,252	78,480	90,252	**882,900**
Bobcats	bhp/mo total	34,500	30,000	31,500	33,000	33,000	63,000	69,000	63,000	66,000	69,000	60,000	69,000	**621,000**
Rollers/Compactors	bhp/mo total	23,000	20,000	21,000	22,000	22,000	42,000	46,000	42,000	44,000	46,000	40,000	46,000	**414,000**
Scrapers (Pans)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	bhp/mo total	21,859	19,008	19,958	20,909	20,909	39,917	43,718	39,917	41,818	43,718	38,016	43,718	**393,466**
Water Trucks	bhp/mo total	12,144	10,560	11,088	11,616	11,616	22,176	24,288	22,176	23,232	24,288	21,120	24,288	**218,592**
Asphalt Paver	bhp/mo total	3,202	2,784	2,923	3,062	3,062	5,846	6,403	5,846	6,125	6,403	5,568	6,403	**57,629**
Gradall	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	bhp/mo total	445,050	387,000	406,350	425,700	425,700	541,800	593,400	541,800	567,600	593,400	516,000	593,400	**6,037,200**
Dewatering Pumps	bhp/mo total	108,192	94,080	98,784	103,488	103,488	197,568	216,384	197,568	206,976	216,384	188,160	216,384	**1,947,456**
Soil Dump Trucks[b]	bhp/mo total	11,158	11,158	11,158	11,158	11,158	11,158	11,158	11,158	11,158	11,158	11,158	11,158	**133,900**

Notes:

a Based on hours of operation per unit in Table F1-5 above and number of units and unit capacity in Table F1-9.

b Soil dump truck horsepower-hour totals based on total hours of operation in Table F1-5 above and unit capacity in Table F1-9.

Table C-6 Construction Equipment Horsepower Hours for P

Equipment	Units	Calendar 2026												2026 Total
Bulldozers	bhp/mo total	54,560	49,600	54,560	54,560	52,080	54,560	57,040	52,080	54,560	54,560	52,080	57,040	**647,280**
Backhoes	bhp/mo total	28,776	26,160	28,776	28,776	27,468	28,776	30,084	27,468	28,776	28,776	27,468	30,084	**341,388**
Bobcats	bhp/mo total	33,000	30,000	33,000	33,000	31,500	33,000	34,500	31,500	33,000	33,000	31,500	34,500	**391,500**
Rollers/Compactors	bhp/mo total	22,000	20,000	22,000	22,000	21,000	22,000	23,000	21,000	22,000	22,000	21,000	23,000	**261,000**
Scrapers (Pans)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	bhp/mo total	20,909	19,008	20,909	20,909	19,958	20,909	21,859	19,958	20,909	20,909	19,958	21,859	**248,054**
Water Trucks	bhp/mo total	11,616	10,560	11,616	11,616	11,088	11,616	12,144	11,088	11,616	11,616	11,088	12,144	**137,808**
Asphalt Paver	bhp/mo total	3,062	2,784	3,062	3,062	2,923	3,062	3,202	2,923	3,062	3,062	2,923	3,202	**36,331**
Gradall	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	bhp/mo total	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	bhp/mo total	141,900	129,000	141,900	141,900	135,450	141,900	148,350	135,450	141,900	141,900	135,450	148,350	**1,683,450**
Dewatering Pumps	bhp/mo total	103,488	94,080	103,488	103,488	98,784	103,488	108,192	98,784	103,488	103,488	98,784	108,192	**1,227,744**
Soil Dump Trucks[b]	bhp/mo total	11,158	11,158	11,158	11,158	11,158	11,158	11,158	11,158	11,158	11,158	11,158	11,158	**133,900**

Notes:

a Based on hours of operation per unit in Table F1-5 above and number of units and unit capacity in Table F1-9.

b Soil dump truck horsepower-hour totals based on total hours of operation in Table F1-5 above and unit capacity in Table F1-9.

Table C-7 Construction Worker Off-site Vehicle Travel for Proposed Action[a]

Equipment	Units	Calendar 2020												2020 Total
Bulldozers	VMT/mo	27,600	25,200	27,600	26,400	25,200	26,400	27,600	25,200	26,400	26,400	25,200	27,600	**316,800**
Backhoes	VMT/mo	41,400	37,800	41,400	39,600	37,800	39,600	41,400	37,800	39,600	39,600	37,800	41,400	**475,200**
Bobcats	VMT/mo	69,000	63,000	69,000	66,000	63,000	66,000	69,000	63,000	66,000	66,000	63,000	69,000	**792,000**
Rollers/Compactors	VMT/mo	34,500	31,500	34,500	33,000	31,500	33,000	34,500	31,500	33,000	33,000	31,500	34,500	**396,000**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	27,600	25,200	27,600	26,400	25,200	26,400	27,600	25,200	26,400	26,400	25,200	27,600	**316,800**
Water Trucks	VMT/mo	13,800	12,600	13,800	13,200	12,600	13,200	13,800	12,600	13,200	13,200	12,600	13,800	**158,400**
Asphalt Paver	VMT/mo	6,900	6,300	6,900	6,600	6,300	6,600	6,900	6,300	6,600	6,600	6,300	6,900	**79,200**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	103,500	94,500	103,500	99,000	94,500	99,000	103,500	94,500	99,000	99,000	94,500	103,500	**1,188,000**
Dewatering Pumps	VMT/mo	27,600	25,200	27,600	26,400	25,200	26,400	27,600	25,200	26,400	26,400	25,200	27,600	**316,800**
Soil Dump Trucks	VMT/mo	55,200	50,400	55,200	52,800	50,400	52,800	55,200	50,400	52,800	52,800	50,400	55,200	**633,600**

Notes:

a Number of trips assumes 10 construction workers required for each piece of construction equipment listed and that each worker makes 1 x 30-mile trip per day on passenger/light-duty vehicles.

10 worker/piece of construction equipment

1 trip per day

30 miles per trip

Table C-7 Construction Worker Off-site Vehicle Travel for F

Equipment	Units	Calendar 2021												2021 Total
Bulldozers	VMT/mo	25,200	24,000	27,600	26,400	25,200	26,400	26,400	26,400	26,400	25,200	26,400	27,600	**313,200**
Backhoes	VMT/mo	37,800	36,000	41,400	39,600	37,800	39,600	39,600	39,600	39,600	37,800	39,600	41,400	**469,800**
Bobcats	VMT/mo	63,000	60,000	69,000	66,000	63,000	66,000	66,000	66,000	66,000	63,000	66,000	69,000	**783,000**
Rollers/Compactors	VMT/mo	31,500	30,000	34,500	33,000	31,500	33,000	33,000	33,000	33,000	31,500	33,000	34,500	**391,500**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	25,200	24,000	27,600	26,400	25,200	26,400	26,400	26,400	26,400	25,200	26,400	27,600	**313,200**
Water Trucks	VMT/mo	12,600	12,000	13,800	13,200	12,600	13,200	13,200	13,200	13,200	12,600	13,200	13,800	**156,600**
Asphalt Paver	VMT/mo	6,300	6,000	6,900	6,600	6,300	6,600	6,600	6,600	6,600	6,300	6,600	6,900	**78,300**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	94,500	90,000	103,500	99,000	94,500	99,000	99,000	99,000	99,000	94,500	99,000	103,500	**1,174,500**
Dewatering Pumps	VMT/mo	25,200	24,000	27,600	26,400	25,200	26,400	26,400	26,400	26,400	25,200	26,400	27,600	**313,200**
Soil Dump Trucks	VMT/mo	50,400	48,000	55,200	52,800	50,400	52,800	52,800	52,800	52,800	50,400	52,800	55,200	**626,400**

Notes:

a Number of trips assumes 10 construction workers required for each piece of construction equipment listed and that each worker makes 1 x 30-mile trip per day on passenger/light-duty vehicles.

10 worker/piece o

1 trip per day

30 miles per trip

Table C-7 Construction Worker Off-site Vehicle Travel for F

Equipment	Units	Calendar 2022												2022 Total
Bulldozers	VMT/mo	25,200	24,000	27,600	25,200	26,400	26,400	25,200	27,600	26,400	25,200	26,400	26,400	**312,000**
Backhoes	VMT/mo	37,800	36,000	41,400	37,800	39,600	39,600	37,800	41,400	39,600	37,800	39,600	39,600	**468,000**
Bobcats	VMT/mo	63,000	60,000	69,000	63,000	66,000	66,000	63,000	69,000	66,000	63,000	66,000	66,000	**780,000**
Rollers/Compactors	VMT/mo	31,500	30,000	34,500	31,500	33,000	33,000	31,500	34,500	33,000	31,500	33,000	33,000	**390,000**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	25,200	24,000	27,600	25,200	26,400	26,400	25,200	27,600	26,400	25,200	26,400	26,400	**312,000**
Water Trucks	VMT/mo	12,600	12,000	13,800	12,600	13,200	13,200	12,600	13,800	13,200	12,600	13,200	13,200	**156,000**
Asphalt Paver	VMT/mo	6,300	6,000	6,900	6,300	6,600	6,600	6,300	6,900	6,600	6,300	6,600	6,600	**78,000**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	94,500	90,000	103,500	94,500	99,000	99,000	94,500	103,500	99,000	94,500	99,000	99,000	**1,170,000**
Dewatering Pumps	VMT/mo	25,200	24,000	27,600	25,200	26,400	26,400	25,200	27,600	26,400	25,200	26,400	26,400	**312,000**
Soil Dump Trucks	VMT/mo	50,400	48,000	55,200	50,400	52,800	52,800	50,400	55,200	52,800	50,400	52,800	52,800	**624,000**

Notes:

a Number of trips assumes 10 construction workers required for each piece of construction equipment listed and that each worker makes 1 x 30-mile trip per day on passenger/light-duty vehicles.

10 worker/piece o

1 trip per day

30 miles per trip

Table C-7 Construction Worker Off-site Vehicle Travel for F

Equipment	Units	Calendar 2023												2023 Total
Bulldozers	VMT/mo	26,400	24,000	27,600	24,000	27,600	26,400	25,200	27,600	25,200	26,400	26,400	25,200	**312,000**
Backhoes	VMT/mo	39,600	36,000	41,400	36,000	41,400	39,600	37,800	41,400	37,800	39,600	39,600	37,800	**468,000**
Bobcats	VMT/mo	66,000	60,000	69,000	60,000	69,000	66,000	63,000	69,000	63,000	66,000	66,000	63,000	**780,000**
Rollers/Compactors	VMT/mo	33,000	30,000	34,500	30,000	34,500	33,000	31,500	34,500	31,500	33,000	33,000	31,500	**390,000**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	26,400	24,000	27,600	24,000	27,600	26,400	25,200	27,600	25,200	26,400	26,400	25,200	**312,000**
Water Trucks	VMT/mo	13,200	12,000	13,800	12,000	13,800	13,200	12,600	13,800	12,600	13,200	13,200	12,600	**156,000**
Asphalt Paver	VMT/mo	6,600	6,000	6,900	6,000	6,900	6,600	6,300	6,900	6,300	6,600	6,600	6,300	**78,000**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	99,000	90,000	103,500	90,000	103,500	99,000	94,500	103,500	94,500	99,000	99,000	94,500	**1,170,000**
Dewatering Pumps	VMT/mo	26,400	24,000	27,600	24,000	27,600	26,400	25,200	27,600	25,200	26,400	26,400	25,200	**312,000**
Soil Dump Trucks	VMT/mo	52,800	48,000	55,200	48,000	55,200	52,800	50,400	55,200	50,400	52,800	52,800	50,400	**624,000**

Notes:

a Number of trips assumes 10 construction workers required for each piece of construction equipment listed and that each worker makes 1 x 30-mile trip per day on passenger/light-duty vehicles.

10 worker/piece o

1 trip per day

30 miles per trip

Table C-7 Construction Worker Off-site Vehicle Travel for F

Equipment	Units	Calendar 2024												2024 Total
Bulldozers	VMT/mo	27,600	25,200	25,200	26,400	27,600	24,000	27,600	26,400	25,200	27,600	25,200	26,400	**314,400**
Backhoes	VMT/mo	41,400	37,800	37,800	39,600	41,400	36,000	41,400	39,600	37,800	41,400	37,800	39,600	**471,600**
Bobcats	VMT/mo	69,000	63,000	63,000	66,000	69,000	60,000	69,000	66,000	63,000	69,000	63,000	66,000	**786,000**
Rollers/Compactors	VMT/mo	34,500	31,500	31,500	33,000	34,500	30,000	34,500	33,000	31,500	34,500	31,500	33,000	**393,000**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	27,600	25,200	25,200	26,400	27,600	24,000	27,600	26,400	25,200	27,600	25,200	26,400	**314,400**
Water Trucks	VMT/mo	13,800	12,600	12,600	13,200	13,800	12,000	13,800	13,200	12,600	13,800	12,600	13,200	**157,200**
Asphalt Paver	VMT/mo	6,900	6,300	6,300	6,600	6,900	6,000	6,900	6,600	6,300	6,900	6,300	6,600	**78,600**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	103,500	94,500	94,500	99,000	103,500	90,000	103,500	99,000	94,500	103,500	94,500	99,000	**1,179,000**
Dewatering Pumps	VMT/mo	27,600	25,200	25,200	26,400	27,600	24,000	27,600	26,400	25,200	27,600	25,200	26,400	**314,400**
Soil Dump Trucks	VMT/mo	55,200	50,400	50,400	52,800	55,200	48,000	55,200	52,800	50,400	55,200	50,400	52,800	**628,800**

Notes:

a Number of trips assumes 10 construction workers required for each piece of construction equipment listed and that each worker makes 1 x 30-mile trip per day on passenger/light-duty vehicles.

10 worker/piece o

1 trip per day

30 miles per trip

Table C-7 Construction Worker Off-site Vehicle Travel for F

Equipment	Units	Calendar 2025												2025 Total
Bulldozers	VMT/mo	27,600	24,000	25,200	26,400	26,400	25,200	27,600	25,200	26,400	27,600	24,000	27,600	**313,200**
Backhoes	VMT/mo	41,400	36,000	37,800	39,600	39,600	37,800	41,400	37,800	39,600	41,400	36,000	41,400	**469,800**
Bobcats	VMT/mo	69,000	60,000	63,000	66,000	66,000	63,000	69,000	63,000	66,000	69,000	60,000	69,000	**783,000**
Rollers/Compactors	VMT/mo	34,500	30,000	31,500	33,000	33,000	31,500	34,500	31,500	33,000	34,500	30,000	34,500	**391,500**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	27,600	24,000	25,200	26,400	26,400	25,200	27,600	25,200	26,400	27,600	24,000	27,600	**313,200**
Water Trucks	VMT/mo	13,800	12,000	12,600	13,200	13,200	12,600	13,800	12,600	13,200	13,800	12,000	13,800	**156,600**
Asphalt Paver	VMT/mo	6,900	6,000	6,300	6,600	6,600	6,300	6,900	6,300	6,600	6,900	6,000	6,900	**78,300**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	103,500	90,000	94,500	99,000	99,000	94,500	103,500	94,500	99,000	103,500	90,000	103,500	**1,174,500**
Dewatering Pumps	VMT/mo	27,600	24,000	25,200	26,400	26,400	25,200	27,600	25,200	26,400	27,600	24,000	27,600	**313,200**
Soil Dump Trucks	VMT/mo	55,200	48,000	50,400	52,800	52,800	50,400	55,200	50,400	52,800	55,200	48,000	55,200	**626,400**

Notes:

a Number of trips assumes 10 construction workers required for each piece of construction equipment listed and that each worker makes 1 x 30-mile trip per day on passenger/light-duty vehicles.

10 worker/piece o

1 trip per day

30 miles per trip

Table C-7 Construction Worker Off-site Vehicle Travel for F

Equipment	Units	Calendar 2026												2026 Total
Bulldozers	VMT/mo	26,400	24,000	26,400	26,400	25,200	26,400	27,600	25,200	26,400	26,400	25,200	27,600	**313,200**
Backhoes	VMT/mo	39,600	36,000	39,600	39,600	37,800	39,600	41,400	37,800	39,600	39,600	37,800	41,400	**469,800**
Bobcats	VMT/mo	66,000	60,000	66,000	66,000	63,000	66,000	69,000	63,000	66,000	66,000	63,000	69,000	**783,000**
Rollers/Compactors	VMT/mo	33,000	30,000	33,000	33,000	31,500	33,000	34,500	31,500	33,000	33,000	31,500	34,500	**391,500**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	26,400	24,000	26,400	26,400	25,200	26,400	27,600	25,200	26,400	26,400	25,200	27,600	**313,200**
Water Trucks	VMT/mo	13,200	12,000	13,200	13,200	12,600	13,200	13,800	12,600	13,200	13,200	12,600	13,800	**156,600**
Asphalt Paver	VMT/mo	6,600	6,000	6,600	6,600	6,300	6,600	6,900	6,300	6,600	6,600	6,300	6,900	**78,300**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	99,000	90,000	99,000	99,000	94,500	99,000	103,500	94,500	99,000	99,000	94,500	103,500	**1,174,500**
Dewatering Pumps	VMT/mo	26,400	24,000	26,400	26,400	25,200	26,400	27,600	25,200	26,400	26,400	25,200	27,600	**313,200**
Soil Dump Trucks	VMT/mo	52,800	48,000	52,800	52,800	50,400	52,800	55,200	50,400	52,800	52,800	50,400	55,200	**626,400**

Notes:

a Number of trips assumes 10 construction workers required for each piece of construction equipment listed and that each worker makes 1 x 30-mile trip per day on passenger/light-duty vehicles.

10 worker/piece o

1 trip per day

30 miles per trip

Table C-8 Construction Equipment Unpaved Road Onsite Travel for Proposed Action[a]

Equipment	Units	Calendar 2020												2020 Total
Bulldozers	VMT/mo	23	21	23	22	21	22	23	21	22	22	21	23	**264**
Backhoes	VMT/mo	35	32	35	33	32	33	35	32	33	33	32	35	**396**
Bobcats	VMT/mo	58	53	58	55	53	55	58	53	55	55	53	58	**660**
Rollers/Compactors	VMT/mo	29	26	29	28	26	28	29	26	28	28	26	29	**330**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	23	21	23	22	21	22	23	21	22	22	21	23	**264**
Water Trucks	VMT/mo	12	11	12	11	11	11	12	11	11	11	11	12	**132**
Asphalt Paver	VMT/mo	6	5	6	6	5	6	6	5	6	6	5	6	**66**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	86	79	86	83	79	83	86	79	83	83	79	86	**990**
Dewatering Pumps	VMT/mo	23	21	23	22	21	22	23	21	22	22	21	23	**264**
Soil Dump Trucks[b]	VMT/mo	495	495	495	495	495	495	495	495	495	495	495	495	**5,942**

Notes:

a Each piece of construction equipment is assumed to make 1 trip per day of operation with a distance of 0.25 miles.

1	trip per day
0.25	miles per trip

b See assumptions in Table F1-5, footnote b.

Table C-8 Construction Equipment Unpaved Road Onsite T

Equipment	Units	Calendar 2021												2021 Total
Bulldozers	VMT/mo	21	20	23	22	21	22	22	22	22	21	22	23	**261**
Backhoes	VMT/mo	32	30	35	33	32	33	33	33	33	32	33	35	**392**
Bobcats	VMT/mo	53	50	58	55	53	55	55	55	55	53	55	58	**653**
Rollers/Compactors	VMT/mo	26	25	29	28	26	28	28	28	28	26	28	29	**326**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	21	20	23	22	21	22	22	22	22	21	22	23	**261**
Water Trucks	VMT/mo	11	10	12	11	11	11	11	11	11	11	11	12	**131**
Asphalt Paver	VMT/mo	5	5	6	6	5	6	6	6	6	5	6	6	**65**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	79	75	86	83	79	83	83	83	83	79	83	86	**979**
Dewatering Pumps	VMT/mo	21	20	23	22	21	22	22	22	22	21	22	23	**261**
Soil Dump Trucks[b]	VMT/mo	386	386	386	386	386	386	386	386	386	386	386	386	**4,636**

Notes:

a Each piece of construction equipment is assumed to make 1 trip per day of operation with a distance of 0.25 miles.

1 trip per day

0.25 miles per trip

b See assumptions in Table F1-5, footnote b.

Table C-8 Construction Equipment Unpaved Road Onsite T

Equipment	Units	Calendar 2022												2022 Total
Bulldozers	VMT/mo	21	20	23	21	22	22	21	23	22	21	22	22	**260**
Backhoes	VMT/mo	32	30	35	32	33	33	32	35	33	32	33	33	**390**
Bobcats	VMT/mo	53	50	58	53	55	55	53	58	55	53	55	55	**650**
Rollers/Compactors	VMT/mo	26	25	29	26	28	28	26	29	28	26	28	28	**325**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	21	20	23	21	22	22	21	23	22	21	22	22	**260**
Water Trucks	VMT/mo	11	10	12	11	11	11	11	12	11	11	11	11	**130**
Asphalt Paver	VMT/mo	5	5	6	5	6	6	5	6	6	5	6	6	**65**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	79	75	86	79	83	83	79	86	83	79	83	83	**975**
Dewatering Pumps	VMT/mo	21	20	23	21	22	22	21	23	22	21	22	22	**260**
Soil Dump Trucks[b]	VMT/mo	673	673	673	673	673	673	673	673	673	673	673	673	**8,074**

Notes:

a Each piece of construction equipment is assumed to make 1 trip per day of operation with a distance of 0.25 miles.

1 trip per day

0.25 miles per trip

b See assumptions in Table F1-5, footnote b.

Table C-8 Construction Equipment Unpaved Road Onsite T

Equipment	Units	Calendar 2023												2023 Total
Bulldozers	VMT/mo	22	20	23	20	23	22	21	23	21	22	22	21	**260**
Backhoes	VMT/mo	33	30	35	30	35	33	32	35	32	33	33	32	**390**
Bobcats	VMT/mo	55	50	58	50	58	55	53	58	53	55	55	53	**650**
Rollers/Compactors	VMT/mo	28	25	29	25	29	28	26	29	26	28	28	26	**325**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	22	20	23	20	23	22	21	23	21	22	22	21	**260**
Water Trucks	VMT/mo	11	10	12	10	12	11	11	12	11	11	11	11	**130**
Asphalt Paver	VMT/mo	6	5	6	5	6	6	5	6	5	6	6	5	**65**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	83	75	86	75	86	83	79	86	79	83	83	79	**975**
Dewatering Pumps	VMT/mo	22	20	23	20	23	22	21	23	21	22	22	21	**260**
Soil Dump Trucks[b]	VMT/mo	361	361	361	361	361	361	361	361	361	361	361	361	**4,335**

Notes:

a Each piece of construction equipment is assumed to make 1 trip per day of operation with a distance of 0.25 miles.

1 trip per day

0.25 miles per trip

b See assumptions in Table F1-5, footnote b.

Table C-8 Construction Equipment Unpaved Road Onsite T

Equipment	Units	Calendar 2024												2024 Total
Bulldozers	VMT/mo	23	21	21	22	23	20	23	22	21	23	21	22	**262**
Backhoes	VMT/mo	35	32	32	33	35	30	35	33	32	35	32	33	**393**
Bobcats	VMT/mo	58	53	53	55	58	50	58	55	53	58	53	55	**655**
Rollers/Compactors	VMT/mo	29	26	26	28	29	25	29	28	26	29	26	28	**328**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	23	21	21	22	23	20	23	22	21	23	21	22	**262**
Water Trucks	VMT/mo	12	11	11	11	12	10	12	11	11	12	11	11	**131**
Asphalt Paver	VMT/mo	6	5	5	6	6	5	6	6	5	6	5	6	**66**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	86	79	79	83	86	75	86	83	79	86	79	83	**983**
Dewatering Pumps	VMT/mo	23	21	21	22	23	20	23	22	21	23	21	22	**262**
Soil Dump Trucks[b]	VMT/mo	336	336	336	336	336	336	336	336	336	336	336	336	**4,037**

Notes:

a Each piece of construction equipment is assumed to make 1 trip per day of operation with a distance of 0.25 miles.

1 trip per day

0.25 miles per trip

b See assumptions in Table F1-5, footnote b.

Table C-8 Construction Equipment Unpaved Road Onsite T

Equipment	Units	Calendar 2025												2025 Total
Bulldozers	VMT/mo	23	20	21	22	22	21	23	21	22	23	20	23	**261**
Backhoes	VMT/mo	35	30	32	33	33	32	35	32	33	35	30	35	**392**
Bobcats	VMT/mo	58	50	53	55	55	53	58	53	55	58	50	58	**653**
Rollers/Compactors	VMT/mo	29	25	26	28	28	26	29	26	28	29	25	29	**326**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	23	20	21	22	22	21	23	21	22	23	20	23	**261**
Water Trucks	VMT/mo	12	10	11	11	11	11	12	11	11	12	10	12	**131**
Asphalt Paver	VMT/mo	6	5	5	6	6	5	6	5	6	6	5	6	**65**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	86	75	79	83	83	79	86	79	83	86	75	86	**979**
Dewatering Pumps	VMT/mo	23	20	21	22	22	21	23	21	22	23	20	23	**261**
Soil Dump Trucks[b]	VMT/mo	247	247	247	247	247	247	247	247	247	247	247	247	**2,962**

Notes:

a Each piece of construction equipment is assumed to make 1 trip per day of operation with a distance of 0.25 miles.

1 trip per day

0.25 miles per trip

b See assumptions in Table F1-5, footnote b.

Table C-8 Construction Equipment Unpaved Road Onsite T

Equipment	Units	Calendar 2026												2026 Total
Bulldozers	VMT/mo	22	20	22	22	21	22	23	21	22	22	21	23	**261**
Backhoes	VMT/mo	33	30	33	33	32	33	35	32	33	33	32	35	**392**
Bobcats	VMT/mo	55	50	55	55	53	55	58	53	55	55	53	58	**653**
Rollers/Compactors	VMT/mo	28	25	28	28	26	28	29	26	28	28	26	29	**326**
Scrapers (Pans)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Grader (Blade)	VMT/mo	22	20	22	22	21	22	23	21	22	22	21	23	**261**
Water Trucks	VMT/mo	11	10	11	11	11	11	12	11	11	11	11	12	**131**
Asphalt Paver	VMT/mo	6	5	6	6	5	6	6	5	6	6	5	6	**65**
Gradall	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Large)	VMT/mo	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Mobile Crane (Truck)	VMT/mo	83	75	83	83	79	83	86	79	83	83	79	86	**979**
Dewatering Pumps	VMT/mo	22	20	22	22	21	22	23	21	22	22	21	23	**261**
Soil Dump Trucks[b]	VMT/mo	247	247	247	247	247	247	247	247	247	247	247	247	**2,962**

Notes:

a Each piece of construction equipment is assumed to make 1 trip per day of operation with a distance of 0.25 miles.

1 trip per day

0.25 miles per trip

b See assumptions in Table F1-5, footnote b.

Table C-9 Construction Equipment Inventory and Utilization

Equipment	# units	Capacity hp/unit[a]	Utilization[b]				
			Site Prep	Cryo Plant Building	Utility Plant Building	Linac Complex	Booster Connection
Bulldozers	4	310	100%	20%	25%	25%	25%
Backhoes	6	109	100%	20%	25%	50%	25%
Bobcats	10	75	75%	20%	75%	25%	25%
Rollers/Compactors	5	250	50%	10%	10%	10%	10%
Scrapers (Pans)	0	407	0%	0%	0%	0%	0%
Grader (Blade)	4	297	50%	10%	25%	10%	10%
Water Trucks	2	330	30%	10%	10%	10%	10%
Asphalt Paver	1	174	10%	10%	10%	10%	10%
Gradall	0	166	0%	0%	0%	0%	0%
Mobile Crane (Large)	0	450	0%	0%	0%	0%	0%
Mobile Crane (Truck)	15	215	25%	25%	75%	75%	25%
Dewatering Pumps	4	294	50%	50%	50%	50%	50%
Dump Trucks	8	452	100%	10%	10%	10%	10%

Notes:

a Based on typical sizes for mid-range equipment.

b Represents utilization of construction equipment for different phases.

Table C-10 Emission Calculation Inputs for Supply Trucks and Topsoil and Borrow Material Handling

Activity				Year	Paved Road Travel						Material Drops[c]	
					Supply Trucks (Onsite)[a]			Supply Trucks (Offsite)[b]			Soil	
EA Option	Location	Area	Activity Type		# trips	mi/trip	mi/yr	# trips	mi/trip	mi/yr	cy	ton
PROP	SURF	Site Preparation	All	2020	288	2.0	576	288	30	8,640		
PROP	SURF	Site Preparation	All	2021	288	2.0	576	288	30	8,640		
PROP	SURF	Site Preparation	All	2022	0	2.0	0	0	30	0		
PROP	SURF	Site Preparation	All	2023	0	2.0	0	0	30	0		
PROP	SURF	Site Preparation	All	2024	0	2.0	0	0	30	0		
PROP	SURF	Site Preparation	All	2025	0	2.0	0	0	30	0		
PROP	SURF	Site Preparation	All	2026	0	2.0	0	0	30	0		
PROP	SURF	Cryo Plant Building	All	2020	325	2.0	650	325	30	9,744		
PROP	SURF	Cryo Plant Building	All	2021	81	2.0	162	81	30	2,436		
PROP	SURF	Cryo Plant Building	All	2022	0	2.0	0	0	30	0		
PROP	SURF	Cryo Plant Building	All	2023	0	2.0	0	0	30	0		
PROP	SURF	Cryo Plant Building	All	2024	0	2.0	0	0	30	0		
PROP	SURF	Cryo Plant Building	All	2025	0	2.0	0	0	30	0		
PROP	SURF	Cryo Plant Building	All	2026	0	2.0	0	0	30	0		
PROP	SURF	Utility Plant Building	All	2020	0	2.0	0	0	30	0		
PROP	SURF	Utility Plant Building	All	2021	0	2.0	0	0	30	0		
PROP	SURF	Utility Plant Building	All	2022	0	2.0	0	0	30	0		
PROP	SURF	Utility Plant Building	All	2023	248	2.0	497	248	30	7,452		
PROP	SURF	Utility Plant Building	All	2024	166	2.0	331	166	30	4,968		
PROP	SURF	Utility Plant Building	All	2025	0	2.0	0	0	30	0		
PROP	SURF	Utility Plant Building	All	2026	0	2.0	0	0	30	0		
PROP	SURF	Linac Complex	All	2020	0	2.0	0	0	30	0		
PROP	SURF	Linac Complex	All	2021	157	2.0	314	157	30	4,715		
PROP	SURF	Linac Complex	All	2022	629	2.0	1,257	629	30	18,861		
PROP	SURF	Linac Complex	All	2023	629	2.0	1,257	629	30	18,861		
PROP	SURF	Linac Complex	All	2024	629	2.0	1,257	629	30	18,861		
PROP	SURF	Linac Complex	All	2025	629	2.0	1,257	629	30	18,861		
PROP	SURF	Linac Complex	All	2026	0	2.0	0	0	30	0		
PROP	SURF	Booster Connection	All	2020	0	2.0	0	0	30	0		
PROP	SURF	Booster Connection	All	2021	0	2.0	0	0	30	0		
PROP	SURF	Booster Connection	All	2022	0	2.0	0	0	30	0		
PROP	SURF	Booster Connection	All	2023	0	2.0	0	0	30	0		
PROP	SURF	Booster Connection	All	2024	0	2.0	0	0	30	0		
PROP	SURF	Booster Connection	All	2025	66	2.0	131	66	30	1,967		
PROP	SURF	Booster Connection	All	2026	112	2.0	225	112	30	3,373		
PROP	UNDERG	Site Preparation	Excavation	2020		2.0	0	0	30	0	26,714	36,064

Table C-10 Emission Calculation Inputs for Supply Trucks and Topsoil

Activity				Year	Diesel Combustion Emissions			Other Construction Activities	
					Supply Trucks[a,b]			Scraper Topsoil Unloading[d]	
EA Option	Location	Area	Activity Type		# trips	mi/trip	mi/yr	cy	ton
PROP	SURF	Site Preparation	All	2020	288	32	9,216		
PROP	SURF	Site Preparation	All	2021	288	32	9,216		
PROP	SURF	Site Preparation	All	2022	0	32	0		
PROP	SURF	Site Preparation	All	2023	0	32	0		
PROP	SURF	Site Preparation	All	2024	0	32	0		
PROP	SURF	Site Preparation	All	2025	0	32	0		
PROP	SURF	Site Preparation	All	2026	0	32	0		
PROP	SURF	Cryo Plant Building	All	2020	325	32	10,394		
PROP	SURF	Cryo Plant Building	All	2021	81	32	2,598		
PROP	SURF	Cryo Plant Building	All	2022	0	32	0		
PROP	SURF	Cryo Plant Building	All	2023	0	32	0		
PROP	SURF	Cryo Plant Building	All	2024	0	32	0		
PROP	SURF	Cryo Plant Building	All	2025	0	32	0		
PROP	SURF	Cryo Plant Building	All	2026	0	32	0		
PROP	SURF	Utility Plant Building	All	2020	0	32	0		
PROP	SURF	Utility Plant Building	All	2021	0	32	0		
PROP	SURF	Utility Plant Building	All	2022	0	32	0		
PROP	SURF	Utility Plant Building	All	2023	248	32	7,949		
PROP	SURF	Utility Plant Building	All	2024	166	32	5,299		
PROP	SURF	Utility Plant Building	All	2025	0	32	0		
PROP	SURF	Utility Plant Building	All	2026	0	32	0		
PROP	SURF	Linac Complex	All	2020	0	32	0		
PROP	SURF	Linac Complex	All	2021	157	32	5,030		
PROP	SURF	Linac Complex	All	2022	629	32	20,119		
PROP	SURF	Linac Complex	All	2023	629	32	20,119		
PROP	SURF	Linac Complex	All	2024	629	32	20,119		
PROP	SURF	Linac Complex	All	2025	629	32	20,119		
PROP	SURF	Linac Complex	All	2026	0	32	0		
PROP	SURF	Booster Connection	All	2020	0	32	0		
PROP	SURF	Booster Connection	All	2021	0	32	0		
PROP	SURF	Booster Connection	All	2022	0	32	0		
PROP	SURF	Booster Connection	All	2023	0	32	0		
PROP	SURF	Booster Connection	All	2024	0	32	0		
PROP	SURF	Booster Connection	All	2025	66	32	2,099		
PROP	SURF	Booster Connection	All	2026	112	32	3,597		
PROP	UNDERG	Site Preparation	Excavation	2020	0	32	0		0

Table C-10 Emission Calculation Inputs for Supply Trucks and Topsoil and Borrow Material Handling

Activity				Year	Paved Road Travel						Material Drops[c]	
					Supply Trucks (Onsite)[a]			Supply Trucks (Offsite)[b]			Soil	
EA Option	Location	Area	Activity Type		# trips	mi/trip	mi/yr	# trips	mi/trip	mi/yr	cy	ton
PROP	UNDERG	Cryo Plant Building	Excavation	2020		2.0	0	0	30	0	2,995	4,043
PROP	UNDERG	Cryo Plant Building	Excavation	2021		2.0	0	0	30	0	2,995	4,043
PROP	UNDERG	Linac Complex	Excavation	2021		2.0	0	0	30	0	20,185	27,250
PROP	UNDERG	Linac Complex	Excavation	2022		2.0	0	0	30	0	40,371	54,501
PROP	UNDERG	Linac Complex	Excavation	2023		2.0	0	0	30	0	20,185	27,250
PROP	UNDERG	Utility Plant Building	Excavation	2023		2.0	0	0	30	0	1,492	2,014
PROP	UNDERG	Linac Complex	Excavation	2024		2.0	0	0	30	0	20,185	27,250
PROP	UNDERG	Booster Connection	Excavation	2025		2.0	0	0	30	0	14,812	19,996
PROP	UNDERG	Booster Connection	Excavation	2026		2.0	0	0	30	0	14,812	19,996

Notes:

[a] Number of trips based on truck information provided to ARCADIS on April 11, 2018.
Equipment was assumed to travel 2 miles per trip on-site.

2 miles per trip

[b] Number of trips based on truck information provided to ARCADIS on April 11, 2018.
Equipment was assumed to travel 30 miles per trip on-site.

30 miles per trip

[c] Based on projected amounts of soil to be moved by trucks specified below, and an average soil density of 100 pounds per cubic foot.

26,714 cubic yards for site preparation (2020)
2,995 cubic yards for Cryo Bldg (2020 and 2021)
20,185 cubic yards for Linac (2021, 2023, 2024)
40,371 cubic yards for Linac (2022)
1,492 cubic yards for Utility (2023)
14,812 cubic yards for Booster (2025, 2026)
100 pounds per cubic foot of soil
1.35 tons per cubic yard

[d] Based on projected 23000 cubic yards of topsoil stripped in 2017 and 2018 and an average soil density of 110 pounds per cubic foot.

23,000 cubic yards of topsoil
110 pounds per cubic foot of soil
1.485 tons per cubic yard

Table C-10 Emission Calculation Inputs for Supply Trucks and Topsoil

Activity				Year	Diesel Combustion Emissions			Other Construction Activities	
					Supply Trucks[a,b]			Scraper Topsoil Unloading[d]	
EA Option	Location	Area	Activity Type		# trips	mi/trip	mi/yr	cy	ton
PROP	UNDERG	Cryo Plant Building	Excavation	2020	0	32	0		0
PROP	UNDERG	Cryo Plant Building	Excavation	2021	0	32	0		
PROP	UNDERG	Linac Complex	Excavation	2021	0	32	0		
PROP	UNDERG	Linac Complex	Excavation	2022	0	32	0		
PROP	UNDERG	Linac Complex	Excavation	2023	0	32	0		
PROP	UNDERG	Utility Plant Building	Excavation	2023	0	32	0		
PROP	UNDERG	Linac Complex	Excavation	2024	0	32	0		
PROP	UNDERG	Booster Connection	Excavation	2025	0	32	0		
PROP	UNDERG	Booster Connection	Excavation	2026	0	32	0		

Notes:

[a] Number of trips based on truck information provided to ARCADIS on April 11, 2018.
Equipment was assumed to travel 2 miles per trip on-site.

2 miles per trip

[b] Number of trips based on truck information provided to ARCADIS on April 11, 2018.
Equipment was assumed to travel 30 miles per trip on-site.

30 miles per trip

[c] Based on projected amounts of soil to be moved by trucks specified below, and an average soil density of 100 pounds per cubic foot.

26,714 cubic yards for site preparation (2020)
2,995 cubic yards for Cryo Bldg (2020 and 2021)
20,185 cubic yards for Linac (2021, 2023, 2024)
40,371 cubic yards for Linac (2022)
1,492 cubic yards for Utility (2023)
14,812 cubic yards for Booster (2025, 2026)
100 pounds per cubic foot of soil
1.35 tons per cubic yard

[d] Based on projected 23000 cubic yards of topsoil stripped in 2017 and 2018 and an average soil density of 110 pounds per cubic foot.

23,000 cubic yards of topsoil
110 pounds per cubic foot of soil
1.485 tons per cubic yard

Table C-11 Paved Road Emissions from On-site Travel

Year	Total Vehicle Miles Traveled[a] (VMT/yr)	Average Vehicle Weight (tons)	Emission Factor[b] (lb/VMT)		Emissions (ton/yr)	
			PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Proposed Action						
2020	1,226	25	1.29	0.32	0.79	0.19
2021	1,053	25	1.29	0.32	0.68	0.17
2022	1,257	25	1.29	0.32	0.81	0.20
2023	1,754	25	1.29	0.32	1.13	0.28
2024	1,589	25	1.29	0.32	1.02	0.25
2025	1,389	25	1.29	0.32	0.89	0.22
2026	225	25	1.29	0.32	0.14	0.04

Notes:

a See Table F1-10.

b Emission factor based on AP-42 Section 13.2.1 Equation 2, an assumed control efficiency of 50% provided by road watering, and parameters in tables above and below.

$E = k * sL^{0.91} * W^{1.02} * (1 - P / 4N) * (1 - 50\%)$ AP-42 Section 13.2.1 (January 2011)

E = emission factor (units of k)
k = particle size multiplier (g/VKT, g/VMT, or lb/VMT)
sL = road surface silt loading (g/m^2)
W = average vehicle weight (tons)
P = Number of days with at least 0.01 in of precipitation (from AP-42 Figure 13.2.1-2)
N = Number of days in averaging period (365 for annual)

Table C-12 Paved Road Emission Factor Calculation Parameters

Parameter	Values	Units
PM_{10} particle size multiplier (k)[a]	0.0022	lb/VMT
$PM_{2.5}$ particle size multiplier (k)[a]	0.00054	lb/VMT
Silt Loading (sL)[b]	70	g/m^2
Number of wet days (P)[c]	120	days

Notes:

a Particle size multipliers obtained from AP-42.

b Silt loading obtained from AP-42 Table 13.2.1-3 for paved roads at sand and gravel processing facilities.

c Number of wet days obtained from AP-42 Figure 13.2.1-2 based on site location.

Table C-13 Paved Road Emissions from Offsite Supply Truck Travel

Year	Total Vehicle Miles Traveled[a] (VMT/yr)	Average Vehicle Weight (tons)	Emission Factor[b] (lb/VMT)		Emissions (ton/yr)	
			PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Proposed Action						
2020	18,384	25	1.69E-02	4.15E-03	0.16	0.04
2021	15,791	25	1.69E-02	4.15E-03	0.13	0.03
2022	18,861	25	1.69E-02	4.15E-03	0.16	0.04
2023	26,313	25	1.69E-02	4.15E-03	0.22	0.05
2024	23,829	25	1.69E-02	4.15E-03	0.20	0.05
2025	20,829	25	1.69E-02	4.15E-03	0.18	0.04
2026	3,373	25	1.69E-02	4.15E-03	0.03	0.01

Notes:

a See Table F1-10.

b Emission factor based on AP-42 Section 13.2.1 Equation 2 and parameters in tables above and below.

$E = k * sL^{0.91} * W^{1.02} * (1 - P / 4N)$ AP-42 Section 13.2.1 (January 2011)

E = emission factor (units of k)
k = particle size multiplier (g/VKT, g/VMT, or lb/VMT)
sL = road surface silt loading (g/m^2)
W = average vehicle weight (tons)
P = Number of days with at least 0.01 in of precipitation (from AP-42 Figure 13.2.1-2)
N = Number of days in averaging period (365 for annual)

Table C-14 Paved Road Emission Factor Calculation Parameters

Parameter	Values	Units
PM_{10} particle size multiplier (k)[a]	0.0022	lb/VMT
$PM_{2.5}$ particle size multiplier (k)[a]	0.00054	lb/VMT
Ubiquitous Baseline Silt Loading (sL)[b]	0.2	g/m^2
Winter Baseline Multiplier[c]	3	--
Operations During Wintertime[d]	20%	%
Calculated Silt Loading (sL)[e]	0.28	g/m^2
Number of wet days (P)[f]	120	days

Notes:

a Particle size multipliers obtained from AP-42.

b Obtained from AP-42 Table 13.2.1-2 for medium volume (500 to 5,000 ADT) public roads.

c Obtained from AP-42 Table 13.2.1-2 for medium volume (500 to 5,000 ADT) public roads.

d Approximate percent of civil/site, excavation, and structural operations during wintertime.

e Calculated silt loading based on ubiquitous baseline, winter baseline, and percent of operations during wintertime.

f Number of wet days obtained from AP-42 Figure 13.2.1-2 based on site location.

Table C-15 Paved Road Emissions from Offsite Construction Worker Vehicle Travel

Year	Total Vehicle Miles Traveled[a] (VMT/yr)	Average Vehicle Weight (tons)	Emission Factor[b] (lb/VMT)		Emissions (ton/yr)	
			PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Proposed Action						
2020	4,672,800	2	1.29E-03	3.16E-04	3.00	0.74
2021	4,619,700	2	1.29E-03	3.16E-04	2.97	0.73
2022	4,602,000	2	1.29E-03	3.16E-04	2.96	0.73
2023	4,602,000	2	1.29E-03	3.16E-04	2.96	0.73
2024	4,637,400	2	1.29E-03	3.16E-04	2.98	0.73
2025	4,619,700	2	1.29E-03	3.16E-04	2.97	0.73
2026	4,619,700	2	1.29E-03	3.16E-04	2.97	0.73

Notes:

[a] See Tables F1-7 and F1-12.

[b] Emission factor based on AP-42 Section 13.2.1 Equation 2 and parameters in tables above and below.

$E = k * sL^{0.91} * W^{1.02} * (1 - P / 4N)$ AP-42 Section 13.2.1 (January 2011)

E = emission factor (units of k)
k = particle size multiplier (g/VKT, g/VMT, or lb/VMT)
sL = road surface silt loading (g/m^2)
W = average vehicle weight (tons)
P = Number of days with at least 0.01 in of precipitation (from AP-42 Figure 13.2.
N = Number of days in averaging period (365 for annual)

Table C-16 Paved Road Emission Factor Calculation Parameters

Parameter	Values	Units
PM_{10} particle size multiplier (k)[a]	0.0022	lb/VMT
$PM_{2.5}$ particle size multiplier (k)[a]	0.00054	lb/VMT
Ubiquitous Baseline Silt Loading (sL)[b]	0.2	g/m^2
Winter Baseline Multiplier[c]	3	--
Operations During Wintertime[d]	20%	%
Calculated Silt Loading (sL)[e]	0.28	g/m^2
Number of wet days (P)[f]	120	days

Notes:

[a] Particle size multipliers obtained from AP-42.

[b] Obtained from AP-42 Table 13.2.1-2 for medium volume (500 to 5,000 ADT) public roads.

[c] Obtained from AP-42 Table 13.2.1-2 for medium volume (500 to 5,000 ADT) public roads.

[d] Approximate percent of civil/site, excavation, and structural operations during wintertime.

[e] Calculated silt loading based on ubiquitous baseline, winter baseline, and percent of operations during wintertime.

[f] Number of wet days obtained from AP-42 Figure 13.2.1-2 based on site location.

Table C-17 Unpaved Road Emissions from Onsite Travel

Year	Total Vehicle Miles Traveled[a] (VMT/yr)	Average Vehicle Weight (tons)	Emission Factor[b] (lb/VMT)		Emissions (ton/yr)	
			PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Proposed Action						
2020	9,308	25	0.82	0.08	3.79	0.38
2021	7,964	25	0.82	0.08	3.25	0.32
2022	11,389	25	0.82	0.08	4.64	0.46
2023	7,650	25	0.82	0.08	3.12	0.31
2024	7,378	25	0.82	0.08	3.01	0.30
2025	6,290	25	0.82	0.08	2.56	0.26
2026	6,290	25	0.82	0.08	2.56	0.26

Notes:

[a] See Tables F1-8 and F1-13.

[b] Emission factor based on AP-42 Section 13.2.2 Equation 1a & Equation 2 for unpaved surfaces at industrial sites, an assumed control efficiency of 50% from watering, and parameters in tables above and below.

$E = k * (s/12)^a * (W/3)^b * [(365 - P)/365] * (1 - 50\%)$ AP-42 Section 13.2.2 (November 2006)

E = emission factor (lb/VMT)
k = particle size multiplier (lb/VMT)
s = surface material silt content (%)
W = average vehicle weight (tons)
a = empirical constant (adimensionless)
b = empirical constant (adimensionless)
P = Number of days with at least 0.01 in of precipitation (from AP-42 Figure 13.2.2-1)

Table C-18 Unpaved Road Emission Factor Calculation Parameters

Parameter	Values	Units
PM_{10} particle size multiplier (k)[a]	1.5	lb/VMT
$PM_{2.5}$ particle size multiplier (k)[a]	0.15	lb/VMT
a[a]	0.9	--
b[a]	0.45	--
Silt Content (s)[b]	7.1	%
Number of wet days (P)[c]	120	days

Notes:

[a] Particle size multipliers and empirical constants obtained from AP-42 Table 13.2.2-2.

[b] Silt loading obtained from AP-42 Table 13.2.2-1 for material storage areas at sand and gravel processing facilities.

[c] Number of wet days obtained from AP-42 Figure 13.2.1-2 based on site location.

Table C-19 Material Drops

Year	Average Throughput[a]	Emission Factor[b] (lb/ton)		Emissions (ton/yr)	
	ton/yr	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Proposed Action					
2020	40,107	4.62E-04	6.99E-05	9.26E-03	1.40E-03
2021	31,293	4.62E-04	6.99E-05	7.23E-03	1.09E-03
2022	54,501	4.62E-04	6.99E-05	1.26E-02	1.91E-03
2023	29,264	4.62E-04	6.99E-05	6.76E-03	1.02E-03
2024	27,250	4.62E-04	6.99E-05	6.29E-03	9.53E-04
2025	19,996	4.62E-04	6.99E-05	4.62E-03	6.99E-04
2026	19,996	4.62E-04	6.99E-05	4.62E-03	6.99E-04

Notes:

a See Table F1-10.

b Emission factor for material drop emissions based on AP-42, Section 13.2.4 equation 1 and parameters provided in tables above and below.

$E = k * 0.0032 * (U / 5)^{1.3} / (M / 2)^{1.4}$ AP-42 Section 13.2.4 (November 2006)

E = emission factor (lb/ton)
k = particle size multiplier (dimensionless)
U = mean wind speed (mph)
M = material moisture content (%)

Table C-20 Material Drop Emission Factor Calculation Parameters

Parameter[a]	Values
PM_{10} particle size multiplier (k)[a]	0.35
$PM_{2.5}$ particle size multiplier (k)[a]	0.053
Mean wind speed (U)[b] (mph)	9
Moisture Content (M)[c] (%)	6.5

Notes:

a Particle size multipliers obtained from AP-42.

b Wind speed represents average 2012 wind speed for Chicago, IL obtained from http://www.wunderground.com/history

c Assumed the average of range of observed surface moisture content values reported in AP-42 Table 13.2.2-3 for unpaved industrial roads. These surfaces are expected to dry quickly than other areas because of traffic-enhanced natural evaporation and, therefore, the selection of this moisture content is expected to be conservative.

Table C-21 Diesel Combustion Emissions from Supply Trucks

Year	Total Vehicle Miles Traveled[a] (VMT/yr)	Emissions[b]													
		CO		NO_X		PM_{10}		$PM_{2.5}$		SO_2		VOC		CO_2	
		Emission Factor (lb/VMT)	tons/yr	Emission Factor (lb/VMT)	tons/yr	Emission Factor (lb/VMT)	tons/yr	Emission Factor (lb/VMT)	tons/yr	Emission Factor (lb/VMT)	tons/yr	Emission Factor (lb/VMT)	tons/yr	Emission Factor (lb/VMT)	metric tons/yr
Proposed Action															
2020	19,610	6.51E-03	6.38E-02	1.69E-02	1.66E-01	8.49E-04	8.32E-03	6.97E-04	6.84E-03	4.03E-05	3.95E-04	1.45E-03	1.42E-02	4.21	37.45
2021	16,844	6.05E-03	5.09E-02	1.53E-02	1.29E-01	7.68E-04	6.47E-03	6.24E-04	5.25E-03	3.93E-05	3.31E-04	1.32E-03	1.11E-02	4.21	32.16
2022	20,119	5.65E-03	5.69E-02	1.39E-02	1.40E-01	7.02E-04	7.06E-03	5.61E-04	5.64E-03	4.03E-05	4.06E-04	1.20E-03	1.21E-02	4.21	38.40
2023	28,067	5.32E-03	7.47E-02	1.27E-02	1.79E-01	6.46E-04	9.06E-03	5.09E-04	7.14E-03	3.96E-05	5.55E-04	1.11E-03	1.55E-02	4.21	53.56
2024	25,418	5.04E-03	6.40E-02	1.18E-02	1.50E-01	5.94E-04	7.55E-03	4.63E-04	5.88E-03	4.03E-05	5.13E-04	1.03E-03	1.31E-02	4.22	48.61
2025	22,217	4.79E-03	5.32E-02	1.10E-02	1.22E-01	5.54E-04	6.16E-03	4.26E-04	4.73E-03	4.11E-05	4.56E-04	9.61E-04	1.07E-02	4.22	42.49
2026	3,597	4.58E-03	8.24E-03	1.03E-02	1.86E-02	5.21E-04	9.38E-04	3.96E-04	7.12E-04	4.01E-05	7.21E-05	9.02E-04	1.62E-03	4.22	6.88

Notes:

[a] See Table F1-10.

[b] Emission factors based on highest EMFAC2007 (version 2.3) for heavy-heavy-duty diesel trucks provided by the South Coast Air Quality Management District..

Table C-22 Combustion Emissions from Construction Worker Vehicles

Year	Total Vehicle Miles Traveled[a] (VMT/yr)	Emissions[b]													
		CO		NO_X		PM_{10}		$PM_{2.5}$		SO_2		VOC		CO_2	
		Emission Factor (lb/VMT)	tons/yr	Emission Factor (lb/VMT)	tons/yr	Emission Factor (lb/VMT)	tons/yr	Emission Factor (lb/VMT)	tons/yr	Emission Factor (lb/VMT)	tons/yr	Emission Factor (lb/VMT)	tons/yr	Emission Factor (lb/VMT)	metric tons/yr
Proposed Action															
2020	4,672,800	5.38E-03	12.57	5.13E-04	1.20	9.45E-05	2.21E-01	6.19E-05	1.45E-01	1.08E-05	2.52E-02	6.01E-04	1.40	1.11	2,347.61
2021	4,619,700	5.03E-03	11.62	4.73E-04	1.09	9.49E-05	2.19E-01	6.23E-05	1.44E-01	1.07E-05	2.47E-02	5.72E-04	1.32	1.11	2,319.42
2022	4,602,000	4.72E-03	10.86	4.37E-04	1.01	9.52E-05	2.19E-01	6.26E-05	1.44E-01	1.07E-05	2.47E-02	5.47E-04	1.26	1.11	2,309.01
2023	4,602,000	4.44E-03	10.22	4.05E-04	0.93	9.55E-05	2.20E-01	6.28E-05	1.44E-01	1.07E-05	2.47E-02	5.25E-04	1.21	1.11	2,308.05
2024	4,637,400	4.21E-03	9.77	3.78E-04	0.88	9.64E-05	2.24E-01	6.36E-05	1.48E-01	1.07E-05	2.49E-02	5.06E-04	1.17	1.11	2,337.35
2025	4,619,700	3.98E-03	9.19	3.51E-04	0.81	9.66E-05	2.23E-01	6.39E-05	1.48E-01	1.07E-05	2.48E-02	4.87E-04	1.12	1.11	2,328.54
2026	4,619,700	3.78E-03	8.72	3.29E-04	0.76	9.68E-05	2.24E-01	6.40E-05	1.48E-01	1.07E-05	2.47E-02	4.69E-04	1.08	1.11	2,328.52

Notes:

[a] See Tables F1-7 and F1-12.

[b] Emission factors based on highest EMFAC2007 (version 2.3) for passenger/light-duty vehicles provided by the South Coast Air Quality Management District..

Table C-23 Diesel Combustion Emissions from Soil Dump Trucks

Year	Total Rating[a] (hp-hr/yr)	Emissions[b]													
		CO		NO_X		PM_{10}		$PM_{2.5}$		SO_2		HC		CO_2	
		Emission Factor (g/hp-hr)	tons/yr	Emission Factor (g/hp-hr)	tons/yr	Emission Factor (g/hp-hr)	tons/yr	Emission Factor (g/hp-hr)	tons/yr	Emission Factor (g/hp-hr)	tons/yr	Emission Factor (g/hp-hr)	tons/yr	Emission Factor (g/hp-hr)	metric tons/yr
Proposed Action															
2020	268,569	0.8425	0.25	2.50	0.74	0.15	0.04	0.15	0.04	0.8128	0.24	0.1669	0.05	530.5	142
2021	209,547	0.8425	0.19	2.50	0.58	0.15	0.03	0.15	0.03	0.8128	0.19	0.1669	0.04	530.5	111
2022	364,954	0.8425	0.34	2.50	1.01	0.15	0.06	0.15	0.06	0.8128	0.33	0.1669	0.07	530.5	194
2023	195,960	0.8425	0.18	2.50	0.54	0.15	0.03	0.15	0.03	0.8128	0.18	0.1669	0.04	530.5	104
2024	182,472	0.8425	0.17	2.50	0.50	0.15	0.03	0.15	0.03	0.8128	0.16	0.1669	0.03	530.5	97
2025	133,900	0.8425	0.12	2.50	0.37	0.15	0.02	0.15	0.02	0.8128	0.12	0.1669	0.02	530.5	71
2026	133,900	0.8425	0.12	2.50	0.37	0.15	0.02	0.15	0.02	0.8128	0.12	0.1669	0.02	530.5	71

Notes:

[a] See Tables F1-6 and F1-11.

[b] Emission factors for SO_2, hydrocarbons (HC), CO, NO_X, and PM from EPA-420-R-10-018, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling--Compression Ignition, July 2010. Engines assumed to be Tier 3 (model years 2006 through 2010). $PM_{2.5}$ = 97% PM_{10}.

Table C-24 Diesel Combustion Emissions from Construction Equipment

Year	Total Rating[a] (hp-hr/yr)	Emissions[b] CO Emission Factor (g/hp-hr)	CO tons/yr	NO_X Emission Factor (g/hp-hr)	NO_X tons/yr	PM_{10} Emission Factor (g/hp-hr)	PM_{10} tons/yr	$PM_{2.5}$ Emission Factor (g/hp-hr)	$PM_{2.5}$ tons/yr	SO_2 Emission Factor (g/hp-hr)	SO_2 tons/yr	HC Emission Factor (g/hp-hr)	HC tons/yr	CO_2 Emission Factor (g/hp-hr)	CO_2 metric tons/yr
Proposed Action															
Bull dozers	2,095,104	0.8425	1.95	2.5000	5.77	0.1500	0.35	0.1455	0.34	0.8128	1.88	0.1669	0.39	530.5107	1,111.46
Backhoes	1,104,998	0.8667	1.06	2.5000	3.05	0.2200	0.27	0.2134	0.26	0.8127	0.99	0.1836	0.22	530.4574	586.15
Bobcats	1,207,800	2.3655	3.15	3.0000	3.99	0.2000	0.27	0.1940	0.26	0.9036	1.20	0.1836	0.24	589.7838	712.33
Rollers/Compactors	1,254,000	0.7475	1.03	2.5000	3.46	0.1500	0.21	0.1455	0.20	0.8127	1.12	0.1836	0.25	530.4574	665.18
Scrapers (Pans)	0	0.8425	0.00	2.5000	0.00	0.1500	0.00	0.1455	0.00	0.8128	0.00	0.1669	0.00	530.5107	0.00
Grader (Blade)	1,191,802	0.7475	0.98	2.5000	3.28	0.1500	0.20	0.1455	0.19	0.8127	1.07	0.1836	0.24	530.4574	632.19
Water Trucks	453,024	0.8425	0.42	2.5000	1.25	0.1500	0.07	0.1455	0.07	0.8128	0.41	0.1669	0.08	530.5107	240.33
Asphalt Paver	64,310	0.8667	0.06	2.5000	0.18	0.2200	0.02	0.2134	0.02	0.8127	0.06	0.1836	0.01	530.4574	34.11
Gradall	0	0.8667	0.00	2.5000	0.00	0.2200	0.00	0.2134	0.00	0.8127	0.00	0.1836	0.00	530.4574	0.00
Mobile Crane (Large)	0	0.8425	0.00	2.5000	0.00	0.1500	0.00	0.1455	0.00	0.8128	0.00	0.1669	0.00	530.5107	0.00
Mobile Crane (Truck)	2,979,900	0.7475	2.46	2.5000	8.21	0.1500	0.49	0.1455	0.48	0.8127	2.67	0.1836	0.60	530.4574	1,580.69
Dewatering Pumps	2,173,248	0.7475	1.79	2.5000	5.99	0.1500	0.36	0.1455	0.35	0.8127	1.95	0.1836	0.44	530.4574	1,152.80
Emergency Generator	167,500	0.8425	0.16	2.5000	0.46	0.1500	0.03	0.1455	0.03	0.8128	0.15	0.1669	0.03	530.5107	88.86
2020	**12,691,686**		**13.05**		**35.64**		**2.26**		**2.19**		**11.49**		**2.52**		**6,804.09**
2021	**11,566,178**		**11.85**		**32.45**		**2.07**		**2.00**		**10.47**		**2.29**		**6,197.90**
2022	**8,817,076**		**8.15**		**24.51**		**1.53**		**1.49**		**7.94**		**1.77**		**4,700.20**
2023	**13,396,690**		**13.59**		**37.62**		**2.36**		**2.29**		**12.13**		**2.68**		**7,181.54**
2024	**11,936,687**		**11.84**		**33.43**		**2.10**		**2.03**		**10.79**		**2.39**		**6,389.90**
2025	**11,766,462**		**11.07**		**32.77**		**2.05**		**1.99**		**10.60**		**2.36**		**6,278.43**
2026	**5,142,056**		**5.08**		**14.39**		**0.90**		**0.87**		**4.65**		**1.02**		**2,750.88**

Notes:

[a] See Tables F1-6 and F1-11. Maximum of 500 hours per year assumed for emergency generator

[b] Emission based on emission factors in table below.

Table C-25 Diesel Engine Emission Factors

Equipment	Emission Factors[a] (g/hp-hr)							BSFC (lb/hp-hr)	HP Category
	CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	HC	CO_2		
Bull dozers	0.8425	2.50	0.15	0.15	0.8128	0.1669	530.5	0.367	300-600
Backhoes	0.8667	2.50	0.22	0.21	0.8127	0.1836	530.5	0.367	100-175
Bobcats	2.3655	3.00	0.20	0.19	0.9036	0.1836	589.8	0.408	75-100
Rollers/Compactors	0.7475	2.50	0.15	0.15	0.8127	0.1836	530.5	0.367	175-300
Scrapers (Pans)	0.8425	2.50	0.15	0.15	0.8128	0.1669	530.5	0.367	300-600
Grader (Blade)	0.7475	2.50	0.15	0.15	0.8127	0.1836	530.5	0.367	175-300
Water Trucks	0.8425	2.50	0.15	0.15	0.8128	0.1669	530.5	0.367	300-600
Asphalt Paver	0.8667	2.50	0.22	0.21	0.8127	0.1836	530.5	0.367	100-175
Gradall	0.8667	2.50	0.22	0.21	0.8127	0.1836	530.5	0.367	100-175
Mobile Crane (Large)	0.8425	2.50	0.15	0.15	0.8128	0.1669	530.5	0.367	300-600
Mobile Crane (Truck)	0.7475	2.50	0.15	0.15	0.8127	0.1836	530.5	0.367	175-300
Dewatering Pumps	0.7475	2.50	0.15	0.15	0.8127	0.1836	530.5	0.367	175-300
Emergency Generator	0.8425	2.50	0.15	0.15	0.8128	0.1669	530.5	0.367	300-600

Notes:

[a] Emission factors for SO_2, hydrocarbons (HC), CO, NO_X, and PM from EPA-420-R-10-018, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling--Compression Ignition, July 2010. Engines assumed to be Tier 3 (ca. 2009 model years). $PM_{2.5}$ = 97% PM_{10}.

Table C-26 Bulldozing Emissions

Year	Hours per Year[a]	Emission Factor[b] (lb/hr)		Emissions (ton/yr)	
		PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Proposed Action					
2020	6,758	0.52	0.28	1.74	0.93
2021	6,768	0.52	0.28	1.75	0.93
2022	2,080	0.52	0.28	0.54	0.29
2023	3,640	0.52	0.28	0.94	0.50
2024	3,136	0.52	0.28	0.81	0.43
2025	3,312	0.52	0.28	0.85	0.46
2026	2,088	0.52	0.28	0.54	0.29

Notes:

[a] Based on Table F1-5 hours of operation per unit and Table F1-9 number of units.

[b] Emission factors based on AP-42 Table 11.9-1 equations and scaling factors for overburnden bulldozing, as recommended in AP-42 Section Table 13.2.3-1 for general land clearing, bulldozing, and compacting activities, and a control efficiency of 50% provided by watering.

$E_{PM10} = 1.0 * s^{1.5} / M^{1.4} * 0.75 * (1 - 50\%)$

$E_{PM2.5} = 5.7 * s^{1.2} / M^{1.3} * 0.105 * (1 - 50\%)$

E_i = emission factor of pollutant i (lb/hr)

s = material silt content (%)

M = material moisture content (%)

Table C-27 Bulldozing Emission Factor Calculation Parameters

Parameter	Values	Units
Silt Content (s)[a]	7.1	%
Moisture Content (M)[b] (%)	6.5	%

Notes:

[a] Silt loading obtained from AP-42 Table 13.2.2-1 for material storage areas at sand and gravel processing facilities.

[b] Assumed the average of range of observed surface moisture content values reported in AP-42 Table 13.2.2-3 for unpaved industrial roads. These surfaces are expected to dry more quickly than other areas because of traffic-enhanced natural evaporation and, therefore, the selection of this moisture content is expected to be conservative.

Table C-28 Topsoil Scraping Emissions

Year	Total Vehicle Miles Traveled (VMT/yr)[a]	Amount of Topsoil[b] (ton/yr)	Topsoil Removal Emission Factor[c] (lb/VMT)		Topsoil Unloading Emission Factor[d] (lb/ton)		Emissions (ton/yr)	
			PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Proposed Action								
2020	0	0	10.1	10.1	0.058	0.058	0.00	0.00
2021	0	0	10.1	10.1	0.058	0.058	0.00	0.00
2022	0	0	10.1	10.1	0.058	0.058	0.00	0.00
2023	0	0	10.1	10.1	0.058	0.058	0.00	0.00
2024	0	0	10.1	10.1	0.058	0.058	0.00	0.00
2025	0	0	10.1	10.1	0.058	0.058	0.00	0.00
2026	0	0	10.1	10.1	0.058	0.058	0.00	0.00

Notes:

[a] See Tables F1-8 and F1-13.

[b] See Table F1-10.

[c] Emission factor from AP-42, Table 13.2.3-1 assuming a control efficiency of 50% for the top soil removal provided by watering. Conservatively assumes TSP = PM_{10} = $PM_{2.5}$.

[d] Emission factor from AP-42, Table 11.9-4 as recommended in AP-42, Table 13.2.3-1 for scrapers removing topsoil. Conservatively assumes TSP = PM_{10} = $PM_{2.5}$.

Table C-29 Grading Emissions

Year	Total Vehicle Miles Traveled (VMT/yr)[a]	Emission Factor[b] (lb/hr)		Emissions (ton/yr)	
		PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Proposed Action					
2020	264	0.77	0.08	0.10	0.011
2021	261	0.77	0.08	0.10	0.011
2022	260	0.77	0.08	0.10	0.011
2023	260	0.77	0.08	0.10	0.011
2024	262	0.77	0.08	0.10	0.011
2025	261	0.77	0.08	0.10	0.011
2026	261	0.77	0.08	0.10	0.011

Notes:

[a] See Tables F1-8 and F1-13.

[b] Emission factors based on AP-42 Table 11.9-1 equations and scaling factors for grading, as recommended in AP-42 Section Table 13.2.3-1, and a control efficiency of 50% provided by watering.

$E_{PM10} = 0.051 * s^2 * 0.60 * (1 - 50\%)$

$E_{PM2.5} = 0.040 * s^{2.5} * 0.031 * (1 - 50\%)$

E_i = emission factor of pollutant i (lb/VMT)

s = material silt content (%)

Table C-30 Grading Emission Factor Calculation Parameters

Parameter	Values	Units
Silt Content (s)[a]	7.1	%

Notes:

[a] Silt content obtained from AP-42 Table 13.2.2-1 for material storage areas at sand and gravel processing facilities.

Table C-31 Construction Days per Year

Year	Days of Construction
2020	23
2020	21
2020	23
2020	22
2020	21
2020	22
2020	23
2020	21
2020	22
2020	22
2020	21
2020	23
2020 Total	264
2021	21
2021	20
2021	23
2021	22
2021	21
2021	22
2021	22
2021	22
2021	22
2021	21
2021	22
2021	23
2021 Total	261
2022	21
2022	20
2022	23
2022	21
2022	22
2022	22
2022	21
2022	23
2022	22
2022	21
2022	22
2022	22
2022 Total	260
2023	22
2023	20
2023	23
2023	20
2023	23
2023	22
2023	21
2023	23
2023	21
2023	22

Table C-31 Construction Days per Year

Year	Days of Construction
2023	22
2023	21
2023 Total	260
2024	23
2024	21
2024	21
2024	22
2024	23
2024	20
2024	23
2024	22
2024	21
2024	23
2024	21
2024	22
2024 Total	262
2025	23
2025	20
2025	21
2025	22
2025	22
2025	21
2025	23
2025	21
2025	22
2025	23
2025	20
2025	23
2025 Total	261
2026	22
2026	20
2026	22
2026	22
2026	21
2026	22
2026	23
2026	21
2026	22
2026	22
2026	21
2026	23

Table C-32 Indirect Emissions from Fermilab Worker Commutes During Operational Period

Total Vehicle Miles Traveled[a] (VMT/yr)	CO		NO_X		PM_{10}		$PM_{2.5}$		SO_2		VOC		CO_2e	
	Emission Factor[b] (lb/VMT)	tons/yr	Emission Factor[b] (lb/VMT)	tons/yr	Emission Factor[b] (lb/VMT)	tons/yr	Emission Factor[b] (lb/VMT)	tons/yr	Emission Factor[b] (lb/VMT)	tons/yr	Emission Factor[b] (lb/VMT)	tons/yr	Emission Factor[b] (lb/VMT)	metric tons/yr
109,500	3.59E-03	0.20	3.07E-04	0.02	9.68E-05	0.01	6.41E-05	0.00	1.08E-05	0.00	4.51E-04	0.02	1.11	55.21

Notes:

[a] Assumes 10 researchers and that each researcher will make one 30-mile trip per day on passenger/light-duty vehicles for 365 days per year.

10 workers
30 mile/day roundtrip
365 day/year

[b] Emission factors based on highest EMFAC2007 (version 2.3) for passenger/light-duty vehicles provided by the South Coast Air Quality Management District for year 2024.

Table C-33 Indirect Greenhouse Gas Emissions from Generation of Electricity for Proposed Action During Operational Period

Annual Electricity Use[a] (MWh/yr)	CO_2		CH_4		N_2O		CO_2e
	Emission Factor[b] (lb/MWh)	tons/yr	Emission Factor[b] (lb/GWh)	tons/yr	Emission Factor[b] (lb/GWh)	tons/yr	metric tons/yr
78,840	1,503.47	59,266.79	18.20	0.72	24.75	0.98	54,045.95

Notes:

[a] Based on an estimated electricity use of 9 MW and 8760 hours of operation per year.

9.00 MW
8,760.00 hr/yr

[b] Emission factors obtained from USEPA's "eGRID 9th edition Version 1.0 Year 2010 GHG Annual Output Emission Rates" for the RFC West subregion.

Table C-34 Direct Emissions from Natural Gas Space Heating During Operational Period

Space Heating Requirement[a] (MMBtu/hr)	CO		NO_X		PM_{10}		$PM_{2.5}$		SO_2		VOC		CO_2		Methane		N_2O		CO_2e
	Emission Factor[b] (lb/10^6 cf)	tons/yr[c]	Emission Factor[b] (lb/10^6 cf)	tons/yr[c]	Emission Factor[b] (lb/10^6 cf)	tons/yr[c]	Emission Factor[b] (lb/10^6 cf)	tons/yr[c]	Emission Factor[b] (lb/10^6 cf)	tons/yr[c]	Emission Factor[b] (lb/10^6 cf)	tons/yr[c]	Emission Factor[b] (lb/10^6 cf)	tons/yr[c]	Emission Factor[b] (lb/10^6 cf)	tons/yr[c]	Emission Factor[b] (lb/10^6 cf)	tons/yr[c]	metric tons/yr
2.7	100	#DIV/0!	84	#DIV/0!	7.60	#DIV/0!	7.60	#DIV/0!	0.60	#DIV/0!	5.50	#DIV/0!	120,000	#DIV/0!	2.30	#DIV/0!	2.20E+00	#DIV/0!	#DIV/0!

Notes:

[a] Calculated using the Calculator.net BTU calculator conservatively assuming a 60,000-square-foot space with a 12-foot height and normal insulation, temperature increase of 75 degrees Fahrenheit (cold winter regions), and a natural gas furnace efficiency of 80%.

[b] Emissions factors from AP-42 Section 1.4 for small uncontrolled boilers (under 100 MMBtu/hr)

[c] Assumes a natural gas higher heating value of Btu/scf and that the heater would be running at full capacity for 0% of the year.