DOE/EA-1570

FINAL

ENVIRONMENTAL

ASSESSMENT

Environmental Assessment for
Construction and Operation of Neutrinos at the Main Injector Off-Axis Electron Neutrino (ν_e) Appearance Experiment (NOνA) at the Fermi National Accelerator Laboratory, Batavia, Illinois, and St. Louis County, Minnesota

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U.S. Army Corps of Engineers, Cooperating Agency
St. Paul District
St. Paul, MN

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SUMMARY

Introduction. This Environmental Assessment (DOE/EA-1570) provides information and analysis of proposed U.S. Department of Energy (DOE) activities associated with constructing and operating facilities for a new neutrino physics research program called NO*ν*A. The NO*ν*A Collaboration is composed of almost 200 scientists and engineers from nearly 30 Universities and Laboratories around the world. The Fermi National Accelerator Laboratory (Fermilab) is the lead laboratory for the DOE, and the University of Minnesota is the lead collaborating university through a Cooperative Agreement with the DOE. The program would generate neutrinos at Fermilab in Batavia, Illinois, for analysis in proposed detectors at Fermilab and at a Far Detector Facility proposed to be built near the Ash River, in St. Louis County, Minnesota.

NOvA activities at the Ash River site entail a wetlands action that requires a permit from the U.S. Army Corps of Engineers (USACE). Consequently, this EA incorporates a wetlands assessment, and the USACE is a Cooperating Agency in this EA. Information contained in this EA will be used by the DOE Office of Science (DOE-SC) and the USACE to determine if the proposed action is a major federal action significantly affecting the quality of the environment.

Purpose and Need. Neutrinos are uncharged, non-ionizing elementary particles that only rarely interact with ordinary matter. The study of the oscillation of neutrinos from one type to another is considered a good way to study important physics questions, such as the properties of the weak interaction, neutrino mass, the contribution of neutrinos to the Dark Matter in the Universe, and the relationship between matter and antimatter. Understanding these particles is an important goal of the worldwide physics community, and operation of the NO*ν*A facility would implement the DOE Office of Science mission.

Proposed Action and Alternatives. The major proposed actions of the NO*ν*A Project consist of the facility modification and construction at both the Fermilab site and in St. Louis County, MN (the Ash River site). The region between the two sites would not be affected by construction, operation, or decommissioning of the proposed action.

Proposed activities at Fermilab include an upgrade of the existing Fermilab accelerator complex with an increase of beam power in the Main Injector. A new underground cavern would be excavated at approximately 345 feet below grade adjacent to an existing tunnel. This new cavern requires a modest excavation of about 1,000 cubic yards of rock using conventional civil construction and mining techniques. The cavern would hold a new 222-ton “Near Detector” to monitor the neutrino beam as it leaves the Fermilab vicinity. Two temporary facilities would be employed aboveground. Early in the program a 90-ton prototype detector would be assembled in an existing Fermilab facility to provide development and optimization for the neutrino detector. To support the blending of approximately 4.2 million gallons of scintillation detector fluid a blending facility would be constructed at Fermilab or a commercial blender near Chicago would be contracted. A constituent in the blending operation would be pseudocumene, a toxic

organic liquid at approximately 5% of the total volume. Blended scintillation fluid would be transported by tanker truck from the blending facility to the Ash River site.

A proposed new NO*ν*A "Far Detector" Facility would be constructed on a site near the US-Canadian border in St. Louis County, MN. Construction would entail a new building with dimensions 67 feet wide by 375 feet long, which would be sunk 40 feet below the existing grade into granite rock. Site preparation would include improvement to an existing logging road to facilitate all-weather access. A proposed 20,000-ton Far Detector would be constructed in part of the new building with components identical to the ones used in the Near Detector, but with dimensions, number and total volume scaled to the larger size.

The proposed action consists of four main activities: (1) excavation and construction; (2) scintillator blending, detector assembly and testing; (3) performance of the NO*ν*A experiment, and (4) decommissioning. The schedule for the proposed action has construction/excavation and assembly starting in 2008. Construction and assembly would continue through 2013. Experiment performance would begin on parts of the devices during the construction period, but sustained operations would begin in 2013 and continue through at least 2019. Following achievement of experiment objectives, decommissioning would occur over a several-year period.

Affected Environment. The existing accelerator complex at Fermilab forms the infrastructure framework upon which the proposed NO*ν*A Experiment would be built. The Fermilab site is located 61 kilometers (38 miles) west of downtown Chicago, Illinois. Its 6,800 acres straddle the boundary between eastern Kane and western DuPage counties in an area of mixed residential, commercial, and agricultural land use with a 2000 Census population of approximately 1,300,000 persons. The Fermilab facilities are a light-industrial setting supporting high-energy research, including underground accelerator rings and beam tunnels, and the Central Laboratory Area. At Fermilab, approximately 1,600 acres have remained in crop production, and about 1,000 acres have been planted in native prairie vegetation. The mixture of vegetation communities makes the Fermilab site a desirable refuge for many species of animals and many bird species use the site as a stopover during spring and fall migration.

The United States Environmental Protection Agency has designated the area within which Fermilab resides as a non-attainment area in the northeastern part of Illinois for the 8-hour ozone standard and the PM-2.5 standard (particulate matter having a median aerodynamic diameter less than 2.5 micrometers) where there are lower thresholds for air emissions of volatile organic compounds and nitrogen oxides.

The proposed location for the NO*ν*A Far Detector Facility is a currently undeveloped parcel of land about 25 miles southeast of International Falls, MN and approximately 1 mile from the boundary of Voyageurs National Park. At closest approach, the detector building would be approximately 1,000 feet from the nearest point of the Ash River, which discharges into Lake Kabetogama about 2.8 miles away. According to the 2000

Census the population density in the vicinity of the site is approximately 1 person per square mile.

No prime farm land, scarce geological resources, surface water bodies, or floodplains are within the proposed 89.6-acre Far Detector site. The approximately 3-mile long, 18.9-acre access road corridor to the proposed site would follow an existing logging road and pass through a wetlands area just as it leaves St. Louis County Road 129. The proposed site has been primarily utilized for timber cutting operations in the past, and no old growth forest exists on the property. The majority of the site has been recently clear-cut and is devoid of tree cover. During recent biological surveys, five occurrences of federal or state threatened or endangered species or critical habitats were observed within 1.5 miles of the site, but none within the site boundary or access corridor.

Environmental Impacts of Proposed Action. Any environmental impact at Fermilab would affect sites that are in use or have been used for other purposes. Impacts on air quality, local traffic and noise levels associated with construction of the proposed NO*ν*A facilities would be temporary. The proposed construction site at Fermilab is not known to contain sensitive biological resources or habitats that would be affected by construction. Labor staffing during construction would be a small fraction of the worker population accessing Fermilab under existing conditions. Effluents and wastes generated during construction would be minimized to the extent practicable and would be managed using existing facilities and procedures. Off-property impacts of the proposed action would be limited to the areas immediately adjacent to the Fermilab property boundary, where minority or low-income residents are not disproportionately congregated. Health and safety risks to workers and members of the public from construction activities are projected to be small.

Changes in work activities at Fermilab related to the operational phase of the proposed project are few. Increasing the Main Injector beam power would increase estimated radionuclide emissions and tritium in ground water. Such increases could be expected to marginally increase the potential estimated dose rate to workers with minimal offsite impacts. Increased beam power would also lead to increased activity and external dose rates from activated components. “Increased dose rates” refers to the potential for dose. DOE does not anticipate an actual increased dose to workers or the public, since engineered and administrative barriers would control exposure. Fermilab currently has an effective radiation exposure control program that would continue under the proposed action operations.

Because the Ash River site proposed for the Far Detector Facility is currently undeveloped, the proposed project would change the appearance and current use of the site. The project would include clearing, grading and excavation disturbing greater than 5 acres, and would comply with a permit issued for the discharge of storm water associated with construction activity under the National Pollutant Discharge Elimination System as implemented by the Minnesota Pollution Control Agency. The site design would minimize potential impacts to surface water. During construction there would be short-

term, localized impacts on air quality from vehicular traffic exhausts and earth-moving operations, similar to construction of any commercial facility of comparable size.

Construction of the access road would result in filling approximately 3.5 acres of wetlands, requiring a permit from the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act and conformance with the requirements of the Wetland Conservation Act of Minnesota. Approximately 5.2 acres of banked wetlands would be purchased to mitigate impacts to existing wetlands due to excavation and construction at the Far Detector site. Under Executive Order 11988, *Floodplain Management*, and Executive Order 11990, *Protection of Wetlands*, Federal agencies are required to consider the impact of proposed actions on wetlands and floodplains. The DOE requirements for compliance with Executive Orders 11988 and 11990 are found in Title 10, *Code of Federal Regulations* (*CFR*), Part 1022, "Compliance with Floodplain/Wetlands Environmental Review Requirements." A wetland assessment is included in this EA, and satisfies all the requirements of 10 *CFR* 1022. The wetlands permitting process has not been completed due to a U.S. Army Corps of Engineers requirement to first have NEPA documentation in place.

Concerns over the potential for archeological resources to be present in the project area at the Ash River site led DOE and the University of Minnesota to coordinate with the Minnesota State Historic Preservation Office and several Native American Tribes with interests in Northern Minnesota. As a result of the consultation under Section 106 of the National Historic Preservation Act, DOE prepared an Analysis of Effects Report. Subsequently, a programmatic agreement was negotiated to perform an archeological survey of the project area in the spring of 2008, prior to construction. The survey would include further investigation of historical resources, including both architectural and cultural resources. The parties to the agreement include the Minnesota State Historic Preservation Officer, the Bois Forte Band of Minnesota Chippewa Tribal Historic Preservation Officer (THPO), the White Earth Band of Minnesota Chippewa THPO, and the DOE. Other invited signatories include the University of Minnesota and the National Park Service, Voyageurs National Park.

Design criteria would be defined to minimize the visual impact of any portion of the Far Detector building that might be visible from Voyageurs National Park. The Far Detector building, which would have an above-ground height of approximately thirty-seven feet or approximately two stories, would not include any windows facing north to minimize reflected sunlight. An earthen berm with native grasses would surround much of the Far Detector building up to the roof line. Exterior colors for all buildings would be muted grays and browns. All north facing building walls would be in neutral colors to decrease contrast and visibility. Native plants and trees would be planted to soften the outlines of all buildings. In addition, the NO*ν*A Project would work with the National Park Service to design additional measures to screen or soften the appearance of the site buildings.

With 100% secondary containment of liquid scintillator and other liquids at every stage of the assembly and installation process, there should be no impact to ground water at the Ash River site during assembly, installation and operation. The adhesive that would be

used to assemble the detector modules contains methyl methacrylate (MMA), a volatile organic compound and a federal hazardous air pollutant. The health and safety plan developed for the project would detail the proposed ventilation controls intended to comply with occupational and environmental concentration standards. Site workers and contractors would conduct work under a University of Minnesota site health and safety plan and procedures for installation and assembly operations.

Some impacts to employees would be expected from the installation and assembly or operation of the NO*v*A experiment. The multiple shipments of materials via truck, tanker or rail car on and between the project sites are subject to routine traffic accidents and accidental spills. Based upon traffic accident statistics, one accident and one injury are expected during materials transportation. Nine accidents and two injuries are expected during worker commutes. Not transportation fatalities are expected. Occupational Safety and Health Administration (OSHA) reportable cases would be approximately 19, or about 1-2 per year of project schedule.

The spill of methyl methacrylate (MMA) or pseudocumene in an accident during delivery from the distributor to the NO*v*A Project in a wetland or other sensitive area could impact exposed sensitive species. While an accident during transport has a calculable probability of *occasional* (approximately 0.03~0.04), the probability that an accident would occur that also causes a spill at an environmentally sensitive area would be several orders of magnitude less (1E-04).

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GLOSSARY

Acronyms and Abbreviations

ac	acre(s)
ACGIH	American Congress of Governmental Industrial Hygienists
AET	American Engineering Testing
ALARA	As Low as Reasonably Achievable
APD	Avalanche photodiodes
AQI	Air Quality Index
Argon-41	Argon-41 radionuclide
bis-MSB	1,4-di-(2-methylstyryl)-benzene
Bq	Becquerel
bgs	below ground surface
Carbon-11	Carbon-11 radionuclide
CAS#	Chemical Abstract Service Number
CDR	Conceptual Design Report
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
Ci	curie(s)
cm	centimeter(s)
CP	Charge Parity
CUB	Central Utility Building
CY	Calendar year
DCG	Derived Concentration Guide
DEHS	Department of Environmental Health & Safety
DOE	U.S. Department of Energy
DOE-SC	U.S. Department of Energy Office of Science
DOT	U. S. Department of Transportation
EA	Environmental Assessment
EAW	Minnesota Environmental Assessment Worksheet
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EQB	Minnesota Environmental Quality Board
ES&H	Environment, Safety, and Health
Fermilab	Fermi National Accelerator Laboratory, Batavia, Illinois
FEMA	Federal Emergency Management Agency

FESHM	Fermilab Environment, Safety, & Health Manual
FNAL	Fermi National Accelerator Laboratory, Batavia, Illinois
FONSI	Finding of No Significant Impact
FRCM	Fermi Radiological Control Manual
ft	foot/feet
FY	Fiscal Year, Federal (October 1 through September 30)
gal	gallon(s)
gpd	gallons per day
gpm	gallons per minute
GeV	giga-electron volts, a billion electron volts
ha	hectare(s)
HEPAP	High Energy Physics Advisory Panel
Hydrogen-3	Hydrogen-3 radionuclide, also known as tritium
Hz	Hertz
IBC	International Building Code
ICARUS	Imaging Cosmic And Rare Underground Signals
ICRP	International Commission on Radiological Protection
ICW	Industrial Cooling Water
IEPA	Illinois Environmental Protection Agency
IFC	International Fire Code
in	inch(es)
IPND	Integration Prototype Near Detector
ISM	Integrated Safety Management
ISO	International Standards Organization
kg	kilogram
km	kilometer(s)
kt	kiloton
kW	kilowatt(s)
L	liter(s)
LCF	Latent cancer fatality
lbs	pound(s)
m	meter(s)
µCi	microcurie(s)
mi	mile(s)
MI	Main Injector
MINOS	Main Injector Neutrino Oscillation Search
ml	milliliter

MMA	methyl methacrylate adhesive
MNDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
mrem	millirem
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MW	MegaWatt
NAAQS	National Ambient Air Quality Standards
NCRP	National Council on Radiation Protection & Measurements
ν_e	Electron neutrino
NEPA	National Environmental Policy Act of 1969
NERP	National Environmental Research Park
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NHIP	National Heritage Information Program
NRHP	National Register for Historic Places
Nitrogen-13	Nitrogen-13 radionuclide
NOνA	NuMI Off-axis νe Appearance
NPDES	National Pollution Discharge Elimination System
NRCS	National Resource Conservation Service
NSF	National Safety Foundation
NuMI	Neutrinos at the Main Injector
OSHA	U.S. Occupational Safety and Health Administration
Oxygen-15	Oxygen-15 radionuclide
Pa	Pascals
pCi	picocurie
PEL-TWA	Permissible Exposure Limit – Time Weighted Average
PPE	Personal Protective Equipment
ppm	parts per million
PPO	2,5-diphenyloxazole
psi	pounds per square inch
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act of 1976
R&D	Research and development
RF	Radio Frequency
RGU	State of Minnesota Responsible Governmental Unit
RPVC	rigid polyvinyl chloride
SAD	Safety Assessment Document

SEH	Short Elliot Hendrickson
Sv	Sievert
Sodium-22	Sodium-22 radionuclide
SHPO	State Historic Preservation Office (Minnesota)
SPCC	Spill Prevention Control and Countermeasures Plan
STEL	Short-Term Exposure Limit
SWPPP	Storm Water Pollution Prevention Plan
TEC	Thermoelectric cooling
TEDE	Total Effective Dose Equivalent
TLV-TWA	Threshold Limit Value-Time Weighted Average
Tritium	Hydrogen-3 radionuclide
USACE	U.S. Army Corps of Engineers
USBM	U.S. Bureau of Mines
WLS	wavelength shifting
yd	yard(s)

DEFINITION OF TERMS

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

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

Attainment area. An area that the EPA has designated as being in compliance with one or more of the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter.

Background radiation. Radiation from (1) cosmic sources, (2) naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear materials), and (3) global fallout as it exists in the environment.

Cherenkov radiation. Electromagnetic radiation emitted when a charged particle passes through an insulator at a speed greater than the speed of light in that medium. The characteristic "blue glow" of nuclear reactors is due to Cherenkov radiation.

Combustible liquid. A combustible liquid is any liquid having a flashpoint at or above 100° F (37.8° C). Combustible liquids are divided into two classes: *Class II Liquids* having flashpoints at or above 100° F (37.8° C) and below 140° F (60° C), and *Class III Liquids* having flashpoints at or above 140°F (60°C).

Criteria Air Pollutants. Six principal pollutants for which the US Environmental Protection Agency has set National Ambient Air Quality Standards, as required by the Clean Air Act. The criteria pollutants are carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur oxides.

curie (Ci). A unit of radioactivity equal to 37 billion disintegrations per second (i.e., 37 billion becquerels); also a quantity of any radionuclide or mixture of radionuclides having 1 curie of radioactivity.

Detector. A particle detector is any device used to sense the passage of atomic or subatomic particles or to measure their properties. For many particle detectors, this involves observing and measuring the radiation (electromagnetic or ionizing) released as particles interact with a gaseous, liquid, or solid medium or an electromagnetic field.

Electron neutrino. Neutrinos are elementary particles, which exist in three different types or "flavors". They are uncharged, non-ionizing and only rarely interact with ordinary matter.

Flammable gas. A gas that is flammable in a mixture of 13% or less (by volume) with air, or the flammable range with air is wider than 12% regardless of the lower limit, at atmospheric temperature and pressure.

Flammable liquid. A liquid having a flashpoint below 37.8°C (100°F) and having a vapor pressure not exceeding 276 kPa (40 psia) at 37.8°C (100°F) is known as a Class I flammable

liquid. Class I flammable liquids are further divided into sub-classes depending on the boiling point and flash point.

Fluvial. Of, pertaining to, or inhabiting a flowing river or stream.

Ground water. Water below the ground surface in a zone of saturation.

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 effects, such as reproductive effects or birth defects, or adverse environmental effects.

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

Physical hazard – any chemical for which there is scientifically valid evidence that it is a

- Flammable or combustible liquid
- Compressed gas
- Explosive
- Flammable solid
- Oxidizer
- Peroxide
- Pyrophoric
- Unstable (reactive) or water-reactive substance.

Health hazard – any material for which there is statistically significant evidence that acute or chronic health effects may occur in exposed individuals. Such material include

- Carcinogens
- Mutagens
- Teratogens
- Toxic or acutely toxic agents
- Reproductive or developmental toxins
- Irritants
- Corrosives
- Sensitizers
- Liver, kidney, and nervous system toxins
- Agents that act on the blood-forming systems
- Agents that damage the lungs, skin, eyes, or mucous membranes.

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 in commerce, and which has been so designated. 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 EPA.

Hectare. Land area equal to approximately 2.47 acres.

Kaon. A kaon (also called K-meson) is any one of a group of four mesons distinguished by the fact that they carry a quantum number called strangeness.

Kilowatt. a thousand watts

Lacustrine. Living or growing in or along the edges of a lake.

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

Leptons. Leptons are fundamental (elementary) particles that have no strong interactions. The six known types of leptons are electrons, electron neutrinos, muons, muon neutrinos, taus, and tau neutrinos.

Limnetic. Of or occurring in the deeper, open waters of lakes or ponds.

Linac. **Lin**ear particle **ac**celerator.

Littoral. Of or on a shore, especially a seashore.

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

Migmatite. A composite rock composed of igneous or igneous-looking and / or metamorphic materials which are generally distinguishable megascopically.

microcuries (μCi). One-millionth of a curie

milliliter. One-thousandth of a liter

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

Muon neutrino. Neutrinos are elementary particles, which exist in three different types or "flavors". They are uncharged, non-ionizing and only rarely interact with ordinary matter.

Palustrine. Of, pertaining to, or living in, a marsh or swamp; marshy.

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.

Pion. A pion (abbreviation for pi meson) is the collective name for three subatomic particles: π^0, π^+, and π^-. Pions are the lightest mesons and play an important role in explaining low-energy properties of the strong nuclear force.

rem. A unit of radiation total effective dose equivalent (TEDE) based on the potential for impact on human cells.

Risk. The product of the probability of occurrence of an event or activity and the consequences 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.

Scintillant. In this report, the scintillant is pseudocumene.

Sievert. The SI (International System of Units) unit of radiation dose equivalent. (1 SV = 100 rem)

Surface water. All bodies of water on the surface of the earth and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.

Tau neutrino. Neutrinos are elementary particles, which exist in three different types or "flavors". They are uncharged, non-ionizing and only rarely interact with ordinary matter.

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.

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	25.40	millimeters	millimeters	0.03937	inches
inches	2.54	centimeters	centimeters	0.393701	inches
feet	0.3048	meters	meters	3.28084	feet
yards	0.9144	meters	meters	1.0936	yards
miles (statute)	1.60934	kilometers	kilometers	0.62137	miles (statute)
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	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	0.404687	hectares	hectares	2.47104	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir.)	28.34952	grams	grams	0.035274	ounces (avoir.)
pounds (avoir.)	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)	29.57353	milliliters	milliliters	0.033814	ounces (U.S., liquid)
quarts (U.S., liquid)	0.9463529	liters	liters	1.0567	quarts (U.S., liquid)
gallons (U.S., liquid)	3.7854	liters	liters	0.26417	gallons (U.S., liquid)
cubic feet	0.02831685	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.7645549	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	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	0.94782	British thermal unit per second	British thermal unit per second	1.055	kilowatt
Force/Pressure			**Force/Pressure**		
pounds (force) per square inch	6.894757	kilopascals	kilopascals	0.14514	
Torr	133.32	Pascals	Pascals	0.0075	

Source: *Engineering Unit Conversions*, M.R. Lindeburg, PE, third Ed., 1993, Professional Publications, Inc., Belmont, California.

* Throughout this EA, units customary to the project team are used. This table is provided to eliminate the need to report the conversion factor between Metric and English systems every time a unit is used.

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
≤	less than or equal to
>	greater than
≥	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.

1. INTRODUCTION

The U.S. Department of Energy (DOE) is proposing to conduct a new experimental research program in neutrino physics. Neutrinos are uncharged, non-ionizing elementary particles that only rarely interact with ordinary matter, including the human body. The experiment would generate neutrinos at the Fermi National Accelerator Laboratory (Fermilab) in Batavia, IL, with observations 504 miles (mi) distant at a proposed Far Detector Facility near the Ash River, in St. Louis County, Minnesota (MN) (the Ash River site). The research program is called NO*ν*A [**N**uMI **O**ff-**A**xis Electron Neutrino (ν_e) **A**ppearance Experiment]. NuMI is an acronym for Neutrinos at the Main Injector. The Main Injector (MI) is a proton accelerator at Fermilab and the proposed Far Detector near the Ash River are shown in Figure 1.1. The NO*ν*A Collaboration is composed of almost 200 scientists and engineers from nearly 30 Universities and Laboratories around the world. The Fermilab is the lead laboratory for the DOE, and the University of Minnesota is the lead collaborating university through a Cooperative Agreement with the DOE.

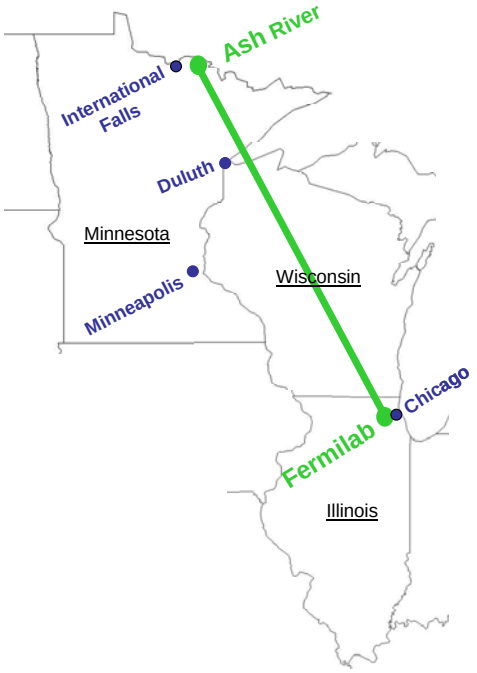

Figure 1.1: Map of the central United States showing Fermilab, the NuMI beamline, and the proposed NO*ν*A Far Detector site near the Ash River, St. Louis County, Minnesota

1.1 National Environmental Policy Act Compliance

In accordance with the National Environmental Policy Act of 1969 (NEPA), Council on Environmental Quality (CEQ) regulations at Title 40, *Code of Federal Regulations* Part

1500, and DOE NEPA implementing procedures at Title 10, *Code of Federal Regulations* Part 1021, DOE has prepared this Environmental Assessment (EA) of the direct, indirect, connected, and cumulative environmental impacts of this research program. NOvA activities at the Ash River site entail a wetlands action that requires a permit from the U.S. Army Corps of Engineers (USACE). Consequently, this EA incorporates a wetlands assessment, and the USACE is a Cooperating Agency in this EA. Information contained in this EA will be used by the DOE and USACE to determine if the proposed action is a major federal action significantly affecting the quality of the human environment. If the proposed action is determined to be a major federal action with potentially significant environmental impacts, an Environmental Impact Statement (EIS) would be required. If the proposed action is not determined to be a major federal action that could result in significant environmental impacts, a Finding of No Significant Impact (FONSI) will be issued, and the action may proceed.

Proposed actions evaluated in this EA include (1) excavation and construction of facilities; (2) blending of scintillator and installation, assembly and filling of detectors; (3) conduct of an experimental research program including operation of an accelerator at an increased power; and (4) future decommissioning activities. Some of the actions would be performed by or for Fermilab Research Alliance, LLC, on behalf of the DOE, at the Fermilab site in Illinois; some of the actions would take place in Minnesota under the auspices of the University of Minnesota through a Cooperative Agreement with DOE.

The Minnesota Environmental Assessment Worksheet (EAW) contained in Appendix A is incorporated into this EA by reference. The University of Minnesota prepared the EAW, acting as the State of Minnesota Responsible Governmental Unit (RGU) and submitted it to the Minnesota Environmental Quality Board (EQB) per State of Minnesota procedures. The EAW has completed State review and has been determined to satisfy State environmental analysis requirements. Its inclusion by reference in this EA follows the CEQ regulations (Title 40, *Code of Federal Regulations*, Section 1506.2) regarding elimination of duplication with State and local procedures.

The State of Minnesota environmental review process is similar to the Federal process for NEPA compliance review, providing public notice, a review and comment period, and a final decision record. The review and comment period for the EAW began on September 10, 2007 with the publication of the notice of availability in the *EQB Monitor* (EQB 2007a). The EAW was distributed to interested parties and local libraries as listed in Appendix A. On November 8, 2007, the RGU determined that an EIS was not necessary, and the decision was published in the *EQB Monitor* on November 17, 2007 (EQB 2007b). Comments received during the review period have been considered and addressed in this EA.

DOE performed a gap analysis comparing the DOE Environmental Assessment guidance to the EAW. Analyses of impacts at the Ash River site are summarized in this EA, supplemented with additional information required by DOE NEPA regulations and guidance.

1.2 Compliance with Wetland Environmental Review

Part of the proposed action includes adding fill to a wetland during construction of the access road to the Far Detector. Under Executive Order 11988, *Floodplain Management*, and Executive Order 11990, *Protection of Wetlands*, Federal agencies are required to consider the impact of proposed actions on wetlands and floodplains. The DOE requirements for compliance with Executive Orders 11988 and 11990 are found in Title 10, *Code of Federal Regulations* (*CFR*), Part 1022, "Compliance with Floodplain/Wetlands Environmental Review Requirements." A floodplain/wetlands assessment consists of a description of the proposed action, a discussion of its effects on the floodplain and wetlands, and consideration of the alternatives. The Executive Orders require Federal agencies to implement floodplain and wetland requirements through existing procedures, such as those established to implement the NEPA. Hence, a wetland assessment is included in this EA, and satisfies all the requirements of 10 *CFR* 1022.

1.3 DOE Office of Science and Fermilab Research Activities

The NOνA project would capitalize on the DOE's investment in the existing NuMI beamline at Fermilab. The NuMI beamline brings high energy protons extracted from the Main Injector into a graphite target. Two parabolic magnetic horns focus the resulting secondary beam which produces neutrinos from pion and kaon decay. The neutrino beam is aimed at the existing Main Injector Neutrino Oscillation Search (MINOS) Far Detector in the Soudan Mine located in Tower, Minnesota.

Whereas MINOS technology was optimized for detecting muon neutrinos, the NOνA design is optimized for detecting electron neutrinos. The proposed NOνA Near Detector at Fermilab would reveal the NuMI neutrino beam composition before oscillations occur, and a proposed Far Detector in northern Minnesota would measure the oscillations after the neutrino beam travels through several hundred kilometers of the earth's surface.

The NOνA Near Detector would be located in the existing NuMI underground experimental hall. The NOνA Far Detector would be positioned approximately 7.5 mi from the central axis of the NuMI neutrino beam in the area of the Ash River. The neutrino beam would pass underground from Fermilab to northern Minnesota. Tunneling is not required; since the neutrinos have so little mass, they simply pass through the earth's crust.

Detailed explanations of the NOνA experiment can be found at the project's website (http://www-nova.fnal.gov). Further information on the research programs of the DOE is available at the DOE Office of Science website (http://www.sc.doe.gov).

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2. PURPOSE AND NEED

The purpose of the NOνA experiment is to advance human understanding of the physics of the neutrino particle. Neutrinos are useful probes of the weak interaction, one of the four fundamental forces in the Universe. They exist in three different forms, and a study of the oscillation of neutrinos from one form to another is considered a good way to study important physics questions, such as the properties of the weak interaction, neutrino mass, the contribution of neutrinos to the Dark Matter in the Universe, and the relationship between matter and antimatter.

The DOE Office of Science has previously constructed a neutrino laboratory and detector at Soudan, MN, which intercepts a neutrino beam from Fermilab, near Batavia IL. The proposed detector at the Ash River site will be aligned to use the same Fermilab-to-Soudan neutrino beam, but at a greater distance. In contrast to the Soudan neutrino detector, which measures the parameters of a neutrino oscillation that is known to occur, the Ash River neutrino detector will search for a different, previously unobserved oscillation.

The observation of neutrino oscillations means that neutrinos have non-zero masses. Knowledge about these oscillations is needed to determine the ordering of the neutrino masses and to search for the effects of neutrino oscillations violating Charge Parity (CP) conservation. CP violation by neutrinos could provide information leading to an understanding of why the Universe is composed solely of matter, rather than equal amounts of matter and antimatter. Understanding these particles is an important goal of the worldwide physics community, and operation of the NOνA facility would implement the DOE Office of Science mission to support basic research in the physical sciences.

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3. PROPOSED ACTION AND ALTERNATIVES

This section describes the proposed action and alternatives to the proposed action, including the No-Action Alternative. Facility design and construction details described for the proposed action are based on conceptual plans described in the NO*v*A *Conceptual Design Report* (Cooper and Ray 2006), as modified by the NO*v*A *Technical Design Report* (NO*v*A 2007b). The final design for construction may differ from that discussed within this EA. However, the nature, scope, and environmental impacts of the proposed action described in this document are expected to substantially reflect and bound those associated with actual construction and operation of the facility as described in the NO*v*A *Technical Design Report.*

3.1 Summary of the Proposed Action

The proposed action would consist of activities occurring in four phases: excavation and construction; detector assembly and installation; operation and performance of the NO*v*A experiment, and decommissioning. All four phases would occur at both Fermilab and at a site near the Ash River in St. Louis County, MN. The NO*v*A Project consists of the following proposed facility modification and construction activities. Details of the facilities are discussed in Section 3.3 for Fermilab and in Section 3.4 for Ash River. Alternatives to the proposed action are identified in Section 3.5, and the No Action Alternative is discussed in Section 3.6.

3.1.1 Proposed Activities at Fermilab

Proposed new or upgraded facilities to be constructed at Fermilab include:

- An Upgrade of the Existing Fermilab Accelerator Complex from 400 kilowatt (kW) to 700 kW beam power
- A 90-ton Integration Prototype Near Detector (IPND) to evaluate components of the NO*v*A detector in an initial research and development phase
- Use of a commercial facility in the Chicago metropolitan area for blending the approximately 4 million gallons needed to fill the three NO*v*A detectors (The alternatives are discussed in Section 3.5)
- A new underground cavern to hold the Near Detector adjacent to the existing MINOS detector in the existing NuMI tunnel at Fermilab
- A 222-ton Near Detector installed in the new underground cavern to measure the inherent NuMI beam as it leaves the Fermilab complex.

3.1.2 Proposed Activities at Ash River

The proposed Far Detector Facility would include new or upgraded facilities to be constructed at the Ash River site. These include:

- A Proposed 20,000-ton (20-kiloton) NO*v*A Far Detector;

- A building to house the detector and Detector Hall; to provide areas for detector assembly and filling; and to accommodate experiment operations and logistical support;
- An upgrade to an existing logging road to allow all-weather access to the site, including adding fill to a wetland.

3.1.3 Activities by NO*ν*A Collaborators at Individual Institutions

The NO*ν*A Collaboration is composed of almost 200 scientists and engineers from nearly 30 Universities and Laboratories worldwide. Work execution described in this assessment relies on the efforts of these collaborators to design, test and evaluate both calculational models and actual physical samples of the materials and methods discussed herein. Therefore the materials and methods encompassing the proposed action may be performed in small scale using laboratory-sized samples at many locations not specifically identified.

Because of the small scale and limited materials in process, environmental impacts of these NO*ν*A-related activities would be anticipated to be similar to and within the range of existing operations at the various educational facilities. Normally, these kinds of activities are categorically excluded from NEPA. The production scale activities which would have the greatest potential for environmental impacts are discussed and evaluated in this assessment.

3.1.4 Sequencing and Schedule

At Fermilab start on the excavation and construction of the new underground cavern would be delayed until 2011, to allow planned use of the NuMI beam by existing experiment plans. In the interim, research and development (R&D) efforts on the IPND would begin with small-scale quality assurance tests on blending operations from the commercial blending facility in the Chicago area and the assembly, filling, and testing of the IPND in 2009. Fewer than 10 personnel would be involved. Construction of the cavern and the blending facility and full-scale blending operations would occur during 2010 to 2013 with approximately 30 scientists and excavation/construction workers. Detector operation is expected through 2020, with an average staff of 2 and several intermittent scientific visitors. At the end of the detector operation period in 2020, draining the detector and demolition of the PVC structure would occur in 6-8 months with a staff of fewer than 10.

At the Ash River site, the University of Minnesota would commence construction in 2008, depending on funds availability and the weather. Site excavation and building construction are expected to last through 2010 with a staff of 10-40 workers. Detector assembly and installation are expected to occur between 2010 and 2013. During installation, 30 to 50 people are expected to work at the site, either as employees or contractors. Detector operation is expected through 2020. Average staff and scientific visitor count during operations is expected to be fewer than 10 people. At the conclusion of the detector operation period, draining the detector and demolition of the

polyvinylchloride (PVC) structure would extend to 2025 with 3-5 personnel. The Cooperative Agreement between DOE and the University will require the DOE to remove all of its equipment and to remediate any issues resulting from its equipment. The University will own the site and buildings.

3.2 Description of the NO*v*A Detectors

Appendix B describes the detector technology for the NO*v*A Experiment and introduces the facilities design and operation and other components required for the experiment. This discussion provides background for understanding the need for the extent of the activities proposed for Fermilab followed by a similar discussion for the Ash River site.

3.3 Fermilab Site Proposed Action

3.3.1 Excavation and Construction Activities at Fermilab

The construction of the proposed NO*v*A facilities at Fermilab would follow conventional construction practices for both surface and tunneling. Access to construction areas would be limited to construction workers and to Fermilab and DOE employees who would administer and monitor construction activities. Experienced contractors would perform the tunneling. All construction activities would conform to applicable regulations of the U. S. Mine Safety and Health Administration (30 *CFR* Parts 1 to 199), the U. S. Occupational Safety and Health Administration (29 *CFR* Part 1926) and the U. S. DOE (10 *CFR* Part 851), as applied through policies and procedures of the Fermilab Environment, Safety and Health Manual (FESHM) (Fermilab 2006) to assure safety to workers and the public and to protect the environment. For example, work plans would address worker protection on excessively cold and hot days.

Fermilab imposes safety requirements on construction contractors by including an appropriate standard appendix in the construction contract. *Exhibit A, Schedule and Supplementary Terms and Conditions* (Fermilab 2006) imposes specific requirements for ensuring that the contractor's health and safety program elements conform to the principles of Integrated Safety Management (ISM) and comply with requirements of the FESHM. The contractor's implementation of the conditions of *Exhibit A* into work practices and compliance with regulatory safety standards during job performance are subject to review by at least two Fermilab officials, the Fermilab Construction Coordinator and the Fermilab ES&H Safety Coordinator. *Exhibit A* describes responsibilities of these officials (Fermilab 2006).

Applicable environmental controls also would be required. For instance, a Storm Water Pollution Prevention Plan (SWPPP) would be prepared in accordance with guidance from the Illinois Environmental Protection Agency (IEPA). Implementation would include erection and maintenance of proper soil erosion barriers around all disturbed soil and rock stockpile areas as specified in the Illinois Urban Manual (USDA 2002). A combination of silt fences, hay bales and excavated temporary waterways would be used to direct storm water away from wetlands and sensitive resources and to detain water

long enough for the sediment to settle prior to flowing into surface water. If needed, a stormwater discharge permit would be obtained from the IEPA.

3.3.1.1 Upgrade of the Neutrino Beam

The neutrino beam from NO*ν*A would be generated by transporting the accelerated protons along the existing NuMI beam line to a target. Proton interactions in the target produce secondary particles, which are refocused along the NuMI line by an electromagnetic device called a horn. Decays of these secondary particles produce the neutrinos used by NO*ν*A. The NuMI neutrino line would handle the increased beam power with upgrades to cooling systems. A new NuMI target would be required to handle the increased beam power and the focusing horn would be moved about 40 ft to optimize the neutrino intensity for NO*ν*A.

Figure 3.1 shows the Fermilab accelerator complex and proton source for NO*ν*A. The accelerator and NuMI upgrades for NO*ν*A would provide an increased beam power relative to the current output (from 400 kW to 700 kW). Increased beam power is accomplished by reconfiguring the Recycler into a proton storage device and by increasing the acceleration rate and repetition rate of the Main Injector (MI). The Recycler and the MI share a common circular tunnel. Cooling modifications to the proton source and upgrades in the NuMI neutrino line are also required to handle the higher beam power. In most cases existing components in the accelerator complex are simply reconfigured for the NO*ν*A upgrade, but a few additional new components are required as described in this section.

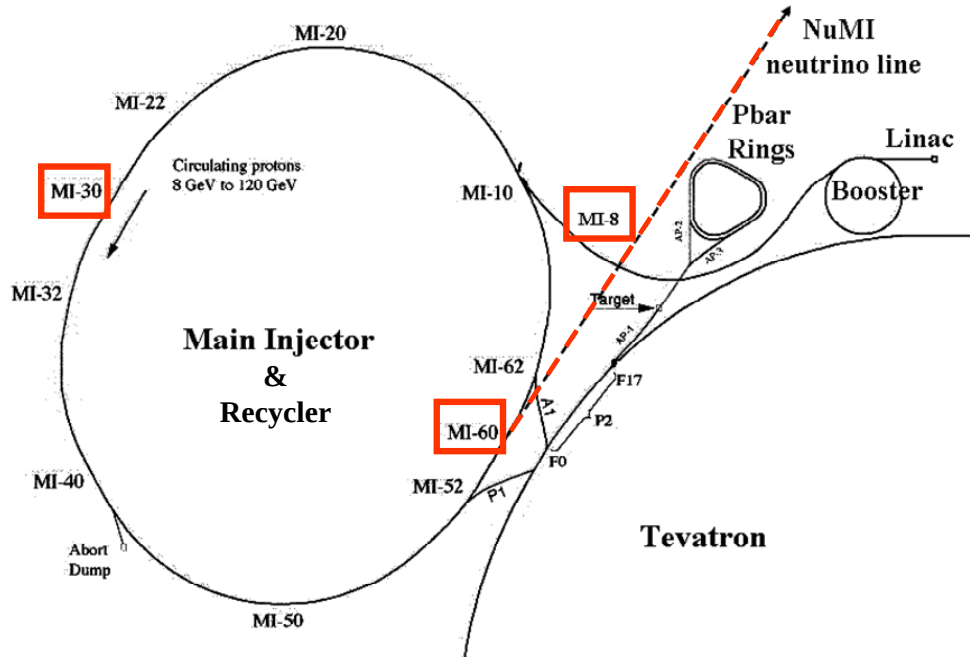


Figure 3.1: Plan view layout of the Fermilab proton source consisting of the Linac, Booster, Recycler, MI and NuMI neutrino line. The Recycler and MI are in the same tunnel.

Recycler Upgrades

The Recycler is a permanent magnet machine designed for beam transport at a single energy (8 GeV). A string of magnets with a single strength can steer a charged beam in a circle, but the beam can only move at a single speed, so machines like the Recycler can store charged particle beams but cannot accelerate those beams.

The Recycler is an existing machine in the MI tunnel and currently serves as the main anti-proton storage ring for the ongoing Tevatron Collider program. As mentioned, when Tevatron Collider operations cease in 2010, the Recycler would be converted for use as a proton storage ring for the MI for NO*v*A. Eleven batches of protons from the Fermilab Booster accelerator can be put into the Recycler over a short period of time. This process is called beam stacking. Figure 3.1 shows the layout of the Recycler, MI and NuMI beamline.

Anti-proton-specific devices would be removed from the Recycler to convert from an anti-proton storage ring to a proton storage ring for the NO*v*A experiment. A new line of magnets would be built to steer protons from the Fermilab Booster accelerator to the Recycler. This proton injection line would be built in an existing tunnel connecting MI-8 (from the Booster) into the Recycler. Similarly, a new extraction line from the Recycler to the MI would be built within the existing tunnel at MI-30. Figure 3.1 indicates the MI-

8 and MI-30 locations around the Main Injector / Recycler tunnel. The injection and extraction beamlines would require new kicker magnet systems to kick (or push) the beam from the beamline into (or out of) the circular machines.

Even a coasting beam at a single energy requires some additional energy input to keep it going, so a new Radio Frequency (RF) system is required for this additional energy input. This coasting beam would use two new RF cavities with controls and power installed in the MI-60 service building. An RF system works by giving the protons an electromagnetic kick along their direction of travel each time they complete a circuit of the circular machine. Each time a proton enters an RF cavity, it sees a voltage difference designed to push it forward. The Recycler instrumentation for beam monitoring would be upgraded as part of the NO*ν*A project.

Main Injector Upgrades

Unlike the Recycler, the MI uses electromagnets, and these magnets can strengthen with time by increasing the electrical power to the electromagnet windings. The MI accelerates protons to an energy of 120 GeV. For NO*ν*A the MI would accelerate only 10% more protons than in current operations, but the beam power out of the MI would be much larger because the MI cycle time (time required to increase the magnet strength) would be reduced from 2.2 seconds to 1.33 seconds. This reduction is accomplished by using the Recycler Ring for beam stacking and avoiding the time currently lost in the MI as the Booster protons are stacked there. The reduction is also accomplished by increasing the maximum MI acceleration rate (rate at which the magnets increase their strength). This faster rate requires an upgrade to one of the magnet power supplies.

The MI magnets give a push to the protons perpendicular to their direction of travel so that the protons keep moving in the circular orbit of the machine. An accelerator like the MI accelerates the beam by giving the protons a push with RF along their direction of travel each time they complete a pass around the circle. Since additional energy must be added to accelerate the beam more quickly, two extra RF stations would be added to complement the existing 18 stations.

NuMI Beamline Upgrades

The target and focusing horn locations would be changed to positions optimized for NO*ν*A neutrino production. A new target would be required to handle the increased beam power. Other parts of the NuMI beamline upgrade would consist of cooling modifications to handle an increase in beam power from 400 kW to 700 kW and power supply upgrades to allow operations at the faster cycle time.

3.3.1.2 NOνA Near Detector Cavern

The proposed NO*ν*A Near Detector would be located in a new underground cavern off the existing MINOS access tunnel as shown in Figure 3.2. This new cavern requires an excavation of about 1,000 yd^3 of rock using conventional civil construction and mining techniques. Access to the underground area is via the existing MINOS vertical shaft.

This Near Detector site would be located 3,287 ft from the NuMI Target Hall and 345 ft below grade. The proposed cavern is on a level grade and can meet the size requirements for the near detector. Necessary utility services can be drawn from supplies existing in the tunnel. The cavern and Near Detector are located off-axis at the same angle of 14.6 milliradians (mrad) as the Far Detector in Ash River, as illustrated in Figure 3.3.

Figure 3.2: Plan view and elevation (top) views of the NuMI beam line at Fermilab. The NOvA Near Detector would be located in the underground tunnel in the area labeled "NOvA cavern".

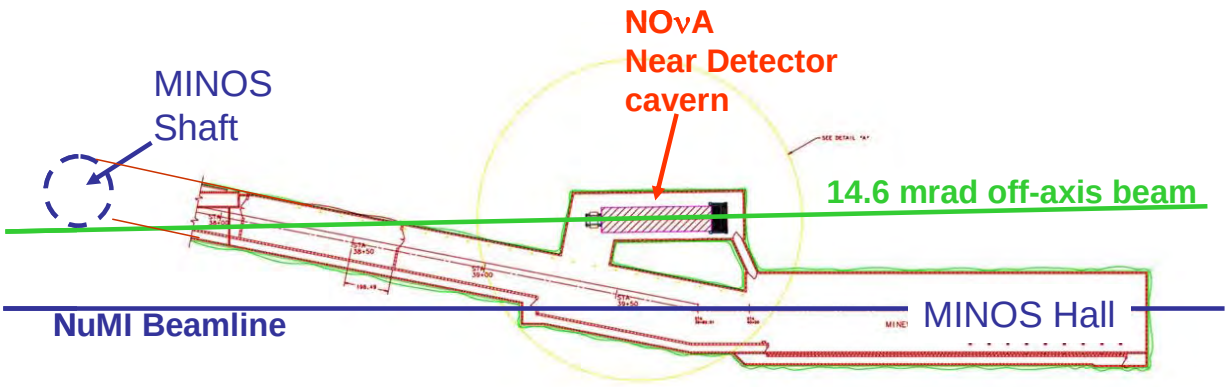
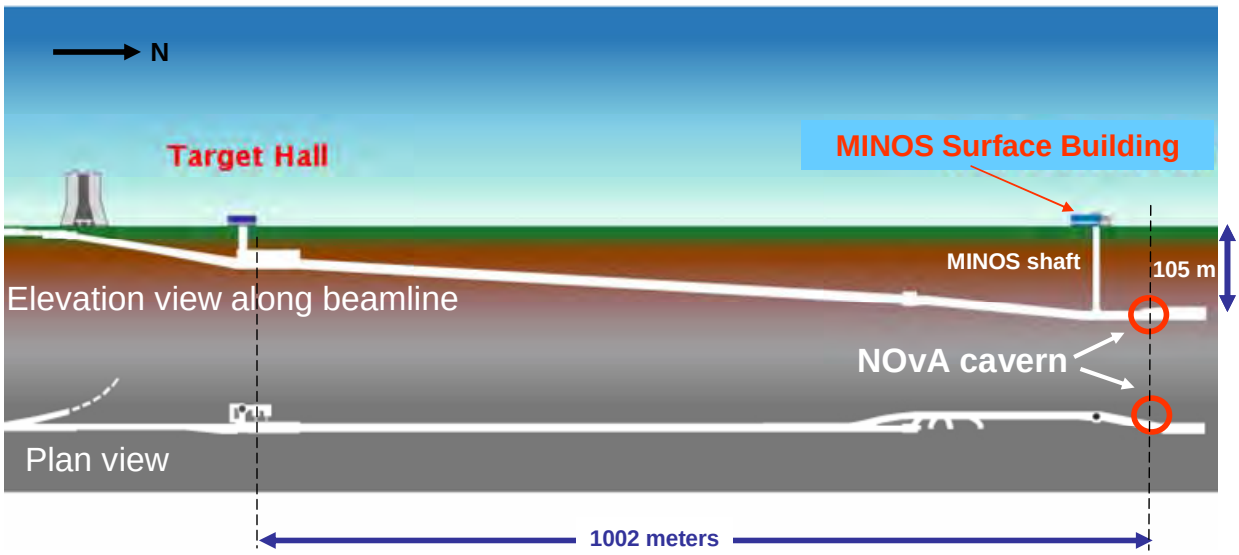


Figure 3.3: A detailed plan view of the MINOS access tunnel from the vertical MINOS shaft to the MINOS hall. The proposed NOvA cavern is indicated.



Removing the waste rock would involve precautions to ensure that particulates would not be introduced into the NuMI tunnel sump which empties into the Fermilab Industrial Cooling Water (ICW) system. At this distance from the Target Hall, the excavated rock should not be activated; however it would be surveyed for radioactivity and managed

according to requirements of the FESHM. Spoils removed from tunnel, primarily shale, would be put into stock piles at Fermilab in accordance with existing permits. The estimated 1000 yd^3 of spoils represents an addition of 2% to the existing 50,000 yd^3 currently in Fermilab stock piles.

The raw exposed rock in the new tunnel cavern would be covered with shotcrete. Shotcrete is concrete projected or "shot" under pressure using a feeder or "gun" onto a surface to form structural shapes including walls, floors, and roofs. The shotcrete helps to maintain integrity, minimize cleaving and reduce falling rock and provides a finished surface to the raw rock cavern.

The construction area in Figure 3.2 would have an interior secondary containment volume sized to hold 100% of the liquid scintillator in the NO*ν*A Near Detector. The new excavation would be separated from the existing tunnel by a full floor to ceiling wall to provide two separate fire protection areas. The fire protection system would incorporate a water mist (fog), water foam, or inert gas system (with breathable levels of oxygen) to address potential scintillator (mineral oil) fires. Fire protection is relevant since PVC outgases chlorine byproducts in the event of a fire.

3.3.1.3 Blending Materials for the Liquid Scintillator

The NO*ν*A experiment requires approximately 4.3 million gal of blended scintillator material to fill the NO*ν*A detectors (see Section 3.3.2.2). Mixing the scintillator components would utilize a facility that can mix them in batches of approximately 7,000 gal.

Scintillator Blending R&D

The initial R&D for blending NO*ν*A scintillator liquid will be performed on a hard stand area north of the Silicon Detector Complex at Fermilab, using less than 1% of the total liquid scintillator quantities that would be needed for the experiment duration. This limited R&D effort to develop procedures and demonstrate the quality of the blended product has been reviewed and approved as a categorical exclusion to further NEPA review (DOE 2007a).

Scintillator Blending Facility

The NO*ν*A Project team analyzed two options for mechanically blending the scintillator materials. The first option would be to use a local commercial toll blender and transport blended materials from that location to Fermilab and Minnesota. The second would be to construct and operate a blending facility at an existing Fermilab site. These alternatives are discussed in Section 3.5

3.3.2 Assembly and Installation Activities at Fermilab

3.3.2.1 Detector Installation and Assembly

Details of NO*ν*A detector design are provided in Appendix B.

Integration Prototype Near Detector

The IPND is an early prototype of the Near Detector, and would be assembled as part of the R&D effort for NO*ν*A. The IPND consists of planes of PVC cells in alternating horizontal and vertical layers. The layers are joined with Devcon-60, a glue containing methyl methacrylate adhesive (MMA), which is a volatile organic compound (VOC) and a federal hazardous air pollutant (HAP). MMA evaporates and is emitted during adhesive application.

The plan is to operate the IPND in the MINOS Surface Building shown in Figure 3.4. Locating the prototype detector on the earth's surface rather than underground allows measurement of the unshielded cosmic ray backgrounds in the detector. Secondary containment for the approximately 20,000 gal of liquid scintillator would be provided by commercially available secondary containment as shown in Figure 3.5. When the detector R&D goals have been accomplished, the liquid scintillator in the IPND would be drained and recovered for subsequent use in the Near Detector. The PVC detector structure would be disassembled and sent down into the new cavern to be used in the Near Detector.

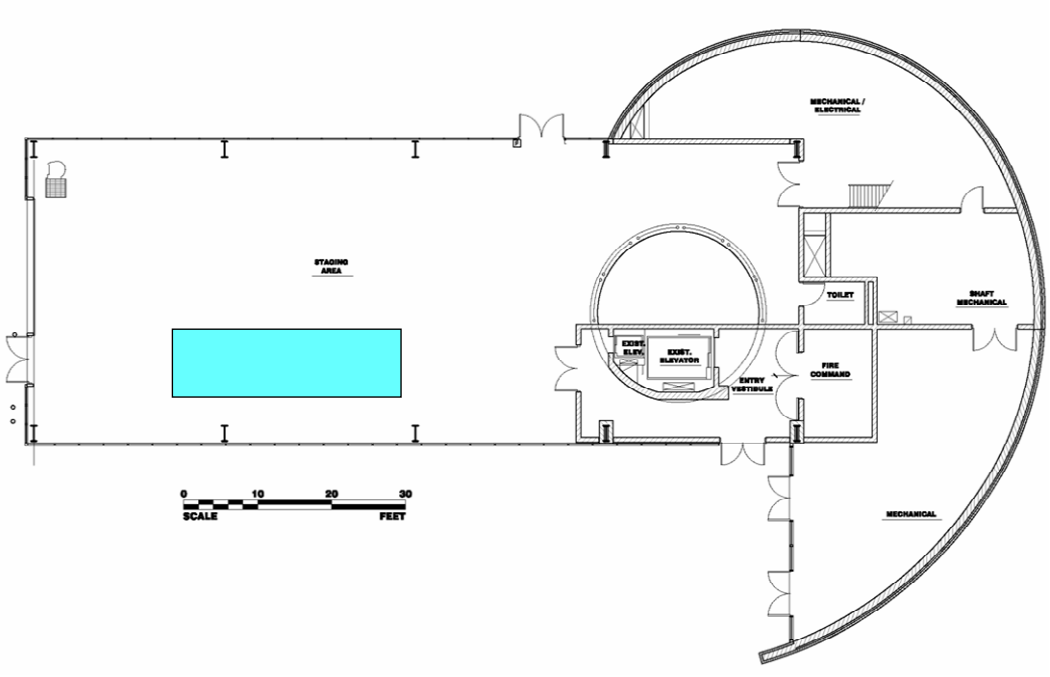


Figure 3.4: Plan view of the location of the NO*ν*A IPND in the MINOS Surface Building.

Figure 3.5: Example commercial secondary containment system which would be attached to the interior side of the drywall walls of the IPND structure inside the existing MINOS Service Building.

Near Detector

An alcove would be cut into the side of the MINOS access tunnel to accept the Near Detector installation at the proper angle to the NuMI beam. Access to the tunnel is through an existing vertical shaft. The Near Detector is an identical copy of the Far Detector, except that the extrusion modules are shorter to accommodate the restrictions of the NuMI underground tunnel and MINOS access shaft.

The detector would need electrical support infrastructure in the tunnel. Necessary readout electronics require one standard 7-ft relay rack and a cooling system. The racks fit easily in the access tunnel downstream of the proposed detector. Electrical power is readily available from existing utilities in the tunnel. Once assembled, the Near Detector would be filled with liquid scintillator. Secondary containment for the full volume of liquid scintillator would be provided by commercially available secondary containment similar to that used for the IPND.

3.3.2.2 Filling Detectors with Liquid Scintillator

Although the NO*ν*A Project involves blending over 4 million gal of liquid scintillator, only approximately 1% (50,000 gal) would be used in detectors at Fermilab. The majority

of the scintillator fluid would be shipped to the Far Detector site, and those operations are discussed below in Section 3.4.

At both locations, a liquid transfer system would fill the PVC modules at a precisely controlled flow rate. During the fill, all piping from the tanker trucks to the detector would be protected with appropriate secondary containment systems and spill control plans.

Filling the IPND with Liquid Scintillator

Filling the IPND would utilize a liquid scintillator distribution system that can accept scintillator from tanker trucks parked within the MINOS Service building. During fill, the scintillator distribution system would deliver any displaced vapor volume from the extrusion modules to the tanker.

Filling the Near Detector with Liquid Scintillator

Once assembled in the cavern, the Near Detector would be filled with liquid scintillator. As with the IPND, the liquid scintillator distribution system would accept liquid scintillator from delivery tankers parked within the MINOS Service building at the top of the shaft and deliver vapors displaced from the modules to the tanker. Delivery from the tanker to the detector would be through a double-walled pipe the length of the shaft and extending to the detector location. A pressure reducing valve would reduce the liquid pressure of the long vertical pipe. A separate pipe would vent vapor back to the tanker.

3.3.3 Operations at Fermilab

Following the period of detector assembly, detector filling, and prototype checkout, the NO*ν*A project enters a phase of experimental performance. Accelerators at Fermilab generate particles that are sent in the direction of the NuMI target and the Near Detector. Electronics in both the Near Detector and the Far Detector observe the particle interactions and record the resulting signals. Collaborating researchers access, analyze, and interpret data files remotely and do not rely on direct access to the detectors. However, routine maintenance, electronic calibrations and repairs, and physical integrity inspections would involve personnel accessing the Detector Halls.

Specific parts of the NO*ν*A Near Detector would be subjected to a safety analysis and operational readiness review by an ES&H Review Panel. A subject matter expert would perform an environmental review, to address any potential issues associated with a proposed operational activity. For instance, this review would ensure that any necessary environmental permits are secured prior to commencement of any permit-required activities. This review also would address proposed activities which would utilize chemicals or which would install/utilize any equipment or process that results in air emissions, so that these operations would be in compliance with the FESHM.

Access to the accelerators, tunnels and detectors of the NO*ν*A Project is required for routine maintenance, calibration and to observe/adjust operation parameters. Anyone who works in the NuMI tunnel would be required to take the Fermilab Underground safety

course (NuMI/MINOS Underground Safety Training, Course Code FN00034/CR) and would be required to use appropriate personal protective equipment.

Routinely, a staff of 2 personnel would be available to support the Near Detector and several visiting scientists during experiment operations. At infrequent occurrences of off-normal operations, access may be necessary to respond to electrical, electronic or mechanical disruptions. As the NO*ν*A project is a research driven project, adjustments and modifications to the installed components may be necessary to respond to experimental observations. All work is planned and performed to be in compliance with the principles and requirements of the FESHM.

3.3.4 Facility Decommissioning at Fermilab

For the duration of the proposed NO*ν*A experiment, information necessary for eventual decommissioning of the NO*ν*A experiments would be collected, documented, and retained for future reference in accordance with existing Fermilab policies. This information would include the details of the design, the history of operation, and records of environmental monitoring.

During the period of decontamination and decommissioning, radioactivity previously produced in the vicinity of the NuMI tunnel would continue to be collected and discharged to the Fermilab surface ponds and ICW system to prevent the radioactivity from entering the aquifer. The monitoring program would continue and results would be evaluated to determine measures needed to adequately protect workers, members of the public, and the environment. Studies are already underway to evaluate the measures to be taken in the context of the present operations of the NuMI beamline in support of the MINOS experiment and possible upgrades to higher beam intensities (Cossairt 2006).

3.3.4.1 Beamline Elements

Each component of the beam line to be removed would be surveyed by health physics personnel in order to identify, label and isolate all components made radioactive by beam operations. Radioactive components for which there is no longer a use would be packaged for shipment and disposed of as radioactive waste according to DOE specifications and Federal, State, and Local regulations in effect at the time of disposal. Non-radioactive wastes would be properly disposed, in accordance with applicable regulatory requirements. There are no disposal sites for any waste materials on the Fermilab site and none are currently planned for the future.

3.3.4.2 Integration Prototype Near Detector

The parts from the IPND would be reused in the construction of the Near Detector. Parts that are not reused would be decommissioned as described above. The drywall enclosure in the MINOS Service building would be dismantled. Each component of the IPND would be surveyed by health physics personnel in order to identify, label and isolate any components made radioactive by beam operations. It is anticipated that all IPND

components would be free of radioactivity because they would only be used in a neutrino beam.

3.3.4.3 Blending Facility

Decommissioning of the Fermilab Blending Facility would require removal of all the tanks, tanker trucks, pumps, and piping used in the blending process. These items can all be cleaned by commercial vendors and offered for recycling via the DOE surplus system.

3.3.4.4 Near Detector

When the NO*v*A Near Detector at Fermilab is to be decommissioned, the experimental apparatus would be disassembled. The components would be reused elsewhere at Fermilab, shipped to other laboratories for use, or made available as surplus equipment according to standard procedures for disposition of United States Government properties. The PVC extrusion modules would be drained of liquid and disposed of as demolition waste; once the Devcon-60 adhesive cures, it no longer poses an eye, skin, or inhalation hazard. The liquid scintillator could be used as an alternative fuel for incineration plants if it is not reused. The underground Near Detector enclosure would remain in place for future use. Each component of the Near Detector would be surveyed by health physics personnel in order to identify, label and isolate any components made radioactive by beam operations. It is anticipated that all Near Detector components would be free of radioactivity since they would only be used in a neutrino beam.

3.4 Proposed Action at Ash River

DOE selected the University of Minnesota as the recipient of a Cooperative Agreement to build and operate the NO*v*A Far Detector facility and access road in collaboration with the NO*v*A Project headquartered at Fermilab. As described in Section 1.1, the University of Minnesota followed and relied upon the State process to prepare an Environmental Assessment Worksheet (EAW) identifying potential environmental impacts. The EAW is incorporated by reference (Appendix A). Analyses of impacts at the Ash River site are summarized in this EA, supplemented with additional information required by DOE NEPA regulations and guidance.

Fermilab and the University of Minnesota have developed a Memorandum of Understanding (MOU) as an agreed-upon plan, intended to establish and maintain management controls that will protect worker safety and the environment during the construction phase and to perform mitigative measures during the construction phase if necessary (NO*v*A 2007a). The excavation and construction on the project will conform to the environmental, safety and health requirements of The University of Minnesota. Project-specific safety requirements would be developed and applied as appropriate. These requirements would include the *Minnesota State Building Code*, which ensures that MN Occupational Safety and Health Administration regulations would be enforceable.

The following description presents the current contemplated size of facility and detector. The facility and detector finally constructed may be smaller.

3.4.1 Excavation and Construction Activities at Ash River

3.4.1.1 The Far Detector Facility Site

The proposed NO*v*A Far Detector Facility site is an approximately 89.6-acre plot that would be acquired by the University of Minnesota. The site is near the Ash River in Section 18 of Township 68 North, Range 19 West, in St. Louis County, MN. The site is 504 mi from Fermilab (as shown previously in Figure 1.1), near the entrance to Voyageurs National Park (Figures 3.6 and 3.7). Of all the alternative United States sites accessible by road, the Ash River site has the optimal characteristic of being the furthest location from Fermilab in the direct line of the NuMI beam.

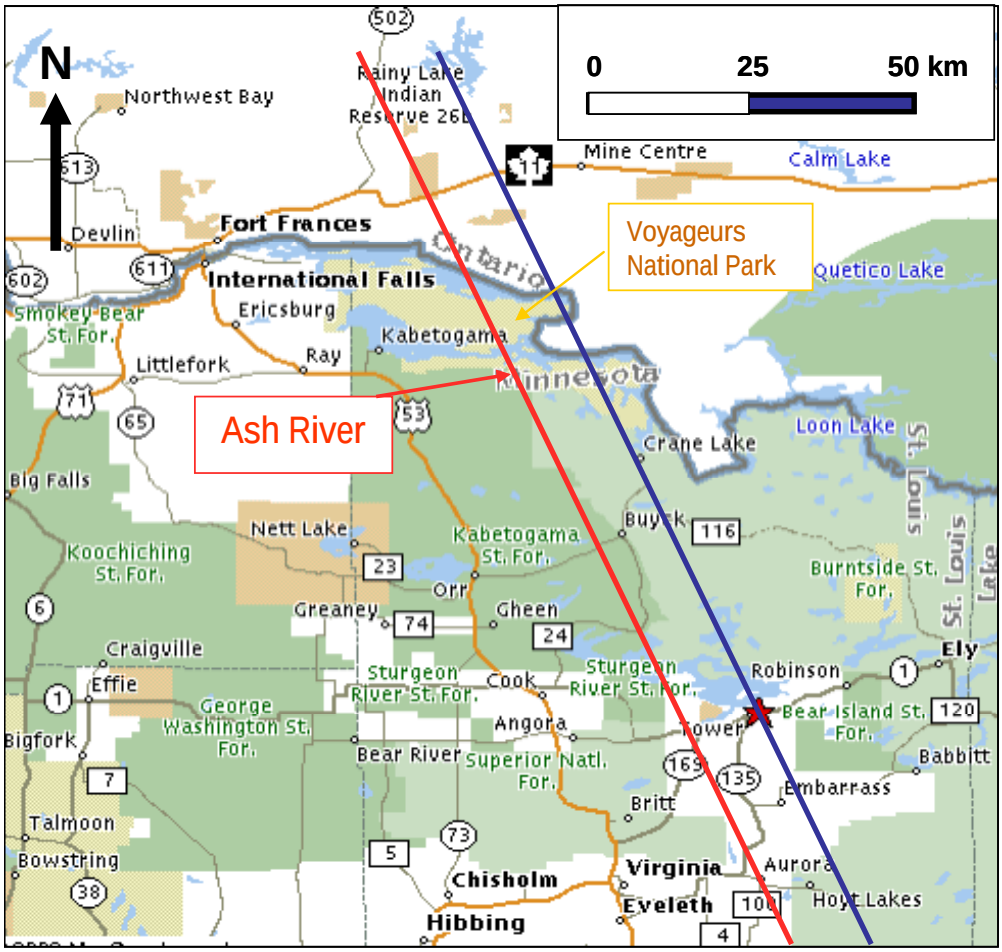


Figure 3.6: Map showing the proposed Far Detector site at Ash River. The NuMI beam centerline (blue) passes through the MINOS detector underground at Soudan (red star). The NO*v*A Ash River site is on the red line to the left (west) of the NuMI beam centerline, ~11.8 km (14.6 mrad) off-axis. Voyageurs National Park and the US-Canada border are just north of the site.

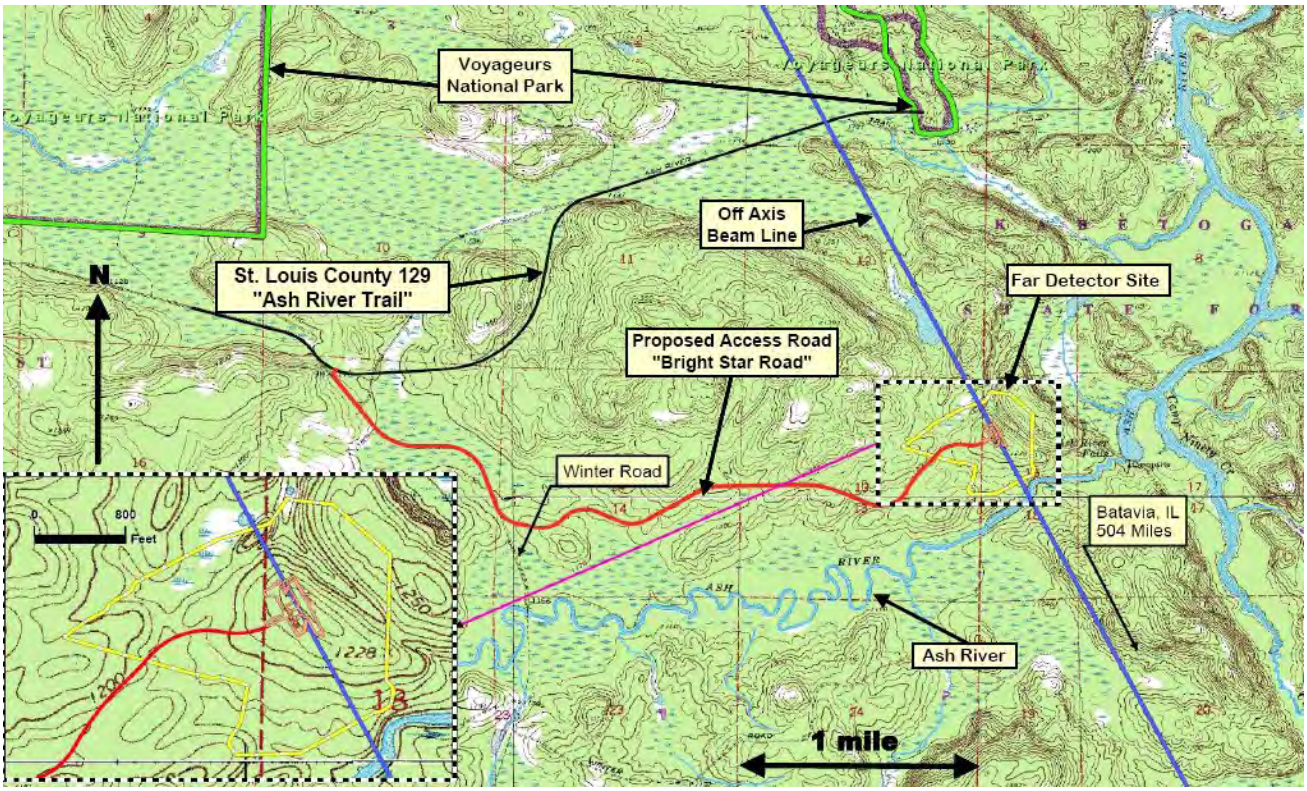


Figure 3.7: Topographic map of the Ash River area and Proposed Far Detector Site. The NO*v*A site is in the rectangle at the end of the access road (red) off St. Louis County Road 129. The inset in the lower left corner shows the site in more detail with the NO*v*A building sitting near the top of a hill at an altitude 1,228 ft above sea level. The entrance road to the Visitor's Center in Voyageurs National Park is shown at the top right center of the map.

3.4.1.2 Access Road and Utilities

Both U.S. 53 and St. Louis County 129 are maintained year-round. Access to the site is currently via an old clay base logging road off St. Louis County 129, known locally as the Ash River Trail. The University of Minnesota would acquire an easement for a proposed 18.9-ac access road corridor, approximately 3 mi in length along the existing roadway. The access road would pass through a wetlands area just as it leaves St. Louis County 129, and an USACE permit would be required to allow construction of an all weather road like St. Louis County 129 to replace the existing logging road. Replacement wetlands would be purchased from a private wetlands bank as mitigation for impacts to existing wetland due to excavation and construction at the Ash River site. Special design features would be incorporated to ensure historical properties are protected.

Under the current plan, the finished road would have two paved traffic lanes, shoulders and open ditches for drainage, similar to St. Louis County 129. Utilities would be buried on either side of the road. The road work would include grading, excavation, potential dewatering, paving and re-vegetation activities. Possible equipment to be used includes standard construction machinery such as trucks, backhoes, graders, compactors, skid-steers, cranes, loaders, compressors, and possibly dewatering pumps.

The proposed site work includes the extension of existing electric and communication utilities and the installation of domestic water well and septic systems. Electric utilities and fiber optic communication lines would be extended from St. Louis County Road 129 along the improved access road. Improvements to the existing transmission system serving the site would also be required but include only upgrades to existing transmission lines to increase capacity. Planned utility upgrades are discussed in Section 28 of the EAW (Appendix A).

3.4.1.3 NOvA Far Detector Facility at Ash River

Figure 3.8 provides a plan view of the Ash River site. The Far Detector Facility would contain an at-grade Service Building, an adjacent, below-grade Assembly Area, and the below-grade NOνA Detector Hall. A perspective view of the building exterior is provided in Figure 3.9. Figure 3.10 shows a cross section through the Detector Hall. More detailed design drawings are available in the EAW, Appendix A. The building footprint, impervious surfaces and landscaping would occupy approximately 6.7 ac. Visual impacts of constructed facilities at the site are discussed in Section 26 of the EAW, Appendix A.

The Detector Hall and Assembly Area would be approximately 67 ft wide by 375 ft long by 38 ft high and excavated 40 ft below the existing grade into granite rock. The roof of the building would consist of 1.5 ft of cast-in-place concrete over 2.5 ft of precast concrete planks. This composite would provide support for 0.5 ft of loose barite (barium sulfate) roof ballast that is necessary to reduce the background radiation from electromagnetic cosmic rays. The sides of the building would be shielded with granite spoils from the excavation. The adjacent Service Building area would be 67 ft wide by 130 ft long by 38 ft high and would be at grade.

The concrete floor and walls of the Assembly Area and Detector Hall would function as secondary containment for scintillator fluid in the PVC modules. The floor and walls would be treated with a sealant (e.g., epoxy based paint) to prevent liquid scintillator from penetrating the porous concrete surface. A space at the base of the detector would create an observation zone for leak detection. The sloped floor of the Detector Hall and Assembly Area would collect and route any spilled scintillator fluid to a scintillator sump.

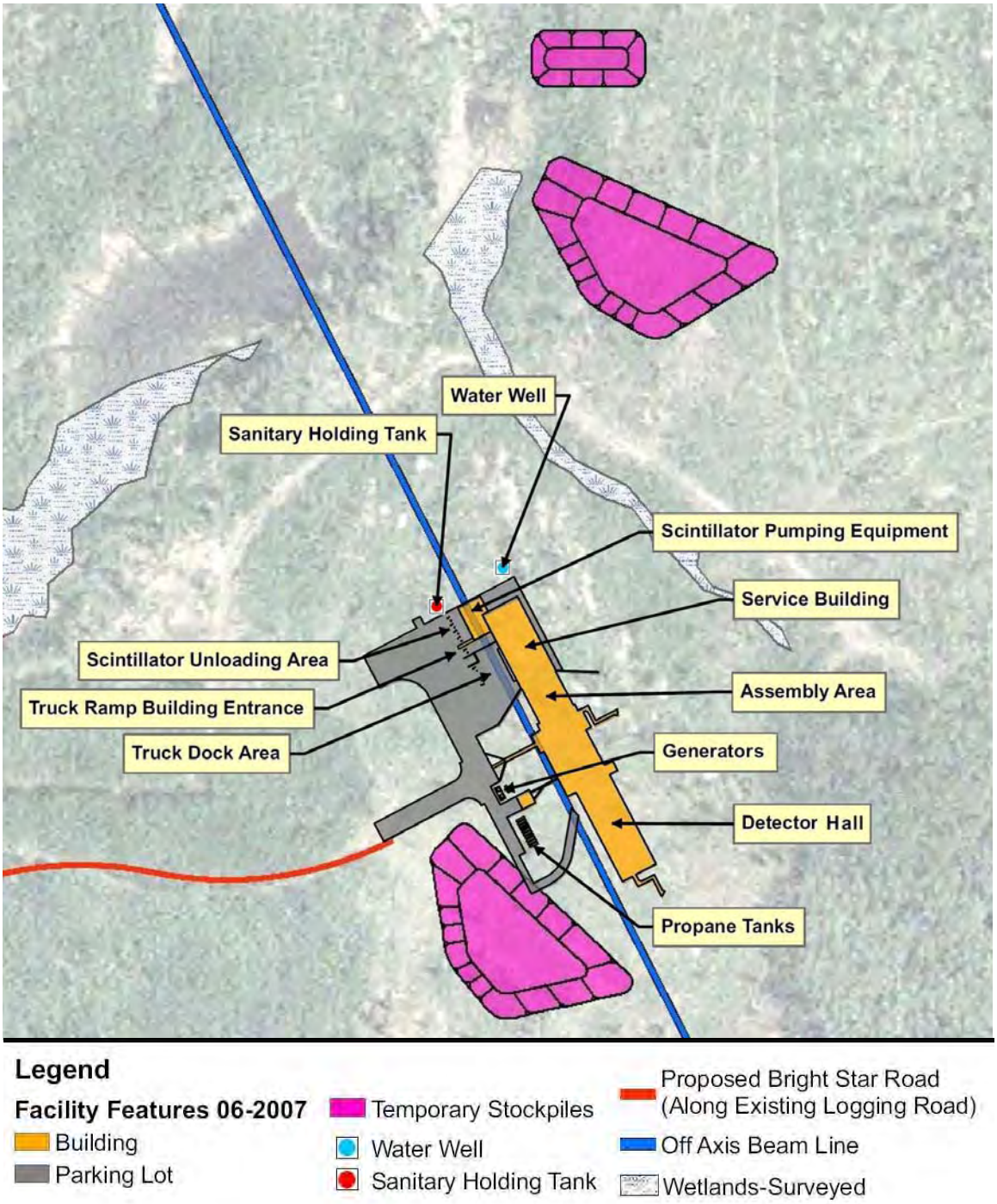


Figure 3.8: The plan view of the Far Detector Facility site. The Detector Hall sits in the south end of the building next to an Assembly Area also below grade. A loading dock and tanker truck delivery area are at grade at the north end of the building, next to the service building**.**

Figure 3.9: A perspective view of the proposed NO*v*A Far Detector building looking east. The bermed area (green) is composed of granite spoils from the excavation. The detector area would be on the right hand side with a module assembly area to its left. A loading dock service area is located to the left of the Assembly Area with recessed and drive-in truck bays. A scintillator tanker handling area is shown on the far left with adjacent bays for four tanker trucks.

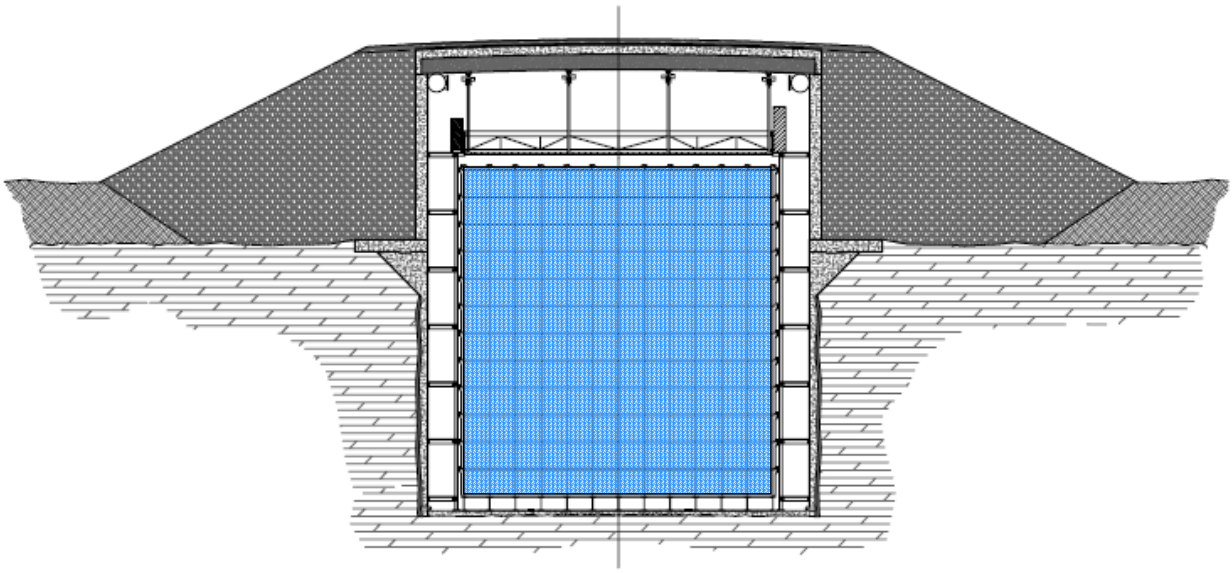


Figure 3.10: Neutrino beam view of the NO*v*A Far Detector Hall. The detector face is shaded blue. It is surrounded by access catwalks and the top is accessible via a rolling access platform suspended from the ceiling. The soil (light gray) has been removed at the detector site for excavation into the granite (block gray). The spoils from the excavation are loaded back on the sides of the detector to a minimum shield depth of 10 ft.

All groundwater would be collected between the solid granite bathtub and the concrete foundation. The groundwater sumps would be isolated from the scintillator sumps, would be exterior to the bathtub, and would be monitored for water levels. Accumulated water would be managed according to NPDES permit and/or SWPPP as appropriate.

The sides of the detector (see Figure 3.10) would be accessible by catwalks along the sides of the Detector Hall. The top of the detector would be accessible by a rolling platform hung from the ceiling of the hall.

The Facility would require an appropriate fire protection system for areas in which the scintillator is handled, stored or used. A water mist (fog) system, water foam system, or inert gas system (with breathable levels of oxygen) would be used. Support spaces including a loading dock, shop, storage and related functions would be housed in the Service Building area, which is the above ground portion of the structure adjacent to the Detector Hall and Assembly Area in the plan view of the building in Figure 3.8.

An outside parking area would be built for four trucks delivering liquid scintillator (see Figure 3.8). This area would be equipped with a sump and a spill-control berm that is sufficient to contain 100% of the liquid from four tankers. Because of the remote site location, the truck turning area next to the loading bays would have a designated helicopter landing area for use in an emergency.

Construction of the proposed Far Detector Facility would include grading, rock and soil excavation, potential de-watering, concrete formwork, structural steel, metal siding and roofing as well as the associated mechanical and electrical infrastructure to support the detector assembly and operation. Possible equipment to be used includes standard construction machinery such as trucks, backhoes, graders, compactors, skid-steers, cranes, loaders, compressors and possibly de-watering pumps.

Construction of a facility the size of the Far Detector Facility requires significant construction staging and segregated stockpiling areas. The stockpiled material would be segregated into topsoil, clay and rock areas. Each stockpile would require sediment and erosion control devices as well as adequate access. Figure 3.8 shows the local area around the building and the proposed stockpile areas.

3.4.2 Assembly and Installation Activities at Ash River

3.4.2.1 Far Detector Assembly

In the Assembly Area of the Far Detector Building, twelve of the extrusion modules get placed side by side on a flat assembly table to form one plane of the NO*ν*A Far Detector. Thirty-one such planes are bonded together with Devcon-60 into a block to form the strong honeycomb-like structure shown in Figure B.4 (Appendix B). 156 metric tons of Devcon-60 with MMA are required for the full 20-kt detector, which places requirements on the building ventilation system due to concerns for MMA vapors in workspaces. MMA has been selected as the adhesive because it has the largest shear and peel strength

of all the adhesives tested to date, and high strength is required for this five-story-tall PVC object.

A custom vacuum lifting fixture would be used to move the modules from incoming truck pallets to a custom glue machine for the MMA application and subsequently onto the flat assembly table. The empty 31-plane block is assembled in a horizontal position, moved down the Far Detector Hall to the previously constructed blocks, and rotated 90 degrees into a standing position.

Five of the 31-plane blocks get attached to one another to form a detector "Superblock". Between Superblocks a gap of 0.75 in serves as an expansion joint (like in a concrete sidewalk) so that when the Superblock is filled with scintillator the stress in the PVC would be limited. If all the Superblocks touched, then filling the blocks would drive the PVC stresses to unacceptably high levels. The expansion gaps serve to limit the stress build-up.

A total of 8 Superblocks plus one smaller set of 2 blocks comprise the full 1302 planes in the NO*v*A Far Detector. The detector is built from south to north, starting against a strong bookend at the south end of the building. When all 42 blocks are in place, the block pivoter is braced to form a north bookend as shown in Figure 3.11.

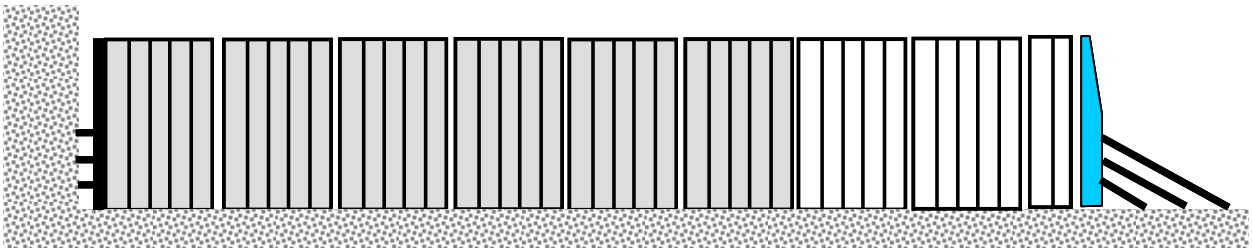


Figure 3.11: The full NO*v*A Far Detector composed of 8 Superblocks and a 2 block section. Expansion gaps are shown between the Superblocks. The detector is built from left to right starting against a strong bookend and assembly ends with the conversion of the block pivoter into another bookend at the right end. This figure shows 6 of the superblocks full of scintillator with 3 blocks yet to be filled**.**

Filling the Far Detector with Liquid Scintillator

The Far Detector would be filled with 4,310,000 gal of liquid scintillator. As construction of blocks proceeds, blocks are filled while additional blocks are being assembled. To avoid a long serial schedule for completion of the detector, scintillator transfer and fill occurs almost in parallel with the PVC plane erection, following the empty PVC module assembly front by one Superblock (5 blocks) in a total 27-month schedule. The required scintillator fill rate of about 18 gal per minute is accomplished with a custom metering machine which fills eight extrusion modules in parallel.

The liquid would be delivered to Far Detector Facility in 7,000-gal tanker trucks. Approximately 600~615 separate tanker truck loads (about 15 tankers per 31 plane block) are required over a period of several years. The liquid scintillator distribution system would be designed to accept liquid scintillator from inbound tankers at a rate of one tanker per day. The delivery system would include components that ensure that filling of the PVC Modules is done at a precisely controlled flow rate. During fill, a large volume of vapor would be displaced from the extrusions and would be returned from the modules back to the tankers. Spill control plans, counter measure materials, personal protective equipment (PPE) and working procedures would be developed for each process that involves work with the blended liquid scintillator.

Outfitting the detector with electronics follows the filling task with about a one-month delay per block. Therefore the Far Detector becomes active linearly throughout the ~ 24 month assembly period.

3.4.3 Operations at the Ash River Site

Following the period of detector assembly, liquid scintillator transfer, detector filling and checkout, the NO*ν*A project enters a phase of experimental performance. Accelerators at Fermilab generate particles that are sent in the direction of the NuMI target, the Near Detector and the Far Detector. Electronics in the Far Detector observe the particle interactions and record the resulting signals. Collaborating researchers access data files remotely and need not rely on direct access to the detectors to analyze and interpret the data. Routine maintenance, electronic calibrations and repairs, and physical integrity inspections would involve personnel accessing the Detector Hall. Routinely, a staff of 5-8 personnel would be at the Far Detector site during experiment operations.

3.4.4 Decommissioning/Disposal at Ash River

The operations at the proposed NO*ν*A Far Detector Facility, as part of the Fermilab Neutrino experimental program, would cease with the decommissioning of the NO*ν*A Project. It is possible that this facility would continue to be used for other experiments not associated with the operation of the Fermilab accelerators. If redeployed by DOE, an appropriate NEPA review would be performed.

When the proposed NO*ν*A Facility is decommissioned, the experimental apparatus would be disassembled. It is anticipated that all Far Detector components would be free of radioactivity since they would only be used in a neutrino beam. The components would be reused, shipped to other laboratories for use, or made available as surplus equipment according to standard procedures for disposition of United States Government properties. The PVC modules would be drained and disposed of as normal waste. The liquid scintillator (primarily mineral oil) could be recycled as an alternative fuel.

Information necessary for eventual decommissioning of the NO*ν*A Project facilities would be collected and documented during the operations, and the records would be retained for future reference. This information would include the details of the design, the

history of operation, and records of environmental monitoring. At the end of the NO*v*A detector decommissioning, the building at Ash River would continue to be the property of the University of Minnesota under the terms of the Cooperative Agreement.

3.5 Alternatives to the Proposed Action

NEPA requires evaluation of the impacts of "reasonable alternatives." "Reasonable Alternatives" are those that satisfy the purpose and need of the proposed action.

3.5.1 Alternatives not addressed in detail in the EA

The following Alternatives were considered and details of these alternatives are discussed in the NO*v*A *Conceptual Design Report* (Cooper and Ray 2006).

- Alternate Near Detector sites were examined at Fermilab, but all options required more excavation and were more expensive.
- Alternate Far Detector sites were examined in Minnesota and Canada. The number of such sites is small due to the small number of all-weather east-west roads in the vicinity. All other possible sites between Lake Superior and the Trans-Canada highway were scientifically inferior. The criteria used to judge possible sites included:
    a) The ability to have the detector as far away from Fermilab as possible;
    b) The ability to have a detector ~ 12 km off-axis from the central NuMI neutrino beam;
    c) Access to the site by existing roads;
    d) Ability to do construction in all seasons on the experimental hall and on the detector;
    e) Access to power, telephone lines, and fiber optic data connections;
    f) The availability of a relatively flat area for construction;
    g) The availability of high ground well above the water table with no wetlands;
    h) The absence of features likely to provoke controversy or litigation; and
    i) A location in Canada would require participation by a Canadian institutional collaborator.
- Alternate roads to the proposed Ash River site that avoid wetlands were considered. A more direct route from the north (see Figure 3.7) across St. Louis County 129 would be shorter and cheaper, but concerns that this would impact wildlife and old growth forest in the area and the view from Voyageurs National Park led to the proposed road along an existing logging road.
- Alternate building designs at Ash River were considered but the proposed design makes the best use of the excavated granite as a cosmic ray shield for the detector.
- Alternate detector technologies were considered for the Far Detector. Most were scientifically inferior, while one alternate required too many years of R&D to be considered viable

3.5.2 Scintillator Blending Facility Alternatives

3.5.2.1 Scintillator Blending

The NO*v*A Project team analyzed two options for mechanically blending the scintillator materials. The first option would be to use a local commercial Toll Blender in the Chicago Area and transport blended materials from that location to Fermilab and Minnesota. The second option would construct and operate a blending facility at an existing Fermilab site.

The NO*v*A Project would purchase the scintillator component ingredients in Table 3.1 and blend them mechanically over a period of several years. Blending materials for the liquid scintillator is a mixing operation, as opposed to a chemical reaction. Table 3.2 shows the chemical names of the ingredients in Table 3.1. Material Safety Data Sheets (MSDS) for the chemicals are provided in Appendix C.

component	purpose	mass fraction	volume (gal)	tot mass (kg)
mineral oil	solvent	94.4%	4,079,841	13,127,298
pseudocumene	scintillant	5.5%	230,057	762,875
PPO	waveshifter #1	0.1%		16,788
bis-MSB	waveshifter #2	0.002%		235
Stadis-425	antistatic agent	0.0003%		62.6
tocopherol (Vit.E)	antioxidant	0.0010%		139
Total		**100.0%**	**4,309,899**	**13,907,259**

Table 3.1: Composition of NO*v*A liquid scintillator

Component	Chemical name
Mineral Oil	NO*v*A would use a Technical grade White Mineral Oil. Chevron ParaLux 701 is an example.
Pseudocumene	1,2,4-Trimethybenzene
PPO	2,5-diphenyloxazole
Bis-MSB	1,4-di-(2-methylstyryl)-benzene
Stadis-425	Proprietary mixture, but primarily composed of kerosene and toluene
Tocopherol	Tocopherol

Table 3.2: Chemical names of NO*v*A Liquid Scintillator components

The mineral oil would arrive by rail car in 25,000 – 30,000 gal loads. The mineral oil from the rail cars would be transferred into a fixed tank to comply with Title 41 of the *Illinois Administrative Code* (IAC) Section 160. Pseudocumene, also a liquid, would arrive in 7,000 gal stainless steel tanker trucks. The waveshifters (PPO and Bis-MSB) are powders and would be delivered to in 5 – 25 kg (11 – 55 lb) fiber drums. The Stadis-425 and Tocopherol additives are liquids added as parts per million to the final blend.

The blending would be performed in two steps: First the wavelength shifting powders would be dissolved in pseudocumene. This blending can be done with in-line blenders. The second step would blend the concentrate with the mineral oil and would result in the final liquid scintillator composition required by the NO*ν*A Project.

3.5.2.2 Toll Blending in the Chicago Area

Many facilities in the Chicago Area are capable of blending oils with chemical additives and simply charge a fee per gallon for the service. A pre-bid request for information by the Fermilab Purchasing Department for the NO*ν*A Project elicited ten responses.

Typical vendors have large sites in industrial areas around Chicago with oil tank farms consisting of tens to hundreds of tanks in the 10,000 to 630,000 gal range. These vendors are usually blending volatile gasoline products for automobile and truck consumption, so blending of the less flammable NO*ν*A Project components would not be outside their envelope of experience.

No tanks would be constructed for the NO*ν*A Project, but tanks dedicated to NO*ν*A would be cleaned and painted on the inside with epoxy-based paint to ensure no contaminants could enter the NO*ν*A mixture. In some cases stainless steel tanks would be available and require only cleaning. Dedicated piping between tanks would allow off-loading the NO*ν*A Project components into two separate tanks and blending the two main components into a third tank. The dedicated piping also would be cleaned before use by the NO*ν*A Project.

Each tank used in blending would come equipped with a surrounding secondary containment berm. Piping systems between tanks would also have secondary containment. At some facilities the entire site serves as a tertiary containment area with another berm on the site boundary. Qualified vendors would already be equipped with secondary containment and electric power.

3.5.2.3 Blending at Fermilab

An alternative blending facility at Fermilab would appear similar to a neighborhood gasoline station with an overhead canopy but with several above ground tanks and pipelines instead of the underground tanks in a typical neighborhood gas station. Possible facility sites have been identified on the northern edge of Fermilab adjacent to the Fermilab railhead. Each possible Fermilab site is a previously disturbed level area that is not currently in use.

The Fermilab railhead is an optimum location because the dominant mineral oil component of liquid material would arrive in railcars. Commercially available liquid containment for railcars would be constructed. The mineral oil from the rail cars would be transferred into a small 7,000 – 10,000 gal fixed tank to comply with Title 41 of the *Illinois Administrative Code* (IAC) Section 160.

Additional electric power would be needed at a Fermilab blending facility. The blending facility would have 100% secondary containment constructed as a curbed concrete area under the canopy and sized for containment of all liquids including the volume of 24-hour rainfall as determined by a 25-year storm.

The main difference in blending operations between a Fermilab facility and a commercial Toll Blender would be in the batch size. While a Toll blender would probably blend 25,000 - 50,000 gal per batch, a Fermilab facility would operate at a smaller scale and blend only 7,000 gal per batch matched to the size of the tanker trucks used to transport the blended scintillator to Minnesota. A Fermilab blending operation would also employ a closed loop system to capture all vapors, which might eventually be vented elsewhere at Fermilab.

Blending operations and quality assurance of the blends would typically require two Fermilab technicians.

3.5.2.4 Decommissioning of Blending Facility

Decommissioning of a Toll Blender facility would be straightforward. Any tanks or piping used by the NO*v*A Project would have to be cleaned just like they were cleaned before NO*v*A Project use. This is standard practice at Toll Blenders.

Decommissioning of a Fermilab Blending Facility would require removal of all the tanks, tanker trucks, pumps, and piping used in the blending process. These items can all be cleaned by commercial vendors and offered for recycling via the DOE surplus system.

3.6 No Action Alternative

Under the no action alternative, the scientific goals for the studies of neutrino oscillations would not be achieved in the U.S. in the near future. There is no other known method by which all the topics of particle physics addressed by this experiment can be explored.

At Fermilab, the no action alternative on NO*v*A would leave the remainder of the large physics research programs unchanged. Tevatron would cease operations in 2010, as planned. Other large collaborative experiments would continue research on neutrino characteristics under existing protocols until about 2012. Fermilab scientists and management would continue research and design towards siting the International Linear Collider, the next generation of large particle accelerator that is being planned by

international science panels. Environmental impacts of the No Action Alternative are discussed in Section 5.5.

At the Minnesota location this alternative would leave the environment essentially unchanged as no other uses for the site are envisioned at this time.

4. AFFECTED ENVIRONMENT

4.1 Fermilab Site

4.1.1 Land Use at Fermilab

The Fermilab site is located 38 mi west of downtown Chicago, Illinois. Its 6,800 ac straddle the boundary between eastern Kane and western DuPage Counties in an area of mixed residential, commercial, and agricultural land use. Immediately to the east is the town of Warrenville (13,363 population), to the west is Batavia (23,866 population), to the north is West Chicago (23,469 population), and to the south and southwest is Aurora (142,990 population). Figure 4.1 shows the location of Fermilab, major transportation resources, and the surrounding communities.

Figure 4.1: Fermilab and the surrounding communities.

Since the spring of 2005, the NuMI facility at Fermilab has been in operation for the MINOS Project. An environmental assessment (DOE 1997) performed for the NuMI facility led to a DOE Finding of No Significant Impact (FONSI) (DOE 1998a) for NuMI operations up to 400 kilowatts (kW) of beam power delivered on target. This section of

document gives a description of the Fermilab environment including the effects of operations with the NuMI beamline for the MINOS Project at a beam power of approximately 400 kW. This chapter includes a description of the air, surface water, groundwater, and occupational safety conditions.

4.1.2 Air Quality at Fermilab

The climate of the area is continental, with cold winters and hot humid summers. There are frequent short period fluctuations in temperature, humidity, and wind speed and direction. The predominant wind direction is generally westerly with the wind direction from the southwest quadrant occurring with a frequency of almost 50 percent. The average wind velocity is typically 6.7 mi per hour. The average annual precipitation at Fermilab ranges from 30 to 35 inches, with roughly two-thirds of the total falling in the period from April 1 to September 30, often in the form of heavy showers and thunderstorms. The relatively flat topography does not significantly affect air flow over or near the site.

The United States Environmental Protection Agency (EPA) established National Ambient Air Quality Standards for particulate matter (PM-2.5) in 1997 and in 2004 established the 8-hour ozone national ambient air quality standard for all areas of the United States. In the northeastern part of Illinois, DuPage and Kane Counties have been designated as moderate non-attainment areas for the 8-hour ozone standard and the PM-2.5 standard. The Fermilab site is within this non-attainment area where there are lower thresholds for air emissions of volatile organic compounds and nitrogen oxides. Fermilab has an Air Pollution Permit that regulates these and other emissions from onsite fuel combustion sources, vapor degreasing operations, and a fuel dispensing facility, in addition to radionuclide emissions from beamline ventilation stacks and a magnet de-bonding oven. Table 4.1 summarizes the emissions of Criteria Air Pollutants from the Fermilab site during operations in 2006.

Pollutant	Besco Boilers	Emergency Generator	Magnet Debonding Oven	Gasoline Storage Tank	CDF[1] & MIPP[2]	Totals in tons
Carbon Monoxide (CO)	1.062	0.168	0.000394	0	0	1.231
Ammonia (NH3)	0.040	0.000	0	0	0	0.040
Nitrous Oxides (NOx)	1.264	0.734	0.000768	0	0	1.999
Particulates	0.096	0.021	0.00241	0	0	0.120
Sulfur Dioxide (SO2)	0.008	0.012	0	0	0	0.020
Volatile Organic Material (VOM)	0.070	0.022	0.000228	0.0204	0.956	1.068

[1] CDF is Collider Detector at Fermilab

[2] MIPP is Main Injector Particle Production

Table 4.1: Estimated release of Criteria Air Pollutants at Fermilab in tons per year for 2006

Tritium and other short-lived radionuclides are produced as a normal by-product of NuMI operations. The airborne radionuclides produced in the NuMI facility are released into the atmosphere through vent stacks to the surface of the Fermilab site. Environmental 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) in recent history (2005 and 2006) and the estimated maximum dose rate at the site boundary from these releases are summarized in Table 4.2 (Martens 2007). This dose rate at the site boundary is assessed for a hypothetical member of the public who would spend the entire year at the location of maximum exposure at the Fermilab site boundary. Total releases are reported annually to the IEPA and the EPA in accordance with conditions of the relevant NESHAP permit (IEPA 2006).

The operations of the NuMI facility for the MINOS Project have not caused Fermilab to approach the regulatory limits for total activity releases or for the dose limit at the site boundary.

Source of Radionuclide Air Emissions	Annual Release of Radionuclides	Estimated Maximum Dose at Site Boundary
Fermilab Accelerators (Excluding NuMI)	30 Curies/year	0.02 mrem/year
NuMI Air Ventilation (Short Lived Radionuclides †)	50 Curies/year	0.02 mrem/year
NuMI Tritiated Water Vapor	20 Curies/year	0.0002 mrem/year
Fermilab Site Wide Total	**100 Curies/year**	**0.04 mrem/year**
Regulatory Limits	**2,000 Curies/year (NESHAP Permit)**	**10 mrem/year (40 CFR 61)**

† The principal radionuclides typically measured to be present include carbon-11, oxygen-15, nitrogen-13, and argon-41 (half-lives from 2 minutes to 1.8 hours).

Table 4.2: Estimated annual release of radionuclide air emissions and estimated maximum dose at the Fermilab site boundary during operations of NuMI at 400 kW of beam power for the MINOS Project.

4.1.3 Hydrogeology at Fermilab

The surficial geology at Fermilab consists of glacial till about 80 ft deep overlaying carbonate layers of bedrock to a depth of about 215 ft thick. Ground water flow in the glacial deposits is generally downward and slow, and the water table fluctuates seasonally between 5 - 15 ft below ground surface (bgs). Water moving through the glacial deposits recharges the underlying bedrock aquifer, which the IEPA has classified as a Class I groundwater aquifer (IEPA 1998).

Below the carbonate bedrock is a shale formation which serves as a low permeability aquitard that confines deeper aquifers. This barrier isolates the groundwater in the vicinity of the NuMI tunnel from the deeper aquifers.

In some cases, the earth shielding around high intensity beam loss areas or around the beam targets becomes radioactive (or is *activated*). Leaching of radionuclides into water or activation of the water in the soil provides a possible mechanism for transport of radioactivity into the surface water from the groundwater. Of the leachable radionuclides known to be produced in Fermilab soil only tritium (H-3) and sodium-22 have the long half-lives, significant production rates, and largest leachabilities into water flowing through the soil to pose the greatest potential hazard. Experience at Fermilab has found that a measurement or estimate that indicates that tritium and sodium-22 concentrations are at or below acceptable levels is a strong indicator that this will hold for the other radionuclides as well (Fermilab 2007c).

The hydrogeology of the Fermilab site along with the NuMI tunnel construction ensures that groundwater in the vicinity of the NuMI facility continuously flows into the NuMI tunnel (Figure 4.2). Therefore, radionuclides produced in the water in the immediate vicinity of the NuMI tunnel flow toward the tunnel. The ground water that flows into the tunnel is collected and continuously pumped to the surface water management system, where it is considered surface water. This water is not a drinking water supply.

Public drinking water supplies in the Batavia area generally withdraw water from the "deeper aquifer" at a depth of 700 ft, whereas private wells are generally situated in the "shallow aquifer" at 200 ft. Some private wells have tapped groundwater at depths from 25 to 100 feet bgs (IEPA 1998 and 2000). The closest private well is between 1 – 1.5 mi from the NuMI tunnel target area.

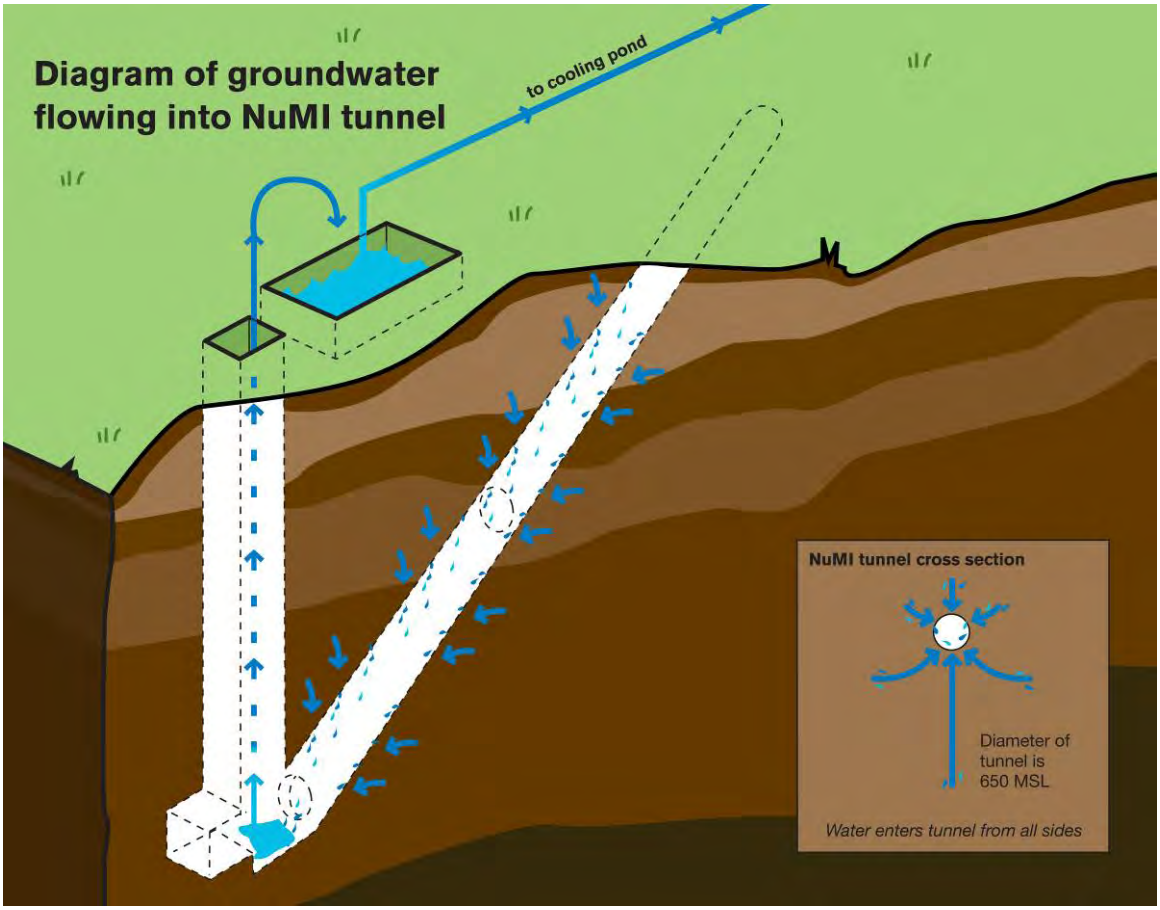


Figure 4.2: Diagram of Groundwater Flowing into the NuMI Tunnel. The NuMI tunnel centerline is 650 feet below mean sea level (MSL).

4.1.4 Surface Water Resources at Fermilab

Three watersheds collect water on site. Surface water runoff in the southeast is into Ferry Creek. The northern part of the site drains to Kress Creek. These two creeks drain to the West Branch of the DuPage River. Surface drainage in the west and southwest is to Indian Creek and the Fox River.

Water flows inward toward the NuMI tunnel from the surrounding dolomite at a rate of about 170 gal per minute. The water flowing into the tunnel is collected in a drainage system and pumped continuously to the surface where it is introduced into the ICW system. The water pumped from the NuMI tunnel can be radioactive; the radionuclides of primary concern are tritium and sodium-22.

The water in the NuMI tunnel and the water in the ICW ponds are subject to DOE standards for surface water as documented in the Fermilab Radiological Control Manual (FRCM Fermilab 2007c). Measurements of tritium in the NuMI discharge water and in the ICW Pond Water and their respective regulatory limits are shown in Table 4.3. The data in Table 4.3 show that tritium was observed at only a small fraction of the regulatory limit, (0.25% to 0.4% of the limit in the NuMI discharge water and 0.05% of the limit in the ICW Pond Water). Similar measurements and regulatory limits for sodium-22 shown in Table 4.4 indicate that sodium-22 was below the analytical detection limit in both water sources (less than 0.3% of the limit in the NuMI discharge water and less than 0.1% of the limit in the ICW Pond Water).

Since the initiation of experiments in the NuMI facility, several steps have been taken to reduce the amount of tritium in the water discharged from the NuMI tunnel. These mitigation steps resulted in a reduction of the tritium levels in the water pumped from the NuMI tunnel by a factor of about 7. All of the measured concentrations are well below the regulatory limit for surface water.

	Tritium Levels (NuMI Discharge Water)	**Tritium Levels (ICW Pond Water)**
NuMI/MINOS Present operations	5-8 pCi/ml [†]	< 1 pCi/ml
DOE Regulatory Limits for Surface Water (DCGs)	2,000 pCi/ml	2,000 pCi/ml

[†] Due to daily fluctuations in the NuMI operating conditions, the tritium concentration in the NuMI discharge water ranges from 5 to 8 pCi/ml.

Table 4.3: Measured concentrations of tritium in the NuMI discharge water and Fermilab ICW ponds during NuMI operations for the MINOS Project and the DOE regulatory limits.

	Sodium-22 Levels (NuMI Discharge Water)	Sodium-22 Levels (ICW Pond Water)
NuMI/MINOS Present operations	< 0.03 pCi/ml *	< 0.01 pCi/ ml *
DOE Regulatory Limits for Surface Water (DCGs)	10 pCi/ml	10 pCi/ml

* No sodium-22 was measured in the NuMI discharge water at the detectable limit of 0.03 pCi/ml. Therefore the sodium-22 concentrations are upper limits.

Table 4.4: Measured concentrations of sodium-22 in the NuMI discharge water and Fermilab ICW ponds during NuMI operations for the MINOS Project and the DOE regulatory limits.

4.1.5 Biological Resources at Fermilab

Most of the land that Fermilab now occupies was actively farmed prior to the existence of Fermilab. Approximately 1,600 ac has remained in crop production, primarily corn. About 1,000 ac has, to date, been planted in native prairie vegetation. The biotic communities within Fermilab include upland forests, oak savannas, prairie remnant, reconstructed prairie, non-native grasslands, old fields, pastures, turfgrass lawns, fence rows, row-crop fields, and various types of wetlands. A mesic upland forest, about 69 ac in size, has bur oak as the dominant canopy tree with other common species including red oak, sugar maple, white ash, swamp white oak, hop hornbeam, basswood, hawthorn, black cherry, bitternut hickory, and box elder. Wetlands include persistent emergent palustrine wetlands, palustrine forested wetlands along the flood plain of Indian Creek, and small palustrine scrub-shrub wetlands.

The mixture of vegetation communities, open fields, deciduous forests, restored prairie, wetlands, and mowed areas, coupled with a large degree of protection from human intrusion, makes the Fermilab site a desirable refuge for many species of animals. It attracts many birds and mammals that are characteristically found in open fields, forests, and forest-edge communities. In addition, many bird species use the site as a stopover during spring and fall migration.

The presence of Federal- or State-identified threatened or endangered species on the Fermilab site was reviewed in 1997 during the assessment of the NuMI project. The conclusion at that time was there were no threatened or endangered species in the area of the NuMI Project. The proposed action under the NO*ν*A Project would occur in the same areas previously reviewed.

The U. S. Fish and Wildlife Service has confirmed the absence of Federal endangered or threatened species within the NuMI/NO*ν*A experimental area (USFWS 2007). The

Illinois Department of Natural Resources (IDNR) was consulted to identify changes to the presence of State endangered or threatened species within the NO*ν*A experimental area (IDNR 2007). Appendix D contains the correspondence related to this inquiry. The conclusion of this process was that there are no endangered or threatened species in the area of the NO*ν*A experiment at Fermilab.

Various types of wetland communities also exist around the Fermilab site. The wetland types at Fermilab include primarily palustrine emergent, forested, scrub-shrub and unconsolidated bottom varieties, lacustrine limnetic and littoral wetlands and riverine intermittent wetlands. The wetlands exist along the creek banks and in the area surrounded by the Main Ring ponds; they are not in the affected area of the NO*ν*A Project.

4.1.6 Cultural and Historical Resources at Fermilab

Comprehensive surveys for prehistoric and historic sites have been conducted within the Fermilab boundaries (Lurie 1990, Bird 1991, and Schaffer 1993). A site-wide Cultural Resources Management Plan completed in 2002, incorporates information from a number of these archeological and architectural surveys (Lurie 2002). The plan identifies, maps, and classifies archeological resources found at Fermilab. No archaeological or historical resources were found in the areas that would be disturbed during construction activities

4.1.7 Socioeconomics / Demographics at Fermilab

Fermilab lies in western DuPage County and eastern Kane County, the westernmost of the six collar counties around Chicago. The populations of DuPage and Kane Counties are growing rapidly. DuPage County is largely urbanized, although considerable development is still occurring in the western part. DuPage County population, currently about 930,000, is expected to be about 985,000 (a 6% increase) by the year 2010. The eastern part of Kane County is the more rapidly developing edge of urbanization which is moving out from the Chicago metropolitan area. The central and western parts of Kane County are mostly agricultural with a few cities, housing developments, and villages dotting the countryside. Kane County population, now about 490,000, is expected to increase to over 590,000 (more than 20%) by the year 2010. Demographic statistics describing the populations in DuPage County, in Kane County and in the State of Illinois are provided in Table 4.5.

Population Demographic	Kane County	DuPage County	Illinois
Population, 2006 estimate	493,735	932,670	12,831,970
Population, percent change, April 1, 2000 to July 1, 2006	22.20%	3.10%	3.30%
Population, 2000	404,119	904,161	12,419,293
Persons under 18 years old, percent, 2005	29.40%	25.80%	25.40%
Persons 65 years old and over, percent, 2005	8.10%	10.20%	12.00%
White persons, percent, 2005 (a)	89.90%	84.80%	79.40%
Black persons, percent, 2005 (a)	5.60%	4.10%	15.10%
American Indian / Alaska Native persons, percent, 2005 (a)	0.40%	0.20%	0.30%
Asian persons, percent, 2005 (a)	2.80%	9.70%	4.10%
Native Hawaiian / Other Pacific Islander, percent, 2005 (a)	0.10%	0.00%	0.10%
Persons of Hispanic or Latino origin, percent, 2005 (b)	27.50%	11.30%	14.30%
White persons not Hispanic, percent, 2005	63.40%	73.90%	65.80%
Persons with a disability, age 5+, 2000	55,563	101,008	1,999,717
Median household income, 2004	$61,246	$66,697	$47,711
Per capita money income, 1999	$24,315	$31,315	$23,104
Persons below poverty, percent, 2004	7.90%	6.00%	11.90%

(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.

Source: U S Bureau of the Census (Census 2000)

Table 4.5 Demographic statistics describing the populations in DuPage County, in Kane County and in the State of Illinois

Fermilab has approximately 2,000 employees, and 1,400 experimenters from all over the world who use the facilities. Most of the employees work in Wilson Hall, a large office building on the Fermilab site, approximately 1 mi east of the proposed NO*ν*A site. Approximately 100 experimenters would work on the proposed NO*ν*A Project, principally performing computations remotely, from offices in Wilson Hall. They would have no need to access the detector or beam facilities. The overall number of scientists who conduct research at Fermilab is not anticipated to change significantly from present levels. Annually, the Laboratory typically has approximately 50,000 day visitors who visit Wilson Hall to attend cultural activities, to take self-guided tours, to participate in activities at Fermilab's science education center, and to conduct business with the Laboratory.

4.1.8 Occupational Health and Safety Experience at Fermilab

Over a 5-year period from 2001 to 2005, the total recordable cases of occupationally-related injuries and illnesses at Fermilab averaged 1.5 cases per 200,000 worker hours (DOE 2007). This rate is lower than the average incidence rate for DOE sites (1.9 cases per 200,000 worker hours). For comparative purposes, the DOE average incidence rates were well below the Bureau of Labor Statistics rates for U.S. private industry of 5.4 cases per 200,000 worker hours during the 5-year period from 2000 to 2004 (most recent data available) (DOE 2007).

Ionizing radiation is produced at Fermilab during operation of the NuMI beamline. The radiation is generated by the interaction of the proton beam with objects such as the target, focusing magnets, collimators, the walls of the tunnels and beam absorbers, or any other material that the proton beam may strike. A major portion of this radiation, known as prompt radiation, is present only when the beam is operating. Exposure of Fermilab employees, visitors, scientific users, and members of the public to this radiation is regulated by DOE in 10 *CFR* 835 and in DOE Order 5400.5 (DOE 1998b), and these regulations are implemented at Fermilab through a detailed written policy in the FRCM (Fermilab 2007c).

The DOE Office of Environment, Safety and Health reports occupational radiation exposure data for monitored DOE and contractor employees (DOE 2007). In 2005, approximately 1,600 Fermilab workers were monitored for occupational radiation exposure. Of that number, only 426 workers actually had a measurable dose equivalent. The average measurable dose equivalent was 38 mrem, and the maximum dose received by any worker was 280 mrem. These values are considerably below the DOE regulatory dose equivalent annual limit of 5 rem (5,000 mrem) or the Fermilab administrative dose goal of 1,500 mrem annually.

Fermilab also tracks the collective dose statistic (the sum of the individual doses measured in the monitored workforce), which is an indicator of the overall workforce radiation exposure. In 2005, the Fermilab collective dose was about 16 person-rem. For perspective, the 426 individuals with measurable dose equivalent would have received about 153 person-rem from background radiation sources during 2005.

4.1.9 Transportation at Fermilab

The regional highway network in the vicinity of Fermilab consists of several main routes: a DOE-maintained road network within the site; US Interstate 88, a multi-lane, high volume route running east-west to the south side of the site, and State Highway 59, a principal 4-6 lane north-south arterial to the east of the site. At peak periods, commuter traffic is often heavy on all primary routes to and from Fermilab. Freight rail service is available at a railhead adjacent to the north side of the site. Transportation resources are shown in Figure 4.1.

4.2 Ash River MN Site

The Minnesota Environmental Assessment Worksheet (EAW) contained in Appendix A is incorporated into this EA by reference. It was prepared by the University of Minnesota, acting as the State of Minnesota Responsible Governmental Unit (RGU) for this environmental review process. For the NO*v*A Project environmental review, Barr Engineering Co, Duluth, MN reviewed the draft EAW and provided the RGU an independent assessment and verification of the information in the EAW (Barr 2007). Information in the following sections is a summary of the EAW, which should be reviewed for detailed discussions of the affected environment.

4.2.1 Land Use at the Ash River Site

The proposed location for the NO*v*A Far Detector Facility is a currently undeveloped parcel approximately 25 mi southeast of International Falls, MN. Details of the land, its proposed use, existing cover types, and proposed changes are discussed in Sections 9 and 10 of the EAW (Appendix A).

4.2.1.1 NOvA Far Detector Facility Site

The proposed facility site consists of three land parcels that total 89.6 ac. Two (2) of the parcels are currently owned by the Minnesota Department of Natural Resources (MNDNR). The third section is currently owned by the Forest Capital Partners (formerly Boise Cascade). Access to the site is via an old clay base logging road which crosses land owned by Forest Capital Partners and the MNDNR. The properties have been primarily utilized for timber cutting operations in the past. The MNDNR Division of Forestry is responsible for management of the site and these timber production areas are parcels within the Kabetogama State Forest.

The proposed facility site contains several logging roads and trails providing access throughout the site. No old growth forest exists on the site. The upland forest cover consists of young stands of trees in areas recently harvested, to middle aged trees in older cut areas. Approximately 80% of the existing tree cover consists of quaking aspen (*Populus tremuloides*). The majority of the site has been clear-cut recently and is devoid of tree cover.

4.2.1.2 Access Road Alignment Right-of-way

The proposed access road alignment consists of 18.9 ac and is approximately 3 mi in length. The access road alignment crosses both wetland and upland land uses that are similar to those found on the facility site. The road also transects through MNDNR-owned timber parcels and private parcels. There are no residential or developed parcels along the proposed access road alignment. Similar to the facility site, there are numerous clearcuts and other recent impacts from timber production in the vicinity of the access road alignment. Neither the proposed facility site nor access the road alignment shows

evidence of potential pollution concerns or potential environmental hazards due to past site uses.

4.2.2 Air Quality at the Ash River Site

St. Louis County in Minnesota continues to meet all federal ambient air quality standards. The air quality in the Ash River area is rated as "good" based upon measurements of the air quality index (AQI). The AQI uses numbers from 0 to 500 to describe the air quality conditions and their possible effects on human health. Readings of 0-50 are described as Good, 51-100 as Moderate, 101-150 as Unhealthy for Sensitive Groups, 151-200 Unhealthy, 201-300 Very Unhealthy, and 301 and above Hazardous. The rating for the Ash River area is based upon an annual average of 257 days with ratings less than a 50.

4.2.3 Hydrogeology at the Ash River Site

The Ash River area of northern Minnesota is characterized by thin glacial deposits overlying Pre-Cambrian shield rocks. The near surface, unconsolidated material is clayey in nature ranging from lean to fat clay to clayey sand. Underlying the clayey surface layer is silty sand extending to the surface of the bedrock. Bedrock geology in the vicinity of the site consists of granitoid rocks and granite-rich migmatite to a depth of over several hundred meters (MNDNR 2001).

Two borings have been made at the proposed Ash River building site to a depth of approximately 60 ft and found 7 – 10 ft of glacial till over solid hard granite to full depth. Two units are identified with the unconsolidated deposits, an upper clayey unit (including lean to fat clay and clayey sand) and a lower silty sand unit. The clay unit was encountered to 2.5 and 4 ft bgs, underlain by the silty sand to 6.5 and 7.5 ft bgs where granitic bedrock was encountered. A packer test done at one boring found the granite exhibited no significant fracturing at these depths.

Twenty-seven additional borings were completed on site. Unconsolidated deposits in these borings are also consistent with the glacial till and have sandy and gravelly deposits overlying bedrock. The depth to bedrock in these borings ranges from 4 - 18 ft bgs. In the wetland portion of the proposed access road to NO*ν*A just off St. Louis County 129, the glacial till is much thicker with one boring not reaching bedrock even at 40 ft in depth. A detailed geotechnical engineering report of the Ash River site is available (SEH 2007).

Groundwater elevations were found to be approximately 2.5 ft below the surface. Given the lack of weathering in the bedrock at the site, it is possible that water infiltrating through the upper soil deposits perches on top of the bedrock. The direction of groundwater movement likely follows the slope of the bedrock. Results of the monitoring and testing indicate the distribution of water is highly variable across the proposed Far Detector site. The occurrence of dry wells and low quantities of water, in wells that exhibit water, suggest that a water table aquifer is not present at the site to the depths investigated, as low as 60 ft bgs. Additional information applicable to geologic and groundwater resources can be found in the EAW Sections 13, 18 and 19.

4.2.4 Surface Water Resources at the Ash River Site

The Ash River site is currently undeveloped, and surface water would follow the natural contours of the lands to the south. At closest approach, the detector building would be approximately 1,000 feet from the nearest point of the Ash River, which discharges into Lake Kabetogama about 2.8 mi away.

There is a 100-year floodplain along the Ash River identified on the National Flood Insurance Program Flood Insurance Rate Map, as seen in Figures 4 and 5 in the EAW (Appendix A). In addition, the Ash River is a Protected Water and has a designated shoreland area within 300 feet of its bank (EAW Figure 7). The shoreland zone also includes the area of the floodplain where it extends beyond the 300-foot defined shoreland area. None of the proposed facility impact footprint is within either the shoreland area or the floodplain of the Ash River. The surface water conditions at the proposed Ash River site are described in the EAW Sections 12, 14 and 17.

4.2.5 Biological Resources at the Ash River Site

The proposed Ash River site is undeveloped woodland that has been previously used for logging. The EAW describes the area in Section 9, the types of cover in section 10, and wildlife and ecological conditions in Section 11.

The habitats within the site boundary are entirely comprised of forested uplands that have been subjected to recent clearcutting activities. There are no fluvial or lacustrine habitats in the affected environment. Patches of un-cut timber are present amid the recently clearcut areas within the facility site boundary. Soils are thin or comprised of exposed Precambrian bedrock outcrops within a relatively rugged topography. These habitats represent the common types of upland habitats found in the surrounding area.

The MNDNR Natural Heritage Information Program (NHIP) was contacted to identify potential state and federally listed Threatened, Endangered, Special Concern species, and sensitive resources in the project area. Consultations with the NHIP concerning threatened and endangered species are discussed in Section 11 of the EAW.

State Threatened, Endangered and Special Concern Species and NHIP Occurrences

The NHIP identified 5 occurrences within a 1.5-mi radius of the project site and is the basis for the following discussion. No occurrences are found within the facility site boundary or footprint of the proposed access road. Four of the five noted occurrences were of tiger beetles (*Cicindela denikei* – state status, Threatened). Two of the tiger beetle occurrences were recorded in 2001 and 2004 approximately 1.5 to 2 miles south of the facility site, up-gradient of a tributary to the Ash River. One location of a population of Lapland buttercup (*Ranunculus lapponicus* – state status, Special Concern) was identified along St. Louis County 129 west of the intersection of the site access road.

Federally Listed Threatened and Endangered Species

St. Louis County is within the breeding range of the bald eagle (*Haliaeetus leucocaphalus* – federal status, Threatened – proposed for delisting), the distributional range of the grey wolf (*Canis lupus* – federal status, Threatened), and the distributional range of the Canada lynx (*Lynx canadensis* – federal status, Threatened). No bald eagle nesting areas are identified within or within a one-mile radius of the site boundary and none were observed during a site reconnaissance. Suitable nest trees for eagle nests were lacking and there were no lakes that serve as foraging habitats for bald eagles in the vicinity of the site boundary. Canada lynx habitat is marginal to poor within the site boundary, due to extensive clearcutting.[1] Grey wolves are known to occur throughout the project area, an area where wolves have long been established prior to and since they were federally listed.

4.2.6 Wetlands at the Ash River Site

The University of Minnesota completed a wetland delineation of the proposed Far Detector Facility site including field delineation in accordance with the Routine Onsite Determination Method and the 1987 USACE Wetland Delineation Manual (USACE 1987). The resulting delineation report was merged with the Combined Wetland Permit Application prepared for the project and submitted to the USACE (RUMN 2007b). In the delineation process two wetlands were identified within the proposed site boundary, and five wetlands were identified along the proposed access road alignment. The EAW in Appendix A discusses wetlands at the Ash River location in Sections 10 and 12, and the locations of the wetlands are shown on Figure 6 of the EAW.

Wetland classification follows the U.S. Fish and Wildlife Service (USFWS) systems as required by Section 404 and the Minnesota Wetlands Conservation Act (WCA). At USACE's request, *Eggers and Reed* (USACE 1997) classifications were also applied to the delineated wetlands. Wetland plant species nomenclature in the application follows the *National List of Plant Species that Occur in Wetlands* (U.S. Department of the Interior 1988), and field guides for the region aided identification.

USFWS Wetland Classifications

Two different classification systems are commonly used in Minnesota to classify wetlands (BWSR 2007). The Circular 39 system, developed by the USFWS in 1956 (USFWS 1956), divides wetlands in Minnesota into eight types. The main differences between them are depth of water and variety of vegetation.

Type 1 wetlands are either seasonally flooded basins or floodplains.
Type 2 wetlands are wet meadows.
Type 3 wetlands are shallow marshes.
Type 4 wetlands are deep marshes.
Type 5 wetlands are open water wetlands, including shallow ponds and reservoirs.
Type 6 wetlands are shrub swamps.

[1] The U.S. Fish and Wildlife Service proposed regulations February 28, 2008 (73 *Federal Register* 10860) to extend the designated critical habitat for the Canada lynx to include St. Louis County, MN. DOE will coordinate with the FWS on this issue as needed.

Type 7 wetlands are wooded swamps.
Type 8 wetlands are bogs.

The Cowardin system, developed by the USFWS in 1979 (Cowardin 1979), is a far more precise classification system, which uses numerous alphabetic and numeric codes to describe a tiered classification system. Each tier describes the components of a wetland more specifically and narrowly than the last. For example for a wetland coded PEMB:

- P means its system is Palustrine (shallow ponds, marshes, swamps, sloughs);
- EM means its class is Emergent Vegetation (erect, rooted and herbaceous vegetation adapted to wet soil conditions); and
- B is its hydrology modifier (substrate is saturated but standing water is seldom present).

An explanation of the detailed codes and a description of the classification systems are available in the respective references.

Far Detector Site Wetland Description

Figure 6 in the EAW (Appendix A) shows the delineated wetlands, and Table 4.6 presents the wetlands areas and classifications. The first two wetlands are on the proposed site; the remaining wetlands are along the access road.

Basin ID[2]	USFWS Wetland Classification			Total Wetland Area (acre)
	Eggers and Reed	Cowardin	Circular 39	
Wetland 1	Sedge Meadow/Shallow Marsh/Deep Marsh/Coniferous Swamp	PEMB/C/F PSS1B/PFO1B	Type 2/3/4/5/7	>5 ac[1]
Wetland 2	Sedge Meadow/Shallow Marsh/Deep Marsh	PEMB/C/F	Type 2/3/4	6 ac[1]
Wetland 4	Coniferous Swamp/Hardwood Swamp	PFO1B	Type 7	0.05 ac
Wetland 5	Sedge Meadow	PFO1A	Type 1	0.01 ac
Wetland 6	Shrub Carr/Alder Thicket	PSS1C	Type 6	0.05 ac
Wetland 7	Shrub Carr/Alder Thicket/ Coniferous Swamp/Hardwood Swamp	PSS1B/PFO1B	Type 6/7	>40 ac[1]
Wetland 8	Shrub Carr/Alder Thicket/ Coniferous Swamp/Hardwood Swamp	PSS1B/PFO4B	Type 6/7	>40 ac[1]

[1] Wetland extends outside the project limits. The entire wetland was not delineated and the area shown is estimated

[2] Wetland 3 was tentatively identified but further analysis showed it lay outside the project boundary

Table 4.6 Summary of Wetland Types at the Far Detector Site

4.2.7 Cultural and Historical Resources at the Ash River Site

In December 2005, The 106 Group Ltd. conducted a Cultural Resources Assessment in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended (T106 2006). The assessment found that no architectural history surveys have been conducted and no properties have been inventoried within the project area. It also shows that no archaeological sites have been recorded or reported within the Project Area, but one site has been recorded (confirmed) and three sites have been reported (not field checked) within one mile of the Project Area. These four sites include three logging camps and a railroad trestle. No previously recorded pre-contact archaeological sites are located within a one-mile radius of the study area.

The study identified an abandoned railroad grade that may retain sufficient integrity to convey potential significance as an early logging road. This section of railroad passing through the western portion of the project area is identified as a "Winter Road" and is shown on Figure 2 of the EAW (Appendix A). The road extends south until it reaches the Ash River. The western portion of the existing access road to the project site originated as this "Winter Road" and was later used as the basis for the rail line that was likely a spur extending from the VRL Railway, which operated a network of rail lines in northern St. Louis and Koochiching counties. This railroad grade would likely be considered for eligibility for the National Register for Historic Places (NRHP), either under Criterion A, for the broad patterns of history related to timber procurement, or under Criterion C, if the grade represents a significant designed system or if the surviving features demonstrate design attributes that help explain how the various components work. Portions of the rail grade have been converted to a lightly traveled gravel road, which has been widened to accommodate local traffic. Cultural resources are further discussed in Section 25 of the EAW.

Although a Phase I archaeological survey has not been conducted, the Cultural Resources Assessment states that areas within 150 meters of the Ash River have high potential to contain pre-contact archaeological materials.

4.2.8 Socioeconomics / Demographics at the Ash River Site

The proposed Ash River site is in an undeveloped rural area of Northeastern Minnesota. The population density is 1 person per square mile (Census 2000). Approximately 35 workers would be needed at the site during construction and only 5 - 8 people would be needed for experiment operations. Demographic statistics describing the populations in St Louis County and in the State of Minnesota are provided in Table 4.7.

Population Demographic	St Louis County	Minnesota
Population, 2006 estimate	196,097	5,167,101
Population, percent change, April 1, 2000 to July 1, 2006	-2.20%	5.00%
Population, 2000	200,528	4,919,479
Persons under 18 years old, percent, 2006	20.05%	24.34%
Persons 65 years old and over, percent, 2006	15.70%	12.14%
White persons, percent, 2006 (a)	94.65%	89.33%
Black persons, percent, 2006 (a)	1.03%	4.47%
American Indian / Alaska Native persons, percent, 2006 (a)	2.12%	1.17%
Asian persons, percent, 2006 (a)	0.75%	3.50%
Native Hawaiian / Other Pacific Islander, percent, 2006 (a)	0.03%	0.05%
Persons of Hispanic or Latino origin, percent, 2006 (b)	0.86%	3.80%
White persons not Hispanic, percent, 2005	93.96%	85.93%
Persons with a disability, age 5+, 2000	31,900	592,448
Median household income, 2004	$43,078	$54,023
Per capita money income, 1999	$23,313	$27,591
Persons below poverty, percent, 2004	12.9%	9.8%

(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.

Source: U S Bureau of the Census (Census 2000)

Table 4.7 Demographic statistics describing the populations in St Louis County and in the State of Minnesota

4.2.9 Occupational Health and Safety at the Ash River Site

The proposed site is undeveloped. Therefore, there is no baseline for occupational health and safety.

4.2.10 Transportation at the Ash River Site

The functional average daily traffic capacity for a rural two-lane county roadway like St. Louis County 129 is in the range of 8,000 to 10,000 vehicles per day (VPD). It currently serves approximately 310 VPD. Transportation at Ash River is discussed in Sections 21 and 22 of the EAW (Appendix A).

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5. POTENTIAL ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION AND THE NO ACTION ALTERNATIVE

This section describes the anticipated environmental impacts of the four elements of the proposed NO*v*A Project: excavation and civil construction, installation and assembly, operation of the experiment, and decontamination and decommissioning of the facilities. This section discusses impacts associated with "normal" activities - those that proceed as planned. Potential impacts related to "off-normal" or accident scenarios are addressed in Chapter 6.

This Chapter describes impacts associated with the Fermilab and Ash River project sites separately, in Sections 5.1 and 5.2, respectively. Section 5.3 discusses the impacts of the blending facility alternatives. The region between Fermilab and the NO*v*A Far Detector would be unaffected by the construction, assembly, operation, and decommissioning activities since the NO*v*A experiment requires no disturbance within the region. Because neutrinos rarely interact with material, they do not activate the material they pass through. Therefore, impacts are not associated with project operations in the region between the near and far detectors. A summary of human health impacts is provided in Section 5.4, and Section 5.5 identifies the potential impacts due to the no action alternative.
1

5.1 Potential Environmental Impacts from Activities at Fermilab

At Fermilab the proposed action would include an upgrade of the existing Fermilab accelerator complex, construction of an underground cavern, and installation of two neutrino detectors, the above-ground IPND and the underground Near Detector. Blending the approximately 4.3 million gal of materials that are needed to fill the three NO*v*A detectors (IPND, Near, and Far) would occur at a commercial blender in the Chicago area or at a blending facility proposed to be built at Fermilab, as described in Section 3.3.2. Impacts from a blending facility at Fermilab include those from construction, blending operations, and material transport. Using a commercial blender would include impacts from blending operations and materials transport, except there would be no construction, and transportation miles to/from Fermilab and Minnesota could be increased slightly, depending on vendor location. The blending facility and prototype detector would be decommissioned early in the experiment schedule when their purpose has been fulfilled. After an extended period of experiment operations and data collection, the other facilities would be decommissioned.

5.1.1 Excavation and Construction at Fermilab

5.1.1.1 Land Use

The areas where excavation and construction would take place on the Fermilab site are currently in use or have been previously used for other purposes.

5.1.1.2 Air Quality

During excavation and construction, the operation of diesel-powered equipment would be expected to introduce quantities of SO_2, NO_2, particulates, and other criteria pollutants to the atmosphere, typical of similar-sized construction projects. These releases would be temporary and reversible, and would not cause any air-quality standards to be exceeded. Particulates (dust) generated during earthmoving activities and vehicle movement over unpaved areas would be minimized by frequent watering or other dust-control measures.

The planned cessation of the Tevatron program during excavation would diminish routine radionuclide emissions to the air. Such emissions are regulated in a permit issued by IEPA pursuant to the State National Emissions Standard for Hazardous Air Pollutants program. NO*ν*A construction and excavation activities would not release radionuclides, volatile organic chemicals or other chemicals to the air.

5.1.1.3 Water Quality

Ground Water

The hydrogeology of the Fermilab site along with the NuMI tunnel construction enables ground water in the vicinity of the NuMI facility, including the proposed NO*ν*A Project, to flow continuously into the NuMI tunnel. Hydrologic modeling indicates that ground water within a 30-ft radius of the tunnel flows towards and into the tunnel at a rate of approximately 170 gal per minute (Martens 2007). Water flowing into the NuMI tunnel enters a drainage system that leads to a sump near the bottom of the tunnel. Water in the sump is pumped to the surface continuously and is used for replenishing the industrial cooling water (ICW) supply ponds at Fermilab.

No other subsurface disturbance or excavation is proposed. As described below, runoff from proposed surface construction activities would be controlled, which also would prevent drainage into ground water.

Surface Water

Surface areas disturbed by construction activities, including equipment staging and laydown areas, stockpile areas for excavated rock, access roads, and subsequent landscaping would be managed under the Fermilab SWPPP. Proper containment and erosion controls would be provided to prevent transport of soil or sediment and machinery lubricants and other construction chemicals into surface waters during storm events.

5.1.1.4 Biological Resources and Wetlands

The surface disturbing activities associated with construction and excavation activities would occur in areas at Fermilab where natural vegetative cover and habitat have been disturbed.

The proposed project would not involve activities within a 100-year floodplain (FEMA 1982). The potential impact of the NuMI beam line on jurisdictional wetlands was analyzed by qualified experts who determined that no adverse impacts would be expected (CTE 1997). The proposed NO*v*A Project beam line is physically identical to the evaluated NuMI pathway; therefore the proposed action would not introduce any new adverse environmental impacts. And since no threatened or endangered species are present, there would be no impact to them.

5.1.1.5 Cultural and Historical Resources

As described in Section 4.1.6, none of the archeological locations identified in the *Fermi National Accelerator Laboratory Cultural Resource Management Plan* (Lurie 2002) coincide with or are near the locations that would be disturbed by construction or excavation-related activities. DOE made a determination of "no historic properties affected" under the National Historic Preservation Act (DOE 2007c). A copy of the determination is included in Appendix E.

5.1.1.6 Occupational Health and Safety

Fermilab employees and contractors would conduct work under the FESHM and implementing procedures for construction and excavation operations. Excavation workers in the tunnel would not be working in areas that have been activated by past accelerator operations, and the beam would be off-line during construction. As indicated in Section 3.1.4, the number of additional personnel on the Fermilab site during the excavation/construction phase is expected to be about 30 individuals or fewer, and project labor hours would be fewer than 60,000 per year.

Based on the Fermilab average incidence of 1.5 cases of injury/illness per 200,000 labor hours, 1 (0.9) case of injury/illness would occur during the two-year period of excavation/construction activities. Based on a national average underground mining incidence rate of 3.5 cases per 200,000 labor hours (DOL 2007), 2 (2.1) cases of injury/illness would be an upper bound on cases occurring during the two-year period. In this and subsequent discussion, "cases" refers to occupational injuries and illnesses that are recordable under U.S. Occupational Safety and Health Administration (OSHA) regulations in Title 29 *CFR* Part 1904. When using reportable case rates and worker hours to calculate total cases, the phrase "a calculation results in" is used to present the numerical estimate resulting from the statistical calculation, and it is not meant to imply that a particular number of injuries or illnesses will actually happen.

5.1.1.7 Transportation

The increase in the number of workers due to construction of the NO*v*A Project would result in only a marginal increase in traffic. For 10 Fermilab construction worker vehicles, assuming a conservative average commute distance of 86 mi (round-trip) for each vehicle, (based on a one-way distance of 43 mi between Chicago and Batavia), results in a total of 430,000 vehicle-miles. For this total a calculation results in 2 (1.68)

accidents, 0 (0.005) fatalities, and 0 (0.48) injuries due to construction worker commutes during the 2-year period. This is based upon Illinois accident, fatality, and injury statistics, which are 3.91E-06, 1.26E-08, and 1.04E-06, per vehicle-mile, respectively (IDOT 2005).

In this and subsequent discussion of transportation impacts, "a calculation results in" is a phrase used to present the numerical estimate resulting from a statistical calculation based on estimates of incident rates, number of vehicles and distances traveled. Distances traveled are estimated in either miles or kilometers, depending on the units of the referenced incident rates. The calculated result is not meant to imply that a particular number of accidents, injuries or fatalities will actually happen.

An estimate of the highway accidents of trucks associated with the construction phase is based on the number of truckloads of spoil material to be moved from the excavation to an existing Fermilab stockpile. It is estimated that approximately 1,000 yd^3 of rock spoils would require removal for the NO*ν*A Project. The truck traffic associated with moving the spoils to on-site stockpile(s) is estimated to be fewer than 10 trucks per day, and would be limited by the rate of excavation and spoil removal operations from the tunnel. Conservatively assuming 15 cubic yards per truckload, this would require the movement of a total of approximately 67 truckloads of spoil material. Hence, the total distance traveled would be low (less than 1,000 vehicle-miles total), and associated impacts essentially zero.

5.1.1.8 Noise and Vibration

The removal of the rock from the existing NuMI tunnel would require blasting operations that would be conducted in accordance with the FESHM. The proposed action, removing 1,000 yd^3 from deep in the tunnel represents only about 1.3% of the 75,000 yd^3 removed in the original NuMI blasting. The noise and vibration effects of the more extensive blasting and excavating for the original NuMI tunnel were evaluated in the NuMI Environmental Assessment (DOE 1997) and found to be not environmentally significant. The proposed blasting, involving a far smaller magnitude, would generate proportionately less noise and vibration.

5.1.1.9 Waste Generation and Disposition

Although the NO*ν*A experiment represents additional activity at Fermilab, the amount of additional waste generated would be a small percentage of routine waste volumes. Most construction wastes would be recycled; however, about 40 m^3 (50 yd^3) might be disposed as routine dumpster/landfill waste. In comparison, Fermilab landfill waste was over 8,700 m^3 in 2006 (Fermi 2007b). Under normal operations, excavation and construction would not produce hazardous wastes.

5.1.2 Installation and Assembly at Fermilab

5.1.2.1 Land Use

The areas where installation and assembly would take place on the Fermilab site are currently in use or have been previously used for other purposes. The site of the proposed assembly of the IPND would be inside of an existing building, thereby avoiding new land use.

5.1.2.2 Air Quality

In this phase the only criteria air pollutant emission sources would be light vehicles used for transportation of experimental components, and emissions from the vehicles of the 8 or so additional workers expected at Fermilab during the installation and assembly phase. This is well within normal Fermilab traffic fluctuations, as the site is open to visitors as well as students and researchers.

Assembly and installation of the IPND and the Near Detector requires the use of the MMA adhesive to glue the PVC layers together. Planning and design indicates the use of less than 2 metric tons (4,400 lbs) to glue both detectors. (Recall that the PVC components of the IPND would be recycled/assembled for use in the Near Detector). MMA evaporates and is emitted during adhesive application. According to the adhesive manufacturer, approximately 2.7% (by mass) of the MMA product will vaporize, so the potential MMA vapor source could be about 120 lbs, with approximately 50 lbs released during assembly of the IPND and the remaining 70 lbs during assembly of the Near Detector several years later. DOE and Fermilab have an established health and safety program that routinely addresses operations of this small scale, and impacts to air quality would be essentially zero.

The only other volatile emission sources associated with the NO*ν*A Project might be small quantities of paints or coatings that are routinely used at the Fermilab site and that are addressed by Fermilab ES&H training and procedures for handling open containers and materials with volatile constituents. These releases would not be expected to cause any air quality standards to be exceeded.

5.1.2.3 Water Quality

Ground Water
One hundred percent secondary containment and sumps would be in place prior to filling to contain and remove any spill or release of material and prevent contact with ground water.

Surface Water
Installation and assembly activities, including filling of the Near Detector, would not involve surface disturbance, and therefore would not be expected to cause erosion, or

increased site drainage to surface water in the area. Activities such as assembly of the IPND would take place in existing buildings, and the blending facility would be erected in a previously disturbed area. Using a commercial blending facility in the Chicago metropolitan area would have little if any effect on surface water, since secondary containment would be employed to prevent releases. The pseudocumene in the scintillation liquid is hazardous to aquatic organisms, so the NO*ν*A project would provide 100% secondary containment for all transfer, storage and use facilities to prevent release to the environment. Potential spills and other accidental releases during transportation are addressed in Chapter 6 and the NO*ν*A Project *Accident Analysis Summary* (NO*ν*A 2007c).

5.1.2.4 Occupational Human Health and Safety

The greatest potential of affecting occupational health and safety during installation and assembly would be the injuries to workers during "normal" activities. With fewer than 10 individuals actually engaged in assembly and installation activities, labor hours would be less than 20,000 per year. A calculation based on Fermilab average incidence of 1.5 cases of injury/illness per 200,000 labor hours results in 0 (0.15) cases of injury/illness during detector assembly and filling operations. Based on a national average for nonresidential building construction incidence rate of 5.4 cases per 200,000 labor hours (DOL 2007), 1 (0.5) case of injury/illness would be an estimated upper bound on cases occurring during the half-year period.

Accidents or "off-normal" occurrences are discussed in Chapter 6. Blending liquid scintillator could expose workers from the commercial facility to pseudocumene, but closed loop transfers and closed-tank blending would reduce potential exposure. Symptoms and effects of exposure to these blending chemicals are described in the MSDS information included in Appendix C. DOE and Fermilab have an established safety program that routinely addresses operations of this small scale.

During detector filling, vapors that potentially could be released to the atmosphere would be analyzed to assure compliance with FESHM air emission requirements. Ventilation controls and ES&H operational procedures would be developed for the project to minimize worker exposure and ensure that any exposures that do occur are well below the American Conference of Governmental Industrial Hygienists (ACGIH) time-weighted average (TWA) threshold limit value (TLV) and also below the short-term exposure limit (STEL).

5.1.2.5 Transportation

For the 8 employees associated with project assembly and installation, and assuming a conservative average commute distance of 86 mi (round-trip) (based on a one-way distance of 43 mi between Chicago and Batavia), a calculation results in an additional 1 (0.67) accidents, 0 (0.002) fatalities, and 0 (0.18) injuries for the six months to one year of this phase as a result of workers commuting 172,000 vehicle-miles to/from the Fermilab site. The calculation is based on the state of Illinois accident, fatality, and injury

rates per vehicle-mile, which are 3.91E-06, 1.26E-08, and 1.04E-06, respectively (IDOT 2005). These numbers represent a minimal increase given the total number of employees at Fermilab and would be offset by workforce reductions due to programmatic changes at Fermilab during the period (i.e., termination of Tevatron operations).

Materials shipments for the assembly and filling of the detectors are few due to the small scale of the facilities at Fermilab. For example, the MMA adhesive would be delivered in two shipments from the distributor resulting in fewer than 1,000 vehicle miles and associated impacts essentially zero.

5.1.2.6 Waste Generation and Disposition

Hazardous materials used during the assembly and installation of the detectors include the liquid MMA adhesive. The Project would receive 660 gal of the Devcon-60 glue in 2 shipments totaling 12 plastic-lined drums. After glue is pumped from the drum, the residual adhesive (perhaps ~0.5%) necessitates that the liner be managed as a hazardous waste. Once the contaminated liner is removed, the uncontaminated metal drum is recyclable. The approximately 3 gal of residual liquid (0.5% of 55 gal in 12 drums) can be fixed by placing absorbent material in the liner. The plastic liners can be volume reduced through compaction to less than 1 m^3. Wastes would be submitted to a licensed waste hauler for disposal at a licensed disposal facility. Such a small volume would easily be managed within the existing waste volumes of Fermilab. In 2006 Fermilab disposed over 20 m^3 of hazardous wastes, of which 75% was “non-routine”, so this volume would not place undue strain on waste disposal capacity.

5.1.3 Operations at Fermilab

Operation of the proposed NO*ν*A experiment on the Fermilab site would follow the requirements of the FESHM. The FESHM implements a fully developed Integrated Safety Management System. Written work plans and emergency response procedures would be developed for all tasks that could pose a hazard.

Operation of the proposed upgraded beamline and NO*ν*A experiment would comply with existing Fermilab safety and beam operations procedures and guidelines as required by the Fermilab Radiological Control Manual (Fermilab 2007c). These procedures are based on the principle of As Low As Reasonably Achievable (ALARA) in the area of radiation protection. Written access procedures would be developed for all areas. A Safety Assessment Document would be written and approved before operation starts.

Total releases to the environment from beamline operations would continue to be reported annually to the Illinois Environmental Protection Agency (IEPA) and the U.S. Environmental Protection Agency (EPA) in accordance with conditions of the relevant NESHAPs permit (IEPA 2006).

A Fermilab Technical Memorandum *An Assessment of Radiological Releases from the NuMI Facility during MINOS and NOvA Operations* (Martens 2007) analyzes the

radiological releases for operating the NuMI facility during proposed NO*ν*A operations has been written. The following sections discussing radionuclide releases and potential concentrations in air, ground water, and surface water are based on the content of this document.

5.1.3.1 Air Quality

Hazardous air emissions from the operation of the project would include radionuclides from the target and its vicinity. Under normal conditions, some of the radionuclides produced by the operation of the Fermilab accelerator become airborne in the form of tritiated water vapor and enter the atmosphere through three mechanisms: 1) ventilation of air from the NuMI underground facility, 2) evaporation of tritiated water from the Central Utility Building (CUB), and 3) evaporation from the Fermilab ponds. Releases under current operations are discussed in Section 4.1.2.

Operating the NuMI beam line under NO*ν*A operating conditions would increase the existing level of radionuclide emissions to the atmosphere commensurate with the proposed increase in beam power to 700 kW. Fermilab estimated bounding radionuclide emissions from the modified NuMI beam line using an operating beam power of 1,500 kW in order to determine potential radiological impacts of increasing the beam power. Estimating the emissions entailed scaling the current radionuclide measurements by the ratio of beam power. Calculating emissions at 1,500 kW, which is over twice the power level proposed for the NO*ν*A experiment operation, provides a very conservative estimate. At a beam power of 1,500 kW, the estimated total radionuclide air emissions that would be released into the atmosphere through vent stacks to the surface of the Fermilab site are 260 Ci/yr (Martens 2007). This estimated radionuclide release is well below the regulatory limit of 2,000 Ci/yr imposed by the Fermilab NESHAPS permit (IEPA 2006).

Hazardous materials are routinely used during Fermilab operations with no impact on air quality. Criteria pollutant emissions from the vehicles of eight additional workers (commuters) could be expected during operations and would fall within the normal site fluctuations.

5.1.3.2 Ground Water

Studies of the leachable radioactivity produced in soil and rock adjacent to NuMI tunnel show that the two principal radionuclides of concern are tritium and sodium-22 (Martens 2007). As shown in Table 5.1, conservative estimates of radioactivity levels in ground water immediately adjacent to the tunnel wall from beam line operations at 1,500 kW (over twice the beam power proposed for NO*ν*A operations) could exceed regulatory drinking water limits for sodium-22. However, this water source is not available for consumption.

Fermilab measurements and calculations show that 99% of all radionuclides that would be produced would be within the first 6 ft of the tunnel wall, and the ground water within

a radius of 30 ft flows into the NuMI tunnel (Martens 2007). Ground water collected within a radius of 30 feet from the tunnel would reduce the concentration of radionuclides including sodium-22, due to NuMI operations to levels much lower than the drinking water regulatory limit. Moreover, this activated water would be collected in the sump at the end of the tunnel and discharged to the Fermilab surface water pond system and subsequently used in the ICW system on site as is the current practice. The cooling ponds that receive the ground water that is pumped from the tunnel are underlain with naturally occurring clay, which inhibits radionuclides, such as tritium or sodium-22 produced during the NuMI and NO*ν*A experiments from re-entering ground water. This water would not be available for public use or consumption, nor would it undergo subsurface transport once entering the ICW.

Spills or accidents involving liquid scintillator from the Near Detector in the NuMI tunnel that might enter the ground water system are addressed in Chapter 6. Releases would be controlled by primary and secondary containment systems as described in Section 3.3.2.

Type of Operations	Estimated Maximum Tritium Level	Estimated Maximum Sodium-22 Level
NuMI/at 1,500 kW	7 pCi/ml	0.7 pCi/ml
Illinois Drinking Water Standard	**20 pCi/ml**	**0.4 pCi/ml**

Table 5.1: Estimated radionuclide concentrations in the ground water immediately adjacent to the NuMI tunnel. Radionuclide levels are estimated within 6 ft outside of the NuMI tunnel under operating conditions that would be expected during the running of the NuMI facility at 1,500 kW of beam power.

5.1.3.3 Surface Water

Discharge of radionuclides from the MI cooling ponds into waters of the State of Illinois is exceedingly rare – only in the event of a rain event of a 500-year flood; however, the discharge is covered by Fermilab's NPDES permit. Volume, flow and concentrations are managed under the FESHM to ensure surface water impacts are controlled.

The estimates for the concentration of tritium and sodium-22 in pond water presented in Tables 5.2 and 5.3 respectively are exceedingly conservative because they assume drought conditions (Martens 2007). In drought conditions the volume of water in the Fermilab pond system would be reduced resulting in a higher concentration of radionuclides. Even under the conservative assumptions of drought conditions, these concentrations would be well below the regulatory limit for radionuclides in surface water. However, release of water from the MI cooling ponds into surface creeks would not occur under drought conditions.

Phase	Tritium Levels (NuMI Sump Water)	Tritium Levels (Pond Water)
NuMI/ NO*ν*A	100 - 200 pCi/ml	25 - 50 pCi/ml
DOE Surface Water Regulatory Limits[1]	**2,000 pCi/ml**	**2,000 pCi/ml**

[1]Source: U. S. Department of Energy Order 5400.5, "Radiation Protection of the Public and the Environment".

Table 5.2: Estimated concentrations of tritium in the NuMI sump and Fermilab ponds. Radionuclide levels are estimated considering current NuMI operations and at 1,500 kW of beam power.

Phase	Sodium-22 Levels (NuMI Sump Water)	Sodium-22 Levels (Pond Water)
NuMI/ NO*ν*A	< 1.2 pCi/ml	< 0.3 pCi/ml
DOE Surface Water Regulatory Limits[1]	**10 pCi/ml**	**10 pCi/ml**

[1]Source: U. S. Department of Energy Order 5400.5, "Radiation Protection of the Public and the Environment".

Table 5.3: Estimated concentrations of sodium-22 in the NuMI sump and Fermilab ponds. Radionuclide levels are estimated considering current NuMI operations and at 1,500 kW of beam power.

5.1.3.4 Utilities at Fermilab

The increase in the Fermilab utility requirements as a result of assembly and operation of the NO*ν*A experiment would not impact public utility supply. Any increase in power, water, and electricity consumption at Fermilab from NO*ν*A would be offset by the projected closure of the Tevatron collider operations scheduled in 2010. Analyses indicate that shutting down Tevatron would save approximately 18 MegaWatt (MW), while NO*ν*A-related improvements to the Main Injector (4.3 MW) and the Booster (2.5 MW) would result in a net decrease in power consumption of approximately 11.2 MW. Utility requirements for the small project staff, including sanitary sewer, natural gas, and drinking water needed for this facility would be provided by existing services at Fermilab, with no upgrade required.

5.1.3.5 Occupational /Human Health and Safety

Occupational impacts projected for the NO*v*A Project would be similar to any workforce in an educational, office or light industrial workplace. Since data are in electronic format, the analysis can and would occur at distributed locations of the collaborating institutions. With fewer than 5 individuals actually assigned to the NO*v*A Project on the Fermilab site to support detector operations, project labor hours would be less than 10,000 per year. A calculation based on Fermilab average incidence of 1.5 cases of injury/illness per 200,000 labor hours results in 0 (0.45) cases of injury/illness during the 6-year period of detector operations. An additional 1 (0.65) accidents, 0 (0.01) fatalities, and 0 (0.17) injuries might result from 5 workers commuting 22 miles per day during the six years of operations (165,000 vehicle-miles).

Occupational Exposure

Exposure from existing Fermilab activities are discussed in Section 4.1.8. Changes in Fermilab accelerator work activities related to the proposed project are few and would not be expected to impact potential occupational exposures. Increased beam power would raise estimated radionuclide emissions and could be expected to marginally raise the potential estimated dose rate to workers from airborne releases, with minimal offsite impacts.

Increased beam power also would raise activity and external dose rates from activated components. Fermilab has an effective radiation exposure control program documented in the Fermilab Radiological Control Manual (Fermi 2007c), the Fermilab ES&H Manual (Fermi 2007a), and associated implementing procedures. Operational controls would be employed and modified as necessary to respond effectively to expected marginal increases in radiation and radioactivity. That is, at the increased beam power proposed, the Fermilab radiological control program and associated engineering and administrative controls would be used to manage potential worker exposures to be as low as reasonably achievable. Values will remain considerably below the DOE regulatory dose equivalent annual limit of 5 rem and the Fermilab administrative dose goal of 1500 mrem annually.

Public Dose

The estimated maximum annual radiation dose at the site boundary that would result from the airborne releases identified in Section 5.1.3.1 is 0.04 mrem (Martens 2007). This dose at the site boundary assumes a hypothetical member of the public who would spend the entire year at the location of maximum exposure at the Fermilab site boundary. This estimated maximum dose is far below the regulatory limit of 10 mrem in a year identified in the NESHAPS regulations (Title 40 *CFR* Part 61).

The total annual dose equates to a probability of latent cancer fatality (LCF) of 2.5×10^{-7} for an individual based on a dose-to-LCF factor of 0.0006 LCF per person-rem for both workers and the general public (ISCORS 2002), essentially zero. This LCF assumes a 10-year operating period for the project.

5.1.3.6 Waste Generation and Disposal

Although the NO*ν*A experiment represents additional activity at Fermilab, the amount of additional waste generated would not significantly alter the current waste volumes. Under normal operations, the experiment does not generate a continuous waste stream; intermittent failed electronic components are replaced, minor liquid leaks are cleaned, and data are analyzed on computers. Quantities of routine waste in a year would be 2-3 m^3 of dumpster/landfill waste. This would be only a minor fluctuation in the waste volume that routinely occurs at Fermilab where landfill waste was over 8,700 m^3 in 2006 (Fermi 2007b). Under normal operations, the experiment would not generate a hazardous waste stream.

5.1.4 Decommissioning Impacts at Fermilab

Facility decommissioning at Fermilab was described in Section 3.3.4, and includes removal of the scintillation liquid and disassembly of the Near Detector from the underground cavern. It is anticipated that most of the equipment and materials involved with the accelerators, NUMI beamline, and target would remain in place to be used in other current or future experiments.

5.1.4.1 Air Quality

Because decommissioning is a low-intensity, methodical process, it will have impacts similar to those in the operations phase (see previous sections). With the NUMI beam off, or no longer assigned to NO*ν*A operations, generation of criteria pollutants could decrease during the decommissioning phase.

5.1.4.2 Water Quality

Water quality impacts during decommissioning would be expected to be less than the impacts during operations discussed in Section 5.1.3.2 and Section 5.1.3.3. With the NUMI beam off, or no longer assigned to NO*ν*A operations, the activation of radionuclides in the ground water would decrease. Radioactivity levels in the sump would decrease as pumping/flow continues, but new radioactivity production would end. Removing liquids from the Near Detector and from the cavern would be in 100% volume secondary containment or pumped through closed loop systems. On the surface, water pumped from the sumps has less radioactivity, so the impact is less, however, continuing operations to support other experiments would preclude the impact from going to zero. Dismantling the blending facility would require dust suppression and storm water runoff controls identified in the FESHM similar to those invoked during installation.

5.1.4.3 Occupational/Human Health and Safety

Decommissioning the NO*ν*A facilities would proceed with little radiological impact, because the detector and equipment in the cavern were exposed only to the neutrino

beam. For ALARA and control purposes ES&H personnel would survey equipment for radioactivity and manage it according to requirements of the FRCM.

With fewer than 10 individuals participating in the NO*ν*A Project decommissioning on the Fermilab site, project labor hours would be less than 20,000 per year. A calculation based on Fermilab average incidence of 1.5 cases of injury/illness per 200,000 labor hours results in 0 (0.15) cases of injury/illness per year during detector decommissioning. With decommissioning scheduled to occupy less than a year, the calculated injury/illness value is an overestimate.

5.1.4.4 Transportation

For employees associated with the project decommissioning, 8-10 worker vehicles are projected at Fermilab. A larger workforce could not work efficiently within the confines of the NUMI tunnel and NO*ν*A cavern. A conservative average commute distance of 86 mi (round-trip) is assumed for each worker, based on a one-way distance of 43 mi between Chicago and Batavia. For the State of Illinois, the accident, fatality, and injury rates per mi are 3.91E-06, 1.26E-08, and 1.04E-06, respectively (IDOT 2005). An additional 1 (0.67) accidents, 0 (0.002) fatalities, and 0 (0.18) injuries might result for the six months to one year of decommissioning due to workers commuting 172,000 vehicle-miles to/from the Fermilab site.

Transport of waste and recycled materials would be a small fraction of the total vehicle miles from commuting, due to the small volumes of materials. (See discussion of decommissioning wastes in Section 5.1.4.5). These vehicle miles represent a minimal increase given the total number of employees and vehicles at the Fermilab, and are an overestimate, as the decommissioning is scheduled to occupy less than one year.

5.1.4.5 Waste Generation and Disposal

At the completion of the NO*ν*A Project, the liquid scintillator will be drained, the detector and associated support systems will be removed, and the cavern will be returned to an empty state. The approximately 30,000 gal used scintillator fluid will be recycled for its mineral oil content.

Once drained of scintillator, the PVC components of the detector can be broken or cut down into manageable sections. The Near Detector is a semi-hollow PVC box with volume of 174 m^3 (228 yd^3). With the Devcon-60 glue residue the detector has no value as recyclable PVC feed stock; however, it is not a hazardous waste and can be disposed as dumpster/industrial waste. The 174 m^3 waste volume is approximately 2% of the 8,700 m^3 dumpster/industrial waste disposed by Fermilab in 2006 (Fermi 2007a), so it should have little impact on landfill capacity.

Decommissioning the surface-level blending facility (if built at Fermilab) would require dismantling storage vessels, blending tanks and piping. Much of the tanks and piping likely could be reused or recycled and would not be dispositioned as “waste”. Drywall

from decommissioning the IPND room in the MINOS building should be in the neighborhood of less than 5 m^3, which would not significantly impact the annual volume of industrial waste from Fermilab. Both these waste streams are non-radioactive, and would qualify as dumpster/landfill waste previously discussed.

5.1.5 Cumulative Impacts at Fermilab

Radiological impacts of the NO*ν*A experiment result from increasing the beam power from 400 kW to 700 kW in the NuMI accelerator. As discussed in this EA, the NO*ν*A proposed action would be an incremental change to the existing Fermilab operational base and would be offset by decreases due to completing the Tevatron Collider research program. Increases in beam power would primarily affect radiological conditions. There are no other current or reasonably foreseeable future projects at Fermilab that may interact with the project described in this EA in such a way as to cause cumulative impacts.

The potential radiological impacts on the environment and human health and safety present the greatest interest to the public. Potential occupational and Fermilab boundary dose increases associated with the increased beam power for NO*ν*A operations are discussed in Section 5.1.3.5. The impacts of the proposed action when added to those from existing accelerator operations are not expected to result in any exceedence of occupational health and safety standards, regulatory limits, or regulatory compliance standards with respect to potential releases to the environment or to general health and safety impacts to workers or the general public.

5.1.6 Socioeconomic Impacts and Environmental Justice at Fermilab

The population demographics for DuPage and Kane Counties and the State of Illinois were shown in Table 4.5. Minority and low-income populations in the Fermilab vicinity are proportionally smaller than in the State-wide population. Off-site impacts of noise and vibration from the proposed action would be limited to the areas immediately adjacent to the Fermilab property boundary, where minority or low-income residents are not disproportionately congregated. Since there is no disproportionality, there is no environmental justice impact.

The number of additional site personnel and contractors required for construction and operations associated with the NO*ν*A experiment at Fermilab would have a marginally positive effect on the local and regional economy. However, the alteration in Fermilab's staffing level or the local and regional construction labor services would not increase appreciably beyond normal historical fluctuations.

5.2 Potential Environmental Impacts at the Ash River Site

At the Ash River site, this proposed action would include improvement to an access road, excavation for and construction of the Far Detector Facility, and assembly of the Far Detector, experiment operations, and facility decommissioning. Operations, activities and procedures would be under the management control of the University of Minnesota and subject to regulatory compliance. Potential environmental impacts are discussed in detail in the Minnesota Environmental Assessment Worksheet (EAW), which is provided in Appendix A. The discussion in the following sections summarizes the information in the EAW and refers the reader to the appropriate section of the EAW for more detailed discussion.

5.2.1 Excavation and Construction at the Ash River Site

5.2.1.1 Land Use

Land use at the Far Detector location is discussed in Sections 9 and 10 of the EAW.

Access Road
Much of the western third of the proposed access road traverses a wetland on an old railroad embankment. Although this road section impacts a wetland, its environmental impact is less than any alternative new right-of-way. Alternative routes would likely affect mature, not recently logged forests and would certainly establish new migration routes for wildlife. Impacts to the wetland and proposed mitigation are discussed in Section 5.2.1.5.

Facility Site
Permanent impacts to this upland habitat will total 5.0 ac and will be restricted to areas that are graded, impervious surfaces (parking and buildings), and the area that is converted to landscaping/turf that will surround the underground facility. A breakdown of this impact area is as follows:

- Detector Facility = 0.67 ac
- Parking area comprised of impervious surfaces = 0.93 ac
- Lawn and landscaping adjacent to building and parking lot = 3.39 ac

The remaining area within the 89.6 ac facility site boundary will remain as undisturbed upland habitat.

Eight (8) acres of temporary stockpiles will be placed within the facility site during construction entirely within the recently clear cut wooded forest cover type. Upon completion of construction, temporary stockpiles would be removed and those areas restored.

5.2.1.2 Air Quality

Construction of the access road and detector building, anticipated to begin in 2008, is estimated to take approximately 2.5 years. During that time, the operation of diesel-powered construction equipment would be expected to introduce quantities of SO_2, NO_2, particulates, and other Criteria Air Pollutants to the atmosphere, typical of similar-sized construction projects. Table 5.4 lists the major types, number, sizes, and operating hours for construction equipment expected to be required during site preparation and construction of the access road and the Far Detector Building (Burns and McDonnell 2007).

Major Construction Sources	Number in Use	Size, Horse-power	Total Engine hours/yr	CO tpy	Total Organic Compounds tpy	SOx, tpy	NOx, tpy	PM-10, tpy
Backhoe/loader	2	50- 100	1000	0.33	0.12	0.10	1.55	0.11
Fork lift	2	50- 100	1000	0.33	0.12	0.10	1.55	0.11
Asphalt Paver	1	100- 175	200	0.12	0.04	0.04	0.54	0.04
Asphalt Roller	1	100- 175	200	0.12	0.04	0.04	0.54	0.04
Water Tanker	1	100- 175	500	0.29	0.11	0.09	1.36	0.10
Excavator	1	100- 175	500	0.29	0.11	0.09	1.36	0.10
Bulldozer	2	175- 300	500	0.50	0.19	0.15	2.33	0.17
Motor Grader	2	175- 300	500	0.50	0.19	0.15	2.33	0.17
Crane – 100 ton	1	300- 600	500	1.00	0.37	0.31	4.65	0.33
Total Tons per year (tpy)				3.5	1.3	1.1	16.2	1.1
EPA AP-42 Emissions Factors, lb/hp-hr				6.68E-03	2.47E-03	2.05E-03	3.10E-02	2.20E-03

Table 5.4. Construction Equipment Emissions during Excavation and Construction at the Far Detector Site

The anticipated annual emissions of criteria pollutants shown in Table 5.4 were estimated using the EPA AP-42 emission factors for small diesel engines shown in the bottom row of the table (EPA 1995). Emissions were calculated using the horsepower at the high end of the typical range for each equipment type as shown in the following example calculation. Therefore it is expected that the actual emissions would be less than shown in the table. Short-term, localized impacts on air quality from vehicular traffic exhausts and earth-moving operations would be similar to construction of any commercial facility of comparable size. These releases would not be expected to cause any air-quality standards to be exceeded.

Example Calculation forBackhoe/Loader (50-100HP) CO emissions:

6.68 E-03 lb of CO/hp-hr x 100 HP x 1,000 hours x 1ton/2,000lbs = 0.33 tons per yr

Dust generated during earthmoving activities and vehicle movement over unpaved areas would be minimized by frequent watering or other dust-control measures. No substantial air-quality impacts associated with implementing the construction phase of the proposed action would be expected.

The potential impacts to air quality at the Ash River site are discussed in Sections 21, 22, 23 and 24 of the EAW included as Appendix A.

5.2.1.3 Water Quality

Ground Water

Dewatering of perched ground water would be required during construction. During construction a temporary dewatering permit would be obtained from the Minnesota Department of Natural Resources (MNDNR). Subsurface investigations indicate the lack of a water table aquifer in the vicinity of the project site down to a depth of greater than 1000 feet. However, if ground water is determined to exist within the bedrock, dewatering throughout the life of the project may be needed to protect the underground structures. Further evaluation would be needed to determine the pumping rate for dewatering; however, if dewatering is required, an additional water appropriations permit would be required from the MNDNR.

The proposed project would require one or more wells for domestic water purposes and to fill storage tanks for fire protection. The well(s) would supply potable water for the normal operating occupancy of 8 – 10 people and would charge the fire protection system (60,000 gallons of storage). A 50 gal/min well drawing from fractures in the granite and perched (non-aquifer) ground water would be suitable for domestic water purposes. Ground water investigations indicated the distribution of water is highly variable, with the occurrence of dry holes and low quantities of water from shallow perched sources, suggesting that supplemental bottled water may be necessary. Well production if successful would not likely impact the productivity of other wells, if there were any in the vicinity of the site.

Hazardous materials used during construction, including oil, gasoline, and paint, would be properly stored within secondary containment, to prevent spills or leaks from escaping into groundwater or surface water.

The potential impacts to the ground water are discussed in detail in Sections 13, 19 and 31 of the EAW included as Appendix A.

Surface Water

If, as anticipated, clearing, grading and excavation could disturb greater than five acres, a permit for the discharge of storm water associated with construction activity would be required from the Minnesota Pollution Control Agency (MPCA). The National Pollutant Discharge Elimination System (NPDES) permit would require implementation of a Storm Water Pollution Prevention Plan (SWPPP) prior to initiating construction. Since runoff from the site would flow toward the Ash River, which is classified by MNDNR as a "Special Water", the SWPPP would need to assure compliance with higher standards than the general NPDES permit requirements. These standards would include storing hazardous materials used during construction, including oil, gasoline, and paint, within

secondary containment, to prevent spills or leaks from being carried by storm water into surface water.

The site design also would minimize potential runoff to surface water by minimizing impervious surfaces, using vegetated swales between impervious areas, and using infiltration or evapotranspiration techniques for collected runoff. Any site dewatering during construction would be discharged to a temporary or permanent sedimentation basin or otherwise treated such that the receiving water or downstream waters are not adversely affected. Final site stabilization following construction would occur according to requirements of the SWPPP and the NPDES permit. The potential impacts to surface water are discussed in detail in Sections 12, 16, 17 and 31 of the EAW included as Appendix A.

5.2.1.4 Biological Resources

Threatened, Endangered and Special Concern Species

Threatened, endangered and special concern species were described in Section 4.2.5 and in Section 11 of the EAW (Appendix A). Further, the DOE initiated consultation with the U.S. Fish and Wildlife Service by requesting advice on federally protected species in the project area (USFWS 2008). By aligning the access road corridor along the existing logging road, destroying additional habitat by constructing a new, more-direct roadway has been avoided. The nature of the project and the surrounding habitats and land uses are such that no measurable effects to Canada lynx or grey wolves or their habitats are anticipated. Measurable effects could be possible if the project were to result in cumulative impacts with other reasonable and foreseeable projects in the area, none of which are proposed to date.

Invasive Species

The introduction of construction and landscaping materials and the transit of multiple vehicles have the potential to introduce exotic and invasive species at the Ash River site. Under Executive Order 13112 DOE has a responsibility to minimize or prevent the introduction of invasive species and provide control.

A major influence on introduction of invasive species is the origin of the traffic and materials and the distance from the site. Distance ranges for traffic and materials have been estimated as (Burns and McDonnell 2007):

- 75 miles: This range is approximately from Virginia, MN, to International Falls, MN. It is expected that the majority of the construction workers will be drawn from an area within 75 miles of the project site. In addition, gravel, sand and concrete sources likely will be found within this range. Of the estimated 3,879 construction-related trips, 55% are expected within this range.
- 150 miles: This range includes Duluth, MN. It is expected that construction materials and raw materials will arrive from within 150 miles of the project site. Of the estimated 3,879 construction related trips, 35% are expected within this range.

- 300 miles: This range includes Minneapolis/St. Paul. It is expected that construction components such as precast concrete planks and pre-fabricated assemblies such as the metal building components may originate within this range. Of the estimated 3,879 construction related trips, 10% are expected within this range.

Preventive measures to avoid or minimize introduction and spread of invasive plants will include education, inspection and design components. The education component will inform the contractors of the potential for invasive species as well as provide them with the information to identify and report invasive species. The inspection component will include incoming construction vehicles for invasive species and require a plan for treatment if discovered. The design component will prohibit purchases or acquisition of plants identified by MNDNR as invasive in Minnesota for use on the project site. In addition, the site will be restored with appropriate alternative native or noninvasive species for planting.

5.2.1.5 Wetlands

Proposed construction at the Far Detector site would impact existing wetlands in the area. All of the wetland impacts are associated with the proposed access road. There are no impacts within the footprint of the building and parking area. Wetland impacts are discussed in Section 10 and 12 of the EAW, shown in Figure 6 of the EAW (Appendix A), and summarized in Table 5.5. Wetland classification codes in Table 5.5 were discussed previously in Section 4.2.6.

Detailed results of the wetlands assessment can be found in the Combined *Wetland Permit Application and Replacement Plan* developed for the project (RUMN 2007b).

Basin ID	Wetland Classification			Total Wetland Area (acre)	Wetland Impact Area	Impact Area as % of Total Wetland Area
	Eggers and Reed	Cowardin	Circular 39			
Wetland 1	Sedge Meadow/Shallow Marsh/Deep Marsh/Coniferous Swamp	PEMB/C/F PSS1B/PFO1B	Type 2/3/4/5/7	>5 ac[2]	No Impact	0%
Wetland 2	Sedge Meadow/Shallow Marsh/Deep Marsh	PEMB/C/F	Type 2/3/4	6 ac[2]	No Impact	0%
Wetland 4	Coniferous Swamp/Hardwood Swamp	PFO1B	Type 7	0.05 ac	1,192 ft2 0.03 ac	60%
Wetland 5	Sedge Meadow	PFO1A	Type 1	0.01 ac	18 ft^2 0.0004 ac	4%
Wetland 6	Shrub Carr/Alder Thicket	PSS1C	Type 6	0.05 ac	No Impact	0%
Wetland 7	Shrub Carr/Alder Thicket/ Coniferous Swamp/Hardwood Swamp	PEMB/PSS1B/ PFO1B	Type 6/7[1]	>40 ac[2]	73,662 ft^2 1.69 ac	<5%
Wetland 8	Shrub Carr/Alder Thicket/ Coniferous Swamp/Hardwood Swamp	PSS1B/PFO4B	Type 6/7[1]	>40 ac[2]	75,958 ft^2 1.74 ac	<5%
Total				>91 ac	**150,830 ft^2 3.46 ac^2**	<4%

[1] The entire wetland complex is Type 6/7. The wetland impacts occur primarily to Type 6 wetlands that exist near the current access road.
[2] Wetland extends outside the project limits. The entire wetland was not delineated and the area shown is estimated.

Table 5.5 Summary of Wetland Impacts at the Far Detector Site

[2] The EAW, completed in 2006, estimated 2.5 acres of wetland impact prior to completing the design of the access road layout and other design refinements that occur during the course of a project schedule. The acreage increase to 3.46 acres results from these design changes and is a more accurate estimate of wetland impacts determined after the EAW was completed.

Regulatory Requirements for Wetlands

Wetlands affected by the project are regulated by several agencies at the federal, state, and local levels including the USACE and the Environmental Protection Agency (EPA) at the federal level; the Minnesota Board of Water and Soil Resources (BWSR) and the Minnesota Pollution Control Agency (MPCA) at the state level; and St. Louis County at the local level. St. Louis County has accepted the responsibility for administering the Minnesota Wetland Conservation Act (WCA) of 1991.

a. Federal Regulations

The USACE is the permitting authority for Section 404 of the Clean Water Act and Section 10 of the River and Harbors Act. The MPCA is the designated approving authority for Section 401 of the Clean Water Act on behalf of the EPA. Upon receipt of the Wetland Permit Application, the USACE must complete a Jurisdictional Determination analysis to determine the extent of Section 404 jurisdiction based upon connectivity to U.S. Navigable Waters.

Federally funded and/or sponsored actions must also comply with federal Executive Order 11990, "Protection of Wetlands", which mandates that federal agencies through their actions, will implement measures to minimize the loss of wetlands. Minimizing the loss of wetlands is achieved by following the Section 404 requirements and permitting through the USACE.

b. State Regulations

Wetlands in the project area are also under the jurisdiction of the Minnesota Wetland Conservation Act of 1991 (WCA), Minnesota Rules (M.R.) Chapter 8420. WCA approvals are implemented by the designated Local Governmental Unit (LGU) and the LGU for the project area is the North St. Louis County Soil and Water Conservation District (SWCD).

Wetlands that are designated Public Waters under M.R. 8420, Parts 6115.0010 – 615.0810 are regulated by the Minnesota Department of Natural Resources (MNDNR). Impacts to Public Waters require a Public Water permit from the MNDNR.

Actions implemented by state agencies that result in wetland impacts are exempt from requiring a WCA permit approval from the designated LGU. Since the University of Minnesota is a state agency, a WCA permit approval will not be required. Nevertheless, State agencies must comply with Governor's Executive Order 00-02, which directs State Departments and Agencies to follow a "No Net Loss Policy" in regard to wetlands. State agencies follow the process, requirements, and mitigation implemented under the WCA and Public Waters rules. Following these requirements, a wetland permit application is submitted to the LGU for review and comment, and the state agencies follow the prescriptive process, although permit approval is not required from the designated LGU.

Wetland Permitting for Ash River

The University of Minnesota prepared a Combined Wetland Permit Application and Replacement Plan and submitted it to the USACE to determine potential impacts to Section 404 jurisdictional wetlands (RUMN 2007b). The USACE has acknowledged receipt and has indicated a preliminary determination that wetland impacts would require a permit and mitigation (USACE 2008). A copy of the USACE correspondence is provided in Appendix F.

The University also submitted the combined application and plan to the WCA LGU for comments to comply with the Governor's Executive Order 00-02. There are no affected Public Waters wetlands affected by the project, so the University did not submit the permit application to the MNDNR.

The Combined Permit Application demonstrates the *wetland sequencing* measures that have been and would be implemented for the project including, in order of importance: wetland impact avoidance; wetland impact minimization; and wetland mitigation. The Application contains the necessary avoidance and minimization analyses. Wetland impact avoidance and minimization were implemented by positioning the footprint of the building and parking area outside of wetland boundaries and by using an existing road alignment for the proposed access road rather than a new road alignment. The application described wetland impact minimization measures that would be implemented during the final design and construction of the access road, which include: road cross section reductions; culverts; slight alignment shifts; and best management practices.

Wetland Mitigation

The Wetland Replacement Plan submitted with the Combined Wetland Permit Application defines the wetland mitigation proposed for the project. Wetland mitigation in Minnesota under both WCA and the Section 404 programs must follow the methods in the St. Paul District Draft Compensatory Mitigation Policy for Minnesota (USACE, 2007). The policy dictates a sequential, "in-kind" and "in-place" approach to identify and locate suitable wetland mitigation for a project within the state.

The proposed NO*v*A Far Detector site is located within Wetland Bank Service Area #2 (Rainy River Basin), and within Major Watershed #77 (Rainy River). The WCA and the USACE rules require wetland replacement at a minimum ratio of one acre for each acre of wetland impact (1:1) and a maximum ratio of 2.5 acres for each acre of impact (2.5:1). The minimum or maximum ratio applies depending upon criteria defined is the USACE draft Compensatory Mitigation Policy (USACE 2007). This policy also contains criteria for "in advance" wetland mitigation, i.e., prior to the impacts from the proposed project.

The same USACE criteria apply for wetland banking. For wetland banking, the "in-advance" requirement is met automatically if credits are purchased from an approved wetland bank. The "in-place" requirement is met if the wetland credits are purchased from a wetland bank in the same Bank Service Area (as defined by the WCA and the USACE) as the impacts. The USACE policy and guidance base the ratios applied for a

project on the amount of in-kind, out-of-kind, and off-site mitigation proposed, and on the quality and nature of the wetland impacts.

Following the USACE policy generated the following results. There were no viable on-site wetland mitigation opportunities besides wetland creation, which is not preferable. Effectively drained wetlands and ditched wetlands are lacking in the project area to provide opportunities for wetland restoration as mitigation. Similarly, wetland restoration opportunities are lacking within the Major Watershed and Bank Service Area. Due to the extensive and intact wetland base in Northern Minnesota, wetland restoration opportunities are very limited when compared to other Bank Service Areas towards the south and west.

Following the USACE policy, opportunities were explored in adjacent Bank Service Areas. In such circumstances, the preferred method of wetland replacement is purchasing credits from an approved private wetland bank. The University of Minnesota entered a purchase agreement with a wetland bank account owner in Bank Service Area #3 in Beltrami County, which is adjacent to Bank Service Area #2. The sale is contingent upon project approval.

St. Louis County, where wetlands impacts would occur, is a county with greater than 80% pre-settlement wetlands, so the required wetland replacement ratios would be 1.5:1. The replacement would be classified as Not-in-Place because the wetland bank is in a different Bank Service Area from the project area where impacts would occur. The replacement would be Out-of-Kind because the impacts in the project area are primarily to Type 6 (scrub swamp) and Type 7 (wooded swamp) wetlands, and the replacement would be from a bank with Type 2 (wet meadow) wetlands. The mitigation is being provided In-Advance of the project impacts. Project wetland impacts and replacement are shown in Table 5.6.

Wetland Area	**Wetland Impact Area (ft^2 / acres)**	**Wetland Replacement**		
		Type	**WCA (1.5:1)**	**USACE (1.5:1)**
Wetland 4	1,192 ft^2 0.03 ac	Private Bank	1,788 ft^2 0.04 ac	1,788 ft^2 0.04 ac
Wetland 5	18 ft^2 0.00 ac	Private Bank	27 ft^2 0.00 ac	27 ft^2 0.00 ac
Wetland 7	73,662 ft^2 1.69 ac	Private Bank	110,493 ft^2 2.54 ac	110,493 ft^2 2.54 ac
Wetland 8	75,958 ft^2 1.74 ac	Private Bank	113,937 ft^2 2.62 ac	113,937 ft^2 2.62 ac
Total Impacts	**150,830 ft^2 3.46 ac**			
		Total Replacement Needed:	**226,245 ft^2 5.19 ac**	**226,245 ft^2 5.19 ac**

Table 5.6 Summary of Wetland Impacts and Replacements at the Far Detector Site

The wetland credits that would be withdrawn from the Beltrami Wetland Bank Account are summarized in Table 5.7.

Wetland Replacement	WCA 1.5:1 Credits Provided	USACE 1.5:1 Credits Provided
Onsite Mitigation	N/A	N/A
Private Wetland Bank – New Wetland Credit	226,245 ft^2 5.19 ac	226,245 ft^2 5.19 ac
Private Wetland Bank – Public Value Credit	N/A	N/A
Total Mitigation Provided	**226,245 ft^2** **5.19 ac**	**226,245 ft^2** **5.19 ac**
Total Mitigation Required	**226,245 ft^2** **5.19 ac**	**226,245 ft^2** **5.19 ac**

Table 5.7 Summary of Wetland Replacement Credits at the Far Detector Site

The University of Minnesota anticipates receiving Section 404 permit approval in June of 2008, after the USACE completes its review of the draft EA and its Jurisdictional Determination analysis in the late spring of 2008. The University is purchasing WCA credits to comply with the Governor's Executive Order 00-02.

5.2.1.6 Cultural and Historical Resources

DOE and the University of Minnesota coordinated with the Minnesota State Historic Preservation Office (SHPO), the Bois Forte Band of Minnesota Chippewa Tribal Historic Preservation Officer (THPO), the Leech Lake Band of Ojibwe THPO, White Earth Band of Minnesota Chippewa THPO, Grand Portage Band of Chippewa THPO, and the Fond du Lac Band of Lake Superior Chippewa Reservation THPO concerning the potential for archeological resources to be present in the project area at Ash River.

Because of the winter conditions during the preparation of an Analysis of Effects Report, a programmatic agreement (PA) was negotiated with the MN SHPO and the Bois Forte and White Earth THPOs. None of the other Bands indicated a desire to consult on the project, and the Advisory Council on Historic Preservation declined an invitation to participate. The PA stipulates that DOE (or the University of Minnesota) would perform an archeological survey of the project area in the spring of 2008, prior to construction, to validate the 2008 Analysis of Effects Report findings. The survey would include further ground investigation to determine whether historical resources are present, both architectural and cultural. The concern is potential impact to a historic railroad grade as well as the potential for occurrences of cultural resources. If such are identified, the PA establishes a process to be followed. Key National Historic Preservation Act documentation is included in Appendix E.

Sections 11, 25 and 26 of the EAW (Appendix A) address cultural and sensitive resources.

5.2.1.7 Occupational/Human Health and Safety

Site excavation workers, construction workers and contractors would conduct work in accordance with a University of Minnesota site health and safety plan and procedures for contractor operations, as required by the NO*v*A Project MOU (NO*v*A 2007a). Potential hazards would be those typically associated with civil excavation and construction. Excavation and construction would involve approximately 35 workers on site for up to 2.5 years for a total of approximately 175,000 labor hours. A calculation based on industry average incidence of 5.4 cases of injury/illness per 200,000 labor hours for construction workers (DOL 2007) results in approximately 5 (4.7) cases of injury/illness during excavation and construction. There are no near-by facilities or concurrent activities that would cause a hazard to construction workers, or vice versa. Emergency response at the remote location would be via helicopter as discussed in Section 3.4.1.3.

5.2.1.8 Transportation

Construction of the proposed NOvA Far Detector Facility, including the Service Building, Assembly Area, and Detector Hall, is anticipated to begin in 2008/2009 and be completed in 2011/2012. During construction, an average of 35 workers is expected to be on site each day. It is estimated that this would result in approximately 20 to 35 cars accessing the site each day, generating 40 to 70 trips per day on St. Louis County 129 for approximately 20 months.

A conservative average commute distance of 50 mi (round-trip) is assumed for each worker, based on a one-way distance of 25 mi between the Ash River site and International Falls. For the state of Minnesota, the accident and fatality rates per vehicle-mile are 1.39E-06, and 8.7E-09, respectively (MDPST 2007). The calculation results in an additional 1 (1.2) accidents and 0 (0.006) fatalities for the slightly less than two years of site excavation and construction as a result of workers commuting 437,500 vehicle-miles to/from the Ash River site.

The NO*v*A Project has estimated 3,879 vehicles delivering materials to the Ash River site during combined excavation/construction and installation/assembly phases (average ~650 vehicles per year). Origins and distances traveled for the vehicles were discussed in Section 5.2.1.4., which would result in 960,052 vehicle miles (1,550,000 vehicle km) for material deliveries. Total accident, fatality, and injury rates for heavy combination trucks in the state of Minnesota were used in the calculations. These rates were 1.76E-07 accidents/km, 1.2E-08 fatalities/km, and 1.21E-07 injuries/km (Saricks and Tompkins 1999). Using the total accident, fatality, and injury rates for Minnesota one calculates an additional 0 (0.26) accidents, 0 (0.019) fatalities, and 0 (0.18) injuries might result during the combined excavation/construction and installation/assembly period.

No traffic congestion is anticipated as a result of excavation/construction activities. The additional traffic generated would not significantly increase the vehicles per day traveled on the roads in the site vicinity or result in congestion in this rural area. Additional traffic would be well within road capacity reported in Section 4.2.9

5.2.1.9 Utilities at Ash River

Power and fiber optic service for the facility would be provided from existing services along St. Louis County 129. These utilities would be extended to the site by buried service installed during construction of the access road. No improvements to the existing fiber optic service are anticipated. Improvements to the existing power transmission service serving the site would be required. Service upgrades would include replacement of the transformer at the Kabetogama substation as well as related service upgrades along the existing transmission line. No new or additional transmission lines would be constructed.

No impacts are expected as a result of buried utility line extension and power transmission improvements. The SWPPP developed for the project would address erosion and sedimentation control and related requirements to ensure that appropriate mitigation measures are implemented in accordance with NPDES requirements. The SWPPP would be submitted to the MPCA for review and approval prior to the start of utility improvements as required. Section 28 of the EAW (Appendix A) addresses utility issues.

5.2.1.10 Waste Generation and Disposal

Hazardous materials used during construction, including oil, gasoline, and paint, would be properly stored, including secondary containment, to prevent spills or leaks, and any waste material would be disposed according to applicable regulatory requirements. Any hazardous wastes generated at the facility would be small volume and would be collected by a licensed waste hauler for disposal at a licensed disposal facility.

Conventional wastes (packaging, empty containers, concrete forms and used lumber) would be typical of that resulting from constructing a 30,000 ft^2 light industrial building. The estimated waste volume of several hundred yd^3 is less than 1% of the 10-year, 430,000 yd^3 dumpster/industrial waste projection by St Louis County for inclusion into its overall 1,204,000 yd^3 of available landfill capacity (SLC 2003).

Based on the proposed actions, waste generation would not create environmental impacts at the Ash River site. Section 20 of the EAW (Appendix A) addresses waste generation and disposal.

5.2.2 Installation and Assembly at the Ash River Site

5.2.2.1 Air Quality

According to the construction and assembly schedule and the estimated number of vehicles and trucks accessing the site, there would be a maximum of 40 site workers and five trucks accessing the site on a daily basis. This would add a maximum of 90 vehicle trips to St. Louis County 129 each day during the peak of the detector assembly. No decrease in local or regional air quality from vehicle-related air emissions is expected as a result of the project during installation and assembly or operations.

Estimated Emissions of Criteria Air Pollutants from Propane Fuel

Propane (or liquefied natural gas)-fired boilers or burners would be installed for space heating and humidification needs. All boilers would employ state-of-the-art, clean-burning technology and would not be expected to require supplemental emission controls. Propane-fueled generators would be used to provide electricity in the event of the loss of utility power. The generators would also be required to employ Best Available Control Technology for emissions, including the use of low-sulfur fuel. Emissions of criteria pollutants from the Ash River facilities shown in Table 5.8 were estimated based on an estimate fuel use of 200 gal/day (750 L/day) for heaters and 460 gal/day (1,740 L/day) for generators using the SCREEN3 atmospheric dispersion code (EPA 1995). (Note emissions at these estimated levels would continue during operations and decommissioning phases of the project).

Criteria Pollutant	Propane Emission Factor (lbs per 1,000 gal)	Emissions		Max Ground Conc	Ground Conc at 2 km	NAAQS Standard	% Standard at max	% Standard at 2 km
		(T/y)	(g/s)	ug/m^3		ug/m^3		
Particulate Matter (PM)	0.6	0.0216	0.00063	0.63	0.10	50	1.3%	0.21%
Sulfur Dioxide ($SO_{2)}$	0.108	0.0039	0.000113	0.11	0.019	78	0.14%	0.024%
Nitrogen Oxide ($NO_{x)}$	19	0.684	0.0200	20.0	3.3	100	20.0%	3.3%
Carbon Monoxide (CO)	3.2	0.115	0.00336	3.4	0.56	10000	0.034%	0.0056%

Table 5.8 Estimated Emissions and Maximum Concentrations of Criteria Air Pollutants from Propane Fuel Combustion

Estimated Emissions of Hazardous Air Pollutants

The assembly adhesive that would be used to construct the detector modules, Devcon-60 contains methyl methacrylate (MMA), a volatile organic compound (VOC) and a federal hazardous air pollutant (HAP). MMA and other volatile constituents would evaporate

during product application. Vapors from the use of Devcon-60 are expected to contribute less than 5 tons of additional VOCs to facility emissions (2.7% of 168 metric tons total, Section 23 of the EAW, Appendix A). Using the SCREEN3 atmospheric dispersion code (EPA 1995) with a conservative assumption that all releases occur in a single year, the maximum estimated ground-level concentration occurs on the site approximately 113 m from the facility exhaust and is 0.46 mg/m^3, considerably less than the OSHA Permissible Exposure Limits (PEL) of 410 mg/m^3 (100 ppm). As MMA and other VOC potential emissions would not exceed regulatory limits on emissions of HAPs per year, an air permit should not be required.

Potential impacts to air quality are discussed in more detail in Sections 20, 21, 22, 23 and 24 of the EAW included as Appendix A.

5.2.2.2 Water Quality

Ground Water

Based on the proposed actions with 100% secondary containment of liquid scintillator and other liquids at every stage of the assembly and installation process, there should be no impact to ground water at the Ash River site during installation and assembly. The potential impact to ground water from a spill or accident involving liquid scintillator is addressed in Chapter 6.

Surface Water

The SWPPP would include mitigation measures and requirements for the protection of surface water during each phase of construction, installation and assembly, operations and decommissioning. No impacts are foreseen with respect to installation and assembly operations. The potential impact to surface water from a spill or accident involving liquid scintillator is addressed in Section 6. The potential impacts to surface water are discussed in detail in Sections 13, 16, 17 and 31 of the EAW included as Appendix A.

5.2.2.3 Occupational/Human Health and Safety

Site workers and contractors would conduct work under a University of Minnesota site health and safety plan that will be developed for the project and according to University procedures for installation and assembly operations. With 40 to 50 individuals actually assigned to the NO*v*A Project on the Ash River site to support detector installation and assembly for a 4-year period, project labor would be approximately 360,000 labor hours. A calculation based on construction industry average incidence of 5.4 cases of injury/illness per 200,000 labor hours results in 10 (9.7) cases of injury/illness during the 4-year period of detector assembly and filling operations.

The methyl methacrylate (MMA) in the assembly adhesive is an eye, skin and respiratory irritant. MMA and other volatile constituents would evaporate during product application. The MSDS for MMA is provided in Appendix C. The irritant nature of the MMA vapors necessitates that the project health and safety plan develop ventilation controls intended

to maintain potential personnel exposures below the ACGIH TLV of 50 ppm and also below the STEL of 100 ppm.

Small quantities of other hazardous products that may be used during assembly and installation operations (e.g., paints or coatings) would be stored and used in accordance with applicable site health and safety procedures and hazardous material regulations.

The MPCA has given NO*v*A a written determination that the blended liquid scintillator to be used in the detector is not considered a hazardous material (MPCA 2005). However, material handling controls will recognize that hazardous constituents were blended into the liquid.

5.2.2.4 Transportation

Assembly of the Far Detector is anticipated to take approximately 48 months and will require up to 45 people on the site each day. It is estimated that this will result in a total of 20 to 45 vehicles accessing the site each day, generating 40 to 90 trips per day on St. Louis County 129. Using logic similar to that described in Section 5.2.1.7, an additional 3 (3.1) accidents and 0 (0.02) fatalities could occur during assembly and filling as a result of workers commuting 562,500 vehicle-miles per year to/from the Ash River site. Accidents and injuries estimated from the estimated 3,879 vehicles delivering materials to the Ash River site, during excavation/construction and installation/assembly phases combined were addressed in Section 5.2.1.7.

During installation/assembly, two materials shipments will vary from the origin of materials described in Section 5.2.1.4: delivery of MMA and delivery of the blended scintillator fluid.

Highway Accident Involving Delivery of MMA

Approximately 42,000 gal of Devcon-60 plastic glue containing MMA would need to be shipped via truck for detector assembly at the Ash River. It is assumed that the Devcon-60 would be supplied in 55-gal drums from a distributor in the Massachusetts area with a travel distance of approximately 2,300 km to St. Louis County. The transport would occur within the states of Massachusetts, Connecticut, New York, Pennsylvania, Ohio, Indiana, Illinois, Wisconsin and Minnesota, primarily on interstate highways. Considering workload projections for the Far Detector assembly, the Devcon-60 would be delivered in 16 shipments of 48 drums each.

Total accident, fatality, and injury rates for heavy combination trucks in the state of Pennsylvania were used in the calculations for the shipment of glue. Pennsylvania has the highest total accident, fatality, and injury rates of the transited states; therefore, applying the total accident, fatality, and injury rates for the state of Pennsylvania to the entire transport route is conservative. The rates for Pennsylvania were 6.79E-07 accidents/km, 2.43E-08 fatalities/km, and 5.33E-07 injuries/km (Saricks and Tompkins 1999). Based on these rates, a calculation results in 0 (0.03) accidents, 0 (0.001) fatalities, and 0 (0.02) injuries over the shipping period for MMA.

Highway Accident Involving Delivery of Blended Scintillator Fluid

A total of approximately 4.2 million gal of liquid scintillator are needed for the Far Detector. Using the 7,000-gal average capacity for the tanker truck, an estimated 600 tanker trucks would drive the approximately 950 km (590 mi) from the vicinity of Fermilab to the Ash River site.

The transport route for the shipment of liquid scintillator from Batavia to St. Louis County would involve travel in Illinois (10%), Wisconsin (65%), and Minnesota (25%). Wisconsin has the highest total accident, fatality, and injury rates of the three states. Therefore, applying the total accident, fatality, and injury rates for the state of Wisconsin to the entire transport route is conservative. Using the total accident, fatality, and injury rates for Wisconsin, a calculation results in an additional 0 (0.3) accidents, 0 (0.01) fatalities, and 0 (0.2) injuries over the shipping period. Total accident, fatality, and injury rates for heavy combination trucks in the state of Wisconsin were used in the calculations for the shipment of liquid scintillator from Batavia , IL (Fermilab or off-site blending facility) to St. Louis county, MN (Far Detector site). These rates were 5.51E-07 accidents/km, 2.22E-08 fatalities/km, and 4.1E-07 injuries/km (Saricks and Tompkins 1999). These values for the accident, fatality, and injury rates are conservative given the transport route for the shipment of liquid scintillator.

The majority of the transport route (97%) is federal interstate or U.S. highways. Interstate accident, fatality, and injury rates are lower than the corresponding total rates used in the calculations, reflecting travel on all types of roads. The use of the total rates gives a more conservative potential number of accidents, fatalities, and injuries than the interstate rates, which would be considered more applicable, given that most of the transport route is interstate/highway.

5.2.2.5 Waste Generation and Disposal

Hazardous materials used during the assembly and installation of the detector include the MMA adhesive. The Project would receive 42,000 gal of the Devcon-60 glue in 16 shipments of 48 drums, for a total of 768 fifty-five gal drums. The drums arrive with a plastic liner containing the liquid, which when pulled leaves the metal drum uncontaminated and a “normal” waste. While the glue is pumped from the drum for use, residual fluid (perhaps ~0.5%) would remain creating a hazardous waste stream for disposition. The approximately 211 gal of residual liquid (0.5% of 55 gal in 768 drums) can be fixed by placing absorbent material in the liner. The plastic liners can be volume reduced through compaction, so that the entire waste stream could be reduced to 5-10 drums (2-4 m^3). Wastes would be submitted to a licensed waste hauler for disposal at a licensed disposal facility. Other potentially hazardous wastes including oil, gasoline, and paint, would be properly stored, including secondary containment, to prevent spills or leaks, and any waste material would be disposed in accordance with applicable regulatory requirements.

Solid wastes generated at the facility would be submitted to a licensed waste hauler for disposal at a licensed disposal facility. The regional landfill in St Louis County currently accepts approximately 50,000 tons per year of mixed municipal solid waste (SLC 2003). Incidental wastes of less than 10 tons per year from the assembly and installation at the Far Detector will have little impact on the local landfill capacity.

5.2.3 Operations at the Ash River Site

5.2.3.1 Air Quality

During normal operation of the facility 8 to 10 people would be commuting daily to the site, much less traffic than during construction or detector assembly. The additional traffic generated during operation would neither significantly increase the vehicles per day traveled on the roads in the site vicinity nor result in congestion in this rural area. Combustion products from propane building heaters (discussed in Section 5.2.2.1) would be the only routine emission during normal operations.

Based on the proposed actions, there would be no impact on local or regional air quality during operations at the Ash River site. Sections 21, 22, 23 and 24 of the EAW address air quality issues related to operations.

5.2.3.2 Water Quality

Ground Water

Based on the proposed actions with 100% secondary containment of liquid scintillator and other liquids, there should be no impact to ground water at the Ash River site during operations. An on-site septic system with a drain field may be constructed to treat the domestic waste output. A site suitability and soils analysis would be completed prior to construction to determine the most appropriate system design. The suitability analysis may indicate the requirement for a holding tank in lieu of a septic system.

The potential impact to ground water from a spill or accident involving liquid scintillator is addressed in Section 6 of this EA. Sections 13 and 18 of the EAW (Appendix A) address activities with the potential for ground water impacts related to operations.

Surface Water

The SWPPP would include mitigation measures and requirements for the protection of surface water during facility operations. No operational impacts to surface water are foreseen. The potential impact to surface water from a spill or accident involving liquid scintillator is addressed in Section 6 of this EA. The potential impacts to surface water are discussed in detail in Sections 13, 16, 17 and 31 of the EAW included as Appendix A.

5.2.3.3 Occupational/Human Health and Safety

Operations at the Far Detector Facility are discussed previously in Section 3.4 of this EA. Site worker and contractors would conduct operations under a University of Minnesota

site health and safety plan and procedures for operations. No adverse impacts to employees are expected from the routine operation of the NO*v*A experiment. With fewer than 10 individuals participating in the NO*v*A Project operations on the Ash River site, project labor hours would be fewer than 20,000 per year for a total of 140,000 labor hours for the 7-year operational period. A calculation based on the educational services industry average incidence of 2.3 cases of injury/illness per 200,000 labor hours (DOL 2007) results in approximately 2 (1.6) cases of injury/illness during facility operations.

5.2.3.4 Transportation

Operations at the Far Detector Facility are discussed previously in Section 3.4 of this EA. Operation of the Far Detector is anticipated to take approximately seven years and will require fewer than 10 people on the site each day. This volume will result in an estimated total of 10 vehicles accessing the site each day, generating 20 trips per day on St. Louis County 129. A conservative average commute distance of 50 mi (round-trip) is assumed for each worker, based on a one-way distance of 25 mi between Ash River Site and International Falls. For the State of Minnesota, the accident and fatality rates per vehicle-mile are 1.39E-06, and 8.7E-09, respectively (MDPST 2007). A calculation results in an additional 1 (1.2) accident and 0 (0.007) fatalities for the 7-year period of detector operations due to workers commuting 875,000 vehicle-miles to/from the Ash River site.

5.2.3.5 Waste Generation and Disposal

Hazardous materials used during operation could include oil, gasoline, and paint, and would be properly stored, including secondary containment, to prevent spills or leaks, and any waste material would be disposed in accordance with applicable regulatory requirements. No hazardous wastes are expected to be generated during the operation of the facility.

In Section 10 of the EAW, conventional wastes generated during the operations phase are estimated to be 30 lbs per day or around 10,000 lbs (5 tons) per year. The regional landfill in St Louis County currently accepts approximately 50,000 tons per year of mixed municipal solid waste (SLC 2003). Wastes from the operations at the Far Detector Facility will have little impact on the local landfill capacity.

5.2.4 Decommissioning at the Ash River Site

Decommissioning at the Far Detector Facility is a low-intensity, methodical process, so it will have impacts similar to those in the operations phase (see previous sections). The building would not be demolished, but the detector and its support systems would be removed. Removal actions take place primarily indoors, so the air would be managed and filtered prior to exhaust. Combustion products from propane building heaters (discussed in Section 5.2.2.1) would be the only routine emissions. Scintillation fluid would be drained/pumped within the 100% containment, to minimize the potential hazard to water resources from spills. The same closed loop transfer systems would contain vapors and displaced gases/fluids during scintillation fluid pumping. The PVC detector structure

would be mechanically size-reduced, eliminating the potential hazard from use of solvents. The PVC with the cured glue is not hazardous. Transportation accidents and workplace injuries would continue to be negligible due to a similar small workforce.

Waste Generation and Disposal

The major difference in this phase is the generation of waste volumes significantly different from that generated in previous phases of the Project. Once drained of scintillator, the rigid PVC components of the detector would be broken or cut down into manageable sections to fit waste containers. Further compaction of the hollow cells may be investigated, but the strength of the PVC may preclude further significant volume reduction.

The Far Detector is a semi hollow PVC box with volume of 27,500 yd^3. With the Devcon-60 glue residue the detector has no value as recyclable PVC feed stock; however, it is not a hazardous waste and can be disposed of as dumpster/industrial waste. The 27,500 yd^3 waste volume is approximately 6% of the 430,000 yd^3 dumpster/industrial waste projection by St Louis County for inclusion into its overall 1,204,000 yd^3 of landfill capacity (SLC 2003).

Although several hundred truckloads may carry away the detector waste, the disposal would be local (~50 mi or less round trip) so that total vehicle miles would be less than 100,000 (or 160,000 vehicle-km). For the State of Minnesota these rates were 1.76E-07 accidents/km, 1.2E-08 fatalities/km, and 1.21E-07 injuries/km (Saricks and Tompkins 1999). A calculation results in an additional 0 (0.028) accident and 0 (0.002) fatalities and 0 (0.02) injuries for the period of detector decommissioning.

5.2.5 Cumulative Impacts at the Ash River Site

There are no current activities or future phases of development planned for the Ash River site, nor are there any other activities or developments proposed by others that are reasonably foreseeable in the area of the proposed project. Therefore no cumulative impacts are anticipated in the area. As discussed in Section 29 of the EAW (Appendix A), future logging efforts are not considered “reasonable and foreseeable actions” in terms of evaluating cumulative impacts as logging has been occurring in the area for over a hundred years and would continue indefinitely in the region as a renewable and managed resource.

5.2.6 Socioeconomic Impacts and Environmental Justice at the Ash River Site

The number of additional site personnel and contractors required for construction and assembly activities associated with the NO*ν*A Project would have a marginally positive and temporary effect on the local and regional economy and construction labor services. However, 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.

The population demographics for St Louis County and the state of Minnesota were shown in Table 4.6. Minority populations in St Louis County are proportionally smaller than in the State-wide population while low-income population is slightly larger. Off-site impacts of noise and vibration from the proposed action would be limited to the areas immediately adjacent to the Ash River site property boundary, where minority or low-income residents are not disproportionately congregated. Since there is no disproportionality, there is no environmental justice impact.

5.2.7 Voyageurs National Park

Visual Impacts

Although portions of the proposed site buildings may be visible from some upland areas of the Voyageurs National Park at a distance of more than two miles, the buildings would be a low feature in contrast to nearby wooded outcrops (RUMN 2007a). The Ash River site is nested among higher hills which screen the site from Voyageurs National Park, and is at least two miles from upland areas of the park from which site buildings may be visible. The NO*ν*A Far Detector Facility would be located on rolling terrain with mixed elevations at ground level ranging from 1,120 to 1,393 feet above mean sea level. Many of the higher elevations are forested with treetops as high as approximately 1,450 feet above mean sea level. The highest point of any building on the site would be approximately 1,271.5 feet above mean sea level.

Design criteria would be defined to minimize the visual impact of any portion of the Far Detector building that might be visible from Voyageurs National Park (RUMN 2007a). The Far Detector building, which would have an above-ground height of approximately thirty-seven feet or approximately two stories, would not include any windows facing north to minimize reflected sunlight. An earthen berm with native grasses would surround much of the Far Detector building up to the roof line. Exterior colors for all buildings would be muted grays and browns. All north facing building walls would be in neutral colors to decrease contrast and visibility. Native plants and trees would be planted to soften the outlines of all buildings. In addition, the NO*ν*A Project would work with the National Park Service to design additional measures to screen or soften the appearance of the site buildings. The potential visual impacts are discussed in detail in Sections 26 of the EAW included as Appendix A.

Noise Impacts

Noise and dust would primarily occur as a result of drilling and blasting to remove granite bedrock. Noise would also result from road construction. These are temporary effects that would occur only during the construction of the facility. Although the project site is relatively remote and greater than one mile from any inhabited dwellings or structures, noise could impact the serenity experienced by nearby residents and visitors to Voyageurs National Park as well as impact wildlife. Hence efforts to mitigate it would be undertaken.

The University of Minnesota estimates that the loudest blast associated with construction will be approximately 140 decibels at the blast site. The sound level from such a blast at the entrance to the park on NPS Highway #1 with no attenuation from vegetation and the rolling topography would be 65 decibels. This decibel level is equivalent to normal conversation. Considering natural attenuation from shrubs and trees in the area, the sound level at the entrance to the park drops to a range of 20 to 30 decibels. This decibel level is equivalent to a whisper or to the noise level found in a rural area.

Drilling/blasting impact would be avoided primarily by completion of that construction phase as quickly as possible, likely within a two- to four-month period. Other construction-related noise impacts would also be mitigated by limiting duration. Additionally, construction activities would occur between 7:00am to 7:00pm where possible. Impacts would be temporary and would return to ambient levels upon completion of the estimated 24-month project construction period. Dust generated would be mitigated by water spray application. These impacts are discussed further in Section 24 of the EAW in Appendix A.

5.3 Impact Analysis of the Blending Facility Alternative

5.3.1 Land Use

The site of the proposed blending facility if at a commercial blending facility would be previously established and blending would occur within existing facilities.

5.3.2 Air Quality

If the liquid scintillator were to be blended at Fermilab, hazardous air emissions would be prevented by the closed loop, chemical handling and blending system, including the capture and minimum release of vapors during operations. Blending at a commercial facility would be regulated by the State of Illinois. Blending would be conducted to ensure that any emissions remained within levels permitted by the State.

5.3.3 Water Quality

All blending, storage and use facilities at the commercial blender or at Fermilab would have 100% secondary containment to prevent release to the environment. The secondary containment would protect vulnerable aquatic organisms from the potentially hazardous pseudocumene in the scintillation liquid.

5.3.4 Occupational Human Health and Safety

The greatest potential of affecting occupational health and safety during blending operations would be the injuries to workers during “normal” activities. With only 2 individuals actually engaged in blending activities at Fermilab, labor hours would be less than 4,000 per year. A calculation based on Fermilab average incidence of 1.5 cases of injury/illness per 200,000 labor hours results in 0 (0.03) cases of injury/illness during

detector assembly and filling operations. A calculation based on a national average for nonresidential building construction incidence rate of 5.4 cases per 200,000 labor hours (DOL 2007) results in 0 (0.1) case of injury/illness as an upper bound on cases occurring during the blending period.

Accidents and reportable cases at the commercial blender would be similar to the upper bound limit for Fermilab, essentially 0 (0.1) case.

During blending, vapors that potentially could be released to the atmosphere would be analyzed to assure compliance with FESHM air emission requirements. Ventilation controls and ES&H operational procedures would be used by a developed for the project to minimize worker exposure and ensure that any exposures that do occur are well below the American Conference of Governmental Industrial Hygienists (ACGIH) time weighted average (TWA) threshold limit value (TLV) and also below the short-term exposure limit (STEL). Commercial blending facility. would have similar monitoring program to insure compliance with State permit limits.

5.3.5 Transportation

Transportation impacts would be similar between the two blending alternatives. For the 2 employees associated with project blending, and assuming a conservative average commute distance of 86 mi (round-trip) (based on a one-way distance of 43 mi between Chicago and Batavia), an additional 0 (0.17) accidents, 0 (0.001) fatalities, and 0 (0.04) injuries might result for this phase due to workers commuting 45,000 vehicle-miles to/from the blending site. The calculation is based on the state of Illinois accident, fatality, and injury rates per vehicle-mile, which are 3.91E-06, 1.26E-08, and 1.04E-06, respectively (IDOT 2005). For Fermi, these numbers represent a minimal increase given the total number of employees at the Fermilab, and would be offset by workforce reductions due to programmatic changes at Fermilab during the period (i.e., termination of Tevatron operations).

Materials shipments include the delivery of the mineral oil and the pseudocumene for blending operations.

Private Vehicles

For the 2 employees associated with project blending, and assuming a conservative average commute distance of 86 mi (round-trip) (based on a one-way distance of 43 mi between Chicago and Batavia), an additional 0 (0.17) accidents, 0 (0.001) fatalities, and 0 (0.04) injuries might result for this phase due to workers commuting 45,000 vehicle-miles to/from the blending site. The calculation is based on the state of Illinois accident, fatality, and injury rates per vehicle-mile, which are 3.91E-06, 1.26E-08, and 1.04E-06, respectively (IDOT 2005). For Fermi, these numbers represent a minimal increase given the total number of employees at the Fermilab, and would be offset by workforce reductions due to programmatic changes at Fermilab during the period (i.e., termination of Tevatron operations).

Materials shipments include the delivery of the mineral oil and the pseudocumene for blending operations.

Rail Accident involving Mineral Oil

It is assumed that the mineral oil would be shipped via rail car from a distributor in the Texas Gulf Coast to a blending facility at Fermilab or to a commercial blending facility in the Fermilab vicinity, with a maximum rail trip distance of 1,800 km. The total projected amount of mineral oil needed for blending the liquid scintillator product is approximately 4.1 million gal. Assuming that the tank cars used for transporting the mineral oil via rail would have approximately 24,000 gal capacity, a total of 171 rail car shipments would be required. The transport would occur within the States of Texas, Arkansas, Missouri, and Illinois. Total accident, fatality, and injury rates for rail transport in the state of Illinois were used in the calculations for the shipment of mineral oil. Illinois has the highest total accident, fatality, and injury rates of the transited states; therefore, applying the total accident, fatality, and injury rates for the State of Illinois to the entire transport route is conservative.

The rates for Illinois were 9.53E-08 accidents/railcar-km, 2.58E-08 fatalities/railcar-km, and 4.35E-08 injuries/railcar-km (Saricks and Tompkins 1999). Therefore, a calculation results in an estimated 0 (0.03) rail accidents, 0 (0.008) rail fatalities, and 0 (0.01) rail injuries due to rail shipment of the total volume of mineral oil.

Highway Truck Accident Involving Pseudocumene Transport

Pseudocumene would need to be shipped via truck to the blending facility at the Fermilab or off-site location. A total of 230,000 gal of pseudocumene, or approximately 35 of the 7,000-gal truck shipments would be required. It is assumed that the pseudocumene would come from a distributor in the Texas Gulf Coast area and that the travel distance would be no more than 1,800 km. The tankers are assumed to be dedicated use so the round-trip distance of 3,600 km is considered resulting in a total of 126,000 vehicle-km. The transport would occur within the States of Texas, Oklahoma, Missouri, and Illinois. Total accident, fatality, and injury rates for heavy combination trucks in the state of Texas were used in the calculations for the shipment of pseudocumene. Texas has the highest total accident, fatality, and injury rates of the transited states; therefore, applying the total accident, fatality, and injury rates for the state of Texas to the entire transport route is conservative.

The rates for Texas were 6.58E-07 accidents/highway-km, 2.70E-08 fatalities/highway-km, and 5.37E-07 injuries/highway-km (Saricks and Tompkins 1999). Assuming similar rates in all states through which transportation will occur, a calculation results in 0 (0.078) accidents, 0 (0.0032) fatalities, and 0 (0.064) injuries during the shipping period for pseudocumene.

5.3.6 Decommissioning Impacts at Fermilab

Facility decommissioning at Fermilab includes removal and contour restoration of the surface-level Blending Facility. Decommissioning of the Fermi surface-level blending facility would require dismantling storage vessels, blending tanks and piping. It is

anticipated that most of the tanks and piping can be reused or recycled and will not be dispositioned as "waste". Any waste should be in the neighborhood of less than 5 m^3, which would not significantly impact the annual volume of industrial waste from Fermilab. This waste stream is non-radioactive, and would qualify as dumpster/landfill waste previously discussed.

Decommissioning would not have to be considered at the commercial facility.

5.4 Cumulative Human Health Impacts

From the discussions in the earlier sections of Chapter 5, the highest impacts to human health occur from transportation of materials, routine worker commuting and accidents and illnesses associated with the workplace activities. Table 5.9 summarizes the accidents, fatalities, injuries and OSHA Reportable Cases estimated for each of the phases at both locations. Assumptions and risk coefficients are discussed in the individual Sections. Also shown in Table 5.9 are the human health impacts from blending operations described in Section 5.3.

Transportation of materials would cause an estimated 1 accident, 1 injury and 0 fatalities with the major contributor being delivery of materials, MMA and scintillation fluid to the Ash River site. Routine daily commuting would cause an estimated 9 accidents, 2 injuries and 0 fatalities, approximately equally divided between Illinois and Minnesota sites [Note: Because the risk coefficients for traffic injuries in Minnesota are not provided (MDPST 2007), the injuries for commuting in Minnesota are assumed to be similar to those in Illinois]. OSHA Reportable cases would be approximately 19, or about 1~2 per year of the Project schedule.

	Transportation of materials			Worker Commuting			Workplace Reportable Cases
Project Phase	accidents	fatalities	injuries	accidents	fatalities	injuries	
Fermilab. IL Site							
Excavation/ Construction	essentially zero			2 (1.68)	0 (0.005)	0 (0.48)	1 (0.9) to 2(2.1)
Installation and Assembly	essentially zero			1 (0.67)	0 (0.002)	0 (0.18)	0 (0.16) to 1 (0.5)
Operations	essentially zero			1 (0.65)	0 (0.01)	0 (0.17)	0 (0.45)
Decommissioning	essentially zero			1 (0.67)	0 (0.002)	0 (0.18)	0 (0.15)
Blending Facility	0 (0.11)	0 (0.011)	0 (0.07)	0 (0.17)	0 (0.001)	0 (0.04)	0 (0.1)
Ash River MN Site							
Excavation/ Construction	0 (0.26)	0 (0.019)	0 (0.18)	1 (1.2)	0 (0.006)	Injury data not available for MN	5 (4.7)
Installation and Assembly	0 (0.33)	0 (0.011)	0 (0.22)	3 (3.1)	0 (0.02)		10 (9.7)
Operations	essentially zero			1 (1.2)	0 (0.007)		2 (1.6)
Decommissioning	0 (0.028)	0 (0.002)	0 (0.02)	essentially zero	essentially zero		essentially zero
TOTAL	1 (0.73)	0 (0.04)	1 (0.5)	9 (9.17)	0 (0.05)	2 (2x1.0)	19 (19.3)

Table 5.9 Summary of Human Health Impacts from the Proposed Action

5.5 Impact Analysis of the Potential No Action Alternative

If the NO*v*A Project does not proceed, the environmental impacts of this no action alternative would be those from current NuMI operations at Fermilab and from logging operations at the Ash River site. The impacts of these existing operations are described in Section 4 of this document. The impacts would cease if and when those activities were ultimately shut down.

The impacts from no action would be largely programmatic and socioeconomic rather than environmental, resulting in loss of employment and delay or disruption of affected DOE and other agency research programs. This alternative could result in potential dismissal of about 200 Fermilab scientific and support staff for lack of programmatic support and funding. Fermilab's support of the nation's strategic goals in science, energy, and the environment for DOE and multiple Federal agencies would be substantially reduced.

In Minnesota, there are no foreseeable developments proposed by others in the area of the proposed project. Economic stimulus from supply and services during the construction and installation/assembly phases of the project would be not be realized.

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6. ACCIDENT ANALYSIS

An accident is an unplanned event or sequence of events that results in undesirable consequences. NEPA requires agencies to consider reasonably foreseeable accidents commensurate with their potential adverse consequences. The term "reasonably foreseeable" generally is assumed to be those occurring with a probability greater than the range of one in a million to one in ten million (DOE 2002). Accident analysis is also required to address the results of an intentional destructive or terrorist act (DOE 2006).

The NO*v*A Project conducted a detailed hazard analysis that identifies the various categories of ES&H hazards that were evaluated for the proposed project (NO*v*A 2006). An extensive analysis of the entire range of accidents (construction, explosion/fire, transportation, and natural phenomena) that are reasonably foreseeable for the NO*v*A Project has been compiled in the NO*v*A Project *Accident Analysis Summary* (NO*v*A 2007c). That analysis identifies the accident analysis methods, the details of accident consequences and the Spill Prevention Control and Countermeasures (SPCC) Plans that would be developed to mitigate the consequences.

6.1 Accident Consequence Categories

Accident risk is based on two factors: probability of occurrence, and magnitude of consequence. For NEPA considerations, the accident analysis focuses on the highest consequence accident. In the NO*v*A *Accident Analysis Summary*, accidents have been assigned to relative probability categories based on both qualitative and semi-quantitative analyses. The range of accidents discussed and their consequences are:

- *Occasional* Accidents with probability of 1 in 100 to 1 in 10,000
  Minor accidents such as a worker trips and falls and other physical injuries (e.g., spraining an ankle) are the most common type of accident that would likely happen occasionally, especially given the duration of the construction phases of the NO*v*A Project. The next most common accident is assumed to be a traffic accident involving commuting workers at the Fermilab or Ash River site with serious injuries to vehicle occupants.

- *Remote* Accidents with probability of 1 in 10,000 to 1 in 1,000,000
  A vehicle rollover or tank rupture accident and chemical release involving one of the trucks transporting liquid scintillator, pseudocumene or MMA is considered to be *remote*.

- *Improbable* Accidents with probability of less than 1 in 1,000,000
  Accident scenarios related to construction, blending of chemicals, detector operation, and decommissioning are considered to be similar in frequency or *improbable*.

There are two considerations in identifying the highest consequence credible accident.

- Human Impact. In terms of impact on humans, the common traffic accident occurring during routine commuting is the accident that is most likely to occur. While the probability of an individual trip resulting in a fatal accident is *improbable*, the number of workers, the commuting distance and the construction duration combine to move the probability of a fatal traffic accident into the *occasional* category (0.005 at Fermilab and 0.03 at Ash River). A human fatality is a "high consequence," but traffic fatality accidents are a recognized occurrence in the modern workplace.

- Environmental Impact. The highest consequence credible accident with environmental impact would be the spill of pseudocumene or MMA in an accident during delivery from the distributor to the NO*v*A Project. Such a release in a wetland or other sensitive area could impact exposed sensitive species. While an accident during transport has a calculable probability of *occasional* (approximately 0.03~0.04 for either chemical) the probability that an accident would occur that also causes a spill at an environmentally sensitive area would be several orders of magnitude less or *remote* (<1E-04).

The NO*v*A Project does not involve the handling or use of radioactive materials, and interactions of the neutrino beam in the Near and Far Detectors do not result in activation or in hazardous external radiation levels. Therefore, no accidents involving the potential release of radiochemicals or exposure to radiation are discussed in this analysis.

6.2 Accident Scenario

The reasonably foreseeable accident scenarios for each project phase were developed based on accidents that have occurred in the past when similar activities have been conducted at other facilities or that were considered possible given the type of work, the materials handled and the setting. An accident could result from a wide variety of causes, including tripping, falling, excavation slope failure, vehicular traffic, electric shock, or equipment or construction materials falling on a worker.

When evaluating accident consequence both impact to humans and to the environment and biota are considered. Common accidents of low consequence are recognized to happen but are not considered further in this analysis.

The discussion here is focused on the single, reasonably foreseeable accident of greatest consequence that might occur in the course of the NO*v*A Project, namely, a transportation accident involving a chemical or liquid spill. The NO*v*A Project involves the use of MMA, a toxic material recognized as a hazardous air pollutant, to construct the detectors. The project also would blend, ship, and use approximately 4.3 million gal of liquid scintillator comprised of mineral oil, pseudocumene, and small quantities of other chemicals (most in powder form) listed in Table 3.2 to fill and operate the detectors. Pseudocumene is an irritant to humans through inhalation or skin contact and is very toxic to aquatic organisms.

Although the presence of flammable and combustible liquids in NO*v*A Project operations has the potential to contribute to an accident severity, an analysis in the NO*v*A hazard Analysis Document (NO*v*A 2006) identifies characteristics and actions that reduce the potential risk of fire. Some of these are:

- Limiting the volume of flammable liquids such as pseudocumene and MMA to minimum necessary for the stage of use;
- Reducing the risk/consequences of a fire by limiting proximity to public way, restricting personnel access and the restriction of ignition sources or open flames;
- Once the pseudocumene has been blended with the mineral oil the potential for fire is greatly reduced as the flash point is raised considerably; and
- Ignition of the blended scintillator liquid en route to or in the detectors requires a high energy source, such as a torch and is much less likely with low energy sources such as sparks or wood fires.

With considerations of the above mitigating measures the fire hazard is credible, but one of low risk and not of highest environmental consequence. The consequences of a fire at the proposed blending facility were addressed in NO*v*A Project *Accident Analysis Summary* (NO*v*A 2007c). Mitigation and response would be similar to what is described in the following sections.

Only a fraction of the transportation accident risks discussed in Sections 5.1 and 5.2 would be expected to involve a tank penetration, rupture, rollover, or serious accident that could include an explosion or fire and the possibility of the shipping contents being released. DOE and Fermilab procedures to pre-qualify contractors with excellent safety records would predict even lower probability of occurrence of accidents than general traffic statistics indicated here. One could expect at least an order of magnitude or more reduced likelihood (10 to 20 times less probable) of an accident occurring where a significant volume of the pseudocumene or MMA might be released to the environment.

6.3 Intentional Destructive and Terrorist Acts

A terrorist attack involving malicious acts intended to destroy the NO*v*A Project resulting in damage to the environment and loss of life was considered by DOE as required by the DOE Policy (DOE 2006). Fermilab is an access-controlled, secure area, provided with 24-hour security. The Ash River site is located within an isolated area that would also have controlled access and security. The two sites would be constructed and the project would be operated in such a manner that would not create a “highly visible” target for malicious acts or acts of terrorism. Because of their nature, a probability of occurrence for intentional acts can not be estimated. If malicious or terrorist acts did occur on the NO*v*A Project sites, consequences most likely would be in the large volume liquid spill category. If the secondary containment were also to be compromised, spills would be expected to have impacts similar to those from conventional accidents discussed in the NO*v*A *Accident Analysis Summary*.

6.4 Methods for Accident Avoidance and Barriers to Release

The environmental impact accidents described in this section and in the NO*v*A *Accident Analysis Summary* are unlikely to occur because of the safety procedures that would be observed in accordance with the NO*v*A Project hazard analysis, SAD documentation, and corresponding ES&H plans and procedures.

Mitigation measures for the various types of construction and operational activities are described in detail in the hazard analysis document prepared for the NO*v*A Project (NO*v*A 2006) and summarized in the NO*v*A *Accident Analysis Summary*. Attachment B of the NO*v*A hazard analysis provides a detailed worksheet for each environmental and safety and health hazard and identifies administrative controls, engineering controls, and mitigation measures for each hazard identified. The primary objective of this worksheet is to protect worker safety and health and the environment and reduce the potential for accidents.

6.4.1 Mitigation Measures for Potential Leaks or Spills

Passive mitigation measures. The passive mitigation measures that would be taken at the Fermilab and Ash River sites to limit the potential environmental impacts of a leak or spill are:

a) All PVC extrusions would be assembled into planes with manifolds and bottom plates. These assemblies would be pressure tested for leaks prior to being assembled and filled with scintillator.
b) Primary containment of liquid scintillator would be provided in the PVC extrusions. Subdivision of the detector into parts containing at most 275 gal of scintillator minimizes the potential for large leaks.
c) All piping systems for filling the NO*v*A detectors would be in accordance with National Fire Protection Association (NFPA) Standard 30, Chapter 5.
d) 100% secondary containment would be provided for all areas where liquid scintillator is located and where transfer operations would occur.

Active mitigation measures. The active mitigation measures that would be taken at the detector sites to limit the potential environmental impacts are:

a) Flow sensors would be built into all filling machines.
b) Emergency stop buttons would be provided on automated transfer systems.
c) Leak detection and alarms would be provided to monitoring leaks.
d) Material and equipment for management of spills would be available at the work site to minimize the volume of any leaks and spills in accordance with the facility SPCC plan.
e) Sumps and collection systems would be provided to provide 100% secondary containment in the event of a spill or release.

6.4.2 Mitigation Measures for Spills while Transporting Chemicals and Liquid Scintillator

The mitigation measures that would be taken for transporting the liquid scintillator to the detector sites to limit potential environmental impacts are:

a) A qualified transportation company would be required to maintain an excellent safety record and regulatory history.
b) All equipment and operators used to transport the liquid scintillator would be required to meet State and Federal Department of Transportation (DOT) certification requirements.
c) All truck shipping would be in a 7,000-gal top fill tanker truck, or similar, that is DOT-approved and meets ISO-certification standards.
d) The transporter would comply with all 49 *CFR* (DOT) regulations for marking, labeling, placarding, and shipping, and shall have all required shipping papers prior to acceptance at the site.
e) A documentation package supplied with each shipment would have an appropriate "Bill of Lading", material MSDS, and State and facility Emergency Response Team phone numbers.
f) Each truck would be required to have a satellite phone or equivalent during transit.
g) The shipper would be instructed to call 911 or State Emergency Response phone number and have the local jurisdiction assume authority in the event of an accident in transit.
h) On-scene first responders would secure the Bill of Lading in the event of any emergency and call 630.840.3414, available 24 hours; Fermilab personnel would provide the first responders with shipment information as needed.

6.5 Environmental Response in the Event of a Release

6.5.1 Fermilab

Fermilab has an established and functional emergency response organization. Potential facilities and operations have been defined, designed and coordinated with the Fermilab Fire Protection Engineer (NO*ν*A 2006) and the FESHM. Emergency response requirements for the NO*ν*A facilities will be integrated into required operational reviews

- Prior to operation of the NO*ν*A detectors, they will be subject to an operational readiness review by the Particle Physics Division.
- Prior to operation of the NO*ν*A detector, it must receive written approval to operate by the Accelerator Division.

6.5.2 Ash River Site

If a release were to occur along the 5.6-km road into the Ash River site, St. Louis County Road 129, or other roads in isolated or sensitive locations, a delayed response time from the St. Louis County or the State of Minnesota could lead to environmental impacts. For example, since wetlands are located adjacent to the currently planned Ash River site

access road, an accident could potentially release blended liquid scintillator (containing pseudocumene) or Devcon-60 (containing MMA) into this environment.

- The spill of the plastic glue into or adjacent to wetlands or waterways could have a negative impact on aquatic life forms due to the toxicity of the MMA constituent. With viscosity similar to a paste, the glue components do not flow readily, nor mix well in water. Vapors from a breached drum are inhalation irritants impacting species in the vicinity of the release, including human responders. Vapors from a breached drum may travel a distance to an ignition source causing flash back.

- The spill of pseudocumene into or adjacent to wetlands or waterways could have a negative impact on aquatic life forms due to its toxicity. Vapors from a punctured tanker truck are inhalation irritants impacting species in the vicinity of the release, including human responders. Vapors may form explosive mixtures with air.

- The spill of blended scintillator would mimic the conditions of a fuel oil spill as the scintillation fluid is 95% mineral oil, but much less flammable. A 7,000 gal spill would result in an oil puddle approximately 30 m by 30 m with a depth of 3 cm (100 ft by 100 ft with a depth of 1 in).

Emergency response plans similar to those implemented for an oil spill would apply to an accident of this type. Responders would use readily available containment technology supplies such as pads and sand to absorb the material. Booms and dykes would be used to contain and direct the flow to less sensitive collection areas.

Material and equipment for management of spills would be available at the work site to minimize the volume of any leaks and spills in accordance with the facility SPCC plan. Sumps and collection systems would provide 100% secondary containment in the event of a spill or release in the fixed facility.

7. LIST OF OUTSIDE AGENCIES CONSULTED

Advance notice and briefings as requested were provided to the following agencies of DOE's proposed action addressed in this EA. The EA also was made available for review and comment.

Fermilab/DOE Consultations

- Illinois Department of Natural Resources
- Office of the Governor of Illinois
- Illinois Historic Preservation Agency
- National Park Service, Voyageurs National Park
- Minnesota Historical Society
- Bois Forte Band of Minnesota Chippewa
- Leech Lake Band of Ojibwe
- White Earth Band of Minnesota Chippewa
- Grand Portage Band of Chippewa
- Fond du Lac Band of Lake Superior Chippewa Reservation
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers, St. Paul, Minnesota, District
- Minnesota Department of Natural Resources
- The Advisory Council on Historic Preservation

University of Minnesota Consultations

- National Park Service, Voyageurs National Park
- U.S. Army Corps of Engineers, St Paul, MN
- Minnesota Environmental Quality Board
- Minnesota Department of Natural Resources
- MNDNR Natural Heritage Information Program
- Minnesota Pollution Control Agency
- Minnesota Natural Resources Conservation Service
- St. Louis County, MN
- Forest Capital Partners, International Falls, MN (private stakeholder)

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[Citation for NO*ν*A EA, when published]

8.1.3 United States Code

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16 USC 1531 et seq. *Endangered Species Act of 1973*. Public Law 100-478, as amended.

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Environmental Assessment for Construction and Operations of Neutrinos at the Main Injector (NuMI) Off-Axis Electron Neutrino (ν_e) Appearance Experiment (NOνA) at the Fermi National Accelerator Laboratory, Batavia IL, and near the Ash River, St. Louis County, MN

Appendices

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Appendix A

Minnesota Environmental Assessment Worksheet

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Version 2/99 – editorial corrections December, 06

ENVIRONMENTAL ASSESSMENT WORKSHEET

Note to preparers: This form and EAW Guidelines are available at http://www.eqb.state.mn.us. The Environmental Assessment Worksheet provides information about a project that may have the potential for significant environmental effects. The EAW is prepared by the Responsible Governmental Unit or its agents to determine whether an Environmental Impact Statement should be prepared. The project proposer must supply any reasonably accessible data for — but should not complete — the final worksheet. If a complete answer does not fit in the space allotted, attach additional sheets as necessary. The complete question as well as the answer must be included if the EAW is prepared electronically.

Note to reviewers: Comments must be submitted to the RGU during the 30-day comment period following notice of the EAW in the *EQB Monitor*. Comments should address the accuracy and completeness of information, potential impacts that warrant further investigation and the need for an EIS.

1. **Project title** NOvA Off Axis Detector Facility at Ash River Site

2. **Proposer** Regents of the University of Minnesota

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4. **Reason for EAW preparation** (check one)

_____EIS scoping _____ Mandatory EAW ____Citizen petition _____ RGU discretion _X_ Proposer volunteered

If EAW or EIS is mandatory give EQB rule category subpart number:

5. **Project location**

County – St. Louis County

City/Township – Project site is located approximately 38 miles southeast of International Falls, Minnesota and 1-1/4 miles southwest of the Settlement of Ash River, off the Ash River Trail (St. Louis County Highway 129).

Section – 13, 14, 15	Township - 68N	Range - 20W	and
Section – 18	Township - 68N	Range - 19W	

Attach each of the following to the EAW:

- County map showing the general location of the project (See **Figure 1**);
- U.S. Geological Survey 7.5 minute, 1:24,000 scale map indicating project boundaries (photocopy acceptable) (See **Figure 2**);
- Site plan showing all significant project and natural features (See **Figure 3**).

6. **Description**

a. Provide a project summary of 50 words or less to be published in the *EQB Monitor*.

The University of Minnesota is proposing to construct an electron neutrino detector for research on sub-atomic particles. The facility will be about 30 miles southeast of International Falls, Minnesota and will include a 38,028 square foot detector assembly and service building, and a 3 mile access road.

b. Give a complete description of the proposed project and related new construction. Attach additional sheets as necessary. Emphasize construction, operation methods and features that will cause physical manipulation of the environment or will produce wastes. Include modifications to existing equipment or industrial processes and significant demolition, removal or remodeling of existing structures. Indicate the timing and duration of construction activities.

The University of Minnesota proposes to construct a physics laboratory on a currently undeveloped site about 1-1/4 miles southwest of the unincorporated settlement of Ash River, MN, The site is about one mile south of St. Louis County Highway 129 (Ash River Trail), about 8 miles east of the intersection of the Ash River Trail and U.S. Highway 53, about 21 miles (straight-line) and about 34 miles by road northeast of Orr, MN and about 38 miles by road southeast of International Falls, MN. The closest straight-line distance to Voyageurs' National Park is 1 mile. The site is accessible from the Ash River Trail via an existing, approximately 3.5 mile long logging road. Upgrading the existing roadway is part of this project.

Project Rationale: The purpose of the proposed physics laboratory known as the Ash River Laboratory and Detector is to house a neutrino detector, which will be constructed by an international group of scientists known as the NOvA Collaboration. Neutrinos are elementary particles, which exist in three different types or flavors. They are uncharged, non-ionizing and only rarely interact with ordinary matter. Neutrinos are useful probes of the weak interaction, one of the four fundamental forces in the Universe. The study of the spontaneous transition of neutrinos from one type to another is considered a good way to study important physics questions, such as the properties of the weak interaction, neutrino mass, the contribution of neutrinos to the dark matter in the universe and the relationship between matter and antimatter. The Office of Science of the U.S. Department of Energy has previously constructed a neutrino laboratory and detector at Soudan, MN and a neutrino beam from Fermi National Accelerator Laboratory (Fermilab), near Batavia IL, to the Soudan laboratory and beyond. The proposed Ash River Laboratory and Detector will use the same Fermilab-to-Soudan neutrino beam. In contrast to the Soudan neutrino detector, which measures the parameters of a neutrino flavor transition that is known to occur, the Ash River site neutrino detector will search for a different, previously unobserved transition. A complementary experiment with a shorter neutrino beam is under construction in Japan.

Site Selection Rationale: The mean energy of a neutrino in a neutrino beam varies depending on the distance of the particular neutrino from the beam centerline. The NOvA Collaboration has determined that the optimal neutrino detector location is 12 km (7.5 miles) from the neutrino beam centerline. This requirement was the primary criterion for site selection. Other site selection criteria were as follows:

(a) The location should be as far as possible from Fermilab to optimize the sensitivity of the experiment.
(b) The site should be accessible to a highway and have reasonable access to electrical power and telecommunications to reduce construction costs and provide long term accessibility.
(c) A location in the United States enhances the project organization.
(d) The location should be elevated, to reduce wetland impacts, and not directly visible from existing parks and other recreational facilities. These factors were considered to reduce the environmental impacts.

Personnel from the Minnesota Department of Natural Resources, the National Park Service and Fermilab participated in preliminary site surveys, although the actual site selection was the responsibility of the University. The selected site is optimal based on the stated criteria.

Site and Laboratory Overview: The proposed physics laboratory site consists of approximately 90 acres of land, much of which has been clear-cut by current or previous owners over the last few years. The main building will have a detector enclosure 295 feet long by 67 feet wide and an assembly area of the same width

and an additional 65 feet in length. The floor of this entire area will be located approximately 40 feet below grade. The entire detector will be surrounded and covered by concrete and aggregate to reduce the effects of cosmic rays coming down naturally from the sky on the detector. Some of the aggregate will consist of a mined mineral known as barite (primarily barium sulfate), which is particularly effective at stopping cosmic rays. Additional features of the physics laboratory include a service building 130 feet long by 67 feet wide built at grade. The Service Building will have one at-grade loading dock and two recessed loading docks. An overhead crane will be used for unloading. Additional site features include the eastern end of the access road and a parking area for 25 vehicles.

Neutrino Detector: The neutrino detector will have a total mass of up to 20,000 metric tons. Approximately 70 percent of the mass will consist of mineral oil with the addition of up to 10 percent by mass of pseudocumene and other organic compounds known as wavelength-shifters. These compounds have the ability to absorb light at one wavelength and re-emit the light at another, longer wavelength, so that light can be more efficiently transmitted and collected. The remaining 30 percent of the mass will consist primarily of polyvinyl chloride (PVC) extrusions, which will house the mineral oil in channels approximately 2.5 inches in width and 52 feet in length. In addition to this primary containment, the neutrino detector enclosure will provide sufficient below-grade, secondary containment for the entire mineral oil inventory plus the entire contents of the water-based fire suppression system.

Roadway, Site and Laboratory Construction: The initial planned onsite activities are the construction of the road, the leveling of the building site and the construction of the physics laboratory. The road will follow the existing logging road, except that some curves will be straightened and some grades will be reduced. The road is designed to be as “fill neutral” as possible, that is, soil and rock removed from the building site will be used for widening the logging road. The current plan is that the finished road will appear similar to the Ash River Trail with two paved traffic lanes, shoulders and open ditches for drainage. Utilities will be buried on either side of the road.

Much of the western third of the road traverses a wetland on an old railroad embankment. Care will be taken to minimize impacts on the wetland and wetland credits will be purchased as a permanent mitigation. Although this road section impacts a wetland, its environmental impact is less than any alternative new right-of-way. Alternative routes would likely affect mature, not recently logged forest areas and would certainly establish new migration routes for wildlife.

Soil and rock borings have established that the Physics Laboratory site is primarily granite with minimal soil cover. Leveling the site and excavating for the building will require both bulldozing of the soil cover and blasting of the rock. We anticipate onsite crushing of excavated rock to provide fill material for the road and aggregate for the concrete required for the Physics Laboratory.

Schedule and Decommissioning: The University expects to commence construction in late Fall 2007 or early Spring 2008, depending on the availability of funds and the weather. Site and building construction is expected to last through 2010. Detector installation is expected to occur between 2010 and 2013. During installation, 30 to 50 people are expected to work at the site, either as employees or visitors. Detector operation is expected through 2025. Average staff and scientific visitor count during operations is expected to be fewer than 10 people. A visitor program for school groups and the general public might include 2,000 to 3,000 people per year.

The University will own the site and buildings, but the neutrino detector and other equipment will be the property of the United States. At the conclusion of the physics research, the University will require the United States to remove all of its equipment and to remediate any issues resulting from its equipment. The University will then determine future use of the building and site in the best interests of the University and the people of Minnesota.

Environmental Issues: Because the site is currently undeveloped, the proposed project will change the appearance and current use of the site. At closest approach, the physics laboratory is just over 1,000 feet from the nearest point of the Ash River, which discharges in Lake Kabetogama. The University and its contractors expect to minimize environmental impacts by (1) depressing the detector into the ground to provide secondary

containment and minimize visual impacts; (2) implementing a Storm Water Pollution Prevention Plan as well as erosion and sedimentation controls to minimize impacts on the Ash River and adjacent waters; (3) using the existing access right-of-way to minimize impacts on wildlife; and (4) purchasing wetland credits to provide no net loss of wetlands in the region.

c. Explain the project purpose; if the project will be carried out by a governmental unit, explain the need for the project and identify its beneficiaries.

The NOvA project is considered basic research to advance human understanding of the physics of the neutrino particle. The project is being constructed in large part due to its location as the most optimal distance from the other laboratories that will jointly conduct the research. Other locations outside of the northern St. Louis County area are not suitable for the technology. The University of Minnesota conducted open houses to identify stakeholders and generate feedback and consensus to select a site that most suitably minimizes environmental effects and community concerns. The National Park Service emerged as a key stakeholder and provided input and consensus to select a site that minimizes potential environmental effects related to Voyageurs National Park. The lead government agency for the project will be the University of Minnesota.

d. Are future stages of this development including development on any outlots planned or likely to happen?
__Yes _X_No

The current design does not include plans for further development.

e. Is this project a subsequent stage of an earlier project? __Yes _X_No

This project is not a subsequent stage of an earlier project.

7. **Project magnitude data**

Total project acreage: The project site is defined as that area in the immediate vicinity of the proposed facility structure and the area within 25 feet of the centerline of the proposed access road. The project site consists of both the 89.63 acres of property referred to as the facility site where the Ash River Laboratory and Detector will be constructed, and the 18.90 acres along the approximately 3-mile access road. The limits of the facility site and the proposed access road corridor are identified on **Figure 2**.

With in the facility site the detector structure will occupy approximately 1.0 acre. The Assembly Space and Service Building will occupy approximately 0.66 acres in area and will be visible above the ground surface. The associated parking area will be 0.92 acres in area.

Number of residential units: unattached - NA attached – NA maximum units per building - NA
Commercial, industrial or institutional building area (gross floor space): total square feet: Approx. 38,038 sq. ft.

Indicate areas of specific uses (in square feet):

Office	1,000 sq. ft. (Includes kitchenette (200 sq. ft.) and conference room (250 sq. ft.).	Manufacturing	NA
Retail	NA	Other industrial	NA
Warehouse	NA	Institutional	37,038 sq. ft.
Light industrial	NA	Agricultural	NA
Other commercial (specify)	NA		

Building height. If over 2 stories, compare to heights of nearby buildings
The building is 22-meters high (72-feet), with the majority of the facilities occurring below ground. Approximately 37.6 feet will be exposed above ground. There are no existing buildings located on or in the vicinity of the project site.

8. **Permits and approvals required.** List all known local, state and federal permits, approvals and financial assistance for the project. Include modifications of any existing permits, governmental review of plans and all direct and indirect forms of public financial assistance including bond guarantees, Tax Increment Financing and infrastructure.

Unit of Government	Types of Applications	Status
FEDERAL:		
U.S. Army Corps of Engineers	Section 404 Permit	To be applied for
Department of Energy	Project funding	Currently in negotiation
STATE:		
Minnesota Pollution Control Agency	National Pollutant Discharge Elimination System NPDES Construction Permit	To be applied for
Minnesota Pollution Control Agency	Section 401 Certification of U.S. Army Corps of Engineers Section 404 permit	To be applied for
Minnesota Department of Health	Domestic Well Permit	To be applied for
Minnesota Pollution Control Agency Minnesota Department of Natural Resources Minnesota Department of Health	Dewatering Permits: ▪ NPDES ▪ Temp. Dewatering Permit (Construction only) ▪ Water Appropriations Permit ▪ Dewatering Well Construction	To be applied for if necessary
Minnesota Department of Natural Resources	Construction Dewatering Permit	To be applied for, if necessary
University of Minnesota	Building Permit	To be applied for
LOCAL:		
St. Louis County	Wetland Conservation Act Permit	To be applied for
St. Louis County Planning Commission	Land Alteration Permit	To be applied for

9. **Land use.** Describe current and recent past land use and development on the site and on adjacent lands. Discuss project compatibility with adjacent and nearby land uses. Indicate whether any potential conflicts involve environmental matters. Identify any potential environmental hazards due to past site uses, such as soil contamination or abandoned storage tanks, or proximity to nearby hazardous liquid or gas pipelines.

The site is currently undeveloped. The facility site consists of three land parcels that total 56 acres. Two (2) of the parcels are currently owned by the Minnesota Department of Natural Resources (MNDNR). The third section is currently owned by the Forest Capital Partners (formerly Boise Cascade). Access to the facility site is via an old clay base logging road which crosses land owned by Forest Capital Partners and the MNDNR. The properties have been primarily utilized for timber cutting operations in the past. The MNDNR Division of Forestry is responsible for management of the site and these timber production areas are parcels within the Kabetegoma State Forest. The proposed facility site contains several logging roads and trails providing access throughout the site. No old growth forest exists on the site. The upland forest cover consists of young stands of trees in areas recently harvested, to middle aged trees in older cut areas. Approximately 80% of the existing tree cover consists of quaking aspen (*Populus tremuloides*). The majority of the facility site has been recently clear-cut and is devoid of tree cover.

The proposed access road alignment crosses both wetland and upland land uses that are similar to those found on the facility site. The road also transects through MNDNR-owned timber parcels and private parcels. There are no residential or developed parcels along the proposed access road alignment. Similar to the facility site, there are numerous clearcuts and other recent impacts from timber production in the vicinity of the access road alignment.

Neither the proposed facility site nor access road alignment show evidence of potential pollution concerns or potential environmental hazards due to past site uses.

10. **Cover types.** Estimate the acreage of the site with each of the following cover types before and after development:

If **Before** and **After** totals are not equal, explain why.

Cover Type	Before		After	
	Facility Site	**Access Road**	**Facility Site**	**Access Road**
Types 1-8 Wetlands	4.13 acres	2.55 acres	4.13 acres	0 acres
Wooded/Forest	84.20 acres	4.35 acres	78.79 acres	0 acres
Brush/Grassland	0 acres	8.9 acres	0 acres	7.6 acres
Cropland	0 acres	0 acres	0 acres	0 acres
Lawn/Landscaping	0 acres	0 acres	3.39 acres	0 acres
Impervious Surfaces	1.30 acres	3.1 acres	3.32 acres	11.3 acres
Other	0 acres	0 acres	0 acres	0 acres
Totals	**89.63 acres**	**18.90 acres**	**89.63 acres**	**18.90 acres**

The table above shows that the existing 89.63 acre facility site area is wooded, with parts having been logged within the last five years. The existing impervious surfaces are associated with natural surface bedrock exposures and logging roads located within the facility site. Construction on the facility site will result in creation of new impervious surfaces. The area of proposed new impervious surfaces includes the laboratory and detector building, service and assembly structure, and the parking area. The area immediately around the structures will be restored after construction as lawn and landscaping.

Cover types were estimated within a 66-foot corridor for the proposed access road. The existing gravel roadway along the corridor is considered impervious surface. The calculations assume the new road will be a 30-foot paved roadway with 10-feet of clear zone on either side. Areas within the 30-foot roadway will be converted to impervious surface, either from the existing gravel road (also considered impervious), wetland, or forest. The 10-foot clear area along either side of the completed roadway is assumed to be converted to brush/grassland after restoration following construction. It is assumed that these areas will be maintained annually to keep brush and trees back from the roadway to maintain the clear zone.

Two wetlands were delineated within the 89.63 facility site boundary, but none of these wetlands will be impacted by the facility or related construction. Four wetlands were delineated along the proposed road alignment. The 0 acres value in the "After" column for the access road is based on the preliminary estimate that there will be 2.52 acres of wetlands impacted by the road. Road related wetland impacts are expected to be refined when detail design plans are developed, but the final wetland impact acreage should be similar. The difference in forest cover acreages for the access road is represented in the after amounts of impervious surface (road surface) and the grassland that will be maintained in the adjacent right-of-way of the access road. Eight (8) acres of temporary stockpiles will be placed within the facility site during construction entirely within the recently clear cut wooded forest cover type. Upon completion of construction, temporary stockpiles will be removed and those areas restored; the 8 acres of restored stockpile areas are included in the 78.79 acres of wooded/forest cover in the "After" column.

11. **Fish, wildlife and ecologically sensitive resources**

a. Identify fish and wildlife resources and habitats on or near the site and describe how they would be affected by the project. Describe any measures to be taken to minimize or avoid impacts.

Facility Site: The habitats within the site boundary are entirely comprised of forested uplands that have been subjected to recent clearcutting activities. There are no fluvial, or lacustrine habitats affected by the project. Patches of un-cut timber are present amid the recently clearcut areas within the facility site boundary. Quaking aspen (*Populus tremuloides*) are the dominant canopy trees with a subcanopy of paper birch (*Betula papyrifera*), balsam fir (*Abies balsamea*) and white spruce (*Picea glauca*). The shrub layer has scattered beaked hazel (*Corylus cornuta*) and the ground cover is dominated with braken fern (*Pteridium acquilinum*) and bigleaf aster (*Aster macrophyllum*). There is no old growth forest within or immediately adjacent to the project site boundary, including red pine (*Pinus*

resinosa) or white pine (*P. strobius*). Soils are thin or comprised of exposed Precambrian bedrock outcrops within a relatively rugged topography. These habitats represent the common types of upland habitats found in the surrounding area.

Permanent impacts to this upland habitat will total 2.11 acres and will be restricted to areas that are graded, impervious surfaces (parking and buildings), and the area that is converted to landscaping/turf that will surround the underground facility. A breakdown of this impact area is as follows:

- Detector Facility = 0.67 acres
- Parking area comprised of impervious surfaces = 0.93 acres
- Lawn and landscaping adjacent to building and parking lot = 3.39 acres

The remaining area within the 89.63 facility site boundary will remain as undisturbed upland habitat. Before and after cover types are also summarized in question 10 of this EAW.

No raptor nests or suitable nest trees were observed within the footprint of these facilities due to recent clearcutting. No deer wintering yards, or other unique habitat feature was identified within or immediately adjacent to the site boundary. Direct impacts to wildlife habitat are anticipated to be relatively minimal and restricted to the areas within the site boundary that are permanently converted to another land use. No direct impacts to fish habitats will occur. Indirect impacts to fish habitats (Ash River) will be minimized through the implementation of required National Pollution Discharge Elimination System (NPDES) permit standards during and after construction.

Surrounding habitats that are outside of the site boundary include Type 3 semi-permanently flooded marshes, Type 6 scrub shrub swamps, and Type 7 black spruce (*Picea mariana*) swamps. Surrounding uplands are similar to the forest communities found within the site boundary and described above, much of which has also been subjected to timber harvesting activities including clearcutting.

Ash River: The Ash River channel and associated floodplain is located 1,160 feet to the south of the facility footprint or the area of the project that will be subject to construction activities. The closest portion of facility footprint (parking lot) is 1,186 from the Ash River channel. During the preliminary planning for this project, the location of the facility was moved further away from the Ash River channel to minimize the potential for disturbance along the shoreline and floodplain. The Ash River is a MNDNR Designated Trout Stream subject to Minnesota Statutes and MNDNR policy. Projects that are within 1,000 feet of a Designated Trout Stream are subject to special conditions set forth in the Statutes and MNDNR policies related to the MNDNR Protected Waters statutes. Although there is no specific statute language on the implementation of Designated Trout Waters best management practices (BMPs), the MNDNR is expected to provide comments and direction on specific measures to reduce the potential for impacts to these waters. Trout stream BMPs often include provisions to reduce tree cover (shading) removal, sediment control, and in-stream habitat loss.

In addition to the potential project implications on the Ash River, other indirect impacts to fish and wildlife habitats are expected to be minimal. Most or all of these surrounding habitats are expected to remain in their current state as natural cover or timber harvesting. No disruptions of wildlife migration, movement, or genetic exchange are anticipated. Habitat fragmentation effects are anticipated to be minimal due to the relatively small size of the project impact area and the anticipated static state of the surrounding habitats. Relatively speaking, large amounts of forest cover in the area have already been subjected to temporary habitat fragmentation as a result of timber harvesting. Minimization of indirect temporary impacts resulting from construction will be implemented through the NPDES permit and erosion control requirements that will be applied.

Access Road: Anticipated impacts to fish and wildlife habitats from the proposed access road include forested upland habitats similar to the conditions described within the site boundary and to Type 6 scrub shrub, Type 7 mixed forest, and Type 8 black spruce and tamarack (*Larix larcina*) bog wetland habitats. Road impacts will be minimized to the greatest extent practicable by using the footprint of the existing roads and avoiding and minimizing wetland impacts. Unavoidable wetland impacts will be mitigated for through the wetland permitting process described in more detail in EAW question 12.

There are no known concentrations of migratory birds protected under the Federal Migratory Bird Treaty Act within the project boundary, and no project effects on such concentrations are anticipated. To comply with and minimize effects on nesting songbirds protected under the Act, tree clearing activities will occur outside of the bird nesting season from April 1 to August 15. This will apply in areas that were not previously clearcut for timber harvesting.

b. Are any state-listed (endangered, threatened or special concern) species, rare plant communities or other sensitive ecological resources such as native prairie habitat, colonial waterbird nesting colonies or regionally rare plant communities on or near the site? _X_ Yes __No
If yes, describe the resource and how it would be affected by the project. Indicate if a site survey of the resources has been conducted and describe the results. If the DNR Natural Heritage and Nongame Research program has been contacted give the correspondence reference number: SEH/MNDNR NHIP License Agreement. Describe measures to minimize or avoid adverse impacts.

The MNDNR Natural Heritage Information Program (NHIP) was contacted to identify potential state and federally listed Threatened, Endangered, Special Concern species, and sensitive resources in the project area (MNDNR correspondence reference # SEH/MNDNR NHIP License Agreement). The NHIP identified 5 occurrences within a 1.5-mile radius of the project site and is the basis for the following discussion. No occurrences are found within the facility site boundary or footprint of the proposed access road.

Federally Listed Threatened and Endangered Species
The project county is within the breeding range of the bald eagle (*Haliaeetus leucocaphalus* – federal status, Threatened – proposed for delisting), the distributional range of the grey wolf (*Canis lupus* – federal status, Threatened), and the distributional range of the Canada lynx (*Lynx canadensis* – federal status, Threatened). No bald eagle nesting areas are identified within or within a one-mile radius of the site boundary and none were observed during a site reconnaissance. Suitable nest trees for eagle nests were lacking and there were no lakes that serve as foraging habitats for bald eagles in the vicinity of the site boundary.

Canada lynx habitat is marginal to poor within the site boundary, due to extensive clearcutting. MNNDR data (MNDNR, 2005) show one un-verified occurrence of the Canada lynx in an area several miles to the south of the project. The majority of the verified occurrences in St. Louis County, including breeding occurrences and radio collared cats occur approximately 50 or more miles to the east of the project area in the eastern part of the Superior National Forest. Despite the poor habitat conditions and lack of verified occurrences, Canada lynx are wide ranging animals that could potentially utilize and establish in the project area in the future. Ongoing MNDNR, U.S Forest Service (USFS), and U.S. Fish and Wildlife Service (USFWS) efforts to monitor this recently listed species are expected to continue.

Grey wolves are known to occur throughout the project area, an area where wolves have long been established prior to and since they were federally listed. Two observations of wolf scat were documented within the project boundary during a 2005 field reconnaissance. The nature of the project and the surrounding habitats and land uses are such that no measurable effects to grey wolves or their habitats are anticipated. Measurable effects could be possible if the project were to cumulatively result in impacts with other reasonable and foreseeable projects in the area. To date there are no other reasonable and foreseeable projects proposed in addition to this project.

State Threatened, Endangered and Special Concern Species and NHIP Occurrences
The NHIP identified no occurrences within the site boundary and five (5) occurrences within a 1.5 mile radius of the site boundary. One occurrence is recorded near the existing access road, approximately 800 feet southeast of the intersection with the Ash River Trail. The following paragraphs provide a general description of the location and characteristics of the occurrences. However, the precise location and details about the species occurrences are not provided, nor published on the figures in this document in order to protect the rare features from exploitation or destruction.

Four of the five noted occurrences were of tiger beetles (*Cicindela denikei* – state status, Threatened). Two of the tiger beetle occurrences were recorded in 2001 and 2004 approximately 1.5 to 2 miles south of the facility site, upgradient of a tributary to the Ash River. Because of the distance of the separation and the fact that they are upgradient from the project site, these occurrences are outside the influence of the proposed project. Habitats for the tiger beetle are microhabitats several square feet in size, ephemeral, and restricted to bare patches of disturbed soil.

Most occurrences of this rare insect are chance sitings or the results of research by the scientific community. Survey, detection and mitigation or habitat management for this species does not exist due to the species biology. Tiger beetle occurrences in the NHIS are primarily included for tracking and monitoring purposes.
The other three noted occurrences are east of the project site along the existing access road and Ash River Trail. One tiger beetle occurrence and one location of a population of Lapland buttercup (*Ranunculus lapponicus* – state status, Special Concern) are identified along the Ash River Trail west of the intersection of the site access road. These locations are outside of the influence of the proposed project. The only noted occurrence within close proximity the project area is a single occurrence of a tiger beetle recorded in 2001 approximately 50 feet off the existing site access road.

12. **Physical impacts on water resources.** Will the project involve the physical or hydrologic alteration — dredging, filling, stream diversion, outfall structure, diking, and impoundment — of any surface waters such as a lake, pond, wetland, stream or drainage ditch? _X_ Yes ___ No
If yes, identify water resource affected and give the DNR Protected Waters Inventory number(s) if the water resources affected are on the PWI: Ash River. Describe alternatives considered and proposed mitigation measures to minimize impacts.

The Ash River and associated floodplain wetlands exist south and east of the project as shown on **Figure 6**. The Ash River is a Protected Water on the Minnesota Department of Natural Resources (MNDNR) Protected Waters Inventory (PWI) Maps (See Figure 7).. The stream segment that flows to the south of the project site is a MNDNR Designated Trout Stream. The National Wetlands Inventory (NWI) shows additional wetland habitat in areas around the proposed project site, including forested bog habitat along the existing access road. A wetland delineation was completed for the project following the U.S Army Corps of Engineers (USACE) wetland delineation manual. Two wetlands were delineated within the facility site boundary and several wetlands are crossed by the proposed access road. The delineated wetlands are shown in **Figure 6**.

There are two wetlands and no streams located within the 89.63 acre facility boundary, but none of the wetlands will be impacted as they are located outside of the facility impact footprint. Therefore, construction of the detector enclosure and the associated parking facilities will not result in dredge and fill impacts to wetland habitat. The Ash River is located approximately 1,186 feet south of the facility parking area. No direct impacts to the Ash River or the associated floodplain wetlands will occur from construction of the proposed project.

Wetland sequencing requirements under the guidance of both the Minnesota Wetland Conservation Act (WCA) and the Section 404 requirements of the USACE were implemented from the on-set of the project and will be implemented through construction. New road alignment alternatives were compared to the wetland impacts associated with improvement of the existing timber access road. All of the new road alignments that were evaluated would result in 20 acres or more of wetland impact. In comparison, improvement of the existing timber access road for the project will impact approximately 2.52 acres of wetlands with dredge and fill impacts. . Improvement of the timber access road will result in reconstruction of approximately 4,205 feet of existing road. Improvement of the existing roadway from a 15-foot unpaved section to a 30-foot paved section will result in filling approximately 2.52 acres of wetland along the existing roadway as shown on **Figure 5**. The existing timber road alignment was selected as the preferred alternative for the access road specifically to minimize wetland impacts. Wetland sequencing will be implemented through the final design and permitting for the access road and will consider measures to minimize the impact footprint within each wetland.

Impacts of this magnitude will require permits from the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act and from St. Louis County under the requirements of the Minnesota Wetland Conservation Act of 1991 (WCA). None of the potentially impacted wetland habitat is designated as a Protected Water or wetland under jurisdiction of the Minnesota Department of Natural Resources.

Both the federal and state wetland regulations require consideration of measures to avoid and minimize impacts to wetlands and will require mitigation of unavoidable impacts by replacement at a minimum ratio of one acre for each acre filled. Sequencing (avoidance and minimization) and mitigation opportunities will be evaluated during project design and discussed with regulatory staff during project permitting. Wetland mitigation will come from within the required USACE Wetland Bank Service Area, from an existing wetland bank located in Beltrami County (BWSR

Account #1266) which provides both WCA and Section 404 wetland credit. The Combined Wetland Permit Application and Replacement Plan will be submitted to the respective review agencies after the completion of the EAW process. Wetland mitigation for the project will be addressed within the Replacement Plan and will follow the required in-kind, in-place sequence for implementing mitigation.

Design details on culvert crossings and hydrologic modeling, and potential for flooding or overtopping of the proposed access road will be evaluated during the final design phase in the future.

13. **Water use.** Will the project involve installation or abandonment of any water wells, connection to or changes in any public water supply or appropriation of any ground or surface water (including dewatering)? X Yes __No
If yes, as applicable, give location and purpose of any new wells; public supply affected, changes to be made, and water quantities to be used; the source, duration, quantity and purpose of any appropriations; and unique well numbers and DNR appropriation permit numbers, if known. Identify any existing and new wells on the site map. If there are no wells known on site, explain methodology used to determine.

The Minnesota Department of Health//Minnesota Geological Survey, County Well Index (CWI) statewide well database was searched to identify wells within the project area. No well records were identified in that search (*County Well Index, Minnesota, January 12, 2005, Minnesota Geological Survey and Minnesota Department of Health).*

Geotechnical borings were drilled at the project site in the fall of 2005 by American Engineering Testing (AET) of St. Paul, Minnesota. Two borings were drilled in the vicinity of the proposed facility structure. A piezometer was constructed at one of the borings after the completion of drilling (as shown on **Figure 4)** and was used to monitor groundwater levels at the site. The piezometer was constructed by driving a 4 inch diameter steel casing to the top of bedrock. The open borehole created by the rock coring was used for the lower portion of the piezometer. A protective steel casing was placed around upper portion of the piezometer. This piezometer is no longer actively monitored and will be abandoned and sealed in accordance with Minnesota Rules, Chapter 4725.

The proposed project will require one or more water wells for domestic water purposes and to fill storage tanks for fire protection. The wells will be sited near the Detector Enclosure in order to serve that facility. The well will be used for potable water for the normal operating occupancy of 8 – 10 people. The well will also be used to charge the Fire Protection system (60,000 gallons of storage). The well will not be used to actively fight fire, but will only be used to charge the storage system. This will limit the capacity need of the facility and the demand on the well. The approximate location of the new well is shown on **Figure 3**.

At a minimum, dewatering of perched groundwater will be required during construction. During construction a temporary dewatering permit will be obtained from the MNDNR. If groundwater is determined to exist within the bedrock, permanent dewatering may be needed to protect the structure. Permanent dewatering will likely consist of a series of perimeter drains that discharge to a gravity outlet or to a sump where the discharge will be pumped out to a temporary or permanent sedimentation basin. Further evaluation will be needed to determine the pumping rate for dewatering; however, it is likely a water appropriations permit will be required.

14. **Water-related land use management district.** Does any part of the project involve a shoreland zoning district, a delineated 100-year flood plain, or a state or federally designated wild or scenic river land use district?
__Yes X No
If yes, identify the district and discuss project compatibility with district land use restrictions.

There is a 100-year floodplain along the Ash River identified on the National Flood Insurance Program Flood Insurance Rate Map (FIRM) (See Figures **4 and 5**). In addition, the Ash River is a Protected Water and has a designated shoreland area within 300 feet of its bank (Figure 7).. The shoreland zone also includes the area of the floodplain where it extends beyond the 300-foot defined shoreland area. None of the proposed facility impact footprint is within either the shoreland area or the floodplain of the Ash River.

15. **Water surface use.** Will the project change the number or type of watercraft on any water body? __Yes _X_No
If yes, indicate the current and projected watercraft usage and discuss any potential overcrowding or conflicts with other uses.

16. **Erosion and sedimentation.** Give the acreage to be graded or excavated and the cubic yards of soil to be moved: Acres: 33 acres (approximately 6 acres for the facility structure, 8 acres for temporary construction stockpiles within the project site, and 19 acres along the access road) ; Cubic Yards: Soil/Clay Stockpile - approximately 84,000 cu. yds.; Rock Stockpile - approximately 74,000 cu. yds.

    Construction of the Detector Enclosure will require excavation of 40 feet overburden and bedrock in the southernmost portion of the structure. The northernmost portion of the structure, where trucks will dock to unload materials, will be constructed approximately 10 feet below existing grade. The grade of the structure has been set to have as much of the facility underground as possible to shield it from cosmic rays, to balance materials on the site, and to have sufficient materials available to backfill around the facility structure. As currently proposed, the Detector Enclosure will have a clear height of 65 feet, measured from the depressed floor of the Detector Enclosure. The roof of the Detector Enclosure will include a cast-in-place concrete overburden to shield the detector from cosmic rays. Topsoil and rock excavated for facility construction will be stockpiled for use in backfilling the facility and for restoration of other disturbed areas of the site.

    Construction of the facility will result in disturbance of approximately 14 acres of the 89.93 acre project site, and reconstruction of the access road will result in the disturbance or approximately 19 acres. Because development of the proposed project will include clearing, grading, and excavation disturbing greater than one acre, it will be required to to comply with the General Permit to discharge storm water associated with construction activity under the NPDES as implemented by the Minnesota Pollution Control Agency (MPCA). Coverage under the General Permit will be applied for and a Stormwater Pollution Prevention Plan (SWPPP) will be prepared prior to the beginning of construction. Runoff from the site will flow to a special water (the Ash River) and ultimately to an impaired water (Lake Kabetogama), so the SWPPP will comply with the more rigorous requirements of the NPDES General Permit. The impairment category for Lake Kabetogama is listed as “mercury” in the Impaired Waters list. No project effects are anticipated on the impairment as no significant mercury based emissions will occur.

    The SWPPP will include a combination of narrative, plan sheets and standard detail sheets that address the foreseeable conditions, at any stage in the construction or post-construction activities. It will include a description of the nature of the construction activity and address the potential for discharge of sediment and/or other potential pollutants from the site.

    The SWPPP will address both temporary and permanent storm water treatment and control at the project site. Temporary sediment basins will be provided to treat runoff prior to discharge from the construction site. The basins will provide storage to contain a two-year, 24-hour storm from each acre contributing to the basin or at least 1,800 cubic feet, whichever is greater. The basin(s) will be designed with the ability to allow complete basin drawdown for maintenance and provide a stabilized emergency overflow to prevent failure of pond integrity and energy dissipation will be provided for the basin outlet. The temporary basins will be constructed and made operational concurrent with the start of soil disturbance. Where temporary sediment basins are not attainable due to site limitations (shallow depth to bedrock), equivalent sediment controls, such as smaller sediment basins, and/or sediment traps, silt fences, vegetative buffer strips or any appropriate combination of measures will be provided for all down slope boundaries of the construction area.

    Permanent storm water management facilities will be designed with a volume equivalent to at least one inch of runoff from the new impervious surfaces, in accordance with the requirements for projects discharging to special waters. Permanent treatment facilities will include wet sedimentation, infiltration/filtration, regional ponds or a combination of acceptable practices to provide treatment to a level approved by the MPCA. Where the proximity to bedrock precludes the installation of typical permanent storm water management practices, other treatment, such as grassed swales, smaller ponds, or grit chambers will be provided prior to discharge to surface waters.

    Sediment control practices will also be utilized to minimize sediment from entering the treatment facilities and ultimately downstream surface waters. Temporary stockpiles on the site will be protected by silt fence or other effective sediment controls until final stabilization is established on the site. Any site dewatering during construction will be discharged to a temporary or permanent sedimentation basin or otherwise treated such that the receiving water or downstream waters are not adversely affected. Regular inspection of the construction site will be made to ensure erosion and sedimentation controls and treatment facilities are functioning.

The SWPPP for the project site will meet necessary special requirements for discharges to Special Waters because the Ash River is a trout stream and because the Ash River discharges to Lake Kabetogama, an impaired water. The special provisions require protections to higher standards than the general permit requirements. The additional requirements include temporary erosion protection or permanent cover within shorter timeframes; temporary sediment basins for smaller contributing areas; permanent storm water management systems with additional storage volume; a 100-foot, undisturbed buffer zone maintained from the special water; runoff rates maintained at pre-construction rates for both the 1- and 2-year, 24-hour precipitation events; and storm water management system designed to minimize any increase in the temperature of trout stream receiving waters from the 1- and 2-year, 24-hour precipitation events. Because the project will discharge to a trout stream, the site design will also minimize impacts by minimizing impervious surfaces, using vegetated swales between impervious areas, use of infiltration or evapotranspiration of runoff and shading of treatment facilities.

Disturbed areas not occupied by the Detector Enclosure or other facility elements, including stockpile areas, will be restored by replacing topsoil and seeding. Trees may be planted to provide additional visual screening of the facility. Final stabilization of the site will be accomplished in accordance with the SWPPP and the requirements of the NPDES permit.

Describe any steep slopes or highly erodible soils and identify them on the site map. Describe any erosion and sedimentation control measures to be used during and after project construction.

The preliminary results of the National Resource Conservation Service (NRCS) St. Louis County Soil Survey (draft in progress) were reviewed to identify soil map units within the facility site and along the access road. The countywide soil survey is currently incomplete and the erodible soil classifications have not been revised to reflect the draft results of the field mapping, so the old Erodible Soils list was referenced and interpolated when possible. The following soils were found mapped within the facility boundary, all of which are classified as "Not Highly Erodible" under the old Erodible Soils classification system.

- Ashlake-Effie Complex, 1 to 8 percent slopes
- Baudette-Littleswan complex, 1 to 4 percent slopes
- Cutaway-Bionditch-Biwabik complex, 1 to 8 percent slopes

Only a portion of the area surrounding the access road alignment has been surveyed and mapped to date (the western third). In addition to the three map units found within the facility boundary, the following soil map units that have been surveyed were present along the proposed access road alignment. Both of these map units were classified as "Not Highly Erodible" under the old Erodible Soils classification system.

- Suomi-Ashlake complex, 1 to 8 percent slopes
- Spooner-Endoaquolls, depressional complex, 0 to 1 percent slopes

There are no steep slopes (i.e. >12%) within the facility site boundary or affected by the access road alignment.

Erosion and sedimentation control measures to be used during and after project construction will be defined during project design. The measures will be designed and implemented in accordance with the NPDES requirements and will be submitted to the MPCA for review and approval prior to the start of construction as described above.

17. **Water quality: surface water runoff**
a. Compare the quantity and quality of site runoff before and after the project. Describe permanent controls to manage or treat runoff. Describe any stormwater pollution prevention plans.

The proposed development will require a NPDES permit from the MPCA and preparation and implementation of a SWPPP as described above. Construction storm water runoff will be treated and managed in accordance with the requirements of the NPDES permit. The controls to be used to manage surface water runoff and to protect downstream water resources will be designed during final design of the proposed project. The SWPPP will be submitted to the MPCA along with the application for the NPDES as required and described above. Post

construction run-off will be treated in accordance with the requirements in the MPCA. Details on appropriate post construction storm water treatment methods will be developed during the final design phases for the access road and the facility site parking lot and for the purposes of the Land Alteration Permit that will be requested from St. Louis County. An industrial storm water permit will not be required. The SWPPP will be prepared and kept at the site during construction by the Permittee who has control of the site, as required by the General Permit.

Containment within the facility will be provided both for the scintillator oil in the detector and for the foam fire suppression system in the building. The facility design will include sufficient storage to contain 100% of the scintillator oil from the detector within the Detector Enclosure. Any scintillator fluid escaping the detector will be collected in a sump, removed, treated and disposed of properly. Similarly, the structure will accommodate containment of the foam fire suppression materials to avoid contact with outside elements or discharge from the site.

b. Identify routes and receiving water bodies for runoff from the site; include major downstream water bodies as well as the immediate receiving waters. Estimate impact runoff on the quality of receiving waters.

Topography on the site results in surface water flow to the south and to the Ash River. The Ash River flows generally east/northeast where it is joined by the Camp Ninety Creek and Gannon Creek before turning north and flowing to Kabetogama Lake. Runoff to the Ash River will be treated in accordance with the approved SWPPP prior to discharge from the site in order to protect the quality of downstream water resources.

18. **Water quality: wastewaters**

a. Describe sources, composition and quantities of all sanitary, municipal and industrial wastewater produced or treated at the site.

No municipal or industrial wastewater will be generated at the facility during construction or operation. Only normal, domestic sanitary wastewater will be discharged from the facility. The average domestic wastewater output for a workplace setting is 16 gallons per person per day. Assuming that 8 to 12 staff will use the facility during operation, daily total output is expected to be 128 to 192 gallons per day respectively. Domestic wastewater generated during construction and detector assembly will be supplemented with portable facilities and construction crews will not use the indoor facilities during construction.

b. Describe waste treatment methods or pollution prevention efforts and give estimates of composition after treatment. Identify receiving waters, including major downstream water bodies, and estimate the discharge impact on the quality of receiving waters. If the project involves on-site sewage systems, discuss the suitability of site conditions for such systems.

A holding tank will be installed to hold domestic waste output and the tank will be emptied regularly or as needed depending on the phase the project. The holding tank contents will be emptied and hauled by truck to Koochiching County Sanitary Sewer District treatment plant located in International Falls. The Sanitary Sewer District was contacted and confirmed that they can capably accept domestic waste from the facility. Sanitary material trucking services can be provided by a local source through private contracting.

c. If wastes will be discharged into a publicly owned treatment facility, identify the facility, describe any pretreatment provisions and discuss the facility's ability to handle the volume and composition of wastes, identifying any improvements necessary.

Wastewater from the holding tank will be trucked and discharged to the wastewater treatment plant in International Falls which is part of the East Koochiching Sanitary Sewer District. The holding tank contents will be emptied and hauled by truck to Koochiching County Sanitary District treatment plant located in International Falls. The Sanitary Sewer District was contacted and confirmed that they can capably accept domestic waste from the facility. Sanitary material trucking services can be provided by a local source through private contracting.

d. If the project requires disposal of liquid animal manure, describe disposal technique and location and discuss capacity to handle the volume and composition of manure. Identify any improvements necessary. Describe any required setbacks for land disposal systems.

Not applicable, no animal waste will be generated from this facility.

19. **Geologic hazards and soil conditions**

a. Approximate depth (in feet) to ground water: 2.5 feet; to bedrock: 4 to 17.8 feet.

American Engineering Testing, Inc. (AET) performed drilling at the project site. Two borings were drilled on the site in September 2005 at the locations AR-1 and AR-2 shown on **Figure 4**. The estimated surface elevations for AR-1 and AR-2 are 1,238 and 1,217 feet above mean sea level (msl) respectively. Borings AR-1 and AR-2 were completed in the vicinity of the building footprint. Rock coring was performed in both borings to depths of 60.2 feet and 57.8 feet, respectively.

Surficial soil deposits above bedrock in the area of the borings vary in thickness from 4 to 17.8 feet. The near surface, unconsolidated material is clayey in nature ranging from lean to fat clay to clayey sand. Underlying the clayey surface layer, is silty sand extending to the surface of the bedrock. Possible cobbles were noted during drilling and mottling of the soils was also indicated. Twenty-seven additional borings were completed on site by AET in October, 2006. These borings locations are also included on Figure 4. Unconsolidated deposits in these borings are also consistent with the glacial till and have sandy and gravelly deposits overlying bedrock at the proposed detector facility. Several borings taken along the proposed access road encountered peat deposits up to a depth of 11 feet over a centerline distance of 3,000 feet. Other borings drilled along the access road encountered clayey glacial till deposits near the ground surface.

Depth to bedrock was found to range from approximately four to eighteen feet below ground surface. Bedrock at the site consists of Vermillion granite massif. Joints were observed in the rock at various depths. Coloration of the rock varies with depth at each boring but generally includes pink and black with gray speckling. Four main lithologies were observed in rock cores from the site. granite, granodiorite, diorite and migmatite.

Groundwater elevations monitored at boring AR-1 were found to be approximately 2.5 feet below the surface. Groundwater elevation was measured at only at AR-1 and represents groundwater elevation only in that location. A perched groundwater interval has been documented at the overburden/bedrock interface at several site locations. This perched water unit, where it occurs, is generally less than 1 foot thick and is likely caused by seasonal runoff and rainfall events. The direction of groundwater movement likely follows the slope of the bedrock at the site from northeast to southwest.

Further investigation was completed on the groundwater condition at the site from January 2007 through May 2007. Results of the monitoring and testing indicate the distribution of water is highly variable across the detector site. The occurrence of dry wells and low quantities of water, in wells that exhibit water, suggest that a water table aquifer is not present at the site to the depths investigated, as low as elevation 1181 feet.

Packer tests were run in the field to gain an indication of the number of fractures in the rock and potential groundwater flow characteristics. The packer tests involved sealing and pressurizing a portion of the cored borehole under 30 psi of pressure. The lack of pressure drop and flow in all tests indicates the rock is not very fractured within the tested zones.

Describe any of the following geologic site hazards to ground water and also identify them on the site map: sinkholes, shallow limestone formations or karst conditions. Describe measures to avoid or minimize environmental problems due to any of these hazards.

None of these geologic site hazards to ground water are known to exist at the site.

b. Describe the soils on the site, giving NRCS (SCS) classifications, if known. Discuss soil granularity and potential for groundwater contamination from wastes or chemicals spread or spilled onto the soils. Discuss any mitigation measures to prevent such contamination.

The NRCS has not yet published a soil survey for St. Louis County. The soil characteristics identified from the site borings show that the site is covered with 6.5 to 7.5 feet of clayey soils. These soils limit the permeability at the site

and minimize potential for groundwater contamination. Further, the results of the packer tests show little fracture of the bedrock, further limiting the potential of surface water into the groundwater table. These same characteristics will also limit infiltration of surface water runoff at the site.

20. **Solid wastes, hazardous wastes, storage tanks**

a. Describe types, amounts and compositions of solid or hazardous wastes, including solid animal manure, sludge and ash, produced during construction and operation. Identify method and location of disposal. For projects generating municipal solid waste, indicate if there is a source separation plan; describe how the project will be modified for recycling. If hazardous waste is generated, indicate if there is a hazardous waste minimization plan and routine hazardous waste reduction assessments.

The proposed NOvA liquid scintillator is a generic equivalent to the commercial product sold by Bicron as BC-517P. The primary ingredient is mineral oil, a petroleum derivative, that is commercially sold as baby oil, as a food additive and as a laxative. It is chosen for its availability in large volumes, relatively low cost, optical transparency and high flash point. The second most common ingredient by weight (about 5%) is Pseudocumene [1,2,4-Trimethylbenzene], a benzene derivative. The remaining ingredients are small amounts of organic ultraviolet wavelength shifters and anti-oxidants. The liquid scintillator is not considered a hazardous material by the Minnesota Pollution Control Agency (MPCA).

A spill containment system has been designed for the tanker trailers carrying liquid scintillator. The system includes a concrete basin sized to contain the full volume from one tanker trailer and has been designed similar to the standards and techniques used in the gasoline industry. This containment system extends to include the scintillator conditioning equipment and piping.

Assuming 8 to 10 employees using the site during working hours of operation, solid waste generated during operation is anticipated to range from 2.7 to 3.5 pounds per person or 25 to 35 pounds per day for the facility (source, U.S. Environmental Protection Agency).

Any solid waste generated during construction, including collected sediment, asphalt and concrete millings, floating debris, paper, plastic, fabric, construction and demolition debris and other wastes will be collected and disposed of properly in accordance with the SWPPP and the NPDES permit. Any hazardous materials used during construction, including oil, gasoline, and paint, will be properly stored, including secondary containment, to prevent spills or leaks.

No hazardous wastes will be created during operation of the facility. Any fuel or other materials maintained at the site for backup power generation or other uses will be stored within the facility structure with proper spill containment features. Solid wastes generated at the facility will be assembled for collection by a licensed waste hauler for disposal at a licensed disposal facility. Solid wastes generated during facility operation will be limited to that typical of office waste.

At the completion of the NOvA Project, the detector and associated support systems will be removed, and the building will be returned to an empty state. The liquid scintillator will be removed by emptying the horizontal and vertical extrusion modules. The vertical extrusion modules will be emptied with an interior pump that operates like a pump at the bottom of a deep water well, and the horizontal extrusion modules will be emptied by gravity flow. Used oil will be recycled. Once drained of scintillator, the PVC components of the detector can be broken down into manageable sections.

b. Identify any toxic or hazardous materials to be used or present at the site and identify measures to be used to prevent them from contaminating groundwater. If the use of toxic or hazardous materials will lead to a regulated waste, discharge or emission, discuss any alternatives considered to minimize or eliminate the waste, discharge or emission.

Epoxy will be used during detector assembly to combine the PVC extrusions into moveable blocks. The type of epoxy will be Devcon Plastic Welder 60. It will be used and maintained, and wastes will be disposed of in accordance with manufacturer recommendations and requirements. Any other hazardous materials used during

construction, including oil, gasoline, and paint, will be properly stored, including secondary containment, to prevent spills or leaks.

Upon completion of assembly, the scintillator liquid will be pumped from the loading dock to the detector. Although not a hazardous material, the transfer of the scintillator liquid will be monitored to avoid leaks and spills. Spill containment systems will be installed beneath the tanker unloading areas. Any fuel or other materials maintained at the site for backup power generation or other uses will be stored within the facility structure with proper spill containment features.

c. Indicate the number, location, size and use of any above or below ground tanks to store petroleum products or other materials, except water. Describe any emergency response containment plans.

The facility will include six (6) 1,000 gallon propane tanks for emergency electrical generation and four (4) 1,000 gallon propane tanks for building heating. These tanks may be above or below ground, but will be constructed in accordance with applicable regulations and protections.

The current design includes extensive pressure and leak testing of the detector components during the manufacturing process. The primary containment for the scintillator is the PVC cells of the detector. The walls and floor of the Detector Enclosure and Assembly Area will provided the secondary containment. These surfaces have been designed to contain 100% of the liquid scintillator as well as the fire protection foam that would be used in the event that a full release of water occurred during a complete release of the scintillator. The surfaces will be coated with a sealant to provide a non-porous surface.

21. **Traffic.**
Parking spaces added: Parking lot is sized for 25 vehicles.

Existing spaces (if project involves expansion): None.

Estimated total average daily traffic generated: 16 – 20 trips per day during operation; up to 90 trips per day during construction.

Estimated maximum peak hour traffic generated (if known) and time of occurrence: Not Available

Provide an estimate of the impact on traffic congestion on affected roads and describe any traffic improvements necessary. If the project is within the Twin Cities metropolitan area, discuss its impact on the regional transportation system.

Access to the project site will be via Ash River Trail (County Road 129). Ash River Trail is a two-lane, paved roadway with a weight capacity of nine (9) tons (*Source: St. Louis County Road Restrictions Map, 2005*). The most recent available daily traffic volume on County Road 129 indicates an average daily traffic volume of 310 vehicles per day (VPD) (*Source: Mn/DOT Traffic Volumes and General Highway Map, 2003*).

Construction of the proposed detector enclosure and assembly building is anticipated to begin in the middle of 2008 and be completed in 2011. During construction of the proposed detector enclosure and assembly building, a maximum of 35 workers are expected to be on site each day. It is estimated that this will result in approximately 20 to 35 cars accessing the site each day, generating 40 to 70 trips per day on Ash River Trail for approximately 20 months. Assuming construction begins in June 2008, construction of the facility structure is anticipated to be complete in February 2011.

It is expected that the detector enclosure and assembly building structures will be complete within 36 months from start of construction and that assembly of the physics detector will begin at that time. Assembly of the physics detector is anticipated to take approximately 48 months and will require up to 20 people on the site each day. It is estimated that this will result in a total of 20 to 30 vehicles accessing the site each day, generating 40 to 60 trips per day on Ash River Trail. Truck traffic delivering materials for the physics detector will include approximately 450 trucks with PVC extrusion over 18 months beginning approximately June 2010 and 750 tanker trucks with

scintillator liquid over 18 months beginning approximately August 2010. This will add one to two trucks at the site each day during detector assembly and will add two to four trips on Ash River Trail each day. Detector assembly is expected to be complete by the end of December 2013.

During normal operation of the facility 8 to 10 people will be on site on a daily basis. This will generate 16 to 20 trips per day over the ten (10) year operating period. Operation of the facility is expected to begin in 2013.

According to this construction and assembly schedule and the necessary number of vehicles and trucks at the site, there will be a maximum of 40 staff and five trucks accessing the site on a daily basis. This will add a maximum of 90 trips to Ash River Trail each day during the peak of the detector assembly.

The functional average daily traffic capacity for a rural two-lane county roadway like Ash River Trail is in the range of 8,000 to 10,000 vehicles per day. It currently serves approximately 310 VPD, leaving ample capacity of utility for the additional construction and operation traffic. The project proposers plan to enhance the site access to Ash River Trail at the site entrance to further facilitate site access and to minimize conflicts with vehicle and trucks turning onto the site access road.

22. **Vehicle-related air emissions.** Estimate the effect of the project's traffic generation on air quality, including carbon monoxide levels. Discuss the effect of traffic improvements or other mitigation measures on air quality impacts. Note: If the project involves 500 or more parking spaces, consult *EAW Guidelines* about whether a detailed air quality analysis is needed.

    No traffic congestion is anticipated as a result of the additional construction or operation traffic from the proposed facility. Therefore, no decrease in air quality from vehicle-related air emissions is expected. The functional average daily traffic capacity for a rural two-lane county roadway like Ash River Trail is in the range of 8,000 to 10,000 vehicles per day (VPD). It currently serves approximately 310 VPD, leaving ample capacity of road for the additional construction and operation traffic. The additional traffic generated during construction will not significantly increase the VPD or result in congestion in this rural area.

23. **Stationary source air emissions.** Describe the type, sources, quantities and compositions of any emissions from stationary sources of air emissions such as boilers, exhaust stacks or fugitive dust sources. Include any hazardous air pollutants (consult *EAW Guidelines* for a listing) and any greenhouse gases (such as carbon dioxide, methane, nitrous oxide) and ozone-depleting chemicals (chloro-fluorocarbons, hydrofluorocarbons, perfluorocarbons or sulfur hexafluoride). Also describe any proposed pollution prevention techniques and proposed air pollution control devices. Describe the impacts on air quality.

    The assembly adhesive that will be used to assemble the modules is Devcon-60. The adhesive contains methyl methacrylate (MMA), which is a volatile organic compound (VOC) and a federal hazardous air pollutant (HAP). MMA evaporates and is emitted during adhesive application. According to the adhesive manufacturer, MMA comprises approximately 2.7% (by mass) of the product.

    The Devcon-60 adhesive will be used to assemble the individual PVC extrusion modules for the detector. A maximum of 15,624 modules can physically fit within the building. Approximate 21.5 pounds of adhesive is required for each module. Thus, the project is expected to use a maximum of 168 tons of Devcon-60. Conservatively assuming the module assembly process is completed within one year, the maximum amount of MMA vapor emitted is 4.5 tons. Minnesota requires an air permit if potential VOC emissions exceed 100 tons per year or if potential emissions of an individual HAP exceed 10 tons per year. Since MMA potential emissions will not exceed 10 tons per year, an air permit will not be required.

    Further, since the project's federal HAP emissions do not exceed 10 tons per year, the National Emission Standards for Hazardous Air Pollutant (NESHAP) for miscellaneous plastic parts coating facilities (40 CFR Part 63, Subpart PPPP) will not apply.

    Minnesota regulates air toxic emissions through its Air Emission Risk Analysis (AERA) program. Due to the relatively low emission rates and restricted timeframe of this project an AERA will likely not be required.

24. **Odors, noise and dust.** Will the project generate odors, noise or dust during construction or during operation?
_X_Yes __No
If yes, describe sources, characteristics, duration, quantities or intensity and any proposed measures to mitigate adverse impacts. Also identify locations of nearby sensitive receptors and estimate impacts on them. Discuss potential impacts on human health or quality of life. (Note: fugitive dust generated by operations may be discussed at item 23 instead of here.)

The proposed facility will not generate odors, noise or dust during operation. Normal construction activities (grading, paving, etc.) will result in dust and noise during construction activities, along with the potential for minor increases of odor. This will be limited to the construction of the Detector Enclosure and Service Building during the first 24 months of construction. All of the impervious surfaces will be non-graveled surfaces reducing the potential for dust. Assembly of the physics detector will be performed within the enclosure and will not result in odors or dust. Some noise will result from operation of equipment used for the detector assembly.

The proposed facility structure is to be founded at an approximate elevation of 1,183 feet. This will require removal of 25 to 40 feet of granitic bedrock by blasting with explosives. Noise and vibration will occur as a result of blasting. The amount of vibration and noise resulting from blasting operations is dependent on the amount of explosive charge and the sequence of the blasting. The project site is relatively remote, greater than one mile from any inhabited dwellings or structures, so the effect to people is not expected to be significant. No structures, other than a few small hunting cabins, exist within one mile of the site, so damage to existing structures is not likely.

Noise will also result from drilling holes in the bedrock for the placement of explosive charges. An air rotary drill will likely perform this work. Both drilling and blasting are temporary effects that will occur only during construction of the facility. Drilling and blasting will likely occur over a two- to four-month period.

Blasting of bedrock will occur during weekdays at the beginning of construction to allow the facility to reside below the existing surface (approximately 25 – 65 feet depending on the terrain). Dust is anticipated with blasting, but there are no sensitive receptors in the surrounding area. Noise and vibrations will occur due to the blasting and from drilling holes in the bedrock for the placement of explosive charges. Both drilling and blasting are temporary effects that will occur only during an approximately two- to four-month period during construction of the facility. Since the proposed site is considered remote, greater than one-mile from any inhabited dwellings or structures, other than a few small hunting cabins, the effect to people or structures is not likely.

Adjacent properties are not expected to be impacted by noise, dust or odors during the construction phase of the project. Dust generated by construction equipment will be mitigated by spray watering areas that are dry and contributing to dust. Dust will also be mitigated by minimizing the area of active disturbance and by restoring disturbed areas as soon as possible after completion of construction. Noise impacts will be mitigated by limiting the time of construction activities between 7:00am to 7:00pm. All impacts to noise, dust and odors will be temporary in nature. Levels will return to existing levels upon completion of project construction.

25. **Nearby resources.** Are any of the following resources on or in proximity to the site?
Archaeological, historical or architectural resources? _X_ Yes ___ No
Prime or unique farmlands or land within an agricultural preserve? ___Yes _X_ No
Designated parks, recreation areas or trails? _X_ Yes ___No
Scenic views and vistas? __Yes _X_ No
Other unique resources? __Yes _X_ No

If yes, describe the resource and identify any project-related impacts on the resource. Describe any measures to minimize or avoid adverse impacts.

Archaeological, Historical and Architectural Resources: The 106 Group Ltd. conducted a Cultural Resources Assessment in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended. The assessment found that no architectural history surveys have been conducted and no properties have been inventoried within the project area. It also shows that no archaeological sites have been recorded or reported within the Project Area, but one site has been recorded (confirmed) and three sites have been reported (not field checked) within one mile of the Project Area. These four sites include three logging camps and a railroad trestle.

No previously recorded precontact archaeological sites are located within a one-mile radius of the study area. The project site is considered to have a low potential for containing contact period sites and post-contact archaeological sites, due to areas of topographic depression and the presence of exposed bedrock. The only area within the site that possesses a high archaeological potential is the southern portion of the site within 150 meters of the Ash River, due to elevated terraces overlooking the river.

The project area and the surrounding region have been used for commercial logging for over 100 years and stands of forest continue to be harvested. The study identified an abandoned railroad grade that may retain sufficient integrity to convey potential significance as an early logging road. This section of railroad passing through the western portion of the project area is identified as a "Winter Road" and is shown on Figure 2. The road extends south until it reaches the Ash River. The western portion of the existing access road to the project site originated as this "Winter Road", which was later used as the basis for the rail line that was likely a spur extending from the VRL Railway which had a network of rail lines in northern St. Louis and Koochiching counties.

This railroad grade would likely be considered for eligibility for the National Register for Historic Places (NRHP), either under Criterion A, for the broad patterns of history related to timber procurement, or under Criterion C, if the grade represents a significant designed system or if the surviving features demonstrate design attributes that help explain how the various components work. Portions of the rail grade have been converted to a lightly traveled gravel road, which has been widened to accommodate local traffic. The road still conveys a strong sense of the direction within an appropriate setting. That portion of the rail grade extending southerly from the road, leading outside of the project area, also has a strong sense of place and direction, while the remnants of the trestle (also outside the project area) further contribute to the material integrity of the line.

The facility footprint is approximately 1,180 feet from the Ash River, well beyond the maximum threshold distance (492 feet or 150 meters) of the river corridor where there is a high potential for containing pre-contact sites. Since the facility is beyond this threshold distance, no additional archaeological testing is necessary and no impacts to significant archaeological sites are anticipated. No project effects to areas of "High Archaeological Potential" are anticipated to occur.

Prime or Unique Farmlands: The Natural Resources Conservation Service (NRCS) was contacted to request preliminary soil survey data that is currently being assembled for St. Louis County. The NRCS web site was then referenced to see if any of the draft soil map units meet the criteria for Prime or Unique as listed on the digitally available Prime or other Unique Farmlands List for St. Louis County (2005). None of the following soil map units that occur within the facility site boundary are classified as Prime, Unique or Soils of Statewide Importance according to the draft survey data and Farmlands List:

- Ashlake-Effie Complex, 1 to 8 percent slopes
- Baudette-Littleswan complex, 1 to 4 percent slopes
- Cutaway-Bionditch-Biwabik complex, 1 to 8 percent slopes

In addition to the three soil map units found within the facility site boundary, the following soil map units that have been mapped to date are within the proposed access road alignment.

- Suomi-Ashlake complex, 1 to 8 percent slopes
- Spooner-Endoaquolls, depressional complex, 0 to 1 percent slopes

The Suomi-Ashlake complex, 1 to 8 percent slopes is recognized as a "Farmland of Statewide Importance" which the NRCS defines as land that does not fully meet the Prime or Unique criteria, but could be economically viable farmland if managed and treated under acceptable farming standards. No Prime or Unique farmland soils are shown within or adjacent to the access road alignment.

Designated Parks, Recreation Areas or Trails: The project site is approximately one mile southeast of the nearest boundary of Voyageurs National Park. This boundary is located on the north side of County Road (CR) 129 approximately one mile northwest of the proposed project access road intersection with CR 129.

The proposed project site is within a parcel of the MNDNR owned and managed Kabetogoma State Forest. These parcels are managed for timber production and are leased for timber removal. They are also open for public use including hunting and recreation. The State Forest parcels are scattered across a wide area of St Louis and Itasca Counties and occupy approximately half of the land ownership in this region. The University of Minnesota and MNDNR are negotiating a land transfer to accommodate development of the facility and access road.

Within State Forest parcels, the Ash River Falls Ski Trails have been developed through a cooperative agreement with the National Park Service and MNDNR. This network of ski trails occurs near where CR 129 intersects with the proposed access road. The existing access road crosses once through a segment of the trail where the proposed access road will follow this segment of the existing access road and cross the trail at the same location. Minimal to no impact to this ski trail network is anticipated as a result of the access road construction and full use of the trail network is expected to continue uninterrupted.

26. **Visual impacts.** Will the project create adverse visual impacts during construction or operation? Such as glare from intense lights, lights visible in wilderness areas and large visible plumes from cooling towers or exhaust stacks?
__Yes _X_ No

Through the public involvement process, the University of Minnesota worked closely with the National Park Service (NPS) to minimize visual and light pollution impacts. The NPS advised on the site selection, preliminary design and provided best management practices to minimize effects. The selection of the Ash River site as a preferred alternative was strongly based on the outcomes of the NPS input and participation.

The project is not expected to create adverse visual impacts during construction or upon completion of the project. There will be no glare from intense lights. The only external lighting at the facility will be at access doors and in parking areas for safety and security. These lights will be directed downward and will be limited in number.

The detector facility will be constructed into an existing hill on the site. The elevation of the existing hill into which the structure will be constructed is approximately 1,240 feet. The proposed structure will be constructed approximately 64 feet within the hill (to elevation 1,176) leaving approximately 31 feet clear at the northern end of the structure. The topography of the hill falls to the south which will result in more of the structure above the existing surface toward the southern end of the structure. The two-story loading dock at the northern end of the facility will be above ground and visible.

Although the structure will extend above the existing grade, the earthen backfill will help it blend into the surrounding area. The undulating topography and the prominent siting of the facility on the hill both extend and limit the visibility of the development. When viewed from the opposite hillside to the south, the facility location on the hillside and the location of the Detector Enclosure make it visible. Views from the north, east, and west, including views from Voyageur's National Park, are not impacted because of the rolling topography and the wooded vegetation.

27. **Compatibility with plans and land use regulations.** Is the project subject to an adopted local comprehensive plan, land use plan or regulation, or other applicable land use, water, or resource management plan of a local, regional, state or federal agency?
_X_Yes __No. If yes, describe the plan, discuss its compatibility with the project and explain how any conflicts will be resolved. If no, explain.

Under the provisions of Title 16, United States Code (USC), Section 3 and Title 36, Code of Federal Regulations (CFR), Chapter 1, Parts 1 – 7, Superintendent's Orders were developed to implement land use and planning policies for the Voyageurs National Park of the National Park Service, U.S. Department of Interior. These policies are such that they only apply to land uses and acreage located within the Park boundaries and do not have implications on the project site.

The MNDNR Division of Forestry is currently converting its regional based forest resource management plans to plans that are based and defined by Ecological Subsections in the MNDNR Ecological Classification System. These Plans address forest management and timber production objectives for lands within state forest lands. The nature and scope of the Plans are such that they are anticipated to be compatible with the project. Upon completion of the

MNDNR transfer of the project parcel to the University of Minnesota, the project area will no longer be a state forest land holding, will be removed from timber production and no longer subject to the Plan.

Under the St. Louis County Comprehensive Plan, a Voyageur Planning Area (VPA) sub-plan was adopted in 1982 with subsequently adopted amendments. The VPA plan provisions that have relevant implications on the project include the following:

- Goals that encourage the development and expansion of major industry while maintaining the rural character and property rights of individuals, while not having major adverse impacts on the environment.
- Policies that encourage development designs that minimize environmental impacts and effects on floodways, soil and rock formations, wetlands, erosion, slopes, and water supply and sanitary system capabilities.
- Developments that can adequately handle anticipated traffic needs, sanitary waste disposal, and minimize noise, odor, dust, and light pollution.
- The establishment of local planning committees in Unorganized Towns are encouraged to review plans and applications.

Concept 8 in the VPA addresses industrial uses and best fits this project, compared to Concept 7 on commercial uses. Concept 8 defines and separates heavy industries that require an industrial zone district from light industries not needing such classification. The unique character of this project and low amount of environmental and social effects anticipated are such that this project meets the light industry criteria. Heavy industries in the traditional sense likely include pulp and paper mills, refineries, and industries that have the potential to discharge waste.

The majority of the VPA addresses natural resources, residential lot and density criteria, shoreland management, and timber production, all common land uses in this region of St. Louis County. A relatively limited number of the provisions in the VPA are relevant and applicable to this project and most of these provisions are general. To date, a planning committee has not been established to review the plans and applications for the project, and it is not known if one will be. This may not be practicable due to the rural, low population density and character of the project area and the proximity to the National Park. The project is such that it is anticipated to be compatible with the goals and policies in the Voyageurs Planning Area sub-plan of the Comprehensive Plan for St. Louis County.

In summary the following plans were identified in the project area:

- The Superintendents Orders for the Voyageurs National Park – U.S. Department of Interior
- The Minnesota Department of Natural Resources Forestry Division Forest Resource Management Plan (currently under revision)
- The Voyageurs Planning Area sub-plan of the Comprehensive Plan for St. Louis County

Of these three plans, the project is only subject to the Voyageurs Planning Area sub-plan of the Comprehensive Plan for St. Louis County.

28. **Impact on infrastructure and public services.** Will new or expanded utilities, roads, other infrastructure or public services be required to serve the project? _X_Yes __No. If yes, describe the new or additional infrastructure or services needed. (Note: any infrastructure that is a connected action with respect to the project must be assessed in the EAW; see *EAW Guidelines* for details.)

    Power and fiber optic service for the facility will be provided from existing services along Ash River Trail. These utilities will be extended to the facility site by buried service installed during construction of the access road. No improvements to the existing fiber optic service are anticipated. Improvements to the existing power transmission service serving the site will be required. The existing electrical service will be upgraded to accommodate the facility. This will include replacement of the transformer at the Kabetogama substation as well as related service upgrades along the existing line. No new or additional transmission lines will be constructed. The proposed upgrades will all be accommodated on existing transmission facilities. As the service reaches the west end of the site access road, it will be routed as an underground line along the access road alignment for the remaining distance to the project site.

Access to the facility site will be provided by a new access road constructed by the developers. No improvements to public roads are required. An enhanced entrance from eastbound Ash River Trail into the project site will be constructed by the developer to most safely and effectively accommodate traffic turning into the project site.

29. **Cumulative impacts.** Minnesota Rule part 4410.1700, subpart 7, item B requires that the RGU consider the "cumulative potential effects of related or anticipated future projects" when determining the need for an environmental impact statement. Identify any past, present or reasonably foreseeable future projects that may interact with the project described in this EAW in such a way as to cause cumulative impacts. Describe the nature of the cumulative impacts and summarize any other available information relevant to determining whether there is potential for significant environmental effects due to cumulative impacts *(or discuss each cumulative impact under appropriate item(s) elsewhere on this form).*

    The proposer anticipates no future phases of development nor is any other developments proposed by others foreseeable in the area of the proposed project; therefore no long term cumulative impacts are anticipated. If new actions are proposed in the area after construction of the project, those actions can include this project in their cumulative effects analysis. To date, this project is the only reasonable and foreseeable action (funded and implemented project, not speculative or unfunded) in the surrounding area. Logging is not considered as a reasonable and foreseeable action as it has been occurring in the area for over a hundred years and will continue indefinitely and is a renewable, managed resource verses a permanent conversion to another land use.

30. **Other potential environmental impacts.** If the project may cause any adverse environmental impacts not addressed by items 1 to 28, identify and discuss them here, along with any proposed mitigation.

    No other adverse environmental impacts are anticipated as a result of the proposed project.

31. **Summary of issues.** *Do not complete this section if the EAW is being done for EIS scoping; instead, address relevant issues in the draft Scoping Decision document, which must accompany the EAW.* List any impacts and issues identified above that may require further investigation before the project is begun. Discuss any alternatives or mitigative measures that have been or may be considered for these impacts and issues, including those that have been or may be ordered as permit conditions.

    Storm water treatment and management: The proposed project will create new impervious surface by improvement and paving of the site access road and by construction of the proposed facility and parking area. Storm water runoff will be treated and managed in accordance with the requirements of the NPDES permit and the Storm Water Pollution Prevention Plan (SWPPP).

    Erosion and sedimentation protection: Construction of the facility will result in disturbance of approximately 33 acres of the site, including the facility structure, site stockpiles and the access road improvements. Because development of the proposed project will include clearing, grading and excavation disturbing greater than five acres, it will comply with the General Permit to discharge storm water associated with construction activity under National Pollutant Discharge Elimination System (NPDES) as implemented by the Minnesota Pollution Control Agency (MPCA). An NPDES permit will be applied for, and will include development and a plan for implementation of a Storm Water Pollution Prevention Plan (SWPPP) prior to beginning construction. Runoff from the site will flow to a special water (the Ash River) and ultimately to an impaired water (Lake Kabetogama), so the SWPPP will be submitted to the MPCA for review and approval at least 30 days before the start of construction.

    The SWPPP will address both temporary and permanent storm water treatment and control at the project site. Erosion and sediment control at the site will include both temporary and permanent sediment basins to treat runoff prior to discharge from the site. Where the proximity to bedrock precludes the installation of typical permanent storm water management practices, other treatment, such as grassed swales, smaller ponds, or grit chambers will be provided prior to discharge to surface waters.

    Disturbed areas not occupied by the Detector Enclosure or other facility elements, including stockpile areas, will be restored by replacing topsoil and seeding. Trees may be planted to provide additional visual screening of the facility. Final stabilization of the site will be accomplished in accordance with the SWPPP and the requirements of the NPDES permit.

Wetlands impacts and mitigation: There are no wetlands or streams located within the impact or construction footprint of the facility site and construction of the Detector Enclosure, and the associated parking facilities will not result in direct impacts to wetland habitat. Construction of the access road will result in filling of wetlands along the western segment of the roadway where the existing logging road bisects existing wetlands. Improvement of the roadway will result in filling approximately two and half (2.5) acres of wetland. The wetland impacts will require permits from the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act and from St. Louis County under the requirements of the Wetland Conservation Act of Minnesota. Both the federal and state wetland regulations require consideration of measures to avoid and minimize impacts to wetlands and will require mitigation of unavoidable impacts by replacement at a minimum ratio of one acre for each acre filled. Sequencing (avoidance and minimization) and mitigation opportunities will be evaluated during project design and discussed with regulatory staff during project permitting.

Dewatering: At a minimum, dewatering of perched groundwater will be required during construction. If groundwater is determined to exist within the bedrock, permanent dewatering will be needed for the structure. Any site dewatering during construction will require a permit. The dewatering will be discharged to a temporary or permanent sedimentation basin or otherwise treated such that the receiving water or downstream waters are not adversely affected.

RGU CERTIFICATION. The Environmental Quality Board will only accept **SIGNED** Environmental Assessment Worksheets for public notice in the EQB Monitor.

I hereby certify that:

The information contained in this document is accurate and complete to the best of my knowledge.
The EAW describes the complete project; there are no other projects, stages or components other than those described in this document, which are related to the project as connected actions or phased actions, as defined at Minnesota Rules, parts 4410.0200, subparts 9b and 60, respectively.
Copies of this EAW are being sent to the entire EQB distribution list.

Signature Kathleen O'Brien Date 8/28/07

Title Vice President, University Services

Environmental Assessment Worksheet was prepared by the staff of the Environmental Quality Board at the Administration Department. For additional information, worksheets or for *EAW Guidelines*, contact: Environmental Quality Board, 658 Cedar St., St. Paul, MN 55155, 651-296-8253, or http://www.eqb.state.mn.us

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Figures

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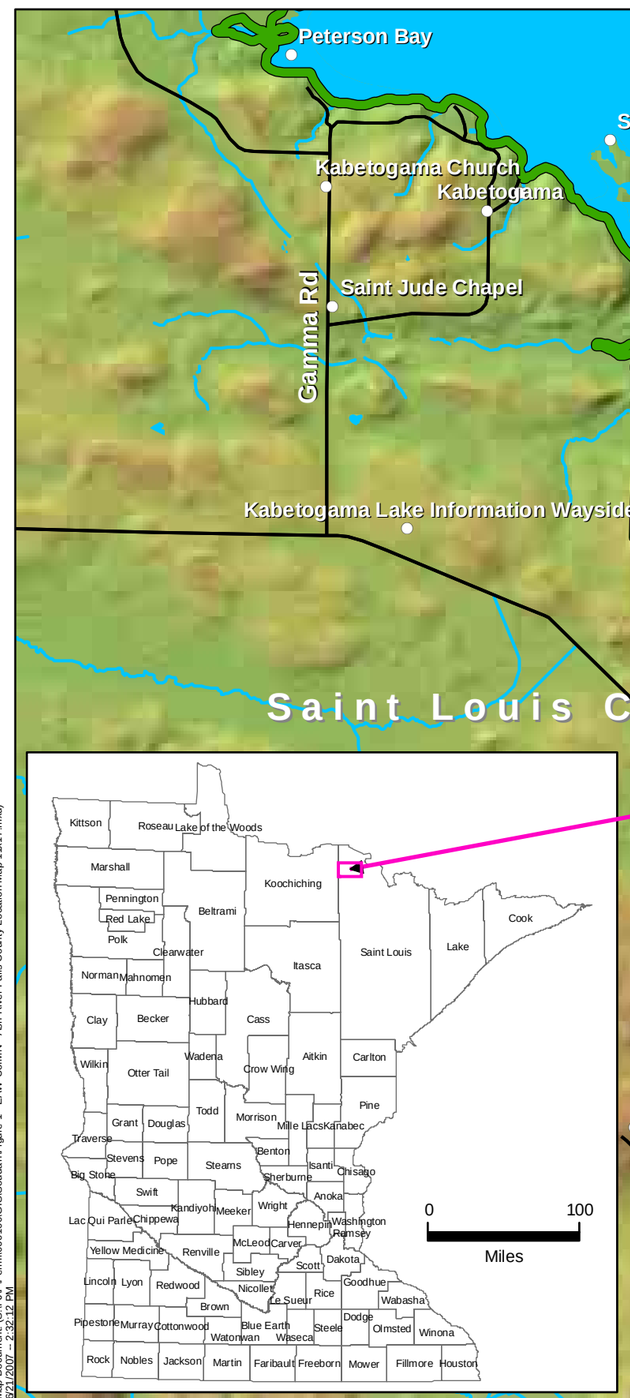
Peterson Bay
Lake Kabetogama
Stagies Point
Kabetogama Church
Kabetogama
Gamma Rd
Saint Jude Chapel
Duck Bay
Voyageurs National Park
Irwin Bay
Bowman Bay
Nebraska Bay
Mud Bay
Daley Bay
Long Slough
Kohler Bay
Indian Point
Tar Point
Lost Lake
Indian Cemetery
Blind Indian Narrows
Blind Ash Bay
Old Dutch Bay
Moose Bay
Sullivan Bay
Moose River
Ash River
Kabetogama Lake Information Wayside
Daley Brook
Ash River Campground
Ash River Lookout Tower
Ash River Tr
Saint Louis County
Gannon Creek
Camp Ninty Creek
Ash River Falls
Access Road
Facility Site Boundary
Off Axis Beam Line
Kabetogama Lookout Tower
Leslie Rd
US Hwy 53
Our Lady Of Fatima Church
Black Duck River



Map Document: (S:\PJ\F\Fermi\060100GIS\Soudan\Figure 1 - EAW UofMN - Ash River Falls County Location Map 11x17.mxd)
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SEH
3535 VADNAIS CENTER DR.
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www.sehinc.com

Project Number
AFERMI0601.00

June 2007

Legend

- Facility Site Boundary
- Proposed Bright Star Road (Along Existing Logging Road)
- Off Axis Beam Line
- Existing Roads
- Geographic Names
- National Park Boundary
- County Boundaries
- Hydrography
- Lakes

Fermilab
Off-Axis Detector
Ash River Falls

Figure 1
Location Map

Projection:
UTM, Zone 15, Meters
NAD83

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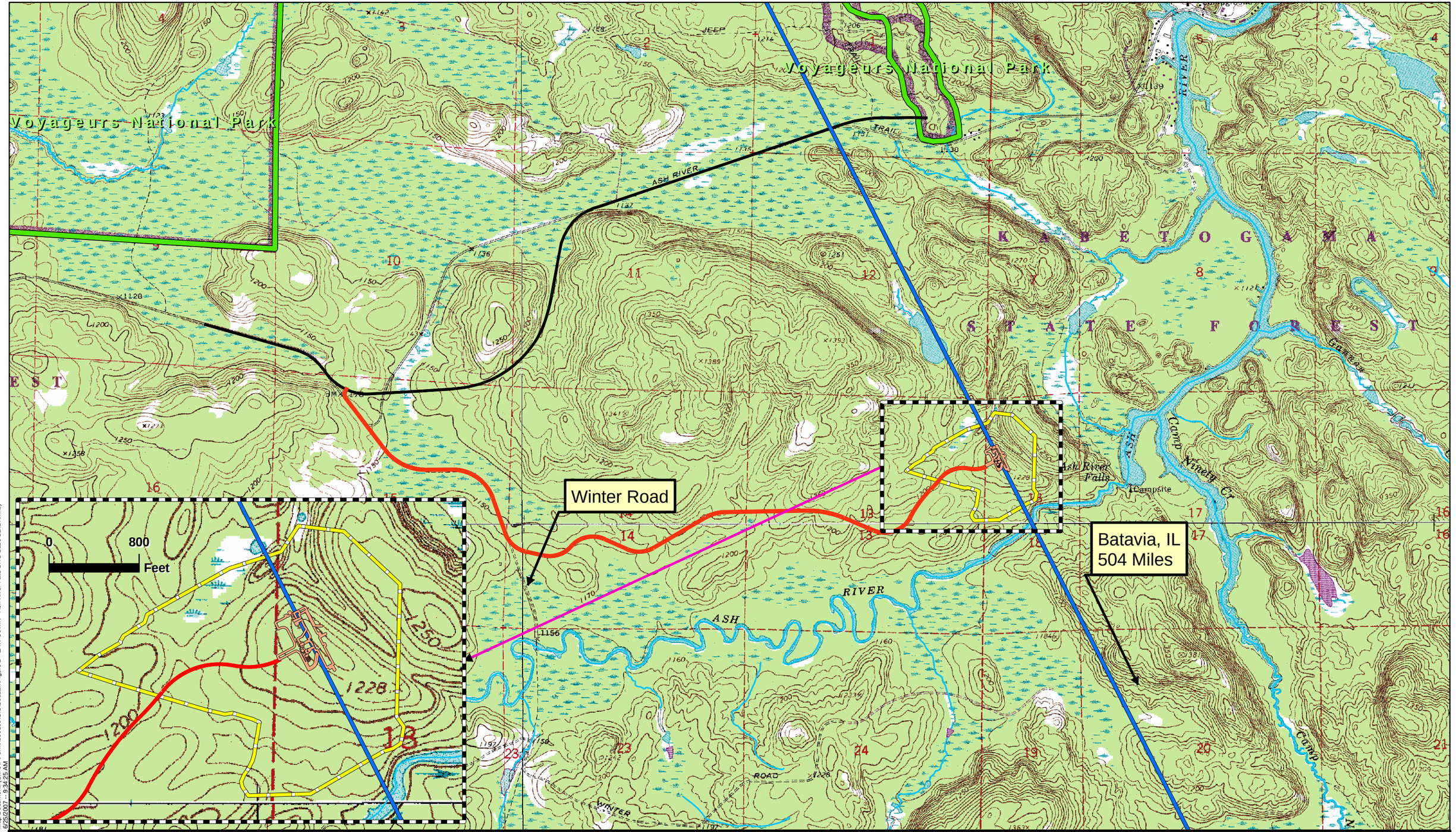

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Project Number
AFERMI0601.00

June 2007

Legend

- Facility Site Boundary
- Facility Layout 06-2007
- Proposed Bright Star Road (Along Existing Logging Road)
- Off Axis Beam Line
- Ash River Trail
- National Park Boundary
- Hydrography

Fermilab
Off-Axis Detector
Ash River Falls

Figure 2
Project Site
7.5 Minute Topo

Projection:
UTM, Zone 15, Meters
NAD83

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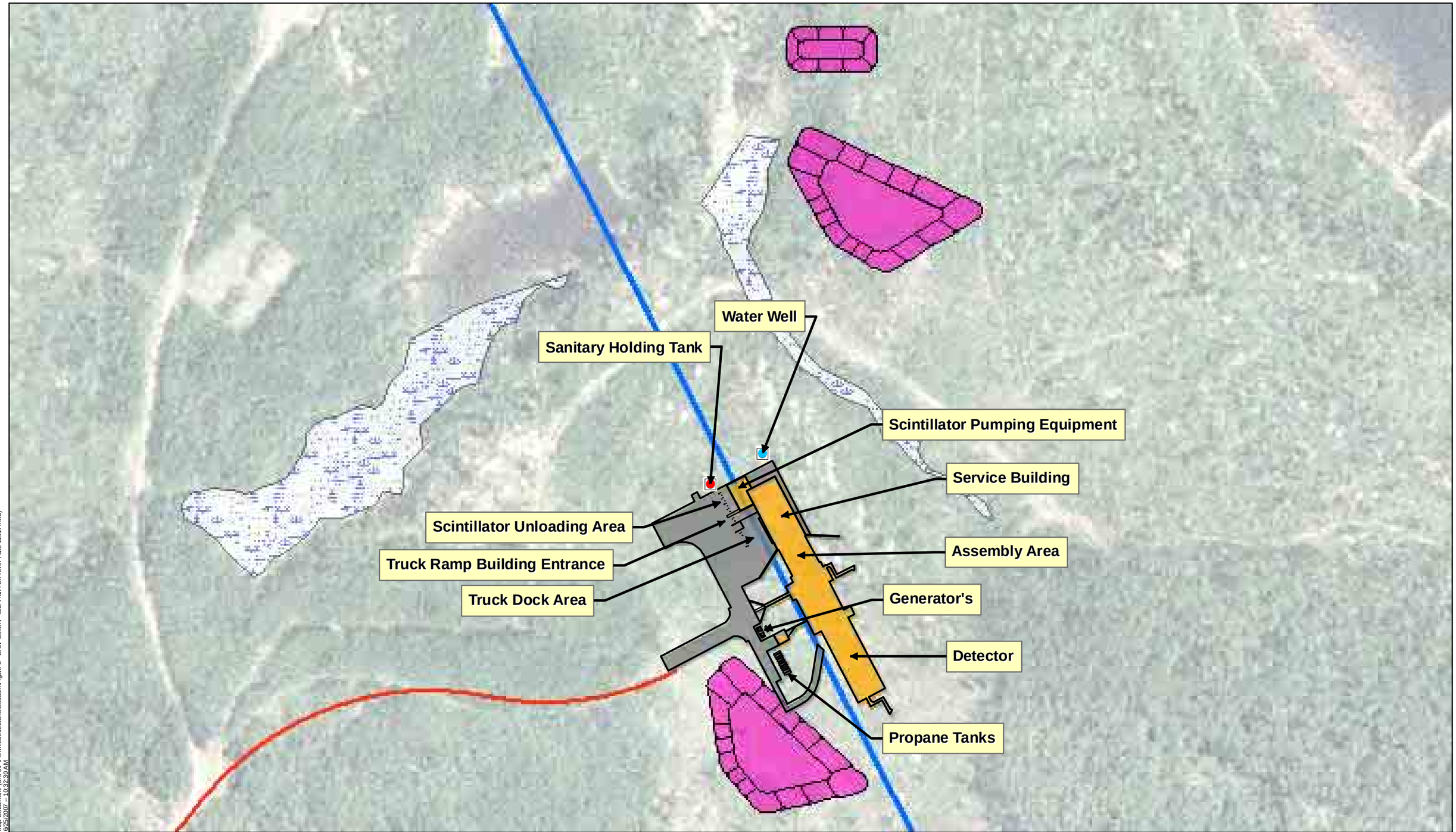
0 2,000 Feet



Map Document: (S:\F\J\FFermi\060100\GIS\Soudan\Figure 3 - EAW UofMN - Site Plan Ash River Falls 11x17.mxd)
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Project Number
AFERMI0601.00

June 2007

Legend

Facility Features 06-2007

- Building
- Parking Lot
- Miscellaneous
- Temporary Stockpiles
- Water Well
- Sanitary Holding Tank
- Proposed Bright Star Road (Along Existing Logging Road)
- Off Axis Beam Line
- Wetlands-Surveyed

Source: USDA-FSA 2003 DOQQs, Fermilab, and SEH.

Fermilab
Off-Axis Detector
Ash River Falls

Figure 3
Facility Site Plan

Projection:
UTM, Zone 15, Meters
NAD83

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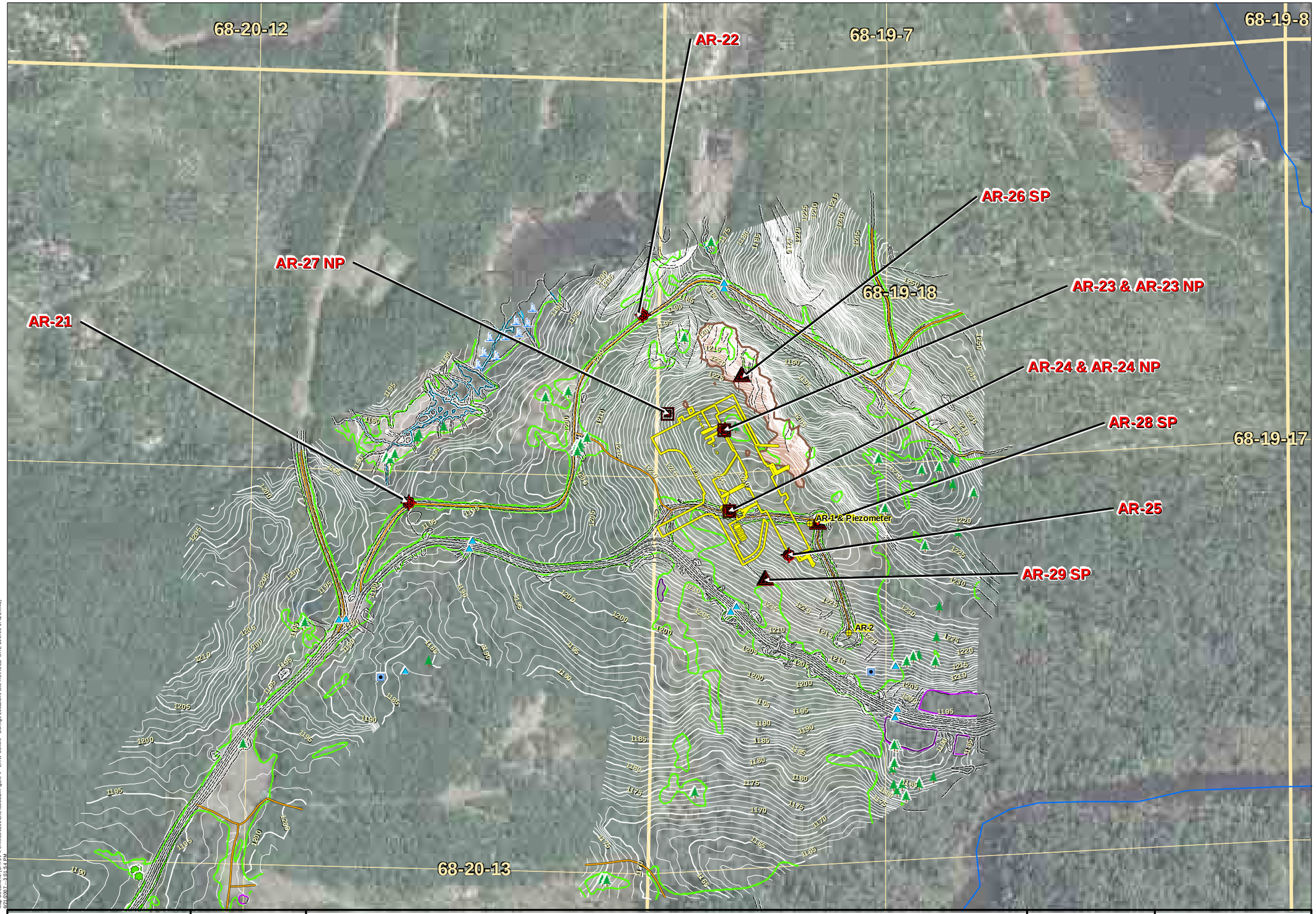
Feet



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Project Number
AFERMI0604.00

June 2007

Legend

- Facility Layout 06-2007
- Boring ID (2005)
- Boring ID (2006)
- Nested Piezometers (2006)
- Shallow Piezometers (2006)
- Surveyed - Bedrock Outcrops

Geodatabase Survey Points

- BUSH
- CULV
- POST
- PP - CULVERT-23 & MISC3-56
- SIGN
- SWAMP
- TREE

Geodatabase Survey Lines

- BRUSHLINE-41
- FLOWLINE-44
- FLOWLINE2-46
- PILE-31
- C-BREAKLINES-38
- ROAD1-34
- ROAD2-36
- ROAD3-26
- ROAD4-61
- SIGN-18
- TREES-40
- Hydrography
- PLS 40's
- PLS Sections

Source: USDA-FSA 2003 DOQQs, MNDNR, MnDOT, Fermilab, AET, UofMN, and SEH.

Fermilab - Project NOvA

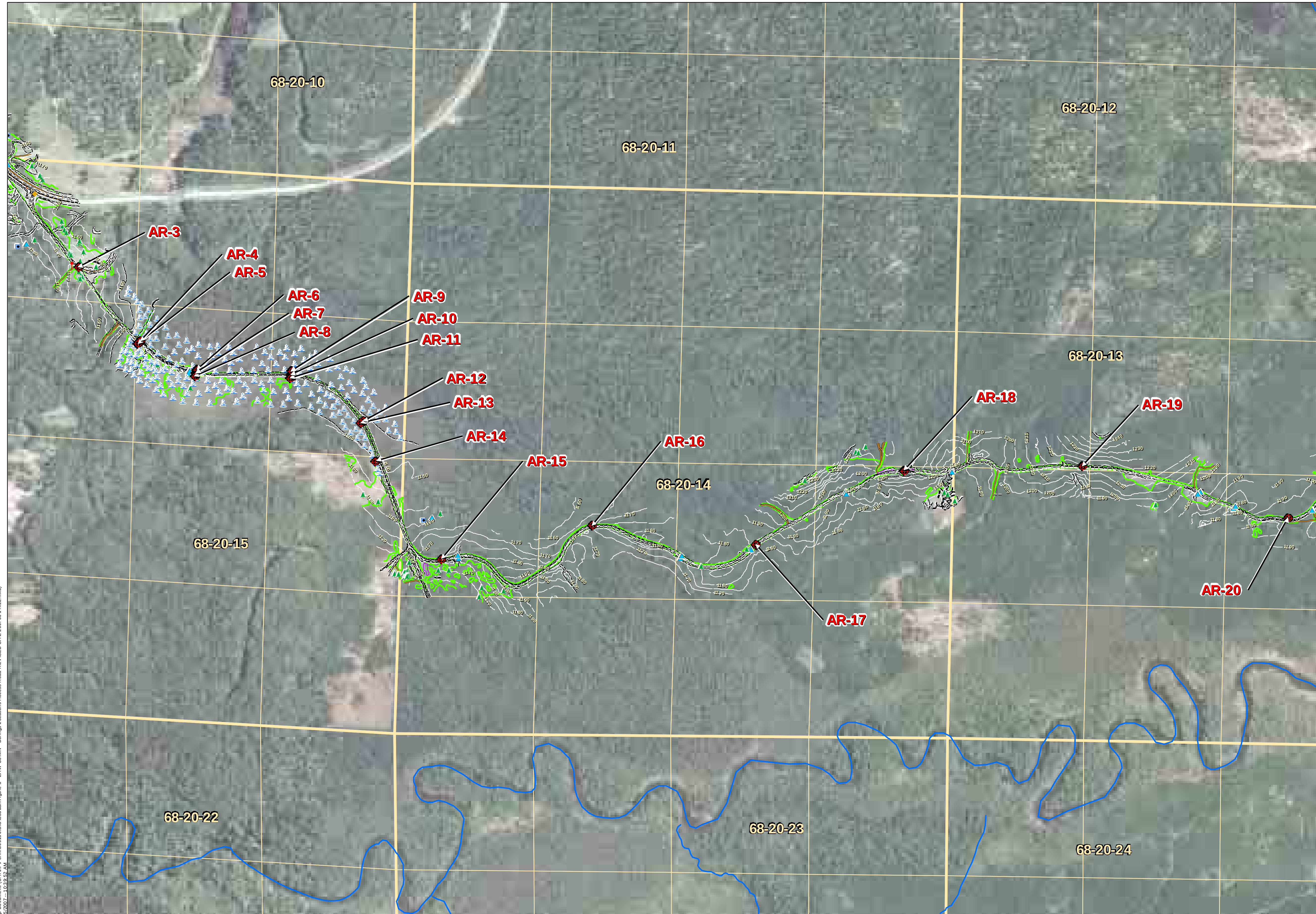
Off-Axis Detector
Ash River Trail

FIGURE 4
Site Facility
Boring Locations

Projection:
UTM, Zone 15, Meters
NAD83

N W E S

0 200 Feet



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Project Number
AFERMI0604.00

June 2007

Legend

- Facility Layout 06-2007
- Boring ID (2005)
- Boring ID (2006)
- Nested Piezometers (2006)
- Shallow Piezometers (2006)

Geodatabase Survey Points

- BUSH
- CULV
- POST
- PP - CULVERT-23 & MISC3-56
- SIGN
- SWAMP
- TREE

Geodatabase Survey Lines

- BRUSHLINE-41
- FLOWLINE-44
- FLOWLINE2-46
- PILE-31
- C-BREAKLINES-38
- ROAD1-34
- ROAD2-36
- ROAD3-26
- ROAD4-61
- SIGN-18
- TREES-40
- Hydrography
- PLS 40's
- PLS Sections

Source: USDA-FSA 2003 DOQQs, MNDNR, MnDOT, Fermilab, AET, UofMN, and SEH.

Fermilab - Project NOvA

Off-Axis Detector
Ash River Trail

FIGURE 5

Access Road
Boring Locations

Projection:
UTM, Zone 15, Meters
NAD83

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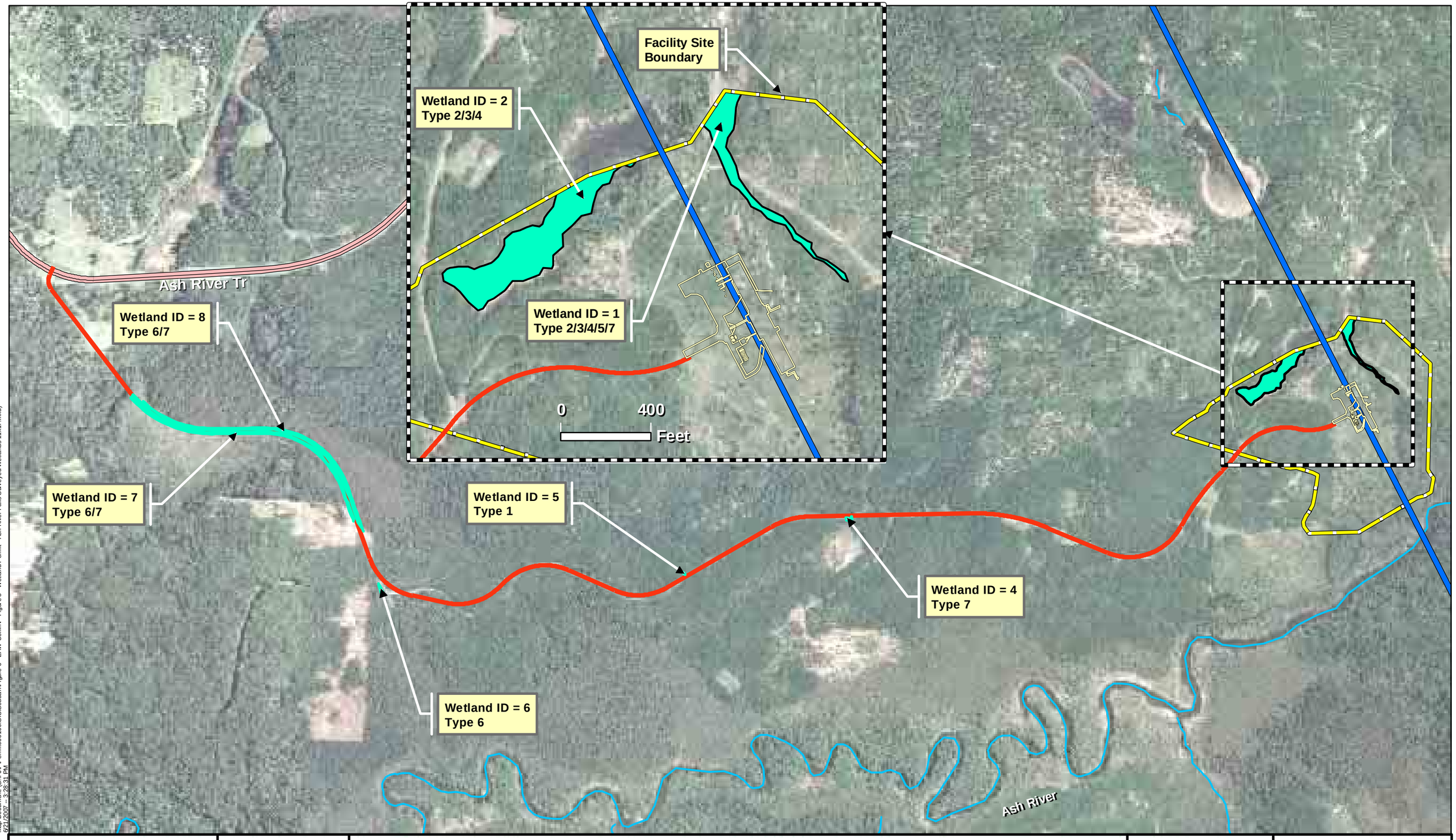
0 600 Feet



Map Document: (S:\FJF\Fermi\060100GIS\Soudan\Figure 6 - EAW UofMN - Figure 5 - Wetland Permit - Ash River Falls Surveyed Wetlands 11x17.mxd)
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Project Number
AFERMI0601.00

June 2007

Legend

- Facility Layout 06-2007
- Off Axis Beam Line
- Proposed Bright Star Road (Along Existing Logging Road)
- Facility Site Boundary
- Ash River Trail
- National Park Boundary
- Surveyed Wetlands along Proposed Road
- Surveyed Wetlands within Site Boundary
- Hydrography

Fermilab
Off-Axis Detector
Ash River Falls

Figure 6
Wetland Delineation Results

Projection:
UTM, Zone 15, Meters
NAD83

N
W E
S

0 1,000 Feet

Voyageurs National Park

Ash River Tr

Unnamed (69-1280 P)

Facility Site Boundary

0 700 Feet

Ash River

Ash River

Map Document: (S:\FJ\F\Fermi\060100\GIS\Soudan\Figure 7 - EAW UofMN - Figure 4 - Wetland Permit - Ash River Falls NWI 11x17.mxd)
6/21/2007 -- 3:26:12 PM

SEH

3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110
PHONE: (651) 490-2000
FAX: (651) 490-2150
WATTS: 800-325-2055
www.sehinc.com

Project Number
AFERMI0601.00

June 2007

Legend

- Facility Layout 06-2007
- Off Axis Beam Line
- Proposed Bright Star Road (Along Existing Logging Road)
- Facility Site Boundary
- Ash River Trail
- National Park Boundary

Public Waters Inventory (PWI)

- PWI Lake
- PWI Wetland

Trout stream or tributary according to Minnesota Rules 6264. Designation is defined on the basis of PLS sections.

- Designated trout stream
- Designated trout stream tributary

Streams - Protected Waters Inventory (PWI)

- Watercourse not indicated on PWI Maps
- Protected watercourse on PWI; indicated on PWI Maps
- Protected Public Ditch; indicated on PWI Maps

Source: USDA-FSA 2003 DOQQs, USGS, MNDNR, Mn/DOT, Fermilab, and SEH.

Fermilab
Off-Axis Detector
Ash River Falls

Figure 7
PWI Map

Projection:
UTM, Zone 15, Meters
NAD83

N W E S

0 2,000 Feet

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Appendix A

Project Drawings

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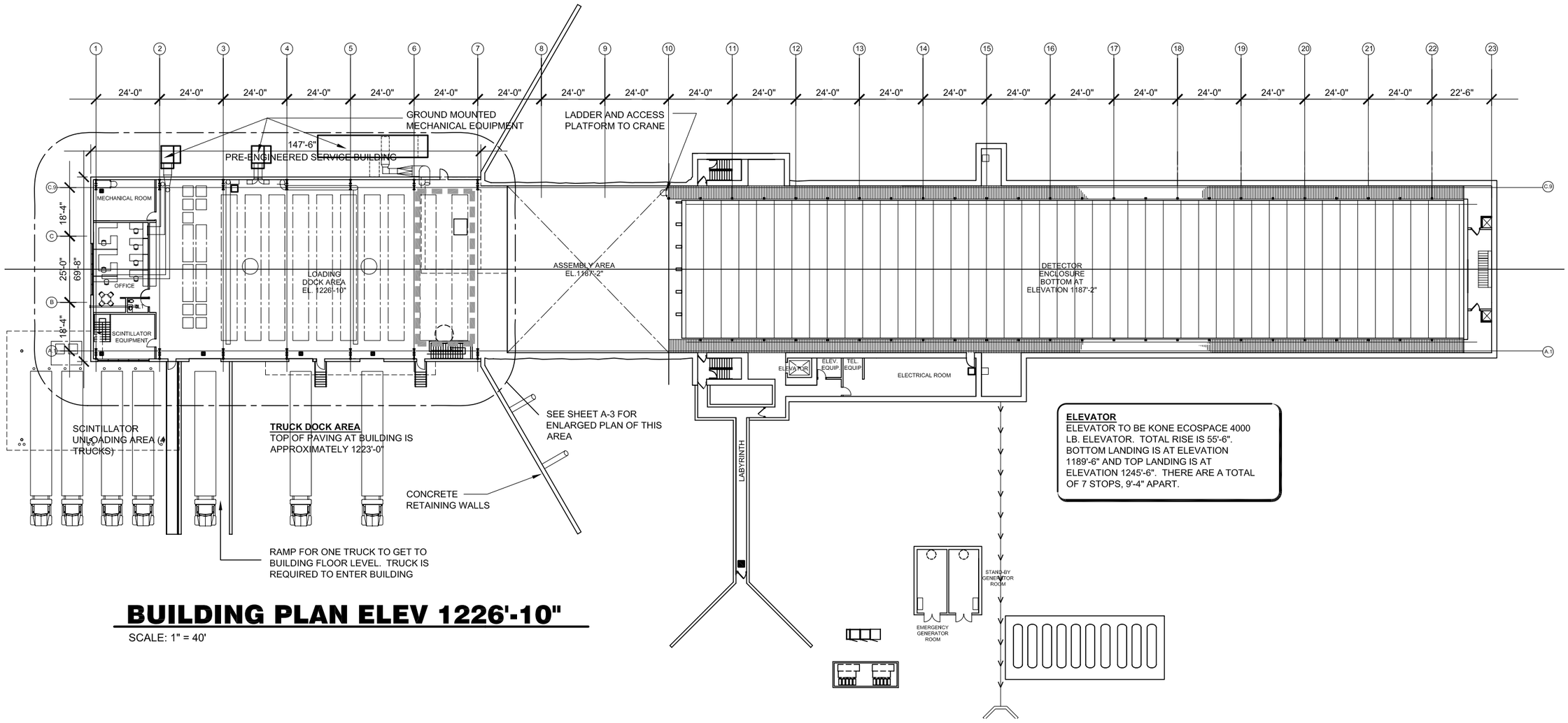
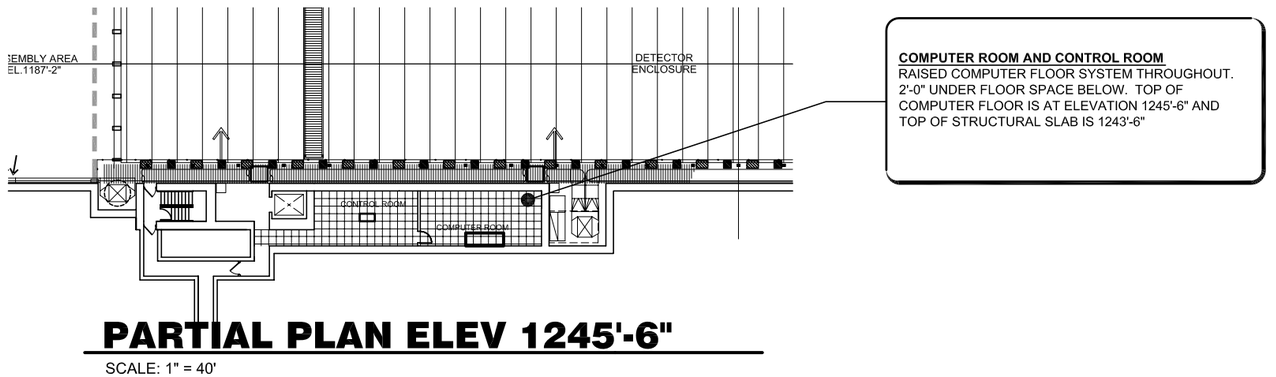


BUILDING PLAN ELEV 1226'-10"

SCALE: 1" = 40'



PARTIAL PLAN ELEV 1245'-6"

SCALE: 1" = 40'

SCALE: 1"=40'-0"

20 0 20 40 60 80 100 FEET

SCALE

FERMI NATIONAL ACCELERATOR LABORATORY

UNITED STATES DEPARTMENT OF ENERGY

NOvA

ARCHITECTURAL PLANS

TITLE - I

DATED:

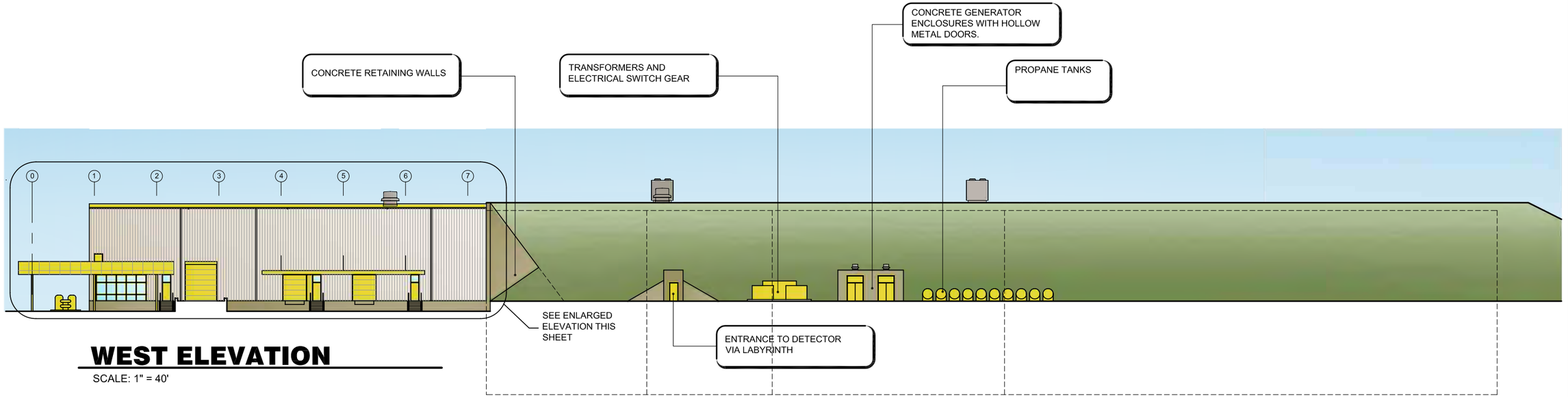
18 APR. 2007

PROJECT NO.

15-1-3

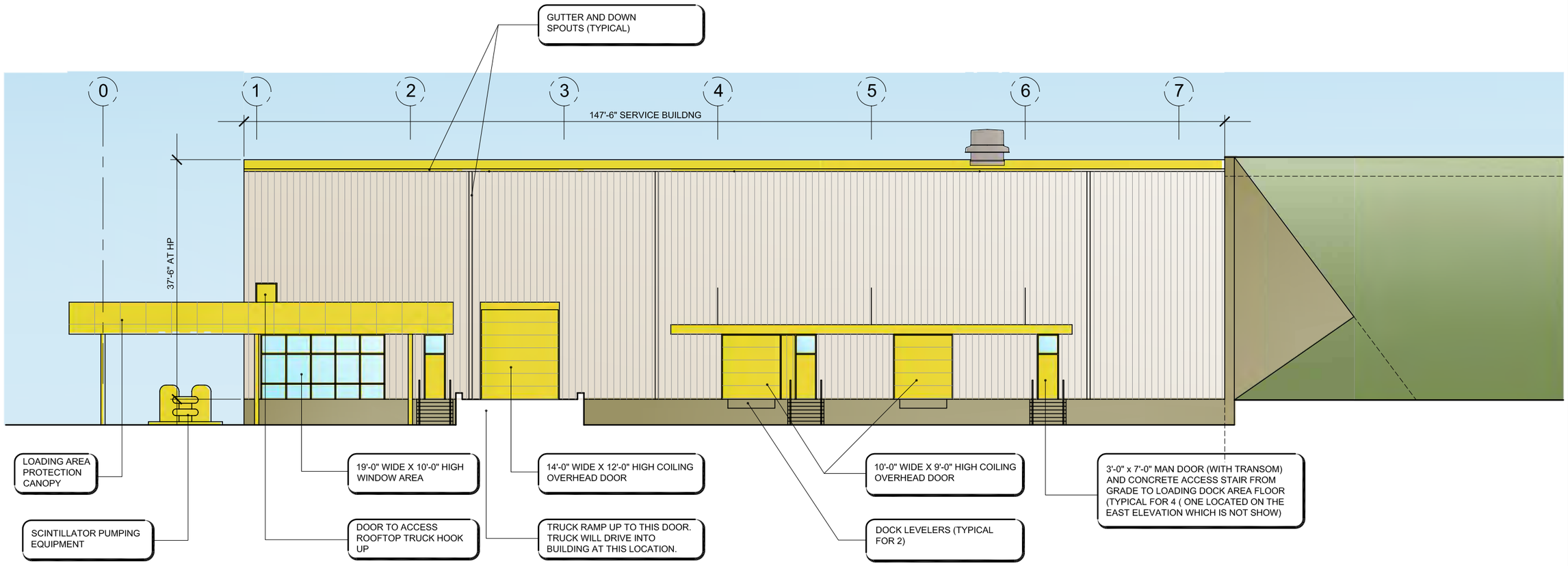
DRAWING NO.

A1



WEST ELEVATION

SCALE: 1" = 40'



ENLARGED WEST ELEVATION - SERVICE BUILDING

SCALE: 1" = 40'

EAST ELEVATION SIMILAR

SCALE: 1"=40'-0"

SCALE 20 0 20 40 60 80 100 FEET

FERMI NATIONAL ACCELERATOR LABORATORY

UNITED STATES DEPARTMENT OF ENERGY

NOvA

EXTERIOR ELEVATIONS

TITLE - I

DATED:

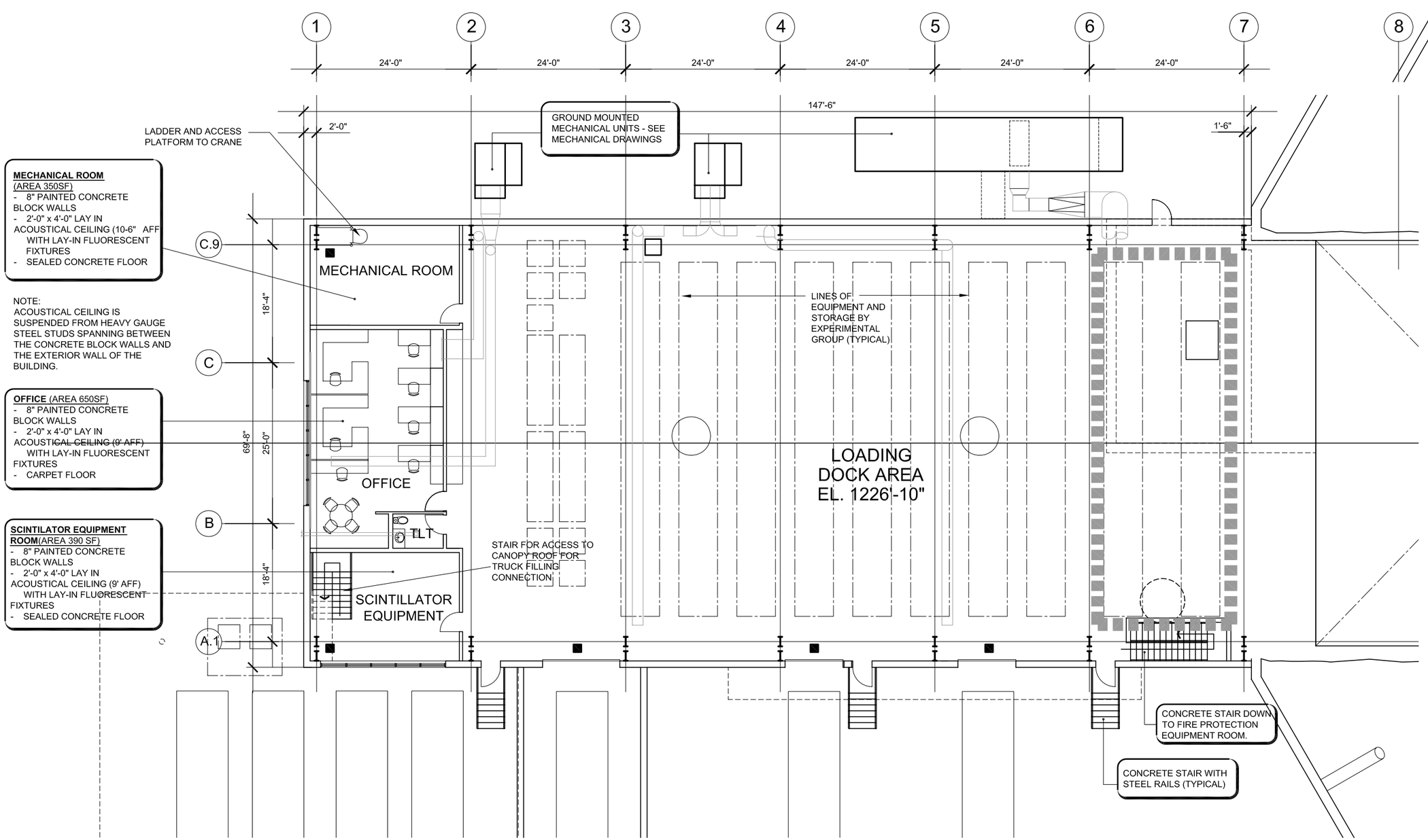
18 APR. 2007

PROJECT NO.

15-1-3

DRAWING NO.

A-2



ENLARGED PLAN OF SERVICE BUILDING -ELEV 1226'-10"

SCALE: 1/16" = 1'-0"

SCALE: 1/16"=1'-0"

8 0 8 16 24 32 40 FEET

SCALE

FERMI NATIONAL ACCELERATOR LABORATORY

UNITED STATES DEPARTMENT OF ENERGY

NOvA

ENLARGED ARCHITECTURAL PLAN AT ELEV. 1226'-10"

TITLE - I

DATED:

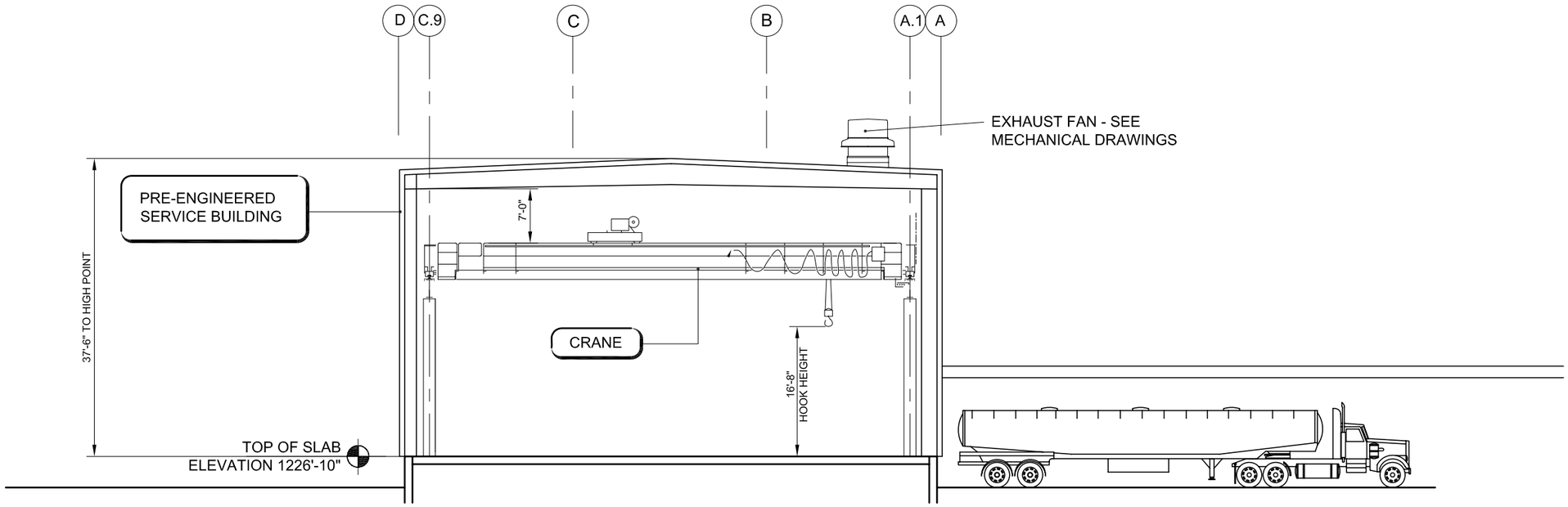
18 APR. 2007

PROJECT NO.

15-1-3

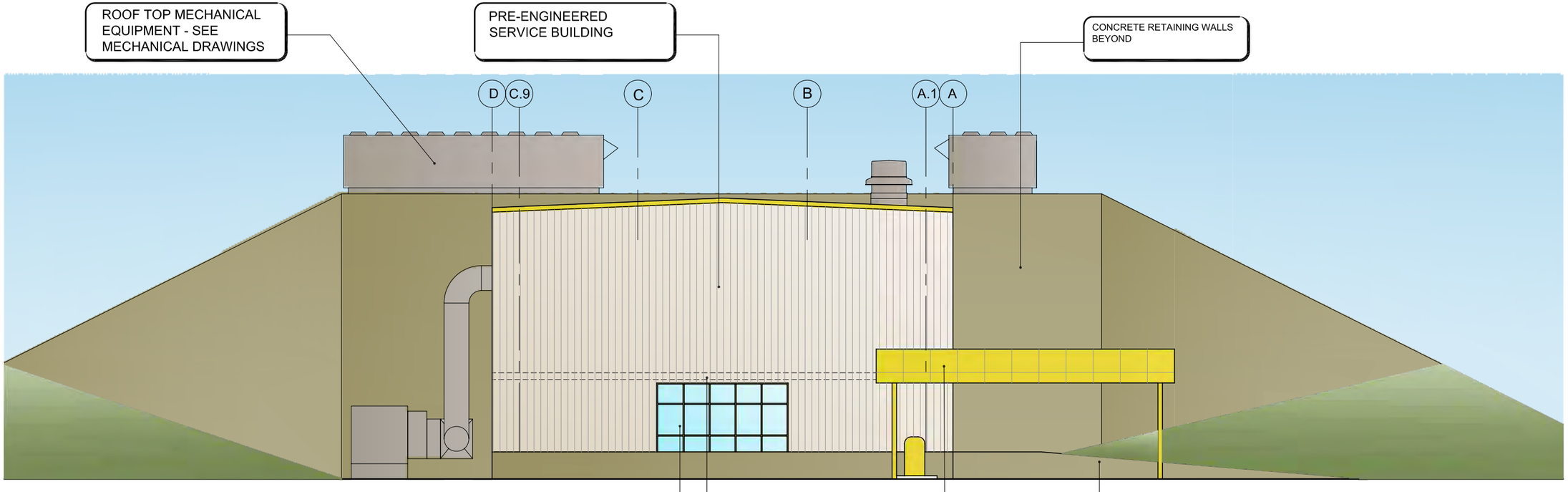
DRAWING NO.

A-3



SECTION THROUGH SERVICE BUILDING

SCALE: 1/16" = 1'-0"



NORTH ELEVATION - SERVICE BUILDING

SCALE: 1/16" = 1'-0"

8 0 8 16 24 32 40 FEET

SCALE

SCALE: 1/16"=1'-0"

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UNITED STATES DEPARTMENT OF ENERGY

NOvA

SERVICE BUILDING SECTION AND ELEVATION

TITLE - I

DATED: 18 APR. 2007

PROJECT NO. 15-1-3

DRAWING NO. A-4

H C-5
G C-5
F C-4
E C-4
D C-3
C C-3
B C-2
A C-2

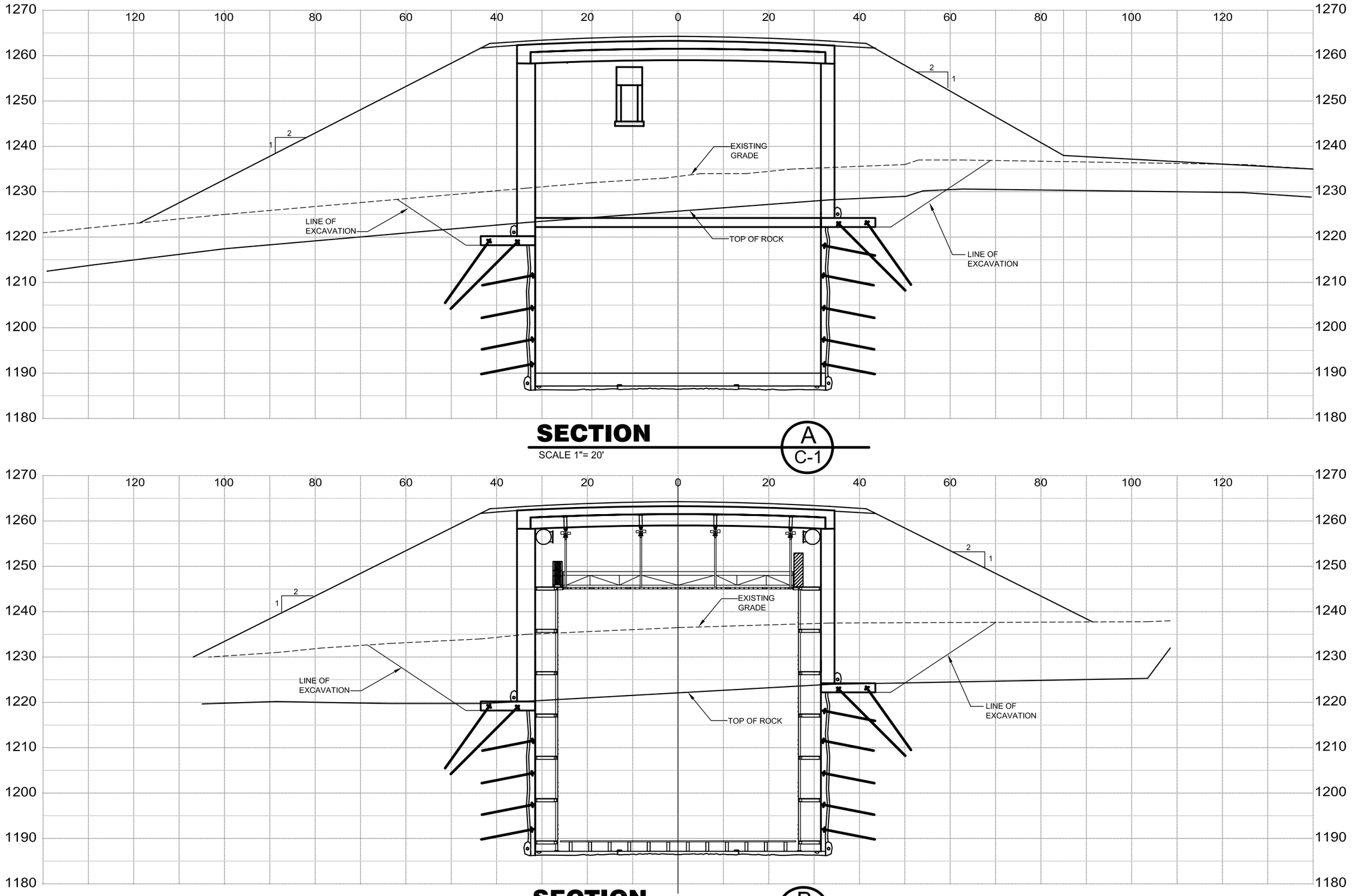
WATER WELL
4" SAN.
2000 GAL. SANITARY HOLDING TANK
HANDICAP ACCESS RAMP
HANDICAP PARKING SPACE
DUMPSTER PAD (15' x 15')
ASPHALT PAVED LOT
W/3" BITUMINOUS PAVEMENT AND 6" AGGREGATE BASE
(4) - 5" P. DUCT
(2) - 5" P. DUCT
PROPANE TANKS
RAMP FOR ACCESS TO TOP OF BERM
POWER (BY OTHERS)
COMMUNICATION (BY OTHERS)

1210 1215 1220 1225 1230 1235 1240 1250 1260 1262 1234 1226 4:1

SCALE:
1" = 50'-0"
50 0 50 100 FEET
SCALE

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY
NOvA
SITE PLAN

TITLE - I
DATED:
18 APR. 2007
PROJECT NO.
15-1-3
DRAWING NO.
C-1



SECTION A / C-1

SCALE 1"= 20'

SECTION B / C-1

SCALE 1"= 20'

SCALE:

1" = 20'-0"

40 20 0 20 FEET SCALE

FERMI NATIONAL ACCELERATOR LABORATORY

UNITED STATES DEPARTMENT OF ENERGY

NOvA

CIVIL CROSS-SECTIONS

TITLE - I

DATED:

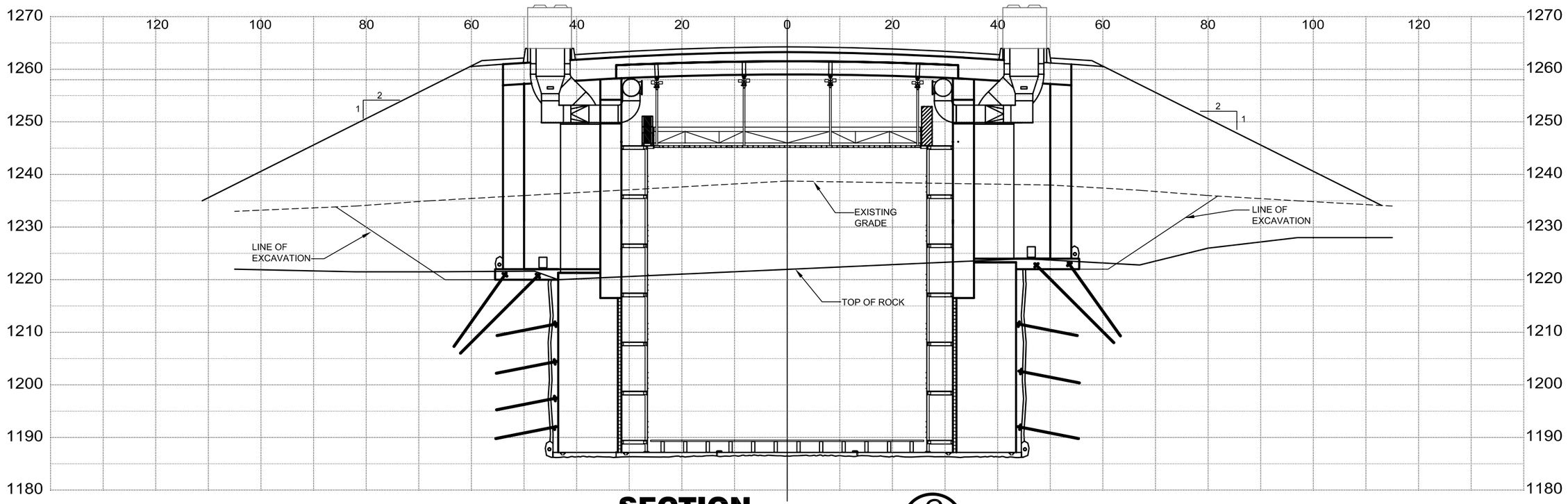
18 APR. 2007

PROJECT NO.

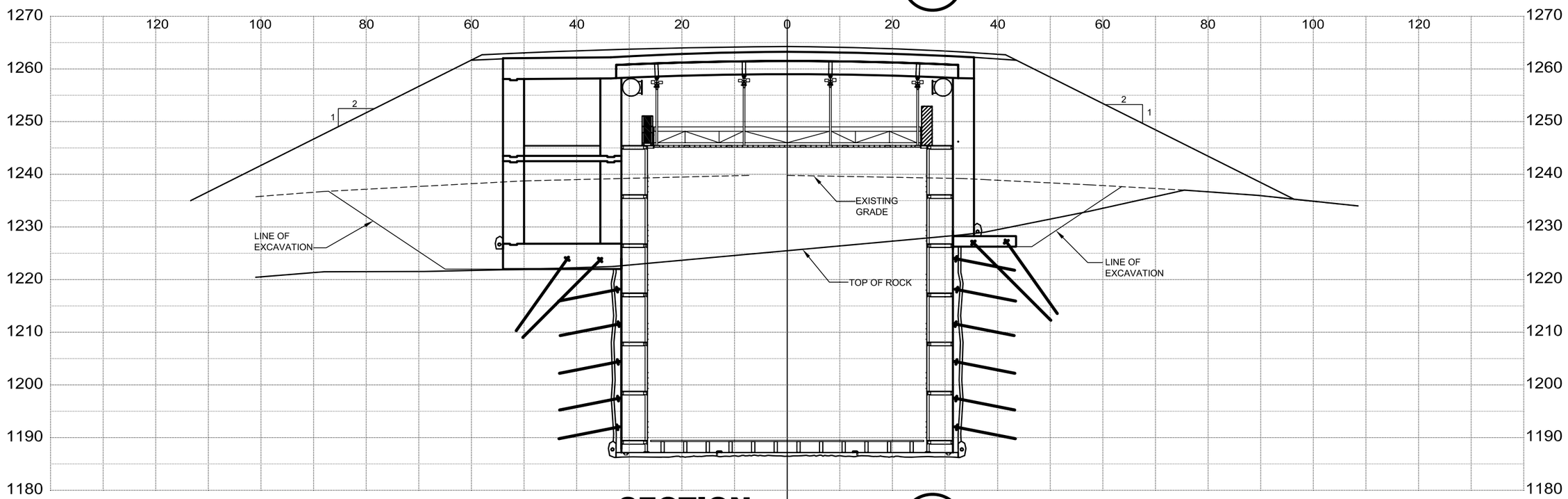
15-1-3

DRAWING NO.

C-2



SECTION C
SCALE 1"= 20'
C-1



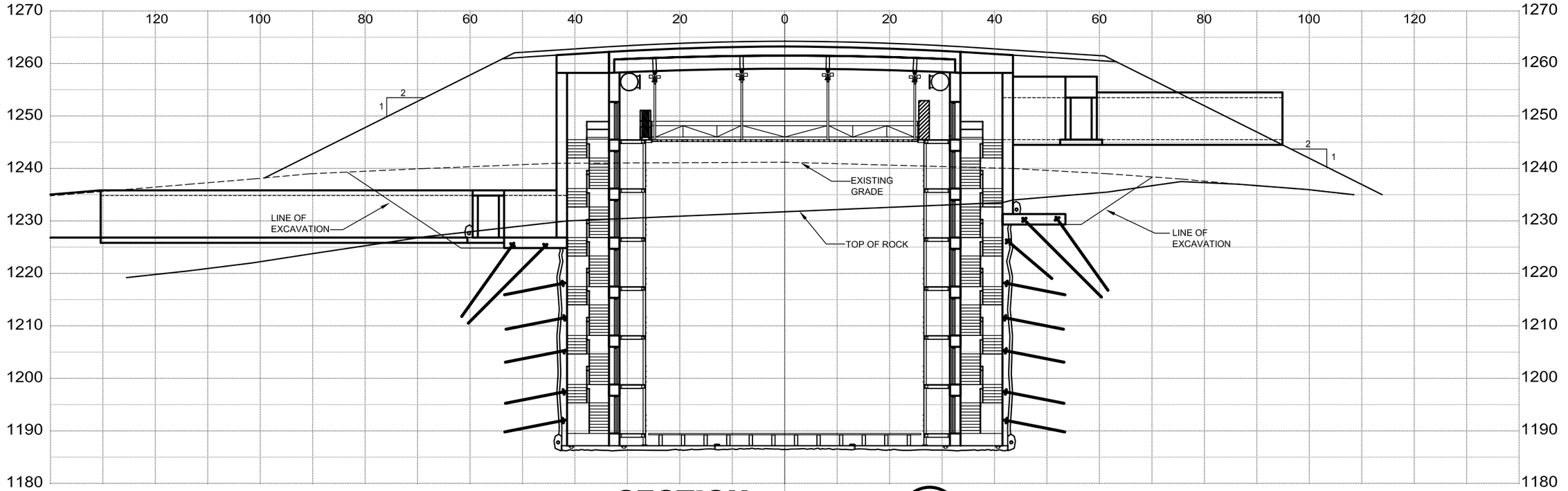
SECTION D
SCALE 1"= 20'
C-1

SCALE: 1" = 20'-0"

20 0 20 40 FEET SCALE

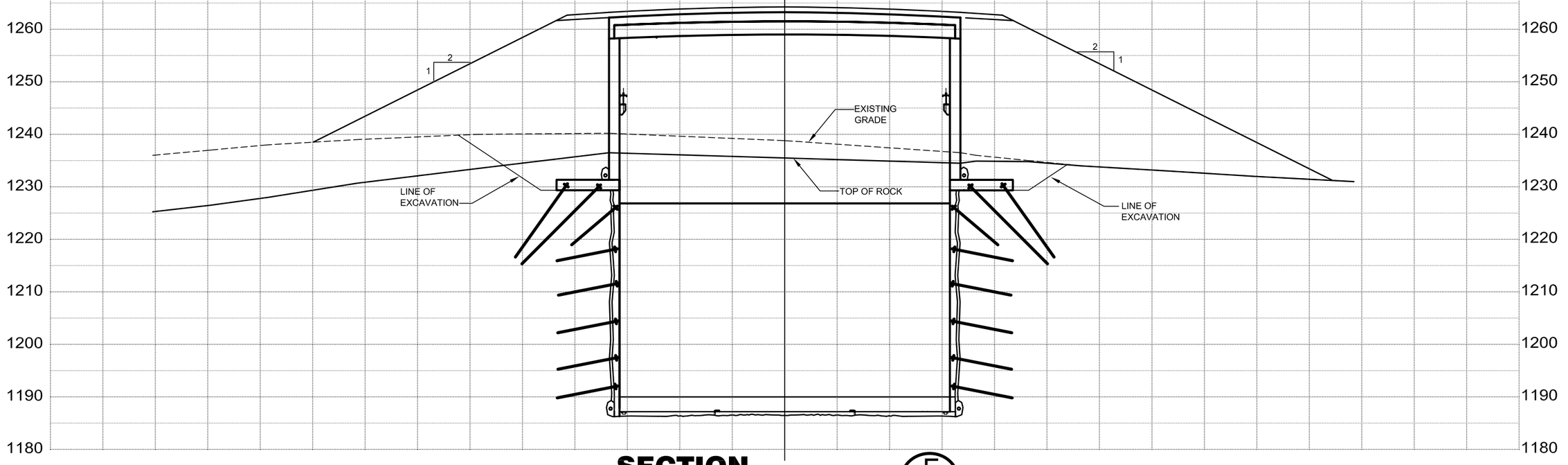
FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY
NOvA
CIVIL CROSS-SECTIONS

TITLE - I
DATED: 18 APR. 2007
PROJECT NO. 15-1-3
DRAWING NO. C-3



SECTION E / C-1

SCALE 1"= 20'



SECTION F / C-1

SCALE 1"= 20'

SCALE: 1" = 20'-0"

20 0 20 40 FEET SCALE

FERMI NATIONAL ACCELERATOR LABORATORY

UNITED STATES DEPARTMENT OF ENERGY

NOvA

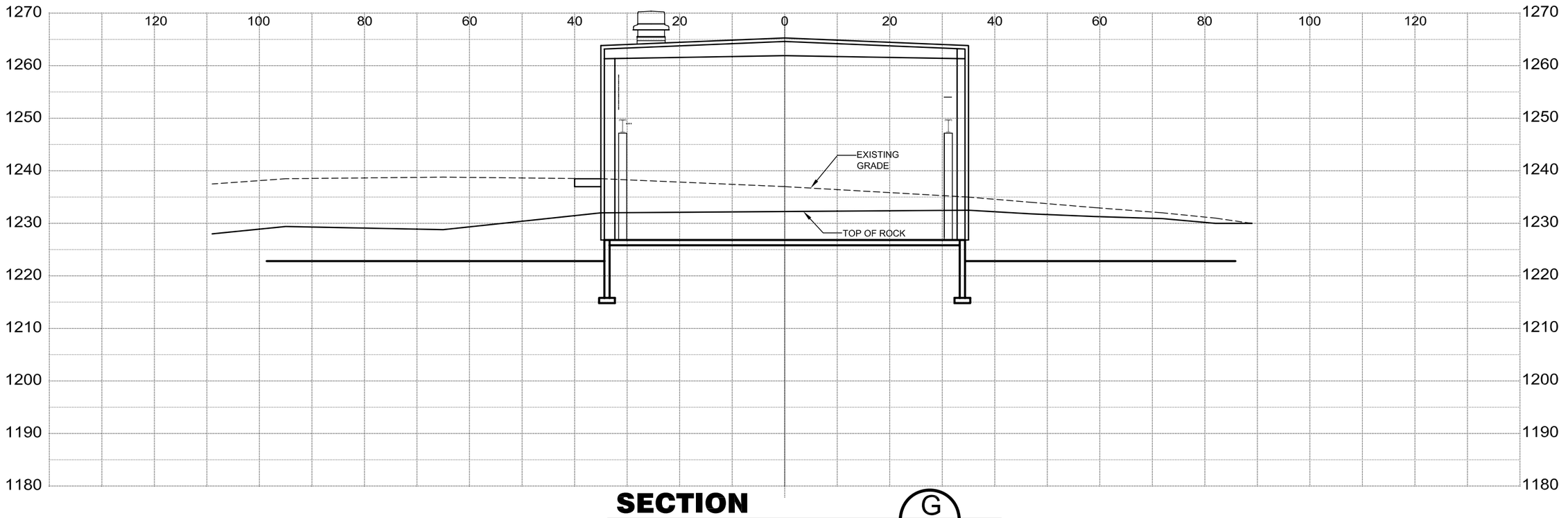
CIVIL CROSS-SECTIONS

TITLE - I

DATED: 18 APR. 2007

PROJECT NO. 15-1-3

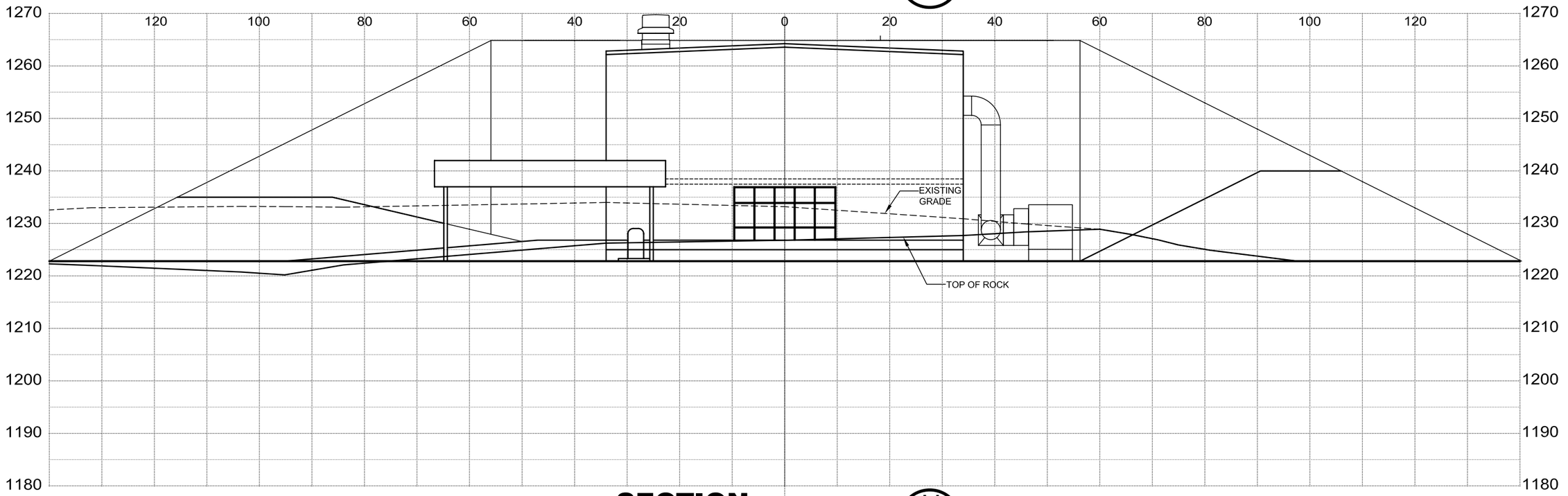
DRAWING NO. C-4



SECTION

SCALE 1"= 20'

G
C-1



SECTION

SCALE 1"= 20'

H
C-1

40
20
0
20
FEET
SCALE

SCALE:
1" = 20'-0"

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

NOvA

CIVIL CROSS-SECTIONS

TITLE - I

DATED:
18 APR. 2007

PROJECT NO.
15-1-3

DRAWING NO.
C-5

ASSEMBLY HALL

CRITERIA
TYPE: HVAC
SUMMER: 70°F ± 5°, 50%RH MAX.
WINTER: 70°F ± 5°, MIN 15%RH
VENTILATION: 20,000 CFM 100% OUTSIDE AIR FOR GLUE EXHAUST SYSTEM (DURING APPROX 2YRS OF BLOCK ASSEMBLY)

CONCEPT:
20,000 CFM 100% OUTSIDE AIR HVAC UNIT WITH DX COOLING (~115 TON), AND WITH SERIES DESSICANT WHEEL, UPSTREAM AND DOWNSTREAM OF COIL, (AAON RL 095 WITH D PAC-PRECISION AIR CONTROL) WITH PROPANE FIRED GAS HEATING SECTION AND STEAM HUMIDIFIER (200 MBTU/H, 188 LB/HR) INTEGRAL TO THE UNIT, DUCTED TO THE SPACE FOR CONTINUATION BY OTHERS.
20,000 CFM EXHAUST FAN, AND EXHAUST DUCT, INTERLOCK WITH SUPPLY HVAC UNIT.

GENERATOR ROOM

CRITERIA
TYPE: HEATING / VENTILATION
SUMMER: AMBIENT
WINTER: 65°F MIN.
VENTILATION PER CODE

CONCEPT:
PROPANE GAS-FIRED UNIT HEATER AND MOTORIZED LOUVER FOR SPACE. DUCTED INTAKE AND EXHAUST VENTILATION FOR GENERATOR RADIATOR, AND ENGINE AIR INTAKE.

CONTROL ROOM

CRITERIA
TYPE: HVAC
(ASSUME SAME AS COMPUTER ROOM).

CONCEPT:
3-Ton (placeholder) INDOOR UNIT SPLIT SYSTEM (MINIMATE)WITH AIRCOOLED CONDENSER, WITH MINIMUM OA OPTION

COMPUTER ROOM

CRITERIA
TYPE: HVAC
72°F, 50%RH MAX, 30%RH MIN.
MAJOR LOADS ARE (6)-8.32KW RACKS AND (2)-5.5 KW RACKS

CONCEPT:
ONE 30-TON OR 85KW CRAC UNIT (LIEBERT DS105) DOWNFLOW FOR UNDERFLOOR AIR DISTRIBUTION, HOT AISLE/COLD AISLE CONCEPT, WITH INFRARED HUMIDIFIER AND ELECTRIC REHEAT WITH R407C AIR COOLED CONDENSER. NO REDUNDANCY

DETECTOR ENCLOSURE

CRITERIA
TYPE: HVAC
SUMMER: 72°F ± 5°, 50°DEWPT MAX.
WINTER: 72°F DB, MIN 15%RH
VENTILATION: MINIMAL, FOR PEOPLE & PRESSURIZATION ONLY

CONCEPT:
TWO 50-TON HVAC UNIT 30,000 CFM WITH 1000 CFM EACH OF OUTSIDE AIR (FOR PEOPLE AND PRESSURIZATION), WITH DEWPOINT CONTROL ECONOMIZER, PROPANE FIRED GAS HEATING SECTION, (AAON RN 050 WITH D-PAC (DIGITAL PRECISION AIR) CONTROL REMOTE ALARM/CONTROL LOCATED IN THE CONTROL ROOM, DUCTED TO THE SPACE, USING COMBINATION OF RIGID GALVANIZED DUCTWORK FROM UNIT THE BRANCH, AND 40" DIAMETER DUCTSOX FABRIC DUCT IN THE DETECTOR HALL. EACH SYSTEM WILL HAVE AN ELECTRIC STEAM HUMIDIFIER (~30 LB/HR, ARMSTRONG SERIES EHU-700-CM14, 480V 14A BASIS) WITH DUCT DISPERSION. A NUMBER OF SELF CONTAINED DX DEHUMIDIFIERS (DESSERT -AIRE LT 750) ARE LOCATED ALONG EACH SIDE FO THE HALL TO HELP MAINTAIN 50F SPACE DEWPOINT. SIX 2,000 CFM WALL FAN WILL DESTRATIFY THE SPACE AIR BRINGING THE LOWER COOLER SPACE AIR TO THE UPPER HALL. THE DETECTOR ENCLOSURE SHALL BE POSITIVE WITH RESPECT TO THE ADJACENT ASSEMBLY HALL AND LOADING DOCK.

ELECTRICAL / TELE ROOM

CRITERIA
TYPE: HEATING / VENTILATING
SUMMER: AMBIENT
WINTER: 65°F MIN, NO MIN RH

CONCEPT:
ELECTRICAL HEATER

1. DESTRATIFICATION WALL PROPELLER FANS (TOTAL 6) 2000 CFM EACH, INTAKE FROM THE BOTTOM OF HALL, DISCHARGE TO UPPER HALL
2. DEHUMIDIFIER 18 LB/HR (TOTAL 8, 4 ON EACH SIDE), DESSERT-AIRE LT-750, LOCATED NEAR LOWER AREA, SEE SECTION
3. PROPANE GAS-FIRED UNIT HEATER
4. ELECTRIC UNIT HEATER

CONTINUATION OF FABRIC DUCTSOX FROM DETECTOR HALL HVAC UNIT, ROUTED AT UPPER HALL

HVAC 100% OUTSIDE-AIR UNIT FOR ASSEMBLY HALL. UNIT LOCATED ON THE ROOF WITH DOWNFLOW SUPPLY DUCT

LABYRINTH

19,000 CFM CONDITIONED SUPPLY

ASSEMBLY AREA EL.1187'-2"

CURTAIN WALL BETWEEN ASSEMBLY HALL AND DETECTOR ENCLOSURE DURING BLOCK ASSEMBLY (BY OTHER DISCIPLINE)

FINAL PUSH-PULL VENTILATION FOR BLOCK RAISER BY OTHERS

20,000 CFM EXHAUST

START OF FABRIC DUCT (TYPICAL)

RIGID GALVANIZED DUCT IN THIS PORTION (TYPICAL)

DETECTOR ENCLOSURE

40" DIAMETER CONTINUOUS FABRIC "DUCTSOX" APPROXIMATELY 170 FEET LONG EACH WAY, WITH 2 ROW OF HANGING SYSTEM AT 10 AND 2 O'CLOCK POSITION, ABOUT 15,000 TOTAL CFM EACH WAY.

DEHUMIDIFIER APPROXIMATELY 76 FT APART TYPICAL

INTAKE FROM THE BOTTOM

CONTROL ROOM

COMPUTER ROOM

ROOF EXHAUST FAN 20,000 CFM, GREENHECK GB-540-75, 7.5 HP, 54"X54" DAMPER SIZE

SEE SECTION FOR EXTENT OF DUCTWORK (TYPICAL)

CONTINUATION OF FABRIC DUCTSOX FROM DETECTOR HALL HVAC UNIT, ROUTED AT UPPER HALL

CRAC UNIT CONNECTED TO OUTDOOR CONDENSING UNIT (NOT SHOWN)

STAND-BY GENERATOR ROOM

EMERGENCY GENERATOR ROOM

MATCH LINE TO SHT M-2

AREA CRITERIA PLAN

SCALE 1"= 25'

ELEVATOR
ELEV. EQUIP.
TEL. EQUIP.
ELECTRICAL ROOM

ELEC ROOM @ LOWER LEVEL

SCALE 1"= 25'

50 FEET
25
0
25 SCALE

SCALE: 1" = 25'-0"

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY
NOvA
CRITERIA AND CONCEPT - 1

TITLE - I
DATED:
18 APR. 2007
PROJECT NO.
15-1-3
DRAWING NO.
M-1

SCINTILLATOR ROOM

CRITERIA
TYPE: HEATING
MIN 68F
VENTILATION: TBD

CONCEPT:
PROPANE GAS-FIRED UNIT HEATER

TOILET

CRITERIA
TYPE: HV
78°F MAX, 70°F MIN
VENTILATION &
PLUMBING PER CODE

OFFICE

CRITERIA
TYPE: HVAC
SUMMER: 75°F ± 5°, 55%RH MAX.
WINTER : 68°F ± 5°, NO MIN RH
VENTILATION: ASHRAE 62

CONCEPT:
ONE 5-TON HVAC DX UNIT WITH ECONOMIZER, PROPANE FIRED GAS HEATING SECTION, HORIZONTAL AIRFLOW CURB, DUCTED THROUGH THE LOADING DOCK WALL TO THE SPACE USING RIGID GALVANIZED DUCTWORK

MECHANICAL ROOM

CRITERIA
TYPE: HEATING / VENTILATION
SUMMER: (AMBIENT)
WINTER : 68°F ± 5°, NO MIN RH
VENTILATION: PER CODE

CONCEPT:
PROPANE GAS-FIRED UNIT HEATER AND VENTILATION LOUVER/DAMPER

LOADING DOCK

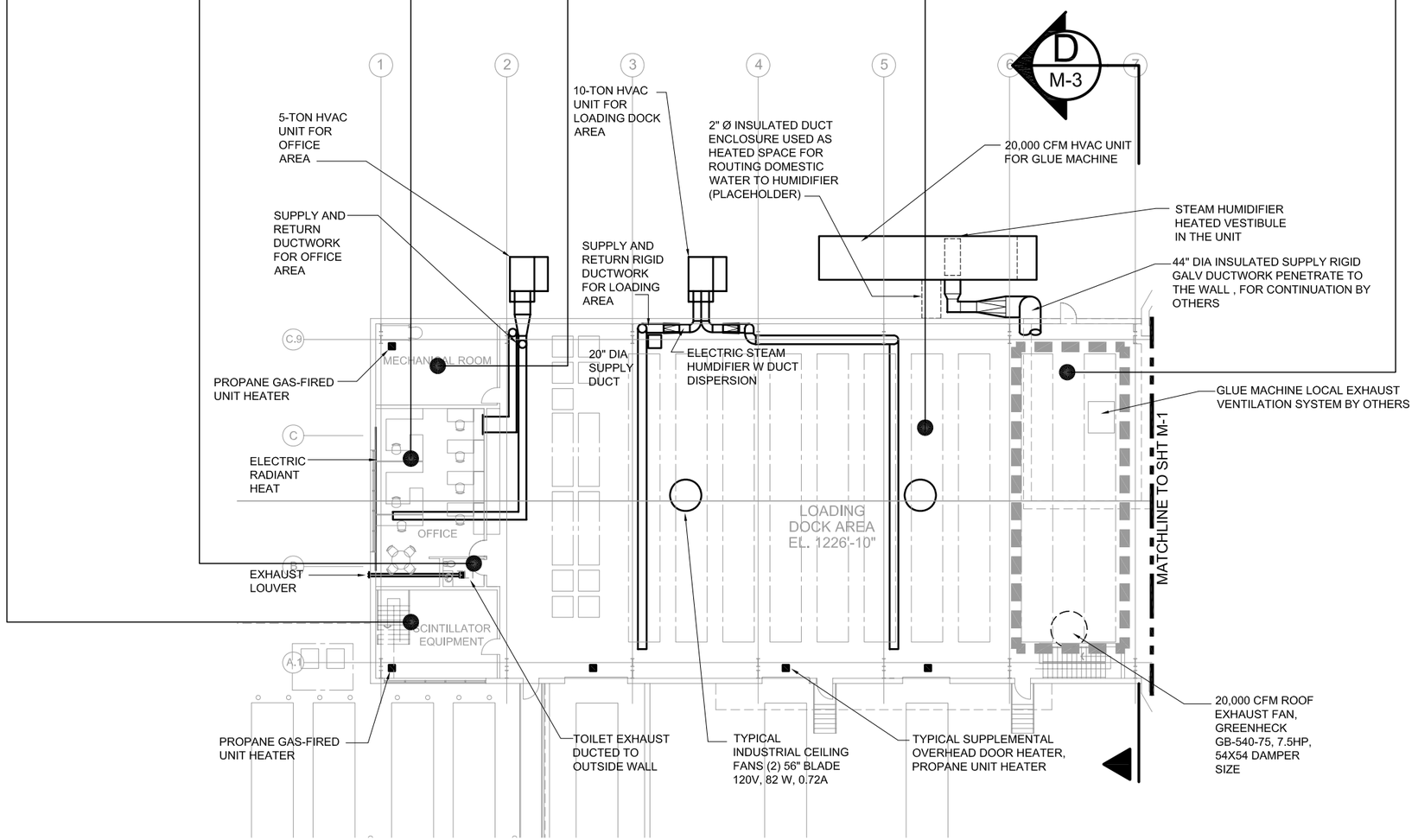
CRITERIA
TYPE: HVAC
SUMMER: 70°F ± 5°, 50%RH MAX.
WINTER : 70°F ± 5°, MIN 15%RH
VENTILATION: NONE

CONCEPT:
ONE 10-TON HVAC DX UNIT WITH ECONOMIZER, PROPANE FIRED GAS HEATING SECTION, HORIZONTAL AIRFLOW CURB, DUCTED TO THE SPACE USING RIGID GALVANIZED DUCTWORK, WITH ELECTRIC STEAM HUMIDIFIER, DOWNSTREAM OF THE UNIT

GLUE MACHINE AREA

CRITERIA
TYPE: HVAC
SUMMER: 70°F ± 5°, 50%RH MAX.
WINTER : 70°F ± 5°, MIN 15%RH
VENTILATION: 20,000 CFM 100% OUTSIDE AIR FOR GLUE LOCAL EXHAUST SYSTEM

CONCEPT:
20,000 CFM 100% OUTSIDE AIR HVAC UNIT WITH DX COOLING (~115 TON), AND WITH SERIES DESSICANT WHEEL, UPSTREAM AND DOWNSTREAM OF COIL, AAON RL 095 WITH PAC-PRECISION AIR CONTROL, WITH PROPANE FIRED GAS HEATING SECTION AND STEAM HUMIDIFIER (200 MBTU/H, 188 LB/HR) INTEGRAL TO THE UNIT, DUCTED TO THE SPACE FOR CONTINUATION BY OTHERS.
20,000 CFM EXHAUST FAN, AND EXHAUST DUCT, INTERLOCK WITH SUPPLY HVAC UNIT.



AREA CRITERIA PLAN

SCALE 1"= 25'

50 25 0 25 FEET
SCALE

SCALE:
1" = 25'-0"

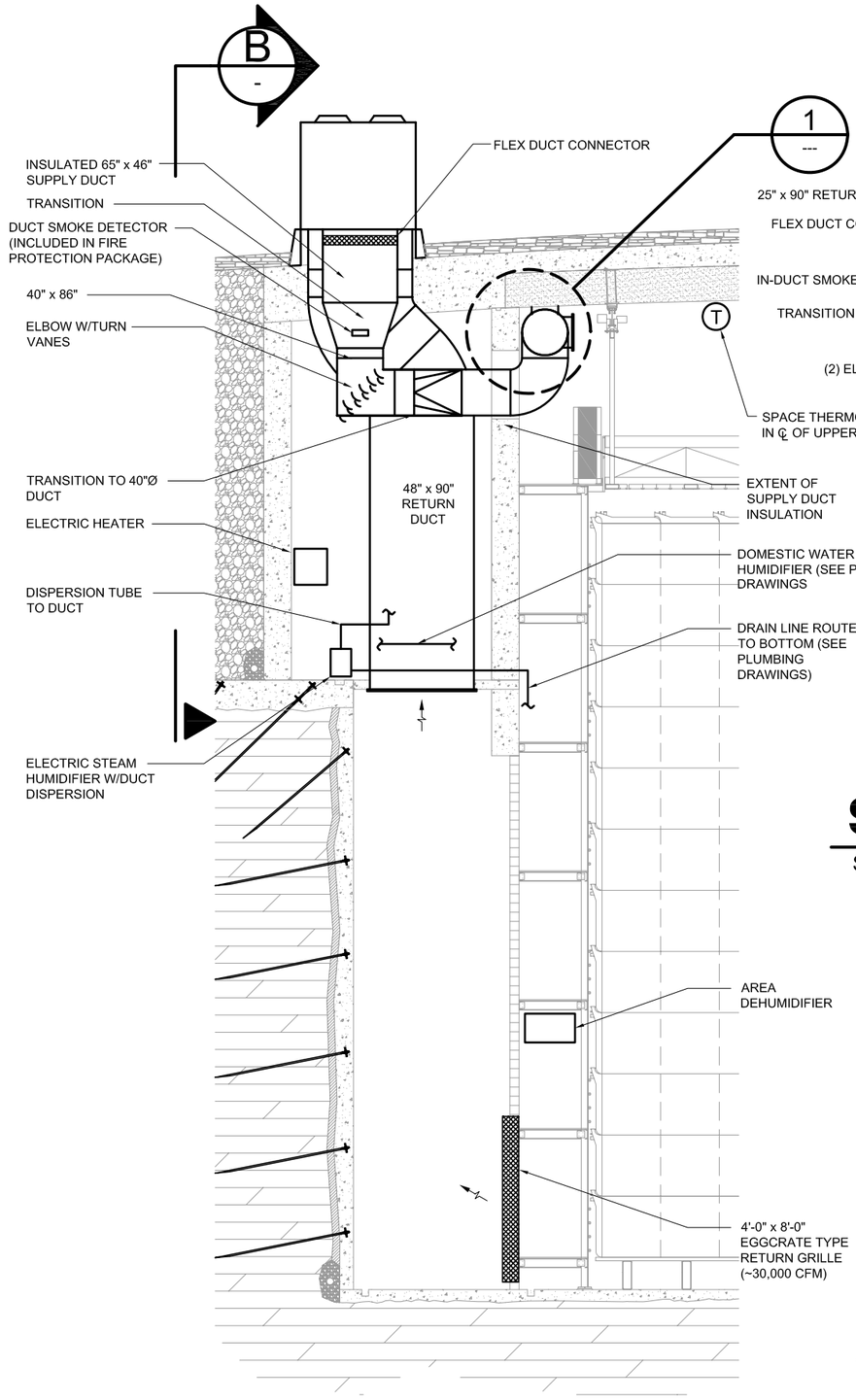
FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY
NOvA
CRITERIA AND CONCEPT - 2

TITLE - I

DATED:
18 APR. 2007

PROJECT NO.
15-1-3

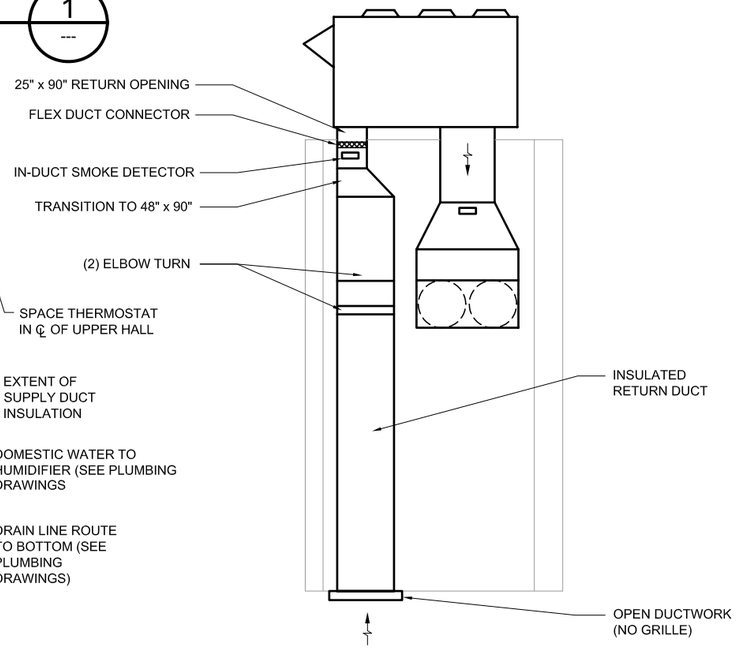
DRAWING NO.
M-2

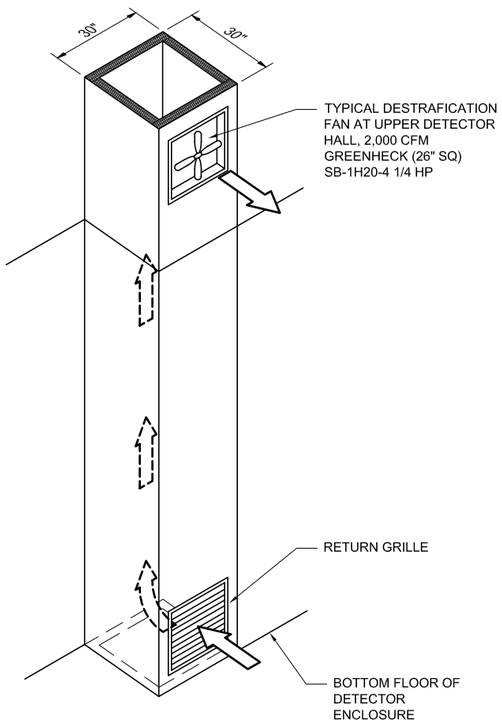


SECTION

SCALE 3/32"=1'-0"

B
-

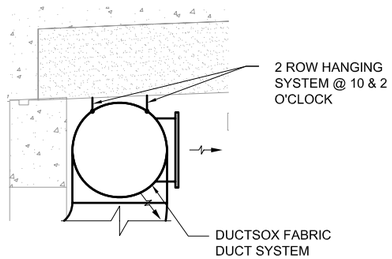




DETAIL

SCALE NONE

2
-



DETAIL

SCALE 3/16"=1'-0"

1
-

SECTION

SCALE 3/32"=1'-0"

A
M-1

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY
NOvA
SECTION SHEET - 1

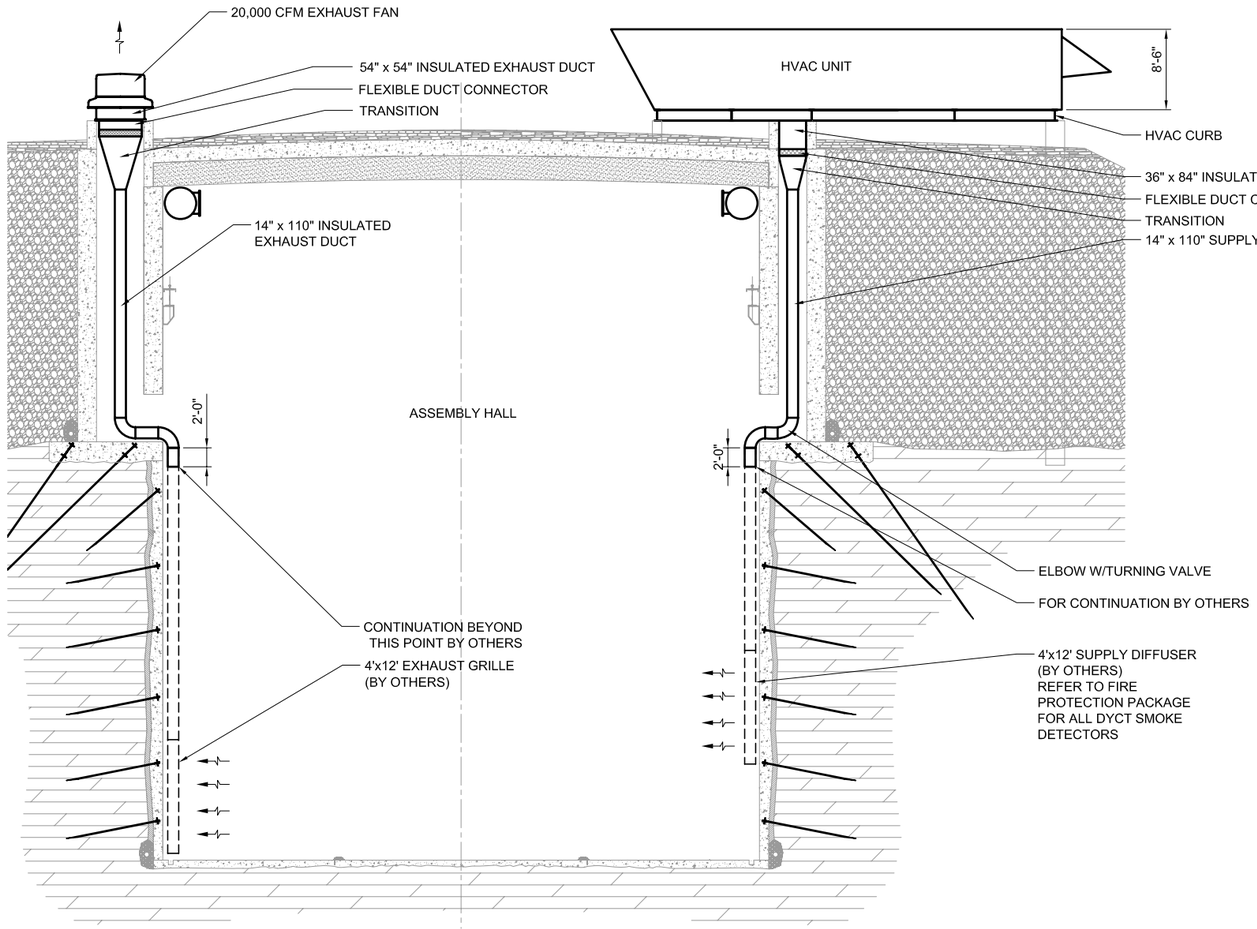
SCALE:

TITLE - I

DATED:
18 APR. 2007

PROJECT NO.
15-1-3

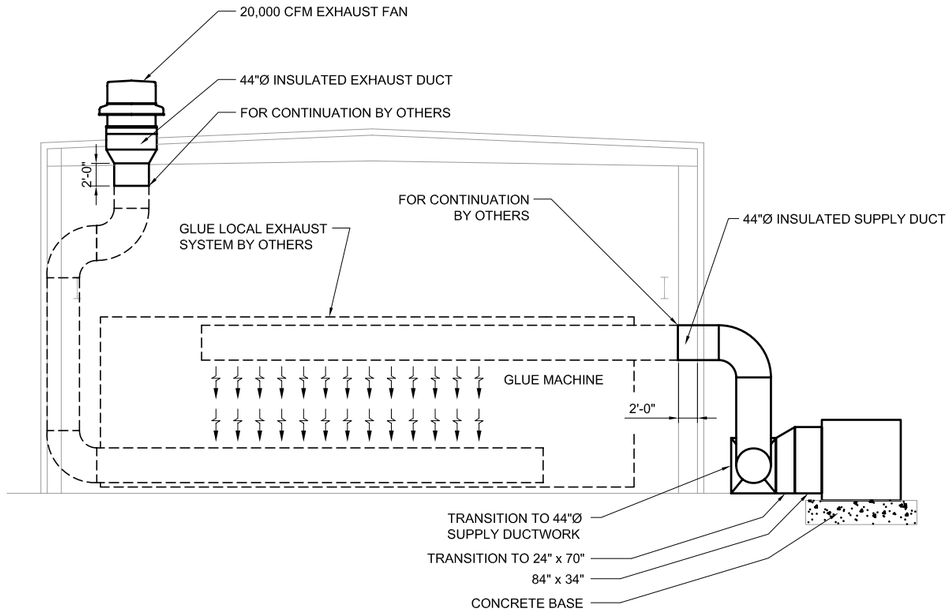
DRAWING NO.
M-3



SECTION

SCALE 1/16"=1'-0"

C
M-1



SECTION

SCALE 1/16"=1'-0"

D
M-1

SCALE: 1/16"=1'-0"

8 0 8 16 24 32 40 FEET
SCALE

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY
NOvA
SECTION SHEET - 2

TITLE - I

DATED:
11 APR 2007

PROJECT NO.
15-1-3

DRAWING NO.
M-4

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Environmental Assessment Worksheet
Transmittal Memo

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MEMORANDUM

TO: Minnesota Environmental Quality Board EAW Distribution List (attached)

DATE: August 28, 2007

RE: Environmental Assessment Worksheet (EAW) prepared for the NOvA Off Axis Detector Facility in Saint Louis County, Minnesota

Enclosed please find a copy of the Environmental Assessment Worksheet (EAW) prepared for the proposed NOvA Off Axis Detector Facility in Saint Louis County, Minnesota. The EAW was prepared on behalf of the Board of Regents of the University of Minnesota, who are the designated Responsible Governmental Unit (RGU) for the proposed project. The EAW was prepared in accordance with the rules and policies of the Minnesota Environmental Quality Board pursuant to Minnesota Statutes, section 116D.04 and 116D.045.

The EAW was prepared as a discretionary EAW since the mandatory EAW threshold criteria in the MEQB rules were not exceeded. In addition, a federal Environmental Assessment (EA) is being prepared for the project by the U.S. Department of Energy since federal funding is involved. The EAW and EA are separate documents and processes for the project and the EA schedule will continue and be completed after the EAW process is complete. The EAW will be an appendix in the EA document ultimately, and a separate public comment period will occur for the EA at a later date.

The enclosed EAW identifies potential project effects, environmental conditions, and permits and approvals anticipated for the project. A public meeting will be held at the VFW Hall, Highway 53 in Orr, MN on Wednesday, September 26 at 7:00 p.m. The 30 day public comment period begins on September 10, 2007. Your comments on the EAW are requested and will be accepted until October 10, 2007 when the public comment period ends.

Written comments and requests for printed copies may be directed to:

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3535 Vadnais Center Drive
St. Paul, MN 55110-5196
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Appendix B

Description of NOvA Detectors

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APPENDIX B

DESCRIPTION OF THE NO*v*A DETECTORS

B.1 The Basic NO*v*A Detector Element

The basic unit of the NO*v*A Detector is a simple rectangular rigid polyvinyl chloride (PVC) plastic cell containing liquid scintillator and a wavelength-shifting fiber (see Figure B.1). Charged particles traverse the cell primarily along its depth (D) and scintillator light is produced in the liquid. The light bounces around in the rectangular cell of width W, depth D, and length L until it is captured by a doubled length of wavelength-shifting fiber or absorbed by PVC or scintillator. At the top of the cell both ends of the looped fiber are directed to one pixel on an Avalanche Photodiode (APD) light detector array, and the light is converted to an electronic signal.

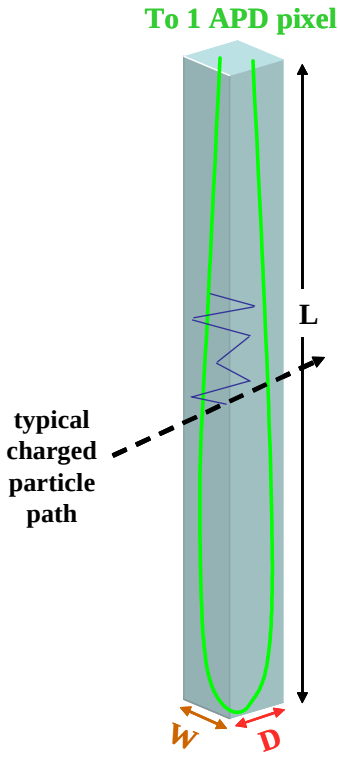

Figure B.1: A PVC cell of dimensions (W, D, L) containing liquid scintillator and a wavelength-shifting fiber (green). A charged particle incident on the front face produces light (blue line) that bounces off the cell walls until absorbed by the fiber. The fiber routes the light to an APD.

The NO*v*A cell is made of a highly reflective titanium dioxide loaded rigid PVC cell. The cell width and depth satisfy the scientific requirements and the cell length is sized to fit on a standard domestic semi trailer truck 53 ft in length. To achieve the 20 kiloton mass for the Far Detector, the cell structure is repeated 500,000 times.

B.2 Liquid Scintillator

Sixty-nine percent (~ 13.8 kilotons) of the NO*v*A Far Detector mass is the liquid scintillator held inside the NOvA cells. The approximately 4.3 million gallons (gal) of liquid scintillator are composed primarily of mineral oil with 5.5% pseudocumene (1,2,4-Trimethylbenzene) as the scintillant. The liquid also contains chemical additives to shift the light wavelength. These additives are PPO (2,5-diphenyloxazole) and bis-MSB [1,4-di(methylstyryl)benzene]. An anti-static agent is added to the liquid at the level of 3 parts per million (ppm) to prevent charge build-up during distribution to the cells. Blending of the scintillator components would take place at Fermilab or at a toll blender in the Chicago area as discussed in Chapter 3 of the NO*v*A *Environmental Assessment*.

B.3 Rigid PVC Extrusions

The mass of the rigid PVC extrusions is ~ 6.2 kilotons or about 31 % of the mass of NO*v*A Far Detector. Assembling 500,000 objects is achieved by using larger rigid PVC extrusions with 16 cells extruded together in a unit as shown in Figure B.2. About 31,000 of the 16-cell extrusions are needed for the full Far Detector.

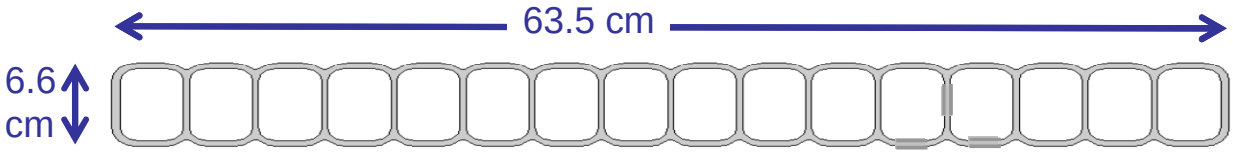

Figure B.2: Drawing of the End View of the NOvA rigid PVC extrusion.

B.4 Extrusion Modules Assembly

Raw extrusions from the commercial supplier are inspected for structural integrity at the vendor's site. The extrusions are sorted to remove any variations in thickness which may arise during the extrusion process and additional sorting may take place to remove extrusions with excess "banana" or curvature along the length.

Next, leak-tight NO*v*A extrusion modules are constructed from the PVC and fiber at the University of Minnesota, a NO*v*A Experiment Collaborator. Two sorted 16-cell objects are attached with methyl methacrylate adhesive, and the 32-cell extrusion module is cut to an exact length. The extrusions are threaded with wavelength shifting fiber loops as in Figure B.1, and each fiber is tested for continuity after installation. The extrusion modules are capped at one end by a simple PVC end plate to contain the liquid scintillator and are capped at the other end by a more complicated fiber manifold which holds the liquid and routes the 64 fiber ends to 32 APD pixels (Figure B.3).

The assembled extrusion modules with fiber manifolds and end caps are 51.5 ft long, sized to fit inside a standard domestic 53-ft semi trailer truck. The end plates and fiber manifolds link the 32 cells into a common liquid volume. Thus the 4.25 ft by 51.5 ft extrusion module forms the primary containment vessel for the liquid scintillator. Each extrusion module holds about 250 - 275 gal of scintillator. As part of the construction process, each completed extrusion module is tested for leaks before being shipped empty to the detector assembly site.

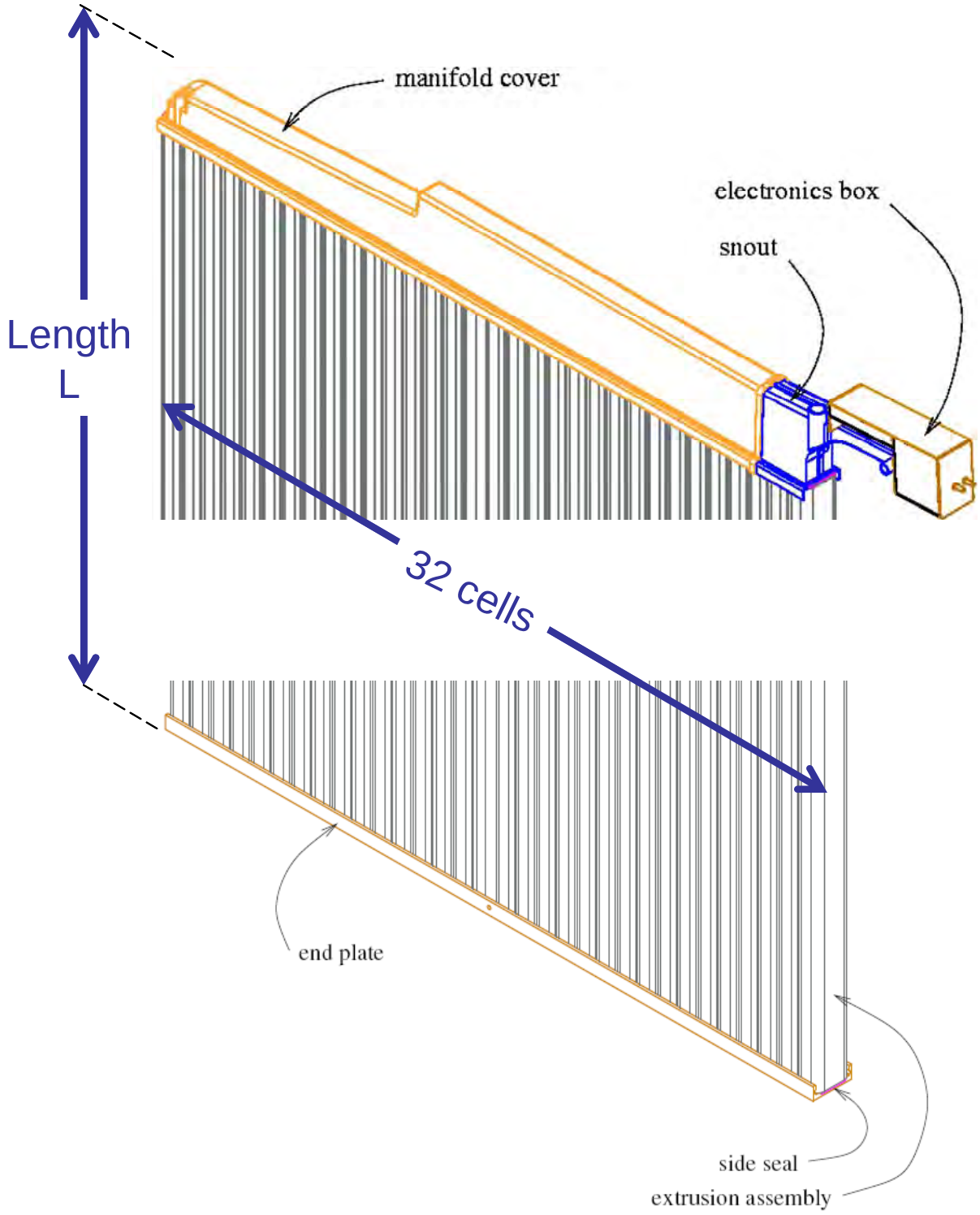

Figure B.3: A NOvA extrusion module constructed from two side by side 16 cell PVC extrusions and capped at both ends to contain the liquid scintillator. The manifold end also routes the 64 fiber ends to the avalanche photodiode array and associated electronics.

B.5 Light Detector, Electronics and Data Acquisition System

The NO*v*A light detector is an Avalanche Photodiode (APD). The thermal electronic noise generated in the APD is reduced by cooling the devices to -15^{o}C (5^{o}F) using thermo-electric (TE) coolers. Heat from the hot side of the TE coolers is removed by a water cooling system in the Far Detector Support Building. There are about 15,000 APDs on front-end boards in the Far Detector, one per extrusion module, which then interface to a standard Ethernet network for off-site data processing and analysis.

B.6 Final Detector Description

There are three NO*v*A detectors in the NO*v*A project: the Far Detector at Ash River, the Near Detector at Fermilab, and an Integration Prototype Near Detector (IPND) at Fermilab. The relative sizes of these detectors are illustrated in Figure B.4. All three detectors have an identical structure and are assembled in alternating layers of vertical and horizontal extrusions as shown in the inset to Figure B.4. This layering organizes the detector into planes with 90^{o} stereo for tracking of particles produced in neutrino interactions originating in the PVC and scintillator mass. Table B.1 lists relevant parameters of the three detectors.

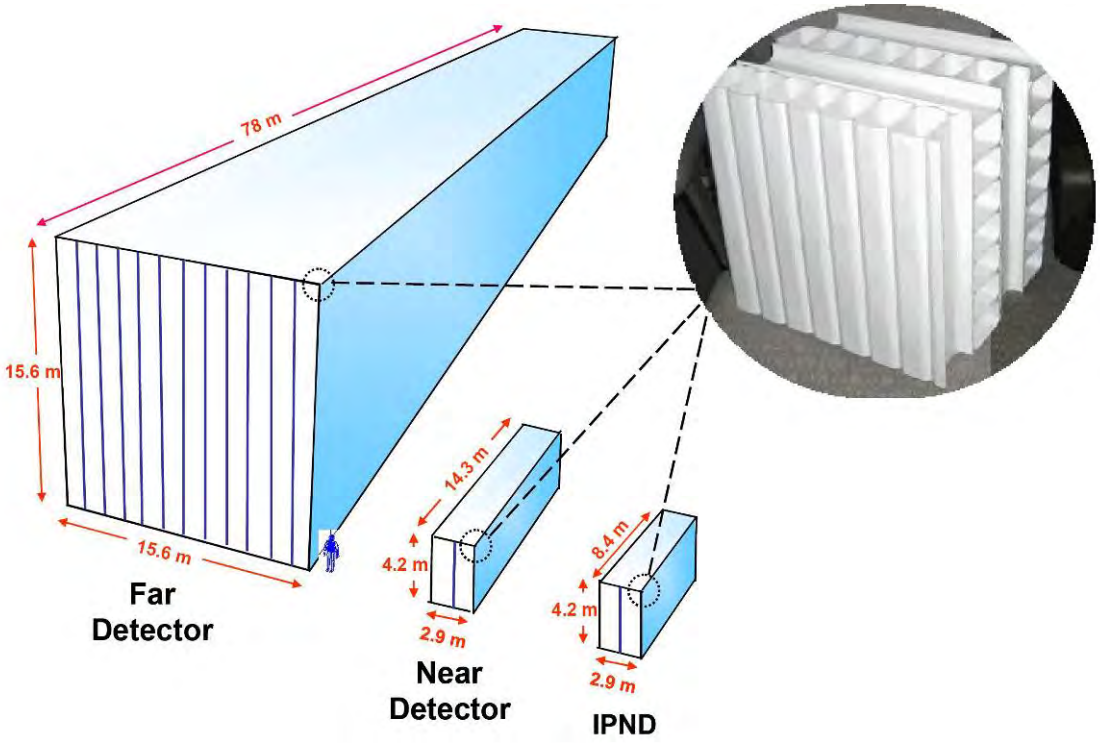

Figure B.4: The three NO*v*A detectors. The inset figure shows that each detector has an identical alternating plane structure composed of vertical and horizontal cells like those shown in Figure B.2.

	Integration Prototype Near Detector (IPND)	**Near Detector**	**Far Detector**
Mass (metric tons)	90 tons	222 tons	20,000 tons
Active Detector Size (width, height, length) in feet	(9.5, 13.8, 27)	(9.5, 13.8, 47)	(51, 51, 282)
Liquid scintillator required (gallons)	19,920	29,600	4,333,000
Wavelength Shifting fiber required (kilometers)	38.6	113	16,750
Number of 32 cell extrusion modules required	335	496 (335 get re-used from the IPND)	15,624
Number of detector channels (cells)	10,720	15,872	499,968

Table B.1: Parameters of the three NO*ν*A detectors. The Far Detector is about 92 times the size of the Near Detector.

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Appendix C

Material Safety Data Sheets for Chemicals

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MSDS for

1,2,4-trimethylbenzene
Pseudocumene

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Safety (MSDS) data for 1,2,4-trimethylbenzene

Safety (MSDS) data for 1,2,4-trimethylbenzene

General
  Synonyms: pseudocumene
  Molecular formula: C9H12
  CAS No: 95-63-6
  EINECS No: 202-436-9
Physical data
  Appearance: colourless liquid
  Melting point: -43.8 C
  Boiling point: 169 C
  Vapour density:
  Vapour pressure:
  Density (g cm-3): 0.876
  Flash point: 48 C
  Explosion limits:
  Autoignition temperature:
  Water solubility: slightly soluble
Stability
  Stable. Incompatible with strong oxidizing agents. Flammable. May form explosive mixtures with air.
Toxicology
  Typical STEL 35 ppm. Typical TWA 25 ppm. May be harmful by ingestion, inhalation or through skin contact. Skin, eye and respiratory irritant.
  Toxicity data
  (The meaning of any toxicological abbreviations which appear in this section is given here.)
  ORL-RAT LD50 5000 mg kg-1
  IPN-RAT LDLO 2000 mg kg-1
  IHL-MUS 8147 ppm acute
  IPN-GPG LDLO 1566 mg kg-1
  Risk phrases
  (The meaning of any risk phrases which appear in this section is given here.)
  R36 R37 R38.
Transport information
Personal protection
  Safety glasses, adequate ventilation.
[Return to Physical & Theoretical Chemistry Lab. Safety home page.]

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MSDS for

Plastic welder Adhesive
Devcon-60

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PLASTIC WELDER II ACTIVATOR

This product appears in the following stock number(s):
14335 14340 14390 DA320

Last revised: 03/05/04
Printed: 3/25/2004

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Tradename: PLASTIC WELDER II ACTIVATOR
General use: Adhesive
Chemical family: Acrylate

MANUFACTURER

ITW Devcon
30 Endicott St.
Danvers, MA 01923

EMERGENCY INFORMATION

Emergency telephone number
(CHEMTREC): (800) 424-9300
Other Calls: (978) 777-1100

2. COMPOSITION/INFORMATION ON INGREDIENTS

HAZARDOUS CONSTITUENTS **Exposure limits**

Constituent	Abbr.	CAS No.	Weight percent	ACGIH TLV	OSHA PEL	Other Limits
3,5-Diethyl-1,2-dihydro-1-phenyl-2-propylpyridine		34562317	1-10	n/e	n/e	n/e
Methyl Methacrylate Monomer	MMA	80626	60 - 100	50 ppm	100 ppm	100 ppm (Canada)

"TLV" means the Threshold Limit Value exposure (eight-hour, time-weighted average, unless otherwise noted) established by the American Conference of Governmental Industrial Hygienists. "STEL" indicates a short-term exposure limit. "PEL" indicates the OSHA Permissible Exposure Limit."n/e" indicates that no exposure limit has been established. An asterisk (*) indicates a substance whose identity is a trade secret of our supplier and unknown to us.

3. HAZARDS IDENTIFICATION

Emergency Overview

Appearance, form, odor: Paste with varied fragrant odor.

WARNING! Flammable. Eye, skin and respiratory irritant. Skin sensitizer. Harmful if inhaled or absorbed through skin. Chronic overexposure may cause liver and kidney effects.

Potential health effects

Primary routes of exposure: ☒ Skin contact ☒ Skin absorption ☒ Eye contact ☒ Inhalation ☐ Ingestion

Symptoms of acute overexposure:

Skin: May cause irritation and sensitization. MMA may be absorbed through the skin.
Eyes: Liquid and vapors causes moderate irritation (burning ssensation, tearing, redness, swelling). May cause corneal damage.

Inhalation:
High concentration is irritant to respiratory tract and may cause dizziness, headache, and anaesthetic effects.

Ingestion:
Causes irritation, a burning sensation of the mouth, throat and gastrointestinal tract and abdominal pain.

Effects of chronic overexposure:
Prolonged exposure may lead to kidney, lung, heart and liver damage.

Carcinogenicity -- OSHA regulated: No **ACGIH: No** **National Toxicology Program: No**
International Agency for Research on Cancer: No

Medical conditions which may be aggravated by exposure:
Preexisting eye and skin disorders and diseases of the lung.

Other effects:
MMA: Developmental toxicity observed in animal tests, but only at levels toxic to the mother. MMA is reported to impair human olfactory function. Overexposure to pyridine and some of its derivatives may include weakness, dizziness, nausea, loss of consciousness, loss of appetite, and sleep disturbances.

4. FIRST AID MEASURES

First aid for eyes:
Flush eye with clean water for at least 15 minutes while gently holding eyelids open. Get immediate medical attention.

First aid for skin:
Immediately remove contaminated clothing and excess contaminant. Flush skin with water. Wash thoroughly with warm soap and water. Consult a physician if irritation develops.

First aid for inhalation:
Remove patient to fresh air. Administer oxygen if breathing is difficult. Get medical attention if symptoms persist.

First aid for ingestion:
Do NOT induce vomiting. Give two glasses of water to dilute if patient is conscious. Get medical attention.

5. FIRE FIGHTING MEASURES

General fire and explosion characteristics:
Vapor forms explosive mixture with air.

Extinguishing media:
☐ Water ☒ Carbon dioxide ☒ Dry chemical ☒ Foam ☐ Alcohol foam

Flash Point (°F): 50 **Method:** TCC

Explosive limits in air (percent) -- Lower: 2.1 **Upper:** 12.5

Special firefighting procedures:
Keep personnel removed and upwind from fire. Wear self contained breathing apparatus and full protective equipment. Cool tank with water spray. Fight fire from a distance as the heat may rupture the tanks.

Unusual fire and explosion hazards:
Sealed containers at elevated temperatures may rupture due to polymerization. Vapors are heavier than air and may travel to ignition sources and flash back.

Hazardous products of combustion:
Toxic vapors may be released upon thermal decomposition (cyanide, nitrogen oxides).

6. ACCIDENTAL RELEASE MEASURES

Spill control:

Avoid personal contact. Eliminate ignition sources. Ventilate area.

Containment:

Dike, contain and absorb with clay, sand or other suitable non-combustible material.

Cleanup:

For large spills, pump to storage/salvage vessels. Soak up residue with an absorbent such as clay, sand, or other suitable material and dispose of properly (RCRA hazardous waste). Add inhibitor to prevent polymerization.

Special procedures:

Prevent spill from entering drainage/sewer systems, waterways, and surface waters. Use non-sparking tools

7. HANDLING AND STORAGE

Handling precautions:

Do not breathe vapor or mist. Do not get in eyes, on skin or clothing. Wash thoroughly after handling. Close container after each use. Ground container when pouring. Keep away from heat, flame or sparks. Use non-sparking tools.

Storage:

Keep in a cool place, without direct exposure to sunlight. Keep container tightly closed and otherwise in accordance with NFPA regulations. Maintain air space in storage containers.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls

Ventilation :

Use ventilation that is adequate to keep employee exposure to airborne concentrations below exposure limits.

Other engineering controls :

Keep container tightly closed. Observe label precautions. Have emergency eye wash and safety shower present.

Personal protective equipment

Eye and face protection:

Wear safety glasses. Wear coverall chemical splash goggles and face shield when eye and face contact is possible.

Skin protection:

Wear impervious butyl rubber clothing as appropriate to prevent contact.

Respiratory protection:

A NIOSH/MSHA air purifying respirator with an organic vapor cartridge may be permissible, however use a positive pressure air supplied respirator if there is any potential for uncontrolled release, or unknown exposure levels.

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific gravity:	0.96	**Boiling point (°F):**	213
Melting point (°F):	n/d	**Vapor density (air = 1):**	3.5
Vapor pressure (mmHg):	28 mm Hg at 68 °F	**Evaporation rate (butyl acetate = 1):**	3
VOC (grams/liter):	< 50 mixed	**Solubility in water:**	n/d
Percent volatile by volume:	n/d	**pH (5% solution or slurry in water):**	4.5-5.5
Percent solids by weight:	n/d		

10. STABILITY AND REACTIVITY

This material is chemically stable. Hazardous polymerization may occur.

Conditions to avoid :
Unstable with heat, direct sunlight, inert gas blanketing, ultraviolet radiation.

Incompatible materials:
Incompatible with strong oxidizing agents and reducing agents, acids and bases. Material is a strong solvent and can soften paint and rubber.

Hazardous products of decomposition:
Carbon monoxide, carbon dioxide, nitrogen oxides, cyanide and smoke.

Conditions under which hazardous polymerization may occur:
Excessive heat, storage in the absence of inhibitor and inadvertant addition of catalyst.

11. TOXICOLOGICAL INFORMATION

Acute oral effects: LD50 (rat): Not available.
Toxicity of MMA exposed near LD50 include blood in the urine and liver changes.

Acute dermal effects: LD50 (rabbit): Not available.
Dermatitis.

Acute inhalation effects: LC50 (rat): Not available. Exposure: 4 hours.
Toxicity of MMA at 8-100 times TLV from respiratory and gastrointestional irritation, lung damage, nervous system effects and blood in urine.

Eye irritation:
Not available.

Subchronic effects:
Inhalation: Repeated exposure of MMA at 5-100 times the TLV include lung damage, pulmonary irritation, liver changes, eye irritation, nasal tissue changes, incoordination and upper respiratory irritation. Ingestion: Liver and kidney affects with altered function in both organs. Skin permeation may occur.

Carcinogenicity, teratogenicity, and mutagenicity:
Possible reproductive hazard based on animal data.

Other chronic effects:
Inhalation: long term exposure of MMA caused inflammation of the nasal cavity, changes in nasal sensory cells and decreased body weight. Ingestion: Can cause decreased body weight, and increased kidney weight

Toxicological information on hazardous chemical constituents of this product:

Constituent	Oral LD50 (rat)	Dermal LD50 (rabbit)	Inhalation LC50 4hr, (rat)
3,5-Diethyl-1,2-dihydro-1-phenyl-2-propylpyridine	> 500 mg/kg	> 1000 mg/kg	n/d
Methyl Methacrylate Monomer	7872 mg/kg	> 5,000 mg/kg	7093 ppm

'n/d' = 'not determined'

12 ECOLOGICAL INFORMATION

Ecotoxicity:

MMA has: estimate of 96 hour median threshold limit: 100-1,000 ppm; 96 hour LC50, fathead minnow: 150 ppm; 96 hour LC50, bluegill sunfish: 232 ppm

Mobility and persistence:

MMA is partially biodegradable in water. BOD-5 day: 0.14 g/g - 0.90 g/g; THOD : 1.92 g/g

Environmental fate:

MMA produces high tonnage material in wholly contained systems. Liquid with moderate mobility. Sparingly soluble in water. High potential for bioaccumulation. Low mobility in soil.

13. DISPOSAL CONSIDERATIONS

Please see also Section 15, Regulatory Information.

Waste management recommendations:

Do not dispose of in a landfill. Incineration is the preferred method of disposal.

14. TRANSPORT INFORMATION

Proper shipping name: Adhesives *****

Technical name : N/A

Hazard class : 3

UN number: 1133

Packing group: II

Emergency Response Guide no.: 128

IMDG page number: N/A

Other: Containers < 30 liters are PG III

*Depending upon the size and type of container, this material may be reclassified as "Consumer Commodity, ORM-D" for shipments within the United States, or "Limited Quantity" elsewhere. Refer to the appropriate regulation.

15. REGULATORY INFORMATION

U.S. Federal Regulations

TSCA
All ingredients of this product are listed, or are exempt from listing, on the TSCA inventory.

The following RCRA code(s) applies to this material if it becomes waste:
D001

Regulatory status of hazardous chemical constituents of this product:

Constituent	Extremely Hazardous*	Toxic Chemical**	CERCLA RQ (lbs)	TSCA 12B Export Notification
3,5-Diethyl-1,2-dihydro-1-phenyl-2-propylpyridine	No	No	0.0	Not required
Methyl Methacrylate Monomer	No	Yes	1000.0	Required

*Consult the appropriate regulations for emergency planning and release reporting requirements for substances on the SARA Section 301 Extremely Hazardous Substance list.

**Substances for which the "Toxic Chemical" column is marked "Yes" are on the SARA Section 313 list of Toxic Chemicals, for which release reporting may be required. For specific requirements, consult the appropriate regulations.

For purposes of SARA Section 312 hazardous materials inventory reporting, the following hazard classes apply to this material: - Immediate health hazard -- Delayed health hazard -- Fire hazard -- Reactivity hazard -

Canadian regulations

WHMIS hazard class(es) : B2; D2B
All components of this product are on the Domestic Substances List.

Regulatory notes:

In normal use, the methyl methacrylate in this product is polymerized during cure. For purposes of air quality regulations, the maximum amount of VOC (i.e. MMA) emitted is negligible (less than 5 %). Actual emissions are a function of substrate and process and should be considered on an individual basis.

16. OTHER INFORMATION

Hazardous Materials Identification System (HMIS) ratings:	Health	Flammability	Reactivity
	2*	3	2

The information and recommendations in this document are based on the best information available to us at the time of preparation, but we make no other warranty, express or implied, as to its correctness or completeness, or as to the results of reliance on this document.

PLASTIC WELDER II ADHESIVE

This product appears in the following stock number(s):
14335 14340 14390 DA305 DA320

Last revised: 03/08/04
Printed: 3/25/2004

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Tradename: PLASTIC WELDER II ADHESIVE
General use: Adhesive
Chemical family: Acrylate

MANUFACTURER

ITW Devcon
30 Endicott St.
Danvers, MA 01923

EMERGENCY INFORMATION

Emergency telephone number
(CHEMTREC): (800) 424-9300
Other Calls: (978) 777-1100

2. COMPOSITION/INFORMATION ON INGREDIENTS

HAZARDOUS CONSTITUENTS **Exposure limits**

Constituent	Abbr.	CAS No.	Weight percent	ACGIH TLV	OSHA PEL	Other Limits
Maleic acid		110167	1 - 10	n/e	n/e	n/e
2,6-Di-tertiary-butyl-para-cresol	BHT	128370	< 5	2 mg/m3	10mg/m3	n/e
p(BD/MMA/STY)		25053092	1 - 10	n/e	n/e	n/e
Carbon tetrachloride		56235	< 1	5 ppm	10 ppm	2 ppm (Canada)
Chlorosulfonated polyethylene		68037398	20 - 30	n/e	n/e	n/e
Methyl Methacrylate Monomer	MMA	80626	50 - 60	50 ppm	100 ppm	100 ppm (Canada)

"TLV" means the Threshold Limit Value exposure (eight-hour, time-weighted average, unless otherwise noted) established by the American Conference of Governmental Industrial Hygienists. "STEL" indicates a short-term exposure limit. "PEL" indicates the OSHA Permissible Exposure Limit."n/e" indicates that no exposure limit has been established. An asterisk (*) indicates a substance whose identity is a trade secret of our supplier and unknown to us.

3. HAZARDS IDENTIFICATION

Emergency Overview

Appearance, form, odor: Off-white paste with varied fragrant odor.

WARNING! Flammable. Eye, skin and respiratory irritant. Skin sensitizer. Harmful if inhaled or absorbed through skin. Chronic overexposure may cause liver and kidney effects.

Potential health effects

Primary routes of exposure: ☒ Skin contact ☒ Skin absorption ☒ Eye contact ☒ Inhalation ☐ Ingestion

Symptoms of acute overexposure:

Skin: May cause irritation and sensitization. MMA and maleic acid may pass through intact skin.

Eyes: Liquid and vapors causes moderate irritation (burning ssensation, tearing, redness, swelling). May cause conjunctivitis and corneal damage.

Inhalation:
High concentration is irritant to respiratory tract and may cause dizziness, headache, and anaesthetic effects.

Ingestion:
Causes irritation, a burning sensation of the mouth, throat and gastrointestinal tract and abdominal pain. May cause vomiting.

Effects of chronic overexposure:
Prolonged exposure may lead to kidney, lung, heart and liver damage.

Carcinogenicity -- OSHA regulated: No **ACGIH: No** **National Toxicology Program: No**
International Agency for Research on Cancer: No

Medical conditions which may be aggravated by exposure:
Preexisting eye and skin disorders and diseases of the lung.

Other effects:
Developmental toxicity observed in animal tests with MMA at levels toxic to the mother. MMA is reported to impair human olfactory function.

4. FIRST AID MEASURES

First aid for eyes:
Flush eye with clean water for at least 15 minutes while gently holding eyelids open. Get immediate medical attention.

First aid for skin:
Immediately remove contaminated clothing and excess contaminant. Flush skin with water. Wash thoroughly with warm soap and water. Consult a physician if irritation develops.

First aid for inhalation:
Remove patient to fresh air. Administer oxygen if breathing is difficult. Get medical attention if symptoms persist.

First aid for ingestion:
Do NOT induce vomiting. Give two glasses of water to dilute if patient is conscious. Get medical attention.

5. FIRE FIGHTING MEASURES

General fire and explosion characteristics:
Vapor forms explosive mixture with air.

Extinguishing media:
☐ Water ☒ Carbon dioxide ☒ Dry chemical ☒ Foam ☐ Alcohol foam

Flash Point (°F): 50 **Method:** TCC

Explosive limits in air (percent) -- Lower: 2.1 **Upper:** 12.5

Special firefighting procedures:
Keep personnel removed and upwind from fire. Wear self contained breathing apparatus and full protective equipment. Cool tank with water spray. Fight fire from a distance as the heat may rupture the tanks.

Unusual fire and explosion hazards:

Sealed containers at elevated temperatures may rupture due to polymerization. Vapors are heavier than air and may travel to ignition sources and flash back.

Hazardous products of combustion:

Carbon monoxide, carbon dioxide, fumaric acid, maleic anhydride fumes, and smoke.

6. ACCIDENTAL RELEASE MEASURES

Spill control:

Avoid personal contact. Eliminate ignition sources. Ventilate area.

Containment:

Dike, contain and absorb with clay, sand or other suitable non-combustible material.

Cleanup:

For large spills, pump to storage/salvage vessels. Soak up residue with an absorbent such as clay, sand, or other suitable material and dispose of properly (RCRA hazardous waste). Add inhibitor to prevent polymerization.

Special procedures:

Prevent spill from entering drainage/sewer systems, waterways, and surface waters. Use non-sparking tools

7. HANDLING AND STORAGE

Handling precautions:

Do not breathe vapor or mist. Do not get in eyes, on skin or clothing. Wash thoroughly after handling. Close container after each use. Ground container when pouring. Keep away from heat, flame or sparks. Use non-sparking tools.

Storage:

Keep in a cool place, without direct exposure to sunlight. Keep container tightly closed and otherwise in accordance with NFPA regulations. Maintain air space in storage containers.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls

Ventilation :

Use ventilation that is adequate to keep employee exposure to airborne concentrations below exposure limits.

Other engineering controls :

Keep container tightly closed. Observe label precautions. Have emergency eye wash and safety shower present.

Personal protective equipment

Eye and face protection:

Wear safety glasses. Wear coverall chemical splash goggles and face shield when eye and face contact is possible.

Skin protection:

Wear impervious butyl rubber clothing as appropriate to prevent contact.

Respiratory protection:

A NIOSH/MSHA air purifying respirator with an organic vapor cartridge may be permissible, however use a positive pressure air supplied respirator if there is any potential for uncontrolled release, or unknown exposure levels.

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific gravity:	0.93-1.05	**Boiling point (°F):**	213
Melting point (°F):	-54	**Vapor density (air = 1):**	3.5
Vapor pressure (mmHg):	28 mm Hg at 68 °F	**Evaporation rate (butyl acetate = 1):**	3
VOC (grams/liter):	< 50 mixed	**Solubility in water:**	n/d
Percent volatile by volume:	n/d	**pH (5% solution or slurry in water):**	
Percent solids by weight:	n/d		

10. STABILITY AND REACTIVITY

This material is chemically stable. Hazardous polymerization may occur.

Conditions to avoid :
Unstable with heat, direct sunlight, inert gas blanketing, ultrviolet radiation.

Incompatible materials:
Incompatible with strong oxidizing agents and reducing agents, metals, amines. Material is a strong solvent and can soften paint and rubber

Hazardous products of decomposition:
Carbon monoxide, carbon dioxide, fumaric acid, maleic anhydride fumes, and smoke.

Conditions under which hazardous polymerization may occur:
Excessive heat, storage in the absence of inhibitor and inadvertant addition of catalyst.

11. TOXICOLOGICAL INFORMATION

Acute oral effects: LD50 (rat): > 2000 mg/kg (estimate)
Toxicity of MMA exposed near LD50 include blood in the urine and liver changes.

Acute dermal effects: LD50 (rabbit): > 3000 mg/kg (estimate)
Dermatitis. Maleic acid is a skin and mucous membrane irritant.

Acute inhalation effects: LC50 (rat): Not available. Exposure: 4 hours.
Toxicity of MMA at 8-100 times TLV from respiratory and gastrointestional irritation, lung damage, nervous system effects and blood in urine.

Eye irritation:
Maleic acid is a severe eye irritant.

Subchronic effects:
Inhalation: Repeated exposure of MMA at 5-100 times the TLV include lung damage, pulmonary irritation, liver changes, eye irritation, nasal tissue changes, incoordination and upper respiratory irritation. Ingestion: Liver and kidney affects with altered function in both organs. Skin permeation may occur.

Carcinogenicity, teratogenicity, and mutagenicity:
Possible reproductive hazard based on animal data.

Other chronic effects:
Inhalation: long term exposure of MMA caused inflammation of the nasal cavity, changes in nasal sensory cells and decreased body weight. Ingestion: Can cause decreased body weight, and increased kidney weight

Toxicological information on hazardous chemical constituents of this product:

Constituent	Oral LD50 (rat)	Dermal LD50 (rabbit)	Inhalation LC50 4hr, (rat)
Maleic acid	708 mg/kg	1560 mg/kg	n/d
2,6-Di-tertiary-butyl-para-cresol	890 mg/kg	n/d	n/d
p(BD/MMA/STY)	n/d	n/d	n/d
Carbon tetrachloride	2350 mg/kg	>20gm/kg	8000ppm
Chlorosulfonated polyethylene	n/d	n/d	n/d
Methyl Methacrylate Monomer	7872 mg/kg	> 5,000 mg/kg	7093 ppm

'n/d' = 'not determined'

12 ECOLOGICAL INFORMATION

Ecotoxicity:

MMA has: estimate of 96 hour median threshold limit: 100-1,000 ppm; 96 hour LC50, fathead minnow: 150 ppm; 96 hour LC50, bluegill sunfish: 232 ppm

Mobility and persistence:

MMA is partially biodegradable in water. BOD-5 day: 0.14 g/g - 0.90 g/g; THOD : 1.92 g/g

Environmental fate:

MMA produces high tonnage material in wholly contained systems. Liquid with moderate mobility. Sparingly soluble in water. High potential for bioaccumulation. Low mobility in soil.

13. DISPOSAL CONSIDERATIONS

Please see also Section 15, Regulatory Information.

Waste management recommendations:

Do not dispose of in a landfill. Incineration is the preferred method of disposal.

14. TRANSPORT INFORMATION

Proper shipping name: Adhesives *

Technical name : N/A

Hazard class : 3

UN number: 1133

Packing group: II

Emergency Response Guide no.: 128

IMDG page number: N/A

Other: Containers < 30 liters are PG III

*Depending upon the size and type of container, this material may be reclassified as "Consumer Commodity, ORM-D" for shipments within the United States, or "Limited Quantity" elsewhere. Refer to the appropriate regulation.

15. REGULATORY INFORMATION

U.S. Federal Regulations

TSCA
All ingredients of this product are listed, or are exempt from listing, on the TSCA inventory.

The following RCRA code(s) applies to this material if it becomes waste:
D001, D019

Regulatory status of hazardous chemical constituents of this product:

Constituent	Extremely Hazardous*	Toxic Chemical**	CERCLA RQ (lbs)	TSCA 12B Export Notification
Maleic acid	No	No	5000.0	Not required
2,6-Di-tertiary-butyl-para-cresol	No	No	0.0	Not required
p(BD/MMA/STY)	No	No	0.0	Not required
Carbon tetrachloride	No	Yes	10.0	Not required
Chlorosulfonated polyethylene	No	No	0.0	Not required
Methyl Methacrylate Monomer	No	Yes	1000.0	Required

*Consult the appropriate regulations for emergency planning and release reporting requirements for substances on the SARA Section 301 Extremely Hazardous Substance list.

**Substances for which the "Toxic Chemical" column is marked "Yes" are on the SARA Section 313 list of Toxic Chemicals, for which release reporting may be required. For specific requirements, consult the appropriate regulations.

For purposes of SARA Section 312 hazardous materials inventory reporting, the following hazard classes apply to this material: - Immediate health hazard -- Delayed health hazard -- Fire hazard -- Reactivity hazard -

Canadian regulations

WHMIS hazard class(es) : B2; D2B
All components of this product are on the Domestic Substances List.

Regulatory notes:

In normal use, the methyl methacrylate in this product is polymerized during cure. For purposes of air quality regulations, the maximum amount of VOC (i.e. MMA) emitted is negligible (less than 5 %). Actual emissions are a function of substrate and process and should be considered on an individual basis.

16. OTHER INFORMATION

Hazardous Materials Identification System (HMIS) ratings:	Health	Flammability	Reactivity
	2*	3	2

The information and recommendations in this document are based on the best information available to us at the time of preparation, but we make no other warranty, express or implied, as to its correctness or completeness, or as to the results of reliance on this document.

Technical Data Sheet

1/3/2007

Plastic Welder™ 60

Description: Toughened structural adhesive, after curing, produces superior strength to load-bearing bonds to engineeered plastics. (ZH5-72-4)

Intended Use: Bond: PVC, Fiberglass, ABS, FRP, PBT, PPO, PCBB, Metton®, Lomod®, Valox®, Noryl® GTX, Minlon®, epoxy, RIM urethane, wood, poorly prepared surfaces, and where outdoor weathering or solvent exposure is anticipated.

Product features:

1:1 mix ratio
Minimal surface preparation
Non-sagging formula
Room temperature cure
Long open time
Low VOC

Limitations:

Typical Physical Properties:

Technical data should be considered representative or typical only and should not be used for specification purposes.

Cured 7 days @ 75° F

Shore Hardness	**78 Shore D**
Gap-Fill	**0.125 in.**
% Solids by Volume	**100**
Adhesive Tensile Lap Shear (PVC)	**1.324 psi**
Specific Volume	**28.1 in.(3)/lb.**

TESTS CONDUCTED

Adhesive Tensile Shear ASTM D 1002
Cured Hardness Shore D ASTM D 2240
Impact Resistance ASTM D 950

Uncured

Color	**Straw**
Viscosity	**Adhesive: 51,000 cps; Acvitator: 60,000 cps**
Weight	**Adhesive: 8.4 lbs./gal.; Activator: 8.00 lbs./gal**
Mixed Viscosity	**55,000 cps**
Mix Ratio by Volume	**1:1**
Mix Ratio by Weight	**1:1**
Mixed Density	**8.20 lbs./gal./.98gm/cc**
Flashpoint	**51°F**
Working Time	**20-30 min. @ 72°F**
Fixture Time	**45-60 min.@72°F, 22°C**
Functional Cure	**2 hrs.**
Full Cure	**24 hrs.**
Service Temperature	**-67°F to 250°F**

Surface Preparation: Clean surface by solvent-wiping any deposits of heavy grease, oil, dirt, or other contaminants. Surface can also be cleaned with industrial cleaning equipment such as vapor phase degreasers or hot aqueous baths. If working with metal, abrade or roughen the surface to significantly increase the microscopic bond area and optimize the bond strength.

Mixing Instructions: ---- Proper homogenous mixing of resin and hardener is essential for the curing and development of stated strengths. ----

25 ML DEV-TUBE
1. Squeeze material into a small container the size of an ashtray.
2. Using mixing stick included on Dev-tube handle, vigorously mix components for one (1) minute.
3. Immediately apply to substrate.

35ML/50 ML/250 ML/380 ML/400 ML CARTRIDGES
1. Attach cartridge to Mark V™ [50ml], 380ml, 250ml [15:1 caulk gun], or 400ml dispensing systems [manual or pneumatic].
2. Open tip.
3. Burp cartridge by squeezing out some material until both sides are uniform (ensures no air bubbles are present during mixing).
4. Attach mix nozzle to end of cartridge.
5. Apply to substrate.

Application Instructions:

1. Apply mixed product directly to one surface in an even film or as a bead.
2. Assemble with mating part within recommended working time.
3. Apply firm pressure between mating parts to minimize any gap and ensure good contact (a small fillet of product should flow out the edges to display adequate gap fill).
4. Bond line thickness of mixed adhesive should be @ .010"-.030" for optimum adhesion.

For very large gaps:
1. Apply product to both surfaces.
2. Spread to cover entire area OR make a bead pattern to allow flow throughout the joint.

Let bonded assemblies stand for recommended functional cure time prior to handling.

ADDITIONAL PRODUCT INFORMATION:
- Can withstand processing forces
- Do not drop, shock load, or heavily load
- Intermittent exposure to temperatures above 250°F do not reduce performance characteristics

STAINLESS STEEL AND ALUMINUM APPLICATIONS:
Apply Devcon Metal Prep 90 to prime and condition aluminum and stainless steel surfaces prior to using Plastic Welder. Metal Prep 90 is fast-drying at ambient temperatures. Plastic Welder can be applied within minutes of its use. Overlap shear strength will improve 30-40% if Metal Prep 90 is used.

Storage:

Store between 55°F and 75°F. Continuous storage above 75°F reduces the shelf life of the materials. Prolonged exposure above 100°F quickly diminishes the product's reactivity, and should be avoided. Shelf life can be extended by refrigeration between 45°F and 55°F. DO NOT FREEZE.

Compliances:

None

Chemical Resistance:

Chemical resistance is calculated with a 7 day, room temp. cure (30 days immersion) @ 75°F)

Acetic (Dilute) 10%	Excellent
Ammonia	Very good
Cutting Oil	Excellent
Glycols/Antifreeze	Excellent
Hydrochloric 10%	Fair
Mineral Spirits	Excellent
Motor Oil	Excellent
Sodium Hydroxide 10%	Very good

Precautions:

Please refer to the appropriate material safety data sheet (MSDS) prior to using this product.

For technical assistance, please call 1-800-933-8266

FOR INDUSTRIAL USE ONLY

Warranty:

Devcon will replace any material found to be defective. Because the storage, handling and application of this material is beyond our control, we can accept no liability for the results obtained.

Disclaimer:

All information on this data sheet is based on laboratory testing and is not intended for design purposes. ITW Devcon makes no representations or warranties of any kind concerning this data.

Order Information:

MSDS for

Methyl Methacrylate, 99%
MMA

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CATALOG # M5590-9 NAME: METHYL METHACRYLATE, 99%

CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
REMOVE AND WASH CONTAMINATED CLOTHING PROMPTLY.
DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

MELTING POINT: -48 C
BOILING POINT: 100 C
SPECIFIC GRAVITY: 0.936
VAPOR DENSITY: 3.5
VAPOR PRESSURE: 29.0 MM @ 20 C

FIRE AND EXPLOSION HAZARD DATA

AUTO IGNITION TEMP.: 435 F
LOWER EXPLOSION LEVEL: 2.12%
UPPER EXPLOSION LEVEL: 12.5%
FLASH POINT: 50 F

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.
FLAMMABLE LIQUID.

UNUSUAL FIRE AND EXPLOSION HAZARDS
VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.
MAY UNDERGO AUTOPOLYMERIZATION.
CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
OXIDIZING AGENTS
PEROXIDES
BASES
ACIDS
REDUCING AGENTS
AMINES
HALOGENS
HEAT
MAY POLYMERIZE ON EXPOSURE TO LIGHT.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
SHUT OFF ALL SOURCES OF IGNITION.
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH AN ACTIVATED CARBON ADSORBENT, TAKE UP AND PLACE IN CLOSED CONTAINERS. TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

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aldrich chemical co.

® P.O. Box 355, Milwaukee, Wisconsin 53201 USA • (414) 273-3850

ATTN: SAFETY DIRECTOR
FERMILAB
P O BOX 500
MS 219
BATAVIA IL 60510
S WILSON

DATE: 06/22/87
CUST # 210714 P.O. #

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # M5590-9 NAME: METHYL METHACRYLATE, 99%
CAS # 80-62-6

TOXICITY HAZARDS

RTECS # OZ5075000
METHACRYLIC ACID, METHYL ESTER
IRRITATION DATA

SKN-RBT 10 GM/KG OPEN	JIHTAB 23,343,41
EYE-RBT 150 MG	INMEAF 14,292,45

TOXICITY DATA

ORL-RAT LD50:7872 MG/KG	JIHTAB 23,343,41
IHL-RAT LC50:3750 PPM	L4CYAT 2,1880,63
IPR-RAT LD50:1328 MG/KG	JDREAF 51,1632,72
SCU-RAT LD50:7500 MG/KG	INMEAF 14,292,45
ORL-MUS LD50:5204 MG/KG	TOLED5 11,125,82
IPR-MUS LD50:1000 MG/KG	INMEAF 14,292,45
SCU-MUS LD50:6300 MG/KG	INMEAF 14,292,45
SCU-DOG LD50:4500 MG/KG	INMEAF 14,292,45
ORL-GPG LD50:6300 MG/KG	INMEAF 14,292,45
IPR-GPG LD50:2000 MG/KG	INMEAF 14,292,45
SCU-GPG LD50:6300 MG/KG	INMEAF 14,292,45

REVIEWS, STANDARDS, AND REGULATIONS
CARCINOGENIC REVIEW:ANIMAL INDEFINITE IMEMDT 19,187,79
CARCINOGENIC REVIEW:HUMAN INDEFINITE IMEMDT 19,187,79
ACGIH TLV-TWA 100 PPM 85INA8 5,406,86
MSHA STANDARD-AIR:TWA 100 PPM (410 MG/M3) DTLVS* 3,168,71
OSHA STANDARD-AIR:TWA 100 PPM FEREAC 39,23540,74
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA 8(A) PRELIMINARY ASSESSMENT INFORMATION, FINAL RULE FEREAC 47,26992,82
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, DECEMBER 1986
NTP CARCINOGENESIS STUDIES (INHALATION);NO EVIDENCE:MOUSE,RAT NTPTR* NTP-TR-314,86
NTP CARCINOGENESIS STUDIES;TEST COMPLETED (CAMERA COPY IN PROGRESS), SEPTEMBER 1986
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
VAPOR OR MIST IS IRRITATING TO THE EYES, MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
CAUSES SKIN IRRITATION.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
MAY CAUSE ALLERGIC RESPIRATORY AND SKIN REACTIONS.
PROLONGED EXPOSURE CAN CAUSE:
NARCOTIC EFFECT.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED

M A T E R I A L S A F E T Y D A T A S H E E T PAGE: 3

CATALOG # M5590-9 NAME: METHYL METHACRYLATE, 99%

WASTE DISPOSAL METHOD
BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY FLAMMABLE.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ----

CHEMICAL SAFETY GOGGLES.
WEAR HEAVY RUBBER GLOVES.
SAFETY SHOWER AND EYE BATH.
FACESHIELD (8-INCH MINIMUM).
USE ONLY IN A CHEMICAL FUME HOOD.
NIOSH/MSHA-APPROVED RESPIRATOR.
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
LACHRYMATOR.
POSSIBLE SENSITIZER.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
REFRIGERATE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

ADDITIONAL INFORMATION
METHYL METHACRYLATE IS INHIBITED WITH 10 PPM HYDROQUINONE MONOMETHYL ETHER. DO NOT STORE UNDER INERT ATMOSPHERE. IT IS ADVISABLE TO USE MATERIAL WITHIN 6 MONTHS.

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

Received 6/26/87

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Milwaukee, Wisconsin 53233
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B-1030 Brussels
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D-7924 Steinheim
Telephone: (07329) 87-0
Telex: 714838 Aldri D
FAX: (07329) 87 39

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MSDS for

2,5-diphenyloxazole
PPO wave shifter #1

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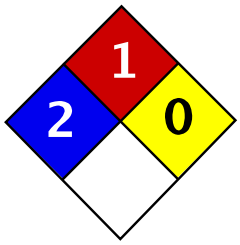

Health	2
Fire	1
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
PPO MSDS

Section 1: Chemical Product and Company Identification

Product Name: PPO

Catalog Codes: SLP1039

CAS#: 92-71-7

RTECS: RP6825000

TSCA: TSCA 8(b) inventory: PPO

CI#: Not available.

Synonym: 2,5-Diphenyloxazole

Chemical Formula: C15H11NO

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
PPO	92-71-7	100

Toxicological Data on Ingredients: PPO LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact: Check for and remove any contact lenses. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin

with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation: Not available.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: These products are carbon oxides (CO, CO2), nitrogen oxides (NO, NO2...).

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks.
Slightly flammable to flammable in presence of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not breathe dust. Wear suitable protective clothing In case of insufficient ventilation, wear suitable respiratory equipment If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Combustible materials should be stored away from extreme heat and away from strong oxidizing agents.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 221.25 g/mole

Color: Not available.

pH (1% soln/water): Not applicable.

Boiling Point: 360°C (680°F)

Melting Point: 71°C (159.8°F)

Critical Temperature: Not available.

Specific Gravity: Not available.

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Insoluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations: TSCA 8(b) inventory: PPO

Other Regulations: Not available..

Other Classifications:

WHMIS (Canada): Not controlled under WHMIS (Canada).

DSCL (EEC): R36/38- Irritating to eyes and skin.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/11/2005 12:23 PM

Last Updated: 10/11/2005 12:23 PM

MSDS for

1,4-di-(2-methylstyryl)-benzene
Bis-MSB wave shifter #2

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Material Safety Data Sheet

Date Printed: 06/FEB/2005
Date Updated: 13/MAR/2004
Version 1.1
According to 91/155/EEC

1 - Product and Company Information

Product Name	1,4-BIS(2-METHYLSTYRYL)BENZENE, 99%
Product Number	222445
Company	Sigma-Aldrich Pty, Ltd Unit 2, 14 Anella Avenue Castle Hill NSW 1765 Australia
Technical Phone #	+61 2 9841 0555
Fax	+61 2 9841 0500
Emergency Phone #	+61 2 9841 0566

2 - Composition/Information on Ingredients

Product Name	CAS #	EC no	Annex I Index Number
1,4-BIS(2-METHYLSTYRYL)BENZENE	13280-61-0	236-285-5	None

Formula	C24H22
Molecular Weight	310.44 AMU

3 - Hazards Identification

4 - First Aid Measures

AFTER INHALATION
If inhaled, remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen.

AFTER SKIN CONTACT
In case of contact, immediately wash skin with soap and copious amounts of water.

AFTER EYE CONTACT
In case of contact, immediately flush eyes with copious amounts of water for at least 15 minutes.

AFTER INGESTION
If swallowed, wash out mouth with water provided person is conscious. Call a physician.

5 - Fire Fighting Measures

EXTINGUISHING MEDIA
Suitable: Water spray. Carbon dioxide, dry chemical powder, or appropriate foam.

SPECIAL RISKS
Specific Hazard(s): Emits toxic fumes under fire conditions.

SPECIAL PROTECTIVE EQUIPMENT FOR FIREFIGHTERS
Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.

6 - Accidental Release Measures

PROCEDURE(S) OF PERSONAL PRECAUTION(S)
Wear respirator, chemical safety goggles, rubber boots, and heavy rubber gloves.

METHODS FOR CLEANING UP
Sweep up, place in a bag and hold for waste disposal. Avoid raising dust. Ventilate area and wash spill site after material pickup is complete.

7 - Handling and Storage

HANDLING
Directions for Safe Handling: Do not breathe dust. Avoid contact with eyes, skin, and clothing.

STORAGE
Conditions of Storage: Keep tightly closed. Store in a cool dry place.

SPECIAL REQUIREMENTS: Light sensitive.

8 - Exposure Controls / Personal Protection

ENGINEERING CONTROLS
Safety shower and eye bath. Mechanical exhaust required.

GENERAL HYGIENE MEASURES
Wash thoroughly after handling. Wash contaminated clothing before reuse.

PERSONAL PROTECTIVE EQUIPMENT
Respiratory Protection: Government approved respirator.
Hand Protection: Compatible chemical-resistant gloves.
Eye Protection: Chemical safety goggles.

9 - Physical and Chemical Properties

Appearance	Color: Light yellow Form: Fine crystals

Property	Value	At Temperature or Pressure
pH	N/A	
BP/BP Range	N/A	
MP/MP Range	180 °C	
Flash Point	N/A	
Flammability	N/A	
Autoignition Temp	N/A	
Oxidizing Properties	N/A	
Explosive Properties	N/A	
Explosion Limits	N/A	
Vapor Pressure	N/A	
SG/Density	N/A	
Partition Coefficient	N/A	
Viscosity	N/A	

Vapor Density	N/A
Saturated Vapor Conc.	N/A
Evaporation Rate	N/A
Bulk Density	N/A
Decomposition Temp.	N/A
Solvent Content	N/A
Water Content	N/A
Surface Tension	N/A
Conductivity	N/A
Miscellaneous Data	N/A
Solubility	N/A

10 - Stability and Reactivity

STABILITY
Materials to Avoid: Strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS
Hazardous Decomposition Products: Carbon monoxide, Carbon dioxide.

11 - Toxicological Information

SIGNS AND SYMPTOMS OF EXPOSURE
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

ROUTE OF EXPOSURE
Inhalation: Material is irritating to mucous membranes and upper respiratory tract.
Multiple Routes: May be harmful by inhalation, ingestion, or skin absorption. Causes eye and skin irritation.

12 - Ecological Information

No data available.

13 - Disposal Considerations

SUBSTANCE DISPOSAL
Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Observe all federal, state, and local environmental regulations.

14 - Transport Information

RID/ADR
Non-hazardous for road transport.

IMDG
Non-hazardous for sea transport.

IATA
Non-hazardous for air transport.

15 - Regulatory Information

CLASSIFICATION AND LABELING ACCORDING TO EU DIRECTIVES
S-PHRASES: 22 24/25
Do not breathe dust. Avoid contact with skin and eyes.

16 - Other Information

WARRANTY

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Inc., shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice or packing slip for additional terms and conditions of sale.

DISCLAIMER

For R&D use only. Not for drug, household or other uses.

Appendix D

Biological Resource Review Correspondence

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EcoCAT
Ecological Compliance Assessment Tool

Applicant:	U.S. Department of Energy/Fermi National Accelerator Laboratory	*IDNR Project #:*	0803332
Contact:	Sally Arnold	Date:	09/27/2007
Address:	Fermi Site Office, P.O. Box 2000 Batavia, IL 60510		

Project: NuMI OFF-AXIS ve APPEARANCE EXPERIMENT (NOvA)
Address: Fermi National Accelerator Laboratory, Kirk Rd. & Pine St., Batavia

Description: Fermilab is planning to expand an existing underground tunnel, known as the Neutrinos at the Main Injector (NuMI) beamline facility, to accommodate a new experiment that will utilize an upgraded NuMI neutrino beam along a new trajectory toward a detector in Minnesota. This new project is called NOvA. The expansion of the underground tunnel will angle slightly off axis from the NuMI beamline and require excavation about 105 meters underneath the Fermilab site for an estimated length of about 18 meters. The tunnel will be about 3-4 meters in diameter. Although the original NuMI beamline required the construction of surface facilities, no additional surface facilities are planned for the NOvA tunneling project. We do not foresee the modification of any ecological habitat.

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
Black-Crowned Night Heron *(Nycticorax nycticorax)*
Blanding'S Turtle *(Emydoidea blandingii)*
Upland Sandpiper *(Bartramia longicauda)*

Location

The applicant is responsible for the accuracy of the location submitted for the project.

County: Kane

Township, Range, Section:
39N, 8E, 25

IL Department of Natural Resources Contact
Impact Assessment Section
217-785-5500
Division of Ecosystems & Environment

Local or State Government Jurisdiction
Other

, Illinois

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.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chicago Ecological Services Field Office
1250 South Grove Avenue, Suite 103
Barrington, Illinois 60010
Phone: (847) 381-2253 Fax: (847) 381-2285

IN REPLY REFER TO:
FWS/AES-CIFO/8-FA-0053 / SL-0054

October 22, 2007

Ms. Sally C. Arnold
Department of Energy
Fermi Site Office
Post Office Box 2000
Batavia, Illinois 60510

Dear Ms. Arnold:

This responds to your letter dated October 1 2007 requesting information on endangered or threatened species for the proposed expansion of an existing underground tunnel. The expansion of the underground tunnel will angle slightly off axis from the existing beamline and require excavation approximately 105 meters underneath the Fermilab site for an estimated length of 18 meters. This tunnel would be approximately 3-4 meters in diameter. No surface facilities are planned nor do you foresee the modification of any ecological habitat. This proposed project is located at T39N, R8E, Section 25 in Kane County, Illinois as depicted on the map you enclosed.

The proposed project site is directly adjacent to Kane County Advanced Identification (ADID) site #s 2851, 2871, and 2860. ADID studies are conducted under the auspices of the U.S. Environmental Protection Agency to identify in advance of specific projects, those wetlands that are of the highest function and value. The results of ADID studies provide landowners and planners with information about the most important aquatic resources in a given area so that advance planning can take them into account.

ADID site #s 2851 and 2871 are determined to have high habitat value. High habitat value wetlands are characterized by having "high quality wildlife habitat, high floristic quality, or high quality aquatic habitat." High value habitat sites are considered "irreplaceable" and unmitigatable based on the fact that the complex biological systems and functions that these sites support cannot be successfully recreated within a reasonable time frame using existing mitigation methods. Both of these ADID sites support northern flatwood communities with ADID site # 2871 also supporting a sedge meadow community.

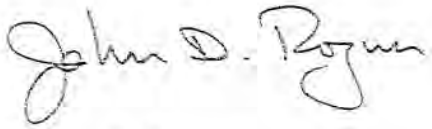
ADID site # 2860 is determined to be a high functional wetland site. High functional wetlands are considered to provide "exceptionally important benefits or functions worthy of extraordinary protection and management considerations." We caution you to avoid impacts, whether direct or indirect, to all three of these ADID sites.

Based on the information provided in your submittal and a review of our records, we do not believe that any federally endangered or threatened species occur in the vicinity of the site. This conclusion is based on the best available information, including information in your submittal, the scientific and technical literature, and our own files. Newer information based on updated surveys, changes in the abundance and distribution of listed species, changed habitat conditions, or other factors could change the conclusion. This could become more likely if projects experience significant delays in implementation. Feel free to contact us if you need more current information or assistance regarding the potential presence of federally listed species.

These comments only address federally listed species. Please contact the Illinois Department of Natural Resources for information on State-listed species. Also, we may have the opportunity to review the project for a broader range of fish and wildlife impacts if it requires a Section 404 permit. We are willing to work with you in advance of formal submittal if it would help streamline the approval process.

If you have any questions, please contact Ms. Cathy Pollack at 847/381-2253 ext. 20, or Ms. Karla Kramer at 847/381-2253 ext. 12.

Sincerely,



John D. Rogner
Field Supervisor

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Twin Cities Field Office
4101 American Blvd E.
Bloomington, Minnesota 55425-1665

MAR 18 2008

Ms. Sally C. Arnold
Document Manager for the NOvA Project
Department of Energy
P.O. Box 2000
Batavia, Illinois 60510

Dear Ms. Arnold:

This responds to your February 4, 2008, letter, requesting information on the potential for encountering threatened or endangered species within a proposed project corridor for the NOvA experiment in northern Minnesota. The proposed project would construct a new Far Detector facility, occupying part of a 90-acre plot near the Ash River in Section 18, T68N, R19W, of St. Louis County. The University of Minnesota, a research partner, would acquire an easement for a 20-acre road corridor for a distance of 3.6 miles. An all-weather road would be constructed over an existing logging road. Wetland impacts would be expected and a Corps of Engineers permit would be required to avoid, minimize, and mitigate all wetland impacts.

Canada lynx (*Lynx canadensis*) may be present in the action area. Canada lynx inhabit conifer forest that contain patches of high quality habitat for snowshoe hare (*Lepus americanus*), their primary prey. Canada lynx have been detected in the general vicinity of the proposed action (e.g., in Voyageurs National Park) and, thus, may be present in the area to be affected by the proposed action. For additional information regarding Canada lynx, contact our office or see our Internet site at <http://www.fws.gov/midwest/Endangered/mammals/lynx/index.html >. Section 7 of the Endangered Species Act of 1973, as amended, requires each federal agency to review any action that it funds, authorized or carries out to determine whether it may affect threatened, endangered, proposed or listed critical habitat. Federal agencies (or their designated representatives) must consult with the Fish and Wildlife Service (Service) if any such effects may occur as a result of their actions. Consultation with the Service is not necessary if the proposed action will not directly or indirectly affect listed species or critical habitat. If a federal agency finds that an action will have no effect on listed species or critical habitat, it should maintain a written record of that finding that includes the supporting rational. Please note that your action area lies within the boundary of proposed critical habitat for Canada lynx. Federal action agencies must avoid actions which are likely to destroy or modify proposed critical habitat. We are available to confer with you further on this matter at your convenience.

If you have any questions, please call Mr. Nick Rowse, of my staff, at 612-725-3548 x210.

Sincerely,

Tony Sullins
Field Supervisor

Cc: Superintendent, Voyageurs National Park, International Falls, MN

Appendix E

Cultural and Historic Resources Documentation

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Department of Energy
Fermi Site Office
Post Office Box 2000
Batavia, Illinois 60510

December 18, 2007

Ms. Anne E. Haaker, Deputy State Historic Preservation Officer
Illinois Historic Preservation Agency
Old State Capitol
Springfield, Illinois 62701

Dear Ms. Haaker:

SUBJECT: NATIONAL HISTORIC PRESERVATION ACT DETERMINATION – FERMI NATIONAL ACCELERATOR LABORATORY (FERMILAB) NEUTRINO DETECTOR, BATAVIA, ILLINOIS

The purpose of this letter is to initiate consultation with your office in order to satisfy Section 106 of the National Historic Preservation Act (Public Law 102-575).

The research program is called NOvA (**Nu**MI **O**ff-**A**xis Electron Neutrino (ν_e) **A**ppearance Experiment). NuMI is an acronym for Neutrinos at the Main Injector. The Main Injector is a proton accelerator at the Department of Energy's (DOE's) Fermilab near Batavia, Illinois. The research program will require two neutrino detectors, one in Minnesota and one on the Fermilab site. We are currently in consultation with the Minnesota State Historic Preservation Officer on the Minnesota detector. The Fermilab detector would be located in a cavern 105 meters (345 feet) below grade and require the excavation of approximately 770 cubic meters (1,000 cubic yards) of rock. Existing shafts and access tunnels would be used. Excavated rock would be placed in surface stock piles.

Both the detector and associated stock pile(s) would be located in areas previously surveyed for historical properties, but where none have been identified. See enclosed Fermi National Accelerator Laboratory Cultural Resources Management Plan dated September 13, 2002. Based on this Plan, DOE has determined, pursuant to 36 Code of Federal Regulations Section 800.4(d)(1), that "no historic properties will be affected" by the Fermilab NOvA detector.

If you have questions, please feel free to contact me via telephone at 630-252-2007 or by e-mail at peter.siebach@ch.doe.gov. Alternatively, you can contact our project manager, Mr. Pepin Carolan, via telephone at 630-840-2227 or via e-mail at pepin.carolan@ch.doe.gov.

Sincerely,

/S/ 12/18/2007

Peter R. Siebach, Lead Agency Official
for National Historic Preservation Act
Compliance
NOvA Project

Enclosure:
As Stated

October 12, 2007

Mr. Dennis Gimmestad
Review and Compliance
Minnesota Historical Society
345 Kellogg Blvd. W.
St. Paul, MN 55102-1903

Dear Mr. Gimmestad:

SUBJECT: NATIONAL HISTORIC PRESERVATION ACT CONSULTATION – NEUTRINO DETECTOR NEAR ASH RIVER, MN

The purpose of this letter is to initiate consultation under Section 106 of the National Historic Preservation Act (16 U.S.C. 470s, as amended) regarding the U.S. Department of Energy's (DOE's) proposal to conduct a new experimental research program in neutrino physics.

The research program is called NOνA [**N**uMI **O**ff-**A**xis Electron Neutrino (ν_e) **A**ppearance Experiment]. NuMI is an acronym for Neutrinos at the Main Injector. The Main Injector is a proton accelerator at DOE's Fermi National Accelerator Laboratory (Fermilab) near Batavia, Illinois. The NuMI beamline is currently aimed at an existing detector in the Soudan Mine located in Soudan, Minnesota. The NOνA research program would require the construction of an additional detector, the NOνA Far Detector, in the area of Ash River, MN, approximately 15 kilometers (9.3 miles) east of U.S. Highway 53 along the Ash River Trail Road (St. Louis County 129), about 40 kilometers (25 miles) southeast of International Falls. The structure housing the detector would be approximately 20.4 meters wide and 114 meters long (67 feet by 375 feet) and excavated 12 meters (40 feet) below the existing grade into granite rock at the site.

The purpose of the NOνA research program would be to advance human understanding of the physics of the neutrino particle, which is similar to an electron, but with an extremely small (almost zero) mass and without the charge. The neutrino flux from the existing NuMI neutrino beamline would be detected and measured using this new detector at the Ash River location, a location specially selected to achieve the physics measurements required for the experiment. Although scientists have much to learn about neutrinos, they know that neutrinos cannot harm the health or safety of people, animals or

other living things. Neutrinos cannot harm the water, the air, or the earth they pass through. The reason they are harmless is that they interact so rarely with other particles of matter. They pass through matter, including the earth, with no effect, as if it were not there. Scientists know that neutrinos are not harmful because of the many neutrino experiments and observations of naturally-occurring neutrinos that have been carried out all over the world since the discovery of neutrinos in 1956. Environmental protection and safety are topics which will be fully addressed in the environmental assessment being prepared for this project, which we intend to send to you in draft.

The University of Minnesota would be DOE's partner on the NOvA research program. DOE proposes to enter into a cooperative agreement with the University of Minnesota, that would provide $45,600,000 to cover construction of the facility to house the NOvA Far Detector. As part of the cooperative agreement, the scientists from the University will participate in the research. Because of the Federal funding, it qualifies as a "Federal undertaking" under the National Historic Preservation Act (NHPA) and is therefore subject to the requirements of the Advisory Counsel on Historic Preservation (ACHP) regulations for Protection of Historic Properties (36 CFR Part 800.16(y)).

Information concerning historic and/or cultural resources that could be located in the vicinity of the proposed site of the NOvA Far Detector is very important to us. If you are aware of such resources, or require additional information, please contact me. I can be reached via telephone at 630-252-2007, or by e-mail at peter.siebach@ch.doe.gov. Alternatively, you can contact our project manager, Mr. Pepin Carolan, via telephone at 630-840-2227 or via e-mail at pepin.carolan@ch.doe.gov. A response by November 9, 2007, would be appreciated.

Sincerely,

Peter R. Siebach
NEPA Compliance Officer

cc: Jim Jones, Minnesota Indian Affairs Council
David Woodward, 1854 Treaty Authority
Kathleen O'Brien, University of Minnesota
Marvin Marshak, University of Minnesota
William Miller, University of Minnesota

Preserving America's Heritage

April 14, 2008

Mr. Peter R. Siebach
Department of Energy
Chicago Operations Office
9800 South Cass Avenue
Argonne, IL 60439

Ref: ***Proposed NOvA Far Detector Facility Project***
Ash River, St. Louis County, Minnesota

Dear Mr. Siebach:

On April 2, 2008, the Advisory Council on Historic Preservation (ACHP) received your notification and supporting documentation regarding the adverse effects of the referenced undertaking on properties listed and eligible for listing on the National Register of Historic Places. Based upon the information you provided, we have concluded that Appendix A, *Criteria for Council Involvement in Reviewing Individual Section 106 Cases,* of our regulations, "Protection of Historic Properties" (36 CFR § 800) does not apply to this undertaking. Accordingly, we do not believe that our participation in the consultation to resolve adverse effects is needed. However, if we receive a request for participation from the State Historic Preservation Officer, Tribal Historic Preservation Officer, affected Indian tribe, a consulting party, or other party, we may reconsider this decision. Additionally, should circumstances change and you determine that our participation is required, please notify us.

Pursuant to 36 CFR § 800.6(b)(1)(iv), you will need to file the final Memorandum of Agreement (MOA), developed in consultation with the Minnesota State Historic Preservation Officer and any other consulting parties, and related documentation with the ACHP at the conclusion of the consultation process. The filing of the MOA and supporting documentation with the ACHP is required in order to complete the requirements of Section 106 of the National Historic Preservation Act.

Thank you for providing us with your notification of adverse effect. If you have any questions or require further assistance, please contact Tom McCulloch at 202-606-8554, or via email at tmculloch@achp.gov.

Sincerely,

Raymond V. Wallace

Raymond V. Wallace
Historic Preservation Technician
Federal Property Management Section
Office of Federal Agency Programs

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PROGRAMMATIC AGREEMENT

BETWEEN THE

UNITED STATES DEPARTMENT OF ENERGY

AND THE

MINNESOTA STATE HISTORIC PRESERVATION OFFICE, BOIS FORTE BAND OF MINNESOTA CHIPPEWA, AND THE WHITE EARTH BAND OF MINNESOTA CHIPPEWA

REGARDING CONSTRUCTION AND OPERATION OF THE FAR DETECTOR FOR THE NEUTRINOS AT THE MAIN INJECTOR OFF-AXIS NEUTRINO APPEARANCE EXPERIMENT

WHEREAS, the United States Department of Energy (DOE) and the University of Minnesota (U of MN) have entered into a cooperative agreement under which DOE will partially fund the proposed construction and operation by the U of MN of a Far Detector Facility (the Project), for the Neutrinos at the Main Injector (NuMI) Off-Axis Neutrino (ν) Appearance Experiment (NOνA)[1]; and

WHEREAS, the Federal funding qualifies the Project as a Federal Undertaking; and

WHEREAS Federal Undertakings are subject to review under the National Historic Preservation Act (NHPA), 16 U.S.C. § 470, Section 106 and the implementing regulations of the Advisory Council for Historic Preservation (ACHP), at 36 C.F.R. Part 800, Subpart B; and

WHEREAS, the proposed site for the Project is in the area of Ash River, Minnesota, approximately 15 kilometers (9.3 miles) east of U.S. Highway 53 along the Ash River Trail Road (St. Louis County 129), about 40 kilometers (25 miles) southeast of International Falls; and

WHEREAS, a cultural resources assessment[2] was completed in December 2005 for the Ash River Site, which indicated low potential for pre-contact archaeological sites to exist within the facility footprint due to the presence of exposed bedrock and shallow soils; and

---

1 The purpose of the NOνA experiment is advance the understanding of the neutrino particle. Neutrinos originating at a proton accelerator at the DOE Fermi National Accelerator Laboratory (Fermilab) near Batavia, Illinois, would be detected at the Far Detector Facility.

2 *Cultural Resources Assessment for the Fermilab NOνA Project – Ash River Falls Site, St. Louis County, Minnesota*, December 2005

WHEREAS, higher potential for pre-contact archaeological sites exists along the proposed access road corridor; and

WHEREAS, the cultural resources assessment recommended "testing to determine if any intact archaeological deposits are present" in higher potential areas; and

WHEREAS, the DOE has defined the Project's area of potential effect (APE) on archaeological resources to include the entire project area, which includes the locations of a detector enclosure and an assembly area 360 feet long by 67 feet wide, and a 130 foot long service building of the same width, as well as an access road and a parking area for 25 vehicles, and all areas of ground disturbance including temporary workspace, areas where construction vehicles may operate, and storage areas, for a total of approximately 121 acres[3]; and

WHEREAS, the APE for architectural history resources was determined by the DOE in consultation with the SHPO to be 1,110 acres and is composed of one known historical resource, a historic railroad grade for the Virginia and Rainy Lake (V&RL) logging railroad, originally identified during the 2005 cultural resources assessment[4]; and

WHEREAS, the entire V&RL logging railroad, including the main line and spurs, is presumed to be eligible for listing on the NRHP[5]; and

WHEREAS, the cultural resources assessment stated: "further research is recommended on this railroad segment"; and

---

3 This includes 4.99 acres for the facility footprint, 84.63 to 97.09 acres of buffer which could possibly be disturbed during construction, and 18.90 acres for the access road (66 foot wide corridor including the road and associated buffer area).

4 The Railroad grade is presumed to be eligible for listing in the National Register of Historic Places because it meets several criteria listed in the Multiple Property Documentation Form for Commercial Logging in Minnesota (1837-1940s). The railroad has potential significance under Criterion A, within the context of Northern Minnesota Lumbering, for contributing the broad patterns of history as the embodiment of employment creation, capital investment, and settlement, by creating transportation systems and supply routes in the formerly isolated northern St. Louis and Koochiching counties. The railroad, including the mainline that extended to dozens of logging camps and the countless logging spurs that allowed the forest to be clear cut, has potential significance under Criterion C as a distinctive, designed system that allowed the vast forests of Northern Minnesota to be economically harvested and shipped to far away mills for processing into milled lumber that was vital to the construction industry in the Midwest and Great Plains in the late nineteenth and the first part of the twentieth century (Douglas A. Birk 1998 Commercial Logging in Minnesota (1837-1940s) National Register of Historic Places Multiple Property Documentation Form, NPS)

5 The railroad line retains sufficient integrity of design, setting, materials, workmanship, feeling, and association. The line is clearly visible, the alignment, scale, and basic orientations of the bed are retained, the character and setting of the line are not marred by modern developments, the line is of adequate length to convey a sense of purpose or destination (Douglas A. Birk 1998 Commercial Logging in Minnesota (1837-1940s) National Register of Historic Places Multiple Property Documentation Form, NPS).

WHEREAS, an analysis of potential effects of the Project[6] was completed in February 2008 for the Ash River Site, which indicated that a no adverse effect determination would be contingent upon certain design recommendations being implemented; and

WHEREAS, snow and ice within the APE have precluded field verification of the conclusions contained in the analysis of effects report; and

WHEREAS, the DOE has determined that potential remains for adverse effect on both pre-contact archaeological sites and the railroad grade; and

WHEREAS, the Minnesota State Historic Preservation Office (MN SHPO) has requested a Phase I archaeological survey within the project APE and DOE has concurred that this will occur prior to any construction activities; and

WHEREAS, the DOE initiated consultation with the Bois Forte Band of Minnesota Chippewa Tribal Historic Preservation Officer (THPO), the White Earth Band of Minnesota Chippewa THPO, the Leech Lake Band of Ojibwe THPO, the Grand Portage Band of Chippewa THPO, and the Fond du Lac Band of Lake Superior Chippewa Reservation Cultural Resources Specialist; and

WHEREAS, the Bois Forte Band of Minnesota Chippewa Tribal Historic Preservation Officer (THPO) and the White Earth Band of Minnesota Chippewa THPO responded, indicating that they are not aware of any occurrences of cultural resources, although not precluding their presence; and

WHEREAS, the Bois Forte Band of Minnesota Chippewa THPO and the White Earth Band of Minnesota Chippewa THPO have indicated a desire to participate as required signatories to this Agreement; and

WHEREAS, in accordance with 36 C.F.R. § 800.6(a)(1)(i)(C), DOE has notified the Advisory Council on Historic Preservation (ACHP) of the Programmatic Agreement with specified documentation and the ACHP has chosen not to participate in the consultation pursuant to 36 CFR § 800.6(a)(1)(iii); and

WHEREAS, the project will require a Department of the Army permit from the U.S. Army Corps of Engineers, St. Paul District pursuant to its regulatory authority under Section 404 of the Clean Water Act (33 U.S.C. 1344); and

WHEREAS, the United States Army Corp of Engineers may have jurisdiction over a wetland in the Project APE and has been consulted concerning this Agreement; and

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6 *Fermilab NOvA Project Ash River Falls Site Analysis of Effects Study, St. Louis County, Minnesota*, February 2008.

WHEREAS, DOE is the lead agency for compliance with the National Historic Preservation Act; and

WHEREAS, satisfaction of this Agreement evidences that the DOE has considered effects on historic properties and has afforded the Advisory Council, the SHPO, the Bois Forte Band of Minnesota Chippewa, and the White Earth Band of Minnesota Chippewa an opportunity to comment, satisfying their responsibilities under Section 106 of the NHPA.

NOW, THEREFORE, the DOE, the MN SHPO, the Bois Forte Band of Minnesota Chippewa THPO, and the White Earth Band of Minnesota Chippewa THPO agree that the Undertaking shall be implemented in accordance with the following stipulations to take into account the effect of the undertakings on historic properties.

STIPULATIONS

The Parties agree as follows:

I. ARCHAEOLOGICAL SURVEY

1. DOE will ensure the completion of a Phase I archaeological survey in Spring, 2008, as weather conditions permit.

2. DOE will ensure that the results of the Phase I archaeological survey are documented in a technical report that satisfies the requirements of *The Secretary of the Interior's Standards and Guidelines for Federal Agency Historic Preservation* [Federal Register, Vol. 48, No. 190, pp. 44716-44740, September 29, 1983] (National Park Service [NPS] 1983).

3. If no archaeological resources are discovered, the project can proceed, subject to the stipulations in parts II-IV.

II. ARCHAEOLOGICAL FINDINGS

If archaeological resources are uncovered at any time (during the survey, or during excavation, construction, or operation of the Far Detector facility), DOE will schedule a meeting among representatives of DOE, the MN SHPO, the U of MN, the Bois Forte Band of Minnesota Chippewa THPO, and the White Earth Band of Minnesota Chippewa THPO. The meeting will be scheduled as soon as possible following discovery of the archaeological resource. Signatories agree to meeting and seeking resolution within 15 days or waive their right to participate.

If all parties concur that the findings are not eligible for listing on the National Register of Historic Places, then work in the area of the discovery can proceed, subject to the stipulations in parts III-IV.

If the findings have potential to be eligible for listing on the National Register of Historic Places then the representatives of the organizations above will develop procedures at the meeting to determine the necessary subsequent level of investigation or mitigation strategy.

A Treatment Plan will be developed and implemented for any archeological site discovered that is eligible for listing on the National Register of Historic Places and that cannot be avoided. The Treatment plan(s) will be prepared in consultation with the SHPO, THPOs, and other consulting parties. Consultation will mean, at a minimum, a seven day review and comment period on the draft plan(s). Failure of the SHPO, a THPO, or other consulting party to comment with that period will be deemed to be concurrence.

III. HISTORIC RAILROAD GRADE

In the January 2008 Analysis of Effects study for this historic railroad grade, recommendations were made that would result in the avoidance of adverse effect to this property. DOE will brief the SHPO on its final design concerning consistency with the Analysis of Effects study recommendations.

If an adverse effect is unavoidable, the DOE will consult with the SHPO and other consulting parties to develop and implement a mitigation plan. If a mitigation plan is required, SHPO review and approval of the plan is required before work can begin.

The SHPO agrees to comment on the mitigation plan within 30 days from the date of receipt. Failure to comment within 30 days shall be deemed as approval, and implementation of the mitigation plan may proceed.

IV. DISCOVERY OF CULTURAL ITEMS OR HUMAN REMAINS

A. DOE and/or the U of MN will assure that survey and excavation/construction procedures address the discovery of any cultural artifacts, as follows:

1. Work will immediately be halted within the area of the discovery;
2. A construction or environmental inspector and the DOE Fermi Site Office (FSO) Manager will be promptly notified of the discovery.
3. The inspector will immediately (including nights, holidays, and weekends) notify the Bois Forte Band of Minnesota Chippewa THPO and/or the White Earth Band of Minnesota Chippewa THPO and invite their cultural resource specialist to assess the discovery.
4. The inspector will also secure the area of discovery to ensure no further disturbance, collection, or removal of those materials occurs.

5. The inspector will establish a buffer to restrict foot access within the immediate area of the discovery.
6. The inspector will also ensure that vehicular traffic across the area is restricted to a location removed from the discovery.

After arrival at the site, the cultural resource specialist will evaluate the discovery and discuss options for addressing the discovery and for work resumption with the inspector. Under the guidance of the DOE-FSO, specific project elements will be redesigned to avoid burial sites (including human remains and associated funerary items) or cultural items unless the costs, loss of time, and impact on the project make such redesign unreasonable after giving great weight to the cultural importance. If the discovery does in fact consist of human remains, the inspector will immediately follow the procedures outlined in Stipulation B, C, or D, as appropriate.

B. If human remains, or cultural items (including burial sites and funerary items indicative of the presence of human remains), as defined by the Native American Graves Protection and Repatriation Act (NAGPRA), are encountered during inventory, testing, mitigation or any construction-related activities, work within a minimum of 50 feet up to 200 feet as possible of the discovery will cease, although travel at any distance from the discovery through the area on existing travel corridors may continue. DOE will immediately (including nights, holidays, and weekends) notify the Signatories of the discovery first via telephone, then followed up by email and/or letter and implement internal procedures for complying with NAGPRA.

C. In accordance with the provisions of Minnesota law (Minn. Stat. § 307.08), the discovery of human remains on state or private lands would be reported promptly to the local sheriff and the Minnesota State Archaeologist. The remains would not be disturbed or removed until authenticated by the State Archaeologist and the Bois Forte Band of Minnesota Chippewa and/or the White Earth Band of Minnesota Chippewa. A best effort will be made to do this within 7-days. Responsibility for further consultation would be at their joint discretion. Recent (i.e., not of cultural significance) human remains would be dispositioned by the local sheriff.

D. Burial sites, human remains, and associated artifacts will be handled with respect from the time they are discovered until the applicable Treatment Plan has been fully implemented. Furthermore, any Treatment Plan for the treatment of human remains will conform to the following:

i. NAGPRA, if and to the extent it may be applicable, regardless of anything in this Agreement that may be contrary to such law.

ii. Excavation of human remains and associated objects will be carried out under the auspices of the Minnesota State Archaeologist, the Bois Forte Band of Minnesota

Chippewa THPO and/or the White Earth Band of Minnesota Chippewa THPO and in accordance with the greatest possible care and precision, ensuring that the physical integrity and orientation of the grave and its contents are respected.

iii. To the maximum extent practicable, the general public will be excluded from viewing any Native American burial site, human remains, or funerary items associated with such remains. No photographs will be taken of such sites or items.

iv. Native American human skeletal remains and associated artifacts will be reinterred in the manner and at the location agreed upon by the Minnesota State Archaeologist, the Bois Forte Band of Minnesota Chippewa THPO and/or the White Earth Band of Minnesota Chippewa THPO.

V. DISPUTE RESOLUTION

Should any signatory to this Agreement object at any time to any actions proposed or the manner in which the terms of this Agreement are implemented, DOE will consult with such party to resolve the objection. If DOE determines that such objection cannot be resolved, DOE will:

A. Forward all documentation relevant to the dispute, including DOE's proposed resolution, to the ACHP. The ACHP, at its discretion, will provide DOE with its advice on the resolution of the objection within thirty (30) days of receiving adequate documentation. Prior to reaching a final decision on the dispute, DOE will prepare a written response that takes into account any timely advice or comments regarding the dispute from the ACHP, signatories and concurring parties, and provide them with a copy of this written response. DOE will then proceed according to its final decision.

B. If the ACHP does not provide its input regarding the dispute within the thirty (30) day time period, DOE may make a final decision on the dispute and proceed accordingly. Prior to reaching such a final decision, DOE will prepare a written response that takes into account any timely comments regarding the dispute from the signatories and concurring parties to the Agreement, and provide them and the ACHP with a copy of such written response.

C. DOE's responsibility to carry out all other actions subject to the terms of this Agreement that are not the subject of the dispute remain unchanged.

VI. EFFECTIVE DATE

The terms of this Agreement will become effective upon the date of the last signature by the Parties.

VII. AMENDMENTS

This Agreement may be amended when such an amendment is agreed to in writing by all signatories. The amendment will be effective on the date a copy signed by all of the signatories is filed with the ACHP.

VIII. TERMINATION

If any signatory to this Agreement determines that its terms will not or cannot be carried out, that party will immediately consult with the other parties to attempt to develop an amendment. If within thirty (30) days (or another time period agreed to by all signatories) an amendment cannot be reached, any signatory may terminate the Agreement upon written notification to the other signatories.

Once the Agreement is terminated, and prior to work continuing on the Project, DOE will either (a) execute another agreement pursuant to 36 CFR § 800.6, or (b) request, take into account, and respond to the comments of the ACHP under 36 CFR § 800.7. DOE will notify the signatories as to the course of action it will pursue.

IX. ANTIDEFICIENCY ACT

Nothing herein will be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C. Sec. 1341. This agreement is neither a fiscal nor a funds obligation document. Nothing in this agreement authorizes or obligates DOE to expend, exchange, or reimburse funds, services or supplies, or to transfer or receive anything of value.

X. AUTHORITY

DOE enters into this Agreement under the authority of section 646 of the Department of Energy Organization Act (Pub. L. 95-91, as amended; 42 U.S.C. sec. 7256).

XI. NO RESTRICTION

This agreement in no way restricts the parties from participating in any activity with other public or private agencies, organizations or individuals.

XII. REQUIRED SIGNATORIES

U.S. DEPARTMENT OF ENERGY

Eric M. Simpson Date: 5/5/08
Eric M. Simpson, Contracting Officer, Chicago Office

Joanna M. Livengood Date: 5/7/08
Joanna M. Livengood, Fermi Site Office Manager

MINNESOTA STATE HISTORIC PRESERVATION OFFICER

Nina Archabal Date: 5/23/08
Nina Archabal

BOIS FORTE BAND OF MINNESOTA CHIPPEWA TRIBAL HISTORIC PRESERVATION OFFICER

Rosemary Berens Date: 5-6-08
Rosemary Berens, Tribal Historic Preservation Officer

WHITE EARTH BAND OF MINNESOTA CHIPPEWA TRIBAL HISTORIC PRESERVATION OFFICER

Thomas McCauley Date: 5/9/08
Thomas McCauley, Tribal Historic Preservation Officer

INVITED SIGNATORIES

UNIVERSITY OF MINNESOTA

Date: 5/10/2008

Marvin L. Marshak, Principal Investigator, NOvA Project, University of Minnesota, Morse-Alumni Professor

U.S. DEPARTMENT OF INTERIOR, PARK SERVICE, VOYAGEURS NATIONAL PARK

Date: 5-6-08

Raoul Lufbery, Acting Superintendent

Appendix F

Correspondence from U.S. Army Corps of Engineers Regarding Wetland Determination

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DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
SIBLEY SQUARE AT MEARS PARK
190 FIFTH STREET EAST, SUITE 401
ST. PAUL MINNESOTA 55101-1638

January 25, 2008

REPLY TO
ATTENTION OF
Operations
Regulatory (2007-4858-TWP)

Peter Siebach
NEPA Compliance Officer, NOvA Project
U.S. Department of Energy
9800 South Cass Avenue
Argonne, IL 60564

Sally Arnold
NEPA Document Manager, NOvA Project
U.S. Department of Energy
Fermi Site Office
P.O. Box 2000
Batavia, IL 60510

Dear Mr. Siebach and Ms. Arnold:

This acknowledges receipt of an application for a Department of the Army permit for a project to construct an access road for entry to a proposed electron neutrino detector facility. The project site is in Sections 13, 14, 15, T. 68N., R. 20W., and Sec. 18, T. 68N., R. 19W, St. Louis County, Minnesota.

In a recent decision on the consolidated cases *Rapanos v. United States* and *Carabell v. United States* (Rapanos), the Supreme Court addressed where the Federal government can apply the Clean Water Act (CWA), specifically by determining whether a wetland or tributary is a water of the U.S. On June 5, 2007, the U.S. Environmental Protection Agency (EPA) and U.S. Army Corps of Engineers (Corps) issued joint guidance to implement the Rapanos decision. The joint guidance will be used by EPA regions and Corps districts to determine whether aquatic resources such as lakes, streams, and wetlands are waters of the U.S., subject to regulation under the CWA. The joint guidance and other information can be obtained from the internet at
http://www.mvp.usace.army.mil/regulatory/

For most projects, including yours, this new guidance will require more site specific documentation than required in the past, and a detailed analysis. A site visit to the property during the growing season will also likely be required. In many cases our evaluations will require coordination with the U.S. Army Corps of Engineers Headquarters and/or the U.S. Environmental Protection Agency (EPA).

Therefore, please be advised that there may be a substantial increase in the amount of time it will take to process your permit application.

We have **preliminarily** determined that your project is subject to Section 404 of the Clean Water Act (33 U.S.C. 1344). Based on our initial review, we believe an individual Department of the Army permit will be required. Our review will include issuance of a public notice and preparation/review of an environmental assessment. State Historical/Archaeological surveys and US Fish and Wildlife studies are also required. It is possible, though unlikely, that a public hearing will be required.

As discussed with you on January 25, 2008, the St. Paul District, Corps of Engineers would like to be a cooperating agency in the preparation of the Environmental Assessment, pursuant to National Environmental Policy Act requirements. Mr. Joe Shoemaker from our Two Harbors office has been assigned as the Corps project manager. Please advise with your acceptance or denial of this request.

If you have any questions, contact Joe Shoemaker in our Two Harbors office at (218) 834-6630. In any correspondence or inquiries, please refer to the Regulatory number shown above.

Sincerely,

For Robert J. Whiting
Chief, Regulatory Branch

Enclosures

Copy furnished:

Brad Kovach, SEH

Appendix G

Responses to Comments on the Draft Environmental Assessment

University of Minnesota Responses to Comments on the Minnesota Environmental Assessment Worksheet

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Comments on the Draft EA and DOE responses

Summer Sky Cohen and Joseph Jacker, Keweenaw Bay Indian Community, Baraga, Michigan

Comment:
The Keweenaw Bay Indian Community Tribal Historic Preservation Office has no interests regarding religious or cultural sites documented at this time in the proposed project areas.

Response:
Thank you for notifying us.

Comment:
The Keweenaw Bay Indian Community urges you to consult other Indian Tribes in your immediate area that may have documented interests in your project site, if you have not already done so.

Response:
DOE notified local Indian Tribes concerning the NOνA project including: the Bois Forte Band of Minnesota Chippewa Tribal Historic Preservation Officer (THPO), the White Earth Band of Minnesota Chippewa THPO, the Leech Lake Band of Ojibwe THPO, the Grand Portage Band of Chippewa THPO, and the Fond du Lac Band of Lake Superior Chippewa Reservation Cultural Resources Specialist. The Bois Forte Band of Minnesota Chippewa and the White Earth Band of Minnesota Chippewa notified DOE of their desire to consult with us pursuant to Section 106 of the National Historic Preservation Act. The consultation commenced in October 2007 and resulted in a Programmatic Agreement, which was executed May 23, 2008. The Programmatic Agreement is appended to this EA.

Comment:
If artifacts or human remain are discovered, please notify the Keweenaw Bay Indian Community THPO immediately so we can assist in making an appropriate determination.

Response:
The Programmatic Agreement contains a "discovery plan" which requires DOE to immediately notify the Bois Forte Band of Minnesota Chippewa, the White Earth Band of Minnesota Chippewa, and the State Archaeologist should artifacts or human remains be discovered, take certain steps to protect them, and commence consultation concerning disposition. The Programmatic Agreement is included as an Appendix to this EA. We will also notify the Keweenaw Bay Indian Community THPO.

Lisa Bonnett, Acting Deputy Director, Illinois Environmental Protection Agency, Springfield, IL

Comment:

The Agency has no objections to the project.

Response:

Thank you for notifying us.

Comment:

A construction site activity stormwater NPDES permit will be required from the Division of Water Pollution Control if more than one acre is disturbed during construction.

Response:

Thank you for the information. At present, the NOvA Project does not anticipate disturbing more than one acre during construction. However, should we find that disturbing more than one acre is necessary, the Department of Energy and/or Fermilab will apply to the Division of Water Pollution Control for a construction site activity stormwater NPDES permit.

UNIVERSITY OF MINNESOTA

School of Physics and Astronomy

318 Tate Laboratory of Physics
116 Church Street S.E.
Minneapolis MN 55455

612-624-1312
Fax: 612-624-4578
marshak@umn.edu

June 24, 2008

Ms. Sally Arnold
U.S. Department of Energy
c/o Fermilab
P.O. Box 500
Batavia IL 60510

Dear Sally:

I am writing to respond to the questions in your email of June 18, regarding the Environmental Assessment Worksheet for the NOvA Far Detector Building and Site.

The Regents of the University of Minnesota are a constitutional entity of the State of Minnesota, as initially chartered by the Territorial Laws of 1851 and by the State Constitution of 1858. The public is officially noticed of the actions of the Regents by the publication of a "Regents' Docket," prior to each meeting, and by "Regents' Minutes," subsequent to each meeting. These documents are open to public inspection during business hours at the offices of the Regents. During recent years, these documents have also been published on the University's website.

The Regents' actions with respect to the NOvA EAW are documented in the Regents' Docket (Facilities Committee section) for November 2007 and in the Regents' Minutes (Facilities Committee section and Board of Regents' section) for November 2007. The Regents' unanimously approved the EAW as documented in the Minutes. A notice of this decision was published in the EQB Monitor on November 19, 2007. Minnesota law allows filing a petition for judicial review for 30 days following the EQB Monitor publication. No such petition was filed. There is no further "approval" process.

With regard to the public and agency comments received regarding the EAW, an individual response was made to each comment. In addition, all of the comments and all of the responses were published in the Regents' Docket (Facilities Committee section), November 2007.

I hope this information answers your questions.

Sincerely,

Marvin L. Marshak
Institute of Technology Professor
Morse-Alumni Professor of Physics

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Response to Comments on the NOvA Off Axis Detector Facility at Ash River Environmental Assessment Worksheet (EAW)

The following agencies and individuals submitted comments on the NOvA Off Axis Detector Facility at Ash River Environmental Assessment Worksheet (EAW) during the public comment period from September 10, 2007, to October 10, 2007:

- United States Department of the Interior, National Park Service, Voyageurs National Park
- Minnesota Department of Natural Resources
- Minnesota Historical Society, State Historic Preservation Office
- Minnesota Department of Health
- Julian Brzoznowski – Citizen
- J. Dale Long – Citizen
- Len and Evie Mankus – Citizens

The comments in each letter are summarized, with corresponding responses provided below.

Comments of the United States Department of the Interior, National Park Service, Voyageurs National Park

Comment 1: The construction schedule on pages three and sixteen of the EAW do not appear to agree. In addition, during project construction the National Park Service estimates as many as ninety trips per day will occur between June 2008 and February 2011, and as many as 450 truckloads of PVC will be delivered to the site between June 2008 and December 2012. More than 750 trips with trucks containing scintillator oil will occur between August 2010 and the end of 2013. Please consider additional measures to limit the impact on visitor traffic entering Voyageurs National Park on park route #1, the road to the Ash River Visitor Center, and on the Ash River Trail.

Response: The construction schedule for the NOvA Project is subject to change as a result of policy and funding considerations by the United States Department of Energy's Office of Science. The University's current expectation is that site construction and road work will begin in spring 2008 and that construction of the Far Detector building will begin in fall 2008. Overall, building construction is expected to last through spring 2010, followed by two years of detector installation.

As indicated in the United States Department of the Interior's comment, the increase in vehicle traffic on U.S. Highway 53 and St. Louis County Highway 129 (Ash River Trail) during all phases of the project is "within customary limits," given the capacity of these roadways and current traffic levels. Based on the forecasted traffic levels for the St. Louis County Highway 129, the anticipated number of truck trips during the construction period will average between six and seven per day. At some phases of construction, there may be more truck trips than the

average of six to seven per day, and at other phases of construction there may be fewer truck trips than the average of six to seven per day. After building construction is complete in mid-2010, the number of truck trips per day will be one or two on average for approximately forty-eight months. U.S. Highway 53 and St. Louis County Highway 129, the roads in the vicinity of the project area, are reasonably straight and level, and provide multiple opportunities for passing safely. The University will cooperate with the St. Louis County Highway Department to optimize the design of the intersection between St. Louis County Highway 129 and the University's new access road to the proposed facility. Expected roadway and intersection design features include separate turning lanes, and warning and directional signs. The University expects very little increased traffic in the vicinity of the intersection of St. Louis County Highway 129 and National Parks Service Highway #1.

Comment 2: Blasting will be audible inside Voyageurs National Park. Please consider loading smaller shots to limit the distance that blasting noise will travel.

Response: The University will consider and implement all reasonable efforts to reduce the effects of blasting noise in Voyageurs National Park and the surrounding area. These efforts will include the use of smaller blasting charges, when possible, to minimize the noise. Blasting will only occur for approximately two to three months. As the EAW notes, the University will limit construction activities, including blasting, to the hours between 7:00 a.m. and 7:00 p.m. on weekdays and will not undertake construction activities on weekends.

The University provides the following additional analysis regarding the anticipated noise from blasting. The shortest distance between the park boundary and the area where blasting will occur is approximately 7,000 feet, or approximately 2,100 meters. The University estimates that the loudest blast associated with construction will be approximately 140 decibels at the blast site. The sound level from such a blast at the entrance to the park on NPS Highway #1 with no attenuation from vegetation and the rolling topography would be 65 decibels. This decibel level is equivalent to normal conversation. Considering natural attenuation from shrubs and trees in the area, the sound level at the entrance to the park drops to a range of 20 to 30 decibels. This decibel level is equivalent to a whisper or to the noise level found in a rural area. The rolling terrain in the area will provide further noise attenuation. Given the noise level associated with blasting, the distance of the park from the blasting area, and the natural noise attenuation as a result of the area's terrain, it is unlikely that park visitors will be aware of the blasting noise when inside the park boundaries.

Comment 3: The facility may be visible from locations inside Voyageurs National Park or along Ash River Trail, and the view of a large industrial facility from locations within the park could adversely affect a visitor's experience of the park.

Response: The NOvA Laboratory building is located on rolling terrain with mixed elevations at ground level ranging from 1,120 to 1,393 feet above mean sea level. Many of the higher elevations are forested with treetops as high as approximately 1,450 feet above mean sea level. The highest point of any building on the site will be approximately 1,271.5 feet above mean sea

level. Thus, although portions of the site buildings may be visible from some upland areas of the Voyageurs National Park at a distance of more than two miles, the buildings will be a low feature in contrast to nearby wooded outcrops.

The University will use design criteria to minimize the visual impact of any portion of the Far Detector building that might be visible from Voyageurs' National Park. The Far Detector building, which will have an above-ground height of approximately thirty-seven feet or approximately two stories, will not include any windows facing north to minimize reflected sunlight. An earthen berm with native grasses will surround much of the Far Detector building up to the roof line. Exterior colors for all buildings will be muted grays and browns. All north facing building walls will be in neutral colors to decrease contrast and visibility. The University will use native plants and trees to soften the outlines of all buildings. In addition, the University will work with the National Park Service to design additional measures to screen or soften the appearance of the site buildings, and will provide the National Park Service with view shed maps upon request.

Comment 4: Construction vehicle traffic will transport exotic plant seeds and plant parts to the facility. These seeds and plant parts, once established, may migrate into Voyageurs National Park.

Response: Because the project is receiving federal funding, the United States Department of Energy must comply with Executive Order 13112 on Invasive Species. The Department of Energy is preparing an Invasive Species Management/Control Plan to be implemented during and after construction of the facility to prevent or minimize the spread of noxious weeds and other invasive species. The University understands that the Department of Energy will seek input from the Department of the Interior before implementing the Invasive Species Management/Control Plan. The University also understands that the Department of Energy's Invasive Species Management/Control Plan will address methods and conditions to reduce the potential for invasive species infestations, including measures to provide clean fill materials free from noxious weeds and other measures to reduce incidental transport of noxious weed species by trucks and equipment.

Comment 5: Given that the facility may be visible from locations within Voyageurs National Park, please ensure that the facility meets site selection rationale (d) in the EAW, which states that the facility location should be elevated to reduce wetland impacts and to address the concern that the facility not be directly visible from existing parks and other recreational facilities.

Response: Please refer to Response to Comment 3 above. The Ash River site is nested among higher hills which screen the site from Voyageur's National Park, and is at least two miles from upland areas of the park from which site buildings may be visible, with the possible exception of the vehicular corridor along St. Louis County Highway 129. Moving the facility further south might decrease its possible visibility from the park, but would increase its visibility from the Ash River and could result in other adverse impacts on the Ash River. The site optimizes site

selection criterion (d) in the EAW by minimizing wetlands impacts and by limiting visibility from possible recreational areas to the north, east, and south.

Comment 6: The EAW does not discuss an alternative location for the facility, near the town of Buyck, which National Park Service staff at Voyageurs National Park considers the optimal location.

Response: An EAW under the Minnesota Environmental Policy Act need not consider alternatives to a proposed project. Nevertheless, the University notes that the Orr-Buyck Road location, which the comment references, was dropped from further consideration because studies by the United States Department of Energy determined that the Ash River location was more suitable for research on sub-atomic particles. In addition, the Department of Energy determined that the potential for environmental impacts was greater at the Orr-Buyck site. The University understands that the Department of Energy determined the Orr-Buyck location would have involved disruption of more wetlands than the Ash River site. In addition, unlike the Ash River site, construction of the facility at the Orr-Buyck site would have adversely affected stands of old-growth forest and high-quality wildlife habitat. In short, the Ash River site better meets all four site selection rationales summarized in the EAW, because: (1) it is located farther from Fermilab than the Orr-Buyck site, meeting EAW site selection criterion (a); it is near St. Louis County Highway 129, the only paved road in the area, meeting EAW site selection criterion (b); (3) it is in the United States, meeting EAW site selection criterion (c); and (4) it is elevated to reduce wetland impacts and is not directly visible from existing parks and other recreational facilities, meeting EAW site selection criterion (d).

The University also believes that the Ash River site provides the University an opportunity to coordinate with the National Park Service at Voyageurs National Park on educational and recreational opportunities, similar to the coordination between the Soudan Laboratory and nearby natural resources exhibits. About 5,000 students and members of the general public take science tours each year at the Soudan Laboratory in Soudan, Minnesota. Many of these visitors also tour natural resource exhibits near Soudan, such as the Ely Wolf Center. The University hopes to cooperate with the National Park Service to create summer research programs for school teachers and undergraduates that would take advantage of both the NOvA laboratory and nearby Voyageurs National Park.

Comment 7: The Far Detector (Assembly Space and Service) building will be seventy-two feet high, with thirty-seven feet protruding above the landscape. The "consensus" reached with the National Park Service regarding site selection and visibility of the building assumed a site with a one-story building in fifty-foot tall trees.

Response: See Responses to Comments 3 and 5.

Comment 8: Please consider restoring the area immediately surrounding the facility and those areas impacted by construction to a natural landscape using native vegetation. Typical lawn and

landscaping plans are exotic to this area and may result in further infestations of exotic plans in the park. The application of native plans may also soften the visual impact of the facility.

Response: In keeping with the intent of Executive Order 13112 on Invasive Species, the facility will be landscaped with native species from the surrounding region. No exotic or non-native species will be used for landscaping. Native trees may also be planted to provide additional screening benefits.

Comment 9: The access road to the facility will overwhelm the parking area for the Ash River Falls Trail and no accommodation for the parking area has been made.

Response: Thank you for your clarification regarding administration of the Ash River Falls Trail. The Department of Energy and the University of Minnesota will work with the Minnesota Department of Natural Resources to preserve access to these ski trails. If construction of an access road to the facility adversely affects the Ash River Falls Ski Trail parking area, the University will provide alternate parking during construction and at the close of construction will return the Ash River Falls Ski Trail parking area to a condition that meets or exceeds its current condition. Access road construction will not have any significant effects on the ski trail network, including the area where St. Louis County Highway 129 intersects with the proposed access road.

Comment 10: The facility may be visible from locations within Voyageurs National Park.

Response: See Response to Comment 5.

Comment 11: Although the Voyageurs National Park Superintendent's authority is not applicable to areas outside the park, the Superintendent has the responsibility to protect park resources and visitor experience of those resources from adversity or impairment, even if that impact originates outside the park.

Response: Comment noted. The only applicable adopted local comprehensive plan, land use plan or regulation, or other land use plan of any governmental agency is the Voyageurs Planning Area sub-plan of the Comprehensive Plan for St. Louis County. As the EAW notes, the project is compatible with the goals and policies of this comprehensive plan.

Comments of the Minnesota Department of Natural Resources

Comment: The University's request for a 200-foot right of way easement from DNR (a sixty-six foot permanent right-of-way, plus a temporary easement of sixty-seven additional feet on each site for construction) could have adverse resource impacts.

Response: The University will limit permanent impact from the road footprint to a sixty-six foot permanent right-of-way. Construction impact in the temporary right-of-way will not be extensive and little impact from construction is expected within the temporary right of way. Construction will be limited in the temporary right-of-way by virtue of use of the existing road alignment. Impacts will be minimized by using the existing road, rather than building a new road alignment through previously undeveloped areas. In addition, as discussed in the EAW, the University will minimize road construction impact to the greatest extent possible by undertaking erosion control measures and by minimizing or avoiding effects on wetlands. The University will mitigate unavoidable wetland impacts through the wetland permitting process, as discussed in the EAW.

Comments of the Minnesota Historical Society, State Historic Preservation Office

Comment 1: The Minnesota Historical Society will need to review a copy of the Cultural Resources Assessment before completing a review of the project.

Response: The United States Department of Energy provided a copy of the Cultural Resources Assessment to the State Historic Preservation Office.

Comment 2: The United States Department of Energy and the United States Army Corps of Engineers must initiate their own cultural resources assessments as soon as possible, to avoid later delays in project implementation.

Response: The United States Department of Energy has received copies of the Cultural Resources Assessment and is evaluating the assessment as it prepares an Environmental Assessment for the project under the National Environmental Policy Act. The United States Army Corps of Engineers will initiate its Section 106 coordination when it receives the Combined Wetland Permit Application requesting a Section 404 permit for the project under the Clean Water Act. The University is currently reviewing the Combined Wetland Permit Application.

Comments of the Minnesota Department of Health

Comment: Reciting the minimum requirements for the construction, repair, and sealing of wells and borings under Minn. R. Ch. 4725.

Response: The University is aware of Minn. R. Ch. 4725, which establishes the minimum distances from sources of contamination for construction of water supply wells. As shown on Figure 3 in the EAW, the University is likely to place the water supply well and the sanitary holding tank at least 125 feet apart. Actual location of the water supply well and the sanitary

holding tank, however, will depend upon the location of groundwater at the site. When construction of the project begins, the University will install the water supply well at least 50 feet from the building where the scintillator oil will be handled and stored, as Minn. R. Ch. 4725 requires. Following installation of the well, the University will place the sanitary holding tank more than 50 feet from the water supply well and in a side gradient or downgradient location, as Minn. R. Ch. 4725 requires.

Comments of Julian Brzoznowski – Orr, Minnesota

Comment: "I feel that it would be a boost to the area and many things could be learned from this project. OK."

Response: Comment noted.

Comments of J. Dale Long – Orr, Minnesota

Comment: "Very good update on the plans and needs for the site. The City of Orr welcomes the project with open arms. With a little imagination who wouldn't want to be part of the possible findings resulting from the research done on this site. The City of Orr would welcome the chance to supply housing needs, airport and recreation for the scientists and employees that will run this program."

Response: Comment noted. The University will continue to work with the City of Orr and surrounding communities to provide support services for the employees and visitors planned for the facility.

Comments of Len and Evie Mankus – Orr, Minnesota

Comment: "We are very fortunate that you are coming to our area for this important endeavor. We hope that Orr can be a service to you."

Response: Comment noted. The University is looking forward to continuing to work with the City of Orr.

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Appendix H

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Department of Energy
Office of Science
Chicago Office
9800 South Cass Avenue
Argonne, Illinois 60439

June 11, 2008

Joanna M. Livengood, Manager
Fermi Site Office

SUBJECT: APPROVAL OF ENVIRONMENTAL ASSESSMENT (EA) FOR CONSTRUCTION AND OPERATION OF NEUTRINOS AT THE MAIN INJECTOR (NUMI) OFF-AXIS ELECTRON NEUTRINO (ν_E) APPEARANCE EXPERIMENT (NOvA) AT THE FERMI NATIONAL ACCELERATOR LABORATORY (FERMILAB), BATAVIA, ILLINOIS, AND ST. LOUIS COUNTY, MINNESOTA (DOE-EA-1570)

On February 14, 2006, you named me the National Environmental Policy Act (NEPA) Compliance Officer (NCO) on the NOvA EA. This memorandum fulfills my responsibility under Department of Energy (DOE) Order 451.1B, Section 5d(8), to advise you on the adequacy of the NOvA EA. Sally Arnold was the Document Manager and Vicki Prouty provided legal counsel. Ms. Arnold involved both Counsel and me in all aspects of EA planning, preparation (including issues resolution), and review.

The NOvA experiment entails constructing and operating facilities for a new neutrino physics research program. DOE's Fermilab is the lead DOE Laboratory on the project and the University of Minnesota is the lead collaborating university through a Cooperative Agreement with DOE. The program is designed to generate neutrinos at Fermilab in Batavia, Illinois, for analysis in proposed detectors at Fermilab and near the Ash River in St. Louis County, Minnesota.

Construction of the access road to the Ash River Site would impact a wetland, requiring a permit from the U.S. Army Corps of Engineers (USACE). Consequently, the EA incorporates a wetlands assessment and the USACE is a cooperating agency on the EA.

Based on the analysis in the EA, I recommend that you determine that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of NEPA. The enclosed Finding of No Significant Impact (FONSI) summarizes my rationale. Per DOE Order 451.1B, Section 5a(9), your signature below will approve the EA, and your signature on the enclosed FONSI will constitute DOE's NEPA clearance.

Despite the completion of DOE's NEPA process, there are two related items which will need to be resolved before construction of the NOvA Far Detector Facility can proceed:

1. The National Historic Preservation Act Programmatic Agreement that DOE entered into with the State of Minnesota, the Bois Forte Band of Minnesota Chippewa, and the White Earth Band of Minnesota Chippewa requires that DOE perform a Phase 1 archaeological survey and also brief the Minnesota State Historic Preservation Office concerning the final design of the access road to the Ash River Site. These actions are intended to ensure that archaeological/historical resources will not be compromised.

2. A wetlands permit from the USACE pursuant to Section 404 of the Clean Water Act is required and must be obtained before DOE undertakes actions which would impact wetlands in the vicinity of the NOvA Far Detector Facility.

Peter R. Siebach
NEPA Compliance Officer
NOvA Project

Enclosures:
1. Preliminary Final NOvA EA
2. Finding of No Significant Impact

Approved:

Joanna M. Livengood, Manager
Fermi Site Office

6/11/08
Date

cc: S. Goel, SC-31.1, GTN, w/o encls.
M. Marshak, University of Minnesota, w/o encls.
J. Cooper, Fermilab, w/o encls.
R. Whiting, Army Corps of Engineers, w/o encls.

U.S. Department of Energy
Finding of No Significant Impact

Construction and Operation of Neutrinos at the Main Injector (NuMI) Off-Axis Electron Neutrino (ν_e) Appearance Experiment (NOνA) at the Fermi National Accelerator Laboratory, Batavia, Illinois, and St. Louis County, Minnesota
(DOE-EA-1570)

AGENCY: U.S. Department of Energy

ACTION: Finding of No Significant Impact

SUMMARY:

The proposed action involves constructing and operating facilities for a new neutrino physics research program. The Department of Energy's (DOE) Fermi National Accelerator Laboratory (Fermilab) is the lead laboratory, and the University of Minnesota is the lead collaborating university through a Cooperative Agreement with the DOE. The program would generate neutrinos at Fermilab in Batavia, Illinois, for analysis in proposed detectors at Fermilab and near the Ash River, in St. Louis County, Minnesota.

Proposed activities at the Ash River site include a wetlands action that requires a permit from the U.S. Army Corps of Engineers (USACE). Consequently, the EA incorporates a wetlands assessment, and the USACE is a Cooperating Agency in the EA. This Finding of No Significant Impact (FONSI) incorporates DOE's wetlands finding, pursuant to Title10, *Code of Federal Regulations*, Part 1022 (10 *CFR* Part 1022) , "Compliance with Floodplain/Wetlands Environmental Review Requirements".

Based on the analysis in the Environmental Assessment (EA), DOE has determined that the proposed action does not constitute a major federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act (NEPA).

DESCRIPTION OF THE PROPOSED ACTION:

Proposed Action: The proposed action would take place at both the Fermilab site and in St. Louis County, MN, near the U.S. – Canadian border. The region between the two sites would not be affected by construction, operation, or decommissioning of the proposed action. The proposed action consists of four main phases: (1) excavation and construction; (2) scintillator blending, detector assembly and testing; (3) performance of the NOνA experiment, and (4) decommissioning.

The construction phase at Fermilab would include an upgrade of the existing Fermilab accelerator complex with an increase of beam power in the Main Injector. A new underground cavern would be excavated at approximately 345 feet below grade adjacent to an existing tunnel. This excavation would remove about 1,000 cubic yards of rock

using conventional civil construction and mining techniques. The cavern would hold a new 222-ton "Near Detector" to monitor the neutrino beam as it leaves the Fermilab vicinity. Above-ground, a 90-ton prototype detector would be assembled in an existing Fermilab facility to provide development and optimization for the neutrino detector. In addition, to support the blending of approximately 4.2 million gallons of scintillation detector fluid, either a blending facility would be constructed at Fermilab or the services of a commercial blender near Chicago would be engaged. A constituent in the blending operation would be pseudocumene, a toxic organic liquid, at approximately 5% of the total volume. Blended scintillation fluid would be transported by tanker truck from the blending facility to the Ash River site.

A proposed new "Far Detector" Facility would be constructed at the Ash River site. The new building would be 67 feet wide by 375 feet long and would be sunk 40 feet below the existing grade into granite rock at the site. Site preparation would include improvement to an existing logging road to facilitate all-weather access. A proposed 20,000-ton Far Detector would be constructed with components identical to the ones used in the Near Detector, but with dimensions, number and total volume scaled to the larger size.

The schedule for the proposed action has construction/excavation and assembly starting in 2008. Construction and assembly would continue through 2013. Experiment performance would begin on parts of the devices during the construction period, but sustained operations would begin in 2013 and continue through at least 2019. Following achievement of experiment objectives, decommissioning would occur over a several-year period.

Purpose and Need: Neutrinos are uncharged, non-ionizing elementary particles that only rarely interact with ordinary matter. The study of the oscillation of neutrinos from one type to another is considered a good way to study important physics questions, such as the properties of the weak interaction, neutrino mass, the contribution of neutrinos to the Dark Matter in the Universe, and the relationship between matter and antimatter. Understanding these particles is an important goal of the worldwide physics community and the DOE Office of Science, and operation of the NOνA facility would advance that goal.

Alternatives: NEPA requires evaluation of the impacts of "reasonable alternatives." "Reasonable Alternatives" are those that satisfy the purpose and need of the proposed action.

The presence of existing NuMI beamline infrastructure at Fermilab fixed the location for the origin of the neutrinos. During conceptual design for the project, several site alternatives for the location of the Far Detector Facility were contemplated for beamline termination. Screening criteria included:

- The ability to have the detector as far away from Fermilab as possible;
- The ability to have a detector ~ 12 km off-axis from the central NuMI neutrino beam;

- Access to the site by existing roads;
- The ability to do construction in all seasons on the experimental hall and on the detector;
- Access to power, telephone lines, and fiber optic data connections;
- The availability of a relatively flat area for construction;
- The availability of high ground, well above the water table with no wetlands;
- The absence of features likely to provoke controversy or litigation; and
- A location in the United States [A location in Canada would require participation by a Canadian institutional collaborator].

Only one site alternative, the proposed site, met the screening criteria for a more thorough evaluation in the EA:

Four non-site alternatives were considered. Three were not analyzed:

- Alternative access roads to the proposed Ash River site that avoid wetlands were considered, but were determined not to be feasible because they did not meet several of the screening criteria, above. For example, a more direct route from the north across St. Louis County 129 would be shorter and cheaper, but would be be controversial because of visibility from Voyageurs National Park, and impact old growth forest and protected wildlife.
- Alternative building designs for the Far Detector Facility were considered but did not address the need to maximize shielding of the detector from background radiation. The proposed design makes the best use of the excavated granite as a cosmic ray shield for the detector.
- Alternative detector technologies were considered for the Far Detector. Most were scientifically inferior, while one alternate required too many years of R&D to be considered viable.

One non-site alternative was considered reasonable for analysis.

- The NO*v*A EA analyzes two options for mechanically blending the scintillator materials. The first option was to use a local commercial toll blender in the Chicago area and transport blended materials from that location to Fermilab and Minnesota. The second option was to construct and operate a blending facility at an existing Fermilab site.

Additionally, the No Action alternative was analyzed. Under the No Action Alternative, the experiment would not be conducted and the scientific goals for the studies of neutrino oscillations would not be achieved in the U.S. in the near future. The No Action Alternative would avoid the potential environmental impacts of the Proposed Action, discussed below.

ENVIRONMENTAL IMPACTS:

The proposed construction site at Fermilab is limited to an underground excavation and a small surface stockpile for excavated rock. These areas are not known to contain historical resources or sensitive biological resources or habitats that would be affected by construction. Rock spoils generated during excavation would constitute a less than 2% increase in existing spoils piles at Fermilab. Labor staffing during construction would be a small fraction of the worker population currently accessing Fermilab. On-site impacts from traffic, air emissions, vibrations, and noise would be small. The EA projects that up to three cases of injury/illness can be expected, two during the excavation phase of construction. It also projects that five traffic accidents during worker commutes would occur, but that no traffic injuries or fatalities would result. Other off-site impacts from the proposed action would be extremely small and largely limited to air and noise impacts, but no noise or air quality standards are expected to be exceeded.

Changes in work activities at Fermilab related to the operational phase of the proposed project are few. Increasing the Main Injector beam power to 700 kW would increase estimated radionuclide emissions and tritium in ground water. Increased beam power would also lead to increased activation of accelerator and beamline components. Such increases could be expected to proportionally increase the potential estimated dose rate to workers. However, increased dose "rates" only refers to the potential for dose – DOE does not contemplate an actual increased dose to workers (or the public), since engineered and administrative barriers will be put into place to limit dose to current limits. The Fermilab radiation exposure control program has been effective in limiting exposure to workers, and doses will remain considerably below the DOE 10 *CFR* Part 835.202 total effective dose limit of 5 rem (5,000 mrem) and the Fermilab administrative dose goal of 1,500 mrem annually. The estimated maximum annual radiation dose at the site boundary that would result from airborne releases is 0.04 mrem. This hypothetical dose is far below the regulatory limit of 10 mrem in a year. Based on established conversion rates, radiation from the experiment would be responsible for no latent cancer fatalities to either workers or the public.

The Far Detector site in Minnesota is currently undeveloped, so the proposed project would change the appearance and current use of the site. The proposed project would include clearing, grading and excavation disturbing greater than 5 acres, and therefore would require a permit issued for the discharge of storm water associated with construction activity under National Pollutant Discharge Elimination System as implemented by the Minnesota Pollution Control Agency. The erosion controls required by the permit, as well as the site location and Facility design, would minimize potential impacts to surface water. During construction there would be short-term, localized impacts on air quality from vehicular traffic exhausts and earth-moving operations, similar to construction of any commercial facility of comparable size.

Construction of the access road would result in filling approximately 3.5 acres of wetlands, requiring a permit from the USACE under Section 404 of the Clean Water Act and conformance with the requirements of the Wetland Conservation Act of Minnesota. Approximately 5.2 acres of banked wetlands would be purchased to mitigate impacts to existing wetlands due to excavation and construction at the Ash River site. Under

Executive Order 11988, *Floodplain Management*, and Executive Order 11990, *Protection of Wetlands*, Federal agencies are required to consider the impact of proposed actions on wetlands and floodplains. The DOE requirements for compliance with Executive Orders 11988 and 11990 are found in 10 *CFR* Part 1022. A wetland assessment was included in the EA, and satisfies all the requirements of 10 *CFR* 1022. The wetlands permitting process has not been completed due to a USACE requirement to first have NEPA documentation in place.

Concerns over the potential for archeological resources to be affected in the project area at the Ash River site have been resolved through the negotiation of a Programmatic Agreement under Section 106 of the National Historic Preservation Act. Signatories include DOE, the Minnesota State Historic Preservation Office, the Bois Forte Band of Minnesota Chippewa, and the White Earth Band of Minnesota Chippewa. The programmatic agreement includes a stipulation that DOE perform an archeological survey of the project area in the spring of 2008, prior to construction. The survey would include further investigation of historical resources, including both architectural (i.e., to address potential impacts to a historic logging railroad grade) and cultural.

To address concerns of the National Park Service, the Far Detector Facility will be designed to minimize its visual impact on Voyageurs National Park. For example, the tallest section of the building (which would have an above-ground height of approximately thirty-seven feet or approximately two stories), will not have any windows facing north (i.e., toward Voyageurs) to minimize reflected sunlight. In addition, an earthen berm with native grasses would surround much of the Far Detector Facility up to the roof line. Exterior colors for all buildings would be muted grays and browns. All north facing building walls would be in neutral colors to decrease contrast and visibility. Native plants and trees would be planted to soften the outlines of all buildings. In addition, the NOνA Project would work with the National Park Service to design additional measures to screen or soften the appearance of the site buildings if needed

100% secondary containment of liquid scintillator and other liquids at every stage of the assembly and installation process, is designed to prevent any release to ground water during assembly, installation and operation. The adhesive that would be used to assemble the detector modules contains methyl methacrylate (MMA), a volatile organic compound and a federal hazardous air pollutant. The health and safety plan developed for the project would detail the proposed ventilation controls intended to comply with occupational and environmental concentration standards. Site workers and contractors would conduct work under a University of Minnesota site health and safety plan and procedures for installation and assembly operations.

Some impacts to employees would be expected from the NOνA experiment. The multiple shipments of materials via truck, tanker or rail car on and between the project sites are subject to routine traffic accidents. Based on traffic accident statistics, one accident and one injury can be expected during transportation of materials (during all phases of the project) and nine accidents and two injuries can be expected during worker commutes (during all phases of the project). No transportation fatalities are expected.

OSHA reportable cases would be approximately 19, or about 1~2 per year of the project schedule.

The spill of MMA or pseudocumene (a hazardous component of the largely mineral oil scintillation fluid) in an accident during delivery from the distributor to the NOvA Project in a wetland or other sensitive area could impact exposed sensitive species. Although an accident during transport has a calculable probability of *occasional* (approximately 0.03~0.04), the probability that an accident would occur that also causes a spill at an environmentally sensitive area would be several orders of magnitude less (1E-04).

Cumulative: Radiological impacts of the NOvA experiment result from increasing the beam power from 400 kW to 700 kW in the NuMI accelerator. As discussed in the EA, the NOvA proposed action would be an incremental change to the existing Fermilab operational base and would be offset by decreases due to completion of the Tevatron Collider research program. Increases in beam power would primarily affect radiological conditions. There are no other current or reasonably foreseeable future projects at Fermilab that may interact with the project described in the EA in such a way as to cause cumulative impacts.

There are no current activities or future phases of development planned for the Ash River site, nor are there any other activities or developments proposed by others that are reasonably foreseeable in the area of the proposed project. Therefore no cumulative impacts are anticipated with respect the project in the Ash River area. Future logging efforts are not considered "reasonable and foreseeable actions" in terms of evaluating cumulative impacts, as logging has been occurring in the area for over a hundred years and would continue indefinitely in the region as a renewable and managed resource.

DETERMINATION:

Based on the analysis in the final EA and consideration of public comments received on the draft EA, DOE has determined that the proposed construction and operation of NOvA at Fermilab and near Ash River, and the use of either a toll blender in the Chicago area or construction of a support facility at the Fermilab to mechanically blend scintillator materials would not individually or cumulatively have a significant affect on the quality of the human environment within the meaning of NEPA. Therefore, the proposed action does not constitute a major federal action within the meaning of NEPA, and an environmental impact statement is not required. With this determination, DOE can proceed with the NOvA project. However, since a permit from the USACE under Section 404 of the Clean Water Act is still required (and per USACE procedures, can not be issued until the NEPA process is complete), any activity involving wetlands will be contingent upon receipt of that permit. Likewise, the terms of the Programmatic Agreement under Section 106 of the National Historic Preservation Act will need to be met before any activities with the potential to effect historic properties are undertaken.

PUBLIC AVAILABILITY:

Copies of the EA are available by contacting:

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U.S. Department of Energy
P.O. Box 500
Kirk Road and Pine Street
Batavia, IL 60510-0500
Telephone: 630/840-2239
E-Mail: sally.arnold@ch.doe.gov

Copies of the EA are also available for review at the following locations:

Batavia Public Library
10 S. Batavia Avenue
Batavia, IL

Warrenville Public Library District
28W751 Stafford Place
Warrenville, Illinois

University Librarian's Office
499 Wilson Library
309 19th Avenue South
Minneapolis, Minnesota

Municipal Building
600 4th Street
International Falls, Minnesota

Fermi National Accelerator Laboratory
Library
Wilson Hall, 3rd Floor
Kirk Road and Pine Street
Batavia, Illinois

The EA may be viewed on-line at: http://www.fnal.gov/pub/neighbors/nova/NOvA-final-EA.pdf

For further information regarding the DOE NEPA process, contact:

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Issued in Batavia, Illinois, this 11th day of June 2008.

Joanna M. Livengood, Manager
Fermi Site Office