
# Fermilab

# Report to the Director on the Fermilab Environment For Calendar Year 2008

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# 1.0 Introduction

Fermilab is not only committed to environmental compliance but also to responsible environmental stewardship. Compliance, which is defined as conformity in fulfilling official requirements, affects every aspect of the Fermilab facility. It affects the staff, funding, new technology, productivity, efficiency, and surrounding environment. To be compliant, Fermilab must adhere to environmental statutes and regulations administered by groups such as the U.S. Environmental Protection Agency, Illinois Environmental Protection Agency, U.S. Army Corps of Engineers, and the state Fire Marshal. These regulations ensure clean air and water, safe disposal of hazardous wastes, and the conservation and protection of resources, wildlife, and the surrounding environment. In addition, Fermilab has many programs dedicated to continually improving and correcting the laboratory's future impact on the environment.

Fermilab's comprehensive environmental monitoring and surveillance program provides for the measurement and interpretation of the impact of Fermilab operations on the public and the environment.[1] Surveillance and monitoring tasks are conducted to confirm compliance with standards and permit limits as well as ensure early detection of an unplanned pollutant release. The location and frequency of sampling are based on established routines, operational considerations and process assessments as well as historic levels of pollutants found in each location. Sampling points are selected based on the potential for adverse impacts. Additionally, samples of effluents and environmental media such as soil and groundwater are collected on the site and at the site boundary. These samples are analyzed and results are compared to applicable guidelines and standards.

Fermilab's Environmental Management System (EMS) was recognized in 2007 by acquiring full ISO 14001 third-party certification. This certification was maintained in 2008 and included two surveillance audits by a third party auditor. An EMS is a set of processes and practices that enable an organization to reduce its environmental impacts and increase its operating efficiency via an ongoing cycle of planning, implementing, evaluating, and improving to achieve compliance with environmental requirements, prevention of pollution, and meeting of continuous environmental goals. ISO 14001 standards require an organization to meet a stringent set of criteria; the organization must have an infrastructure and management plan that facilitates measurable environmental objectives. An important purpose of this report is to present the current status of these objectives.

Results of Fermilab's environmental monitoring and surveillance, compliance with all specific environmental regulations, environmental protection activities, progress on environmental restoration, waste management and corrective action activities are discussed in this report. The report is arranged by environmental topic and specific environmental compliance requirement.

# 2.0 Summary of Significant Environmental Issues

*Spill Control Containment and Countermeasure (SPCC) Compliance*
Beginning in 2002, the US Environmental Protection Agency underwent a lengthy process to update and strengthen the regulations for SPCC (40 CFR 112). The focus of this regulation is on oil spill prevention, preparedness and proper response to spills. Historically Fermilab has had limited exposure under the existing SPCC rules with the issuance of an SPCC plan for the Giese Road electrical transformer. Changes to the regulations have required the lab to reevaluate additional sources of oil maintained on site to determine applicability to the new rules. In 2008 an ad hoc group of the Environmental Protection Subcommittee was convened to oversee the effort. Subsequently a environmental consulting firm was hired to help Fermilab interpret the regulations and develop a comprehensive SPCC plan covering our oil sources.

*Federal Sustainability Goals*
In 2008 Fermilab began developing a series of Environmental Management Program plans (EMP) to meet the requirements of Executive Order (EO) 13423, *Strengthening Federal Environmental, Energy and Transportation Management* and DOE's associated implementing orders. Fermilab uses EMPs to set measurable objectives

and targets for significant environmental aspects associated with facility operations under our Environmental Management System.

EO 13423 outlines sustainability goals agencies will be required to meet in these areas: energy efficiency; renewable energy; petroleum use; water conservation; environmentally preferable purchasing; pollution prevention and recycling; toxic chemical reduction; high performance existing buildings; new buildings; vehicle fleet management. Fermilab evaluated the goals against our list of environmental aspects and developed EMPs for goals relevant to current site operations. DOE will require conformance with the requirements of the executive order in 2009.

*Tritium in Surface Water*

The strategy for managing surface water continued to be based on avoiding discharges of tritium into offsite waterways. When necessary, procedural changes made during 2006 were employed to restrict the movement of cooling water to the eastern lakes (i.e., Lake Law and A.E. Sea) by transferring it to Casey's Pond and the Kress Creek watershed. These actions limited the discharge from the eastern lakes to *waters of the state*. Swan Lake (headwaters of Indian Creek) was maintained at a level low enough to permit discharge only one month during the year.

## 3.0 Ecological Issues

Fourteen National Environmental Research Park (NERP) projects were in differing stages of progress during 2008. The projects along with the name of the sponsoring institution are listed below:

- Assessment of the Impact of Biological Controls on Garlic Mustard (*Alliara petiolata*) and on Non-target Species in Forest Communities, Argonne National Laboratory
- Bird Surveys at Fermilab, Fermilab
- Feedbacks between Plants, Mycorrhizal Fungi, and Soil Nutrient Dynamics, Argonne National Laboratory
- Investigation of Carbon Dioxide and Nitrogen Fluxes in Terrestrial Ecosystems at Fermilab, Argonne National Laboratory
- Hydrologic and Plant Community Controls on Soil Carbon Accrual after Cessation of Agriculture, Argonne National Laboratory
- Ascomycete Fungi in Bison Dung from the Fermilab Bison Herd, The Field Museum
- Bioenergy Experimental Plots at Fermilab, Argonne National Laboratory
- Management of Roundworm Infection in the raccoon Population, Wheaton College
- Floristic Characteristics Of Prairie Restoration Sites In The Greater Chicago Region, Governor's State University
- Evaluation of Biological and Chemical Management Practices for Emerald Ash Borer, Morton Arboretum
- Reintroduction of Barn Owls at Fermilab
- Investigation of the microbial associates of switchgrass (*Panicum virgatum*)
- Monitoring Potential Impacts of Canadian National Railroad Purchase of Elgin, Joliet, and East Rail Lines: Fermilab Segment.

The Laboratory's Ecological Land Management Plan[2] was updated in 2008. Existing prairie tracts were enriched with forbs and burned or mowed to discourage intrusion of brush, trees and exotic plants.

Fermilab carries out wildlife management to the extent necessary to protect the primary mission of the Laboratory and to preserve the Fermilab ecosystem. The Lab has a "nuisance animal" permit issued by the Illinois Department of Natural Resources (IDNR) that allows for the trapping and elimination of these nuisance animals. During 2008, five animals were euthanized, and one animal was released to Willowbrook Wildlife Center in Glen Ellyn, IL, for rehabilitation. In addition, Fermilab intensively manages the population of whitetail deer on site to preserve the ecosystem. Fermilab contracts with the U.S. Department of Agriculture Wildlife Services Group to reduce the herd to an optimum number annually. This activity requires approval and permitting from IDNR; during 2008, 39 whitetail deer were removed.

## 4.0 Environmental Management System (EMS)

Executive Order (EO) 13148, *Greening the Government through Leadership in Environmental Management*, required each Federal agency to implement an Environmental Management System (EMS) at its facilities by December 31, 2005. DOE issued Order 450.1 to ensure execution of EO 13148 at all DOE facilities. An EMS is a set of processes and practices that enable an organization to reduce its environmental impacts and increase its operating efficiency via an ongoing cycle of planning, implementing, evaluating, and improving to achieve compliance with environmental requirements, prevention of pollution, and meeting of continuous environmental improvement goals. In addition, a comprehensive EMS will assimilate the principles of the Integrated Safety Management System (ISMS) into an Integrated ES&H Management System (IES&HM), addressing facility operational hazards that have the potential to impact individuals and/or the environment.

In April and July of 2005, DOE Chicago Office (CH), Safety and Technical Services, reviewed the implementation status and progress of the EMS at Fermilab. In September of 2005, Fermilab's EMS was evaluated by a three member assessment team comprised of individuals from the DOE Chicago Operations Office (CH), the DOE Argonne Site Office, and Argonne National Laboratory, to provide the Fermilab Site Office (FSO) with a basis for formally declaring that Fermilab had implemented the EMS related requirements contained in EO 13148 and DOE Order 450.1. The review team issued a positive recommendation to the FSO Manager concerning the EMS Self-Declaration Process for Fermilab. In December of 2005, the FSO Manager stated, in a letter to the Office of Science that "Fermilab fully conforms to the EMS requirements of DOE Order 450.1."

During 2006, the EMS data questionnaire was developed by the Office of Management and Budget to monitor progress of federal agencies in EMS implementation. DOE chose the time frame for 2006 reporting to coincide with the fiscal year reporting that EPA will require by October 2008. EMS status information for Fermilab was submitted by the December 2006 deadline and used to generate the OMB Environmental Stewardship Scorecard for DOE.

In mid 2006, Fermilab decided that its mission would be improved by acquiring full ISO 14001 third-party certification. ISO 14001 standards require an organization to meet a stringent set of criteria; the organization must have an infrastructure and management plan that facilitates compliance with environmental laws and standards, to improve its environmental performance and to achieve measurable environmental objectives. The standards are not a government requirement but instead they signify an organization's commitment to best environmental practices.

The laboratory began its efforts to become ISO 14001 certified in July 2006 by developing a request for proposals that was sent out to prospective registrars to perform the necessary third-party registration for certification. A contract was awarded to NSF International Strategic Registrations (NSF ISR) in late September to perform those duties. NSF ISR performed two audits of the lab's EMS in 2006, a Desk Audit in late October and a Readiness Review Audit in December. Findings that resulted from the December Readiness Review were addressed in a Corrective Action Request Plan completed in early 2007. Approval of this plan followed by a Registration Audit that was initiated in July 2007 resulted in the lab being recommended by NSF ISR for ISO 14001 registration. Fermilab was notified of its ISO 14001 standards registration in August of 2007.

In 2008 the DOE requested that Fermilab declare conformance by June 30, 2009 with goals outlined in Executive Order 13423, *Strengthening Federal Environmental, Energy and Transportation Management* and (DOE) Implementing Order 430.2B, *Departmental Energy, Renewable Energy and Transportation Management*. The executive order replaces 13143 and outlines expectations for sustainable practices at federal facilities. In response Fermilab developed a series of Environmental Monitoring Program plans related to the sustainable practices. A status update to DOE on our progress was provided in September 2008. Fermilab was also subjected to two ISO 14001 surveillance audits by NSF in 2008. The audits occurred in February and October and focused on activities in PDD and TD respectively. Fermilab remained in conformance with the requirements of the 14001 standard.

## 5.0 Environmental Monitoring and Surveillance

The goal of the Fermilab Environmental Monitoring Program (EMP) is to assist Laboratory management in decision-making by providing data relevant to impacts that Fermilab operations have on the surrounding environment. The EMP includes effluent monitoring which is used to confirm compliance with permits, generally at a particular point. Environmental surveillance is conducted at various locations to intercept the pathway of potential pollutants to receptors such as plants, animals or members of the public. Fermilab collects environmental data for reporting purposes or whenever it is necessary or useful in conducting the business of the Laboratory. Line organizations have the responsibility to recognize and understand the environmental aspects of their operations and to conduct their work in an environmentally sound manner.

The pathways available for movement of chemicals and radioactive materials from Fermilab operations to the public are the atmosphere, surface water, groundwater, and via the roadways (transportation of materials to and from the site). Environmental surveillance consists of collecting and analyzing samples of various media and measuring penetrating radiation (e.g. muons) within and at the site boundaries.

Ground and surface waters are sampled at locations near operating areas, potential contamination sources and along potential transport pathways. In addition to air and water surveillance, samples of soil are collected and analyzed for radioactivity to ascertain whether there is build-up of radioactive materials in the environment due to long-term operations.

Surface water, air, groundwater, soil and sediment samples are analyzed for radionuclide concentrations. Surface waters are also monitored for potential chemical constituents. While levels of penetrating radiation are in some places measurable near operational areas on the site, the levels decrease rapidly with distance from the sources. External penetrating radiation and airborne emissions are commonly below instrument detection levels at the site boundary and must be estimated to provide information about the maximum potential radiation doses to offsite populations. The results of the environmental surveillance program are interpreted and compared with environmental standards where applicable. The Fermilab Environmental Monitoring Plan, which is maintained by the ES&H Section provides more details.

## 5.1 Air Quality

Fermilab's Lifetime Operating Air Pollution permit issued by the Illinois Environmental Protection Agency (IEPA) under the Clean Air Act includes a *National Emissions Standards for Hazardous Air Pollutants* or NESHAPs element, which covers airborne radionuclides. In addition, the permit takes into account those criteria pollutants such as particulate matter, nitrogen oxides, carbon monoxide, volatile organic materials and sulfur oxides associated with the operation of various pieces of equipment.

Airborne radionuclides are normally released to the atmosphere from operating target stations. Measures, to keep these releases ALARA, are incorporated into the operating processes and procedures at these facilities. Monitoring is conducted at targeting areas where air emissions are considered a significant contributor to the overall transport of radioactive materials offsite. In addition, a small quantity of airborne radionuclides is contributed by the operation of the Magnet Debonding Oven. The air permit was revised in 1991 by the IEPA to include the Main Injector as a source of radioactivation at Fermilab. The air permit application stated that total activity released from the Lab would average no greater than 2000 Curies in a year with a maximum of 9000 Curies in a year; current and planned operations are far below these levels.

The radiation doses potentially received by the offsite public due to Fermilab operations are calculated from data gathered through environmental surveillance of the onsite sources. Selected vent stacks are monitored directly with stack monitors and indirectly by taking soil samples in the vicinity of the stacks. The dose for the air pathway is calculated using a Gaussian plume computer simulation model called Clean Air Assessment Package-1988 (CAP-88PC2). This model was created by the USEPA to predict the movement of airborne

radionuclides and its use is dictated by regulations governing hazardous air pollutants at 40 CFR 61. Maximum calculated concentrations off-site are predicted to be below the level that could be detected by direct monitoring.

Fermilab is not a significant source of chemical air pollution. The permits cover emissions caused by open burning conducted for prairie/land management and fire extinguisher and firefighter training, a magnet debonding oven, a fuel dispensing facility, a vapor degreaser, radionuclide emission stacks, a 2200 horsepower emergency standby diesel fuel fired generator, the Collider Detector at Fermilab (CDF) and the Main Injector Particle Production (MIPP) gas circulating systems, and the operation of several natural gas-fired boilers. Pollutant levels are estimated based on the knowledge of the processes that generate them and the characteristics of individual pollutants. The results are submitted to the Illinois Environmental Protection Agency in an annual air emissions report.

## 5.1.1 Radioactive Air Emissions

Operation of the debonding oven, when radioactive components are being burned, is a potential source of tritium. In 2008, the debonding oven burned one radioactive magnet (there were 9 other magnets burned); the release from this one magnet was conservatively estimated to be 0.000165 Ci for the year. The Anti-Proton Area stack, used in Colliding Beam operations, and the MiniBooNE and NuMI stacks are estimated to have released a total of approximately 136.6 Curies in 2008. These radioactive air emissions were approximately 2% of the annual average (2000 Curies) expected from operations as acknowledged in the current air pollution permit application on file with the Illinois Environmental Protection Agency (IEPA). No detectable levels of radionuclides reached the site boundaries. Doses to the public from emissions in 2008 continued to be well below the Environmental Protection Agency (EPA) standard of 10 mrem/year and also much less than the EPA's continuous monitoring threshold of 0.1 mrem/year. Using the CAP-88PC2 gaussian dispersion model, the highest dose equivalent to any member of the public was estimated to be 0.0364 mrem.

Fermilab's 2008 Radionuclide Air Emissions Annual Report was submitted to the DOE FSO in May 2009. The report is distributed by the DOE FSO to the USEPA and IEPA.

## 5.1.2 Non-Radioactive Air Emissions

The IEPA decided in late 1996 that the level of air emissions at the Laboratory did not warrant the issuance of a Federally Enforceable State Operating Permit (FESOP) and therefore issued a Lifetime Operating Permit to Fermilab in 1999. In 2000, the permit was revised to add a vapor degreaser to the previously permitted air pollution sources and in 2004 to add a 2200 horsepower emergency standby diesel fuel fired generator located at the Feynman Computing Center, and again in 2006 to include both the CDF and MIPP gas circulating systems. The current permit covers the magnet debonding oven, three natural gas-fired boilers at the Central Utility Building (CUB), a 12,000-gallon gasoline storage tank with a stage 1 and stage 2 vapor balance system, accelerator tunnel ventilation stacks, a vapor degreaser at Industrial Building 3, the standby diesel generator, and the CDF and MIPP gas circulating systems. Permit conditions require the monthly logging of fuel consumption for covered fuel combustion sources and solvent usage at the degreaser. Source operations were reviewed by Fermilab personnel again this year to ensure that permitted equipment continued to operate and be maintained in accordance with permit conditions. The Annual Air Emission Report for 2008, which provides an estimate of criteria pollutant emissions was submitted to the Illinois Environmental Protection Agency (IEPA) in May 2009.

## 5.2 Penetrating Radiation

Operation of the Fermilab accelerator and associated beamlines produce ionizing radiation such as neutrons and muons. Beamlines and experiments are designed so that most of the radiation is absorbed before reaching the ground surface and outdoor areas. The neutrons are absorbed by shielding. The remaining radiation that emerges above the surface presents a very small potential for radiation dose. Small muon fields have been measured in conjunction with the operation of the Fixed Target beamlines in the past. These beamlines were not operated in 2008. Since the removal of most of the Main Ring magnets from the Tevatron tunnel, the A0 beam absorber replaced the C0 beam absorber as the primary absorber. Unlike the C0 absorber, the Tevatron beam has to be bent down into the earth to be directed to the A0 absorber. Due to this beamline feature, the ground absorbs the muons emerging from the A0 absorber. Therefore, no muons are detected from its operation. Both the MiniBooNE and NuMI experiments have the potential to produce measurable muon flux; however, the 8 GeV energy protons used in MiniBooNE are too low in energy to produce muons that can escape the bulk shielding surrounding the experiment. The NuMI beamline bends the beam down so that the muons produced are absorbed deep underground as part of the beamline design.

Another potential source of exposure to ionizing radiation is the centralized radioactive materials storage area referred to as the Railhead. This source of penetrating radiation was monitored continuously in 2008 by a large ionization chamber located in the Railhead colloquially called a 'Hippo.' The Hippo measurements are supplemented by periodic onsite surveys. Based on measurements made in 2008, it is estimated that radioactive materials stored at the Railhead contributed a dose equivalent at the site boundary in 2008 which was not directly measureable as different from background. The maximum radiation dose equivalent to an individual at the nearest offsite house was thus estimated to be statistically distinguishable from background in 2008.

## 5.3 Surface Water Quality

Fermilab discharges liquid effluent to surface water bodies and to sanitary sewers. The Lab holds National Pollutant Discharge Elimination System (NPDES) permits that govern discharges to surface water from stormwater runoff, cooling water, and effluents from various onsite construction projects. In addition to monitoring for the physical and chemical parameters required by NPDES permits, samples of surface water are taken annually from selected water bodies and analyzed for radionuclides. These surface waters are sampled for radionuclides based upon their potential for contamination. Aqueous process wastewaters are directed to sanitary sewers and ultimately discharged to publicly owned treatment works (POTWs) in Batavia and Warrenville. Wastewater discharges are controlled by criteria set forth in the Fermilab Environment, Safety, and Health Manual Chapter 8025.

### 5.3.1 Radioactive Releases to Surface Water

Numerous sumps collect and drain water from building footings and from under beamline tunnels in the Tevatron, Main Injector, and the Experimental Areas. Water collected by these sumps often contains detectable concentrations of radionuclides (primarily tritium, $^{3}H$) that have been leached by rainwater from radioactive soil near beam targets and absorbers or released accidentally to sumps from beamline cooling water systems. These sumps discharge to ditches and ponds onsite.

In addition, water is also collected from the NuMI tunnel system. NuMI water also contains measurable concentrations of tritium. The water collected consists primarily of groundwater that has infiltrated into the tunnel. This high-quality water is pumped from the tunnel and directed into the ICW system where it is used primarily for make-up water for the CUB cooling towers. Excess NuMI water and effluent from the towers is directed to the ICW pond system.

In 2005 measureable tritium was detected in surface water discharges from the site at our permitted outfall locations (specifically Indian Creek). Subsequently Fermilab instituted measures to reduce the levels in accordance with our ALARA (as low as reasonably achievable) policy. Fermilab continues to monitor the surface water system and the outfalls for the presence of tritium Fermilab's recently re-issued, site specific NPDES permit includes monitoring requirements for tritium at all six of our outfalls. Monitoring for radioactivity in on-site surface water continues to be a primary component of Fermilabs routine environmental surveillance program.

## 5.3.2 Non-Radioactive Releases to Surface Water

Monitoring for non-radiological chemical constituents in surface water was limited to NPDES permit parameters (temperature, flow, pH, and chlorine) this year. Discharge Monitoring Reports for six different outfalls were submitted monthly to the IEPA. In 2008 there were no exceedances of discharge limits to waters of the state.

## 5.3.2.1 Cooling Water System

Fermilab's individual site specific NPDES permit authorizes the discharge of commingled cooling water and storm water runoff to surface waters through outfalls to Kress, Indian and Ferry Creeks. Due to the presence of the RCRA-permitted (Resource Conservation and Recovery Act) Hazardous Waste Storage Facility on-site, the NPDES permit also regulates storm water discharges from designated solid waste management units (SWMUs). The Storm water Pollution Prevention Plan required by this NPDES permit is periodically modified to reflect changes that occur as part of the RCRA Facility Investigation (RFI) of the SWMU sites. The NPDES permit dictates that water temperature, pH, flow, and tritium is to be monitored at all six outfalls; chlorine concentration is monitored at the Kress and Indian Creek outfalls. The monitoring results are reported to the IEPA on a monthly basis.

In 2007 Fermilab contracted services to treat cooling ponds for algae and pond weeds using a state licensed applicator which continued through 2008. The ongoing zebra mussel infestation of the industrial cooling water system pipes and pumping infrastructure is managed by FESS using a water treatment specialty company. A monitoring system for the water level at the Kress Creek outfall was constructed in 2008 and is monitored by our Metasys, building automation system.

## 5.3.2.2 Releases to Sanitary Sewers

An Individual NPDES permit allows Fermilab to pre-treat and release effluent from the Central Utility Building (CUB) regeneration process to the City of Batavia sanitary sewer system. The pretreatment permit requires the collection and analysis of composite process effluent samples for specified metals on a quarterly basis. Samples are also collected and analyzed from each discharge for accelerator-produced radionuclides in order to confirm released radioactivity meet DOE guidelines. In 2008, 79,950 gallons of process wastewater were discharged to the Batavia sewer system. In 2006, the regeneration process was re-designed to ensure that all effluents leaving CUB are compliant. In 2008, all effluent discharges were in compliance with the pre-treatment permit. Effluents are also analyzed for tritium and other radionuclides. All effluents in 2008 were compliant with specified levels in the Department of Energy Derived Concentration Guide for radionuclides. A total of 752.8 µCi of tritium and 127.2 µCi of $^{7}$Be were released to the sanitary sewer from the CUB during 2008. No other radionuclides were detected.

Monitoring stations, located at the site boundary, sample sewer discharges to the municipalities of Batavia and Warrenville. The discharge at these locations is a mixture of all effluents contributing to that sanitary sewer system. Analytical results are compared to municipal discharge limits to track compliance. The monitoring stations were not operated continuously in 2008. The Batavia sewer sampler composited monthly samples for 7 months and the Warrenville sampler collected samples for 4 months.

Beginning with the August sample of 2005, composited during the month of July, tritium was first detected at the Batavia monitoring station. Detections continued for the remainder of 2005 with a maximum activity of 4.1 pCi/ml measured from a grab sample collected in September of that year. Tritium was sporadically detected just above the detection limit of 1 pCi/ml from samples in 2006 and 2007. No tritium was detected in 2008 samples.

## 5.4 Groundwater Quality

The Illinois Environmental Protection Agency (IEPA) publishes groundwater quality standards[3] and defines Class I groundwater as a non-degradable resource, which is to be highly protected. The water that is located in or near the dolomite aquifer 50 to 70 feet below the ground surface of Fermilab is classified as Class I groundwater according to criteria published by the IEPA[4]. Water in the overlying Quaternary deposits has been demonstrated to be Class II water and therefore has less stringent standards.

Four background monitoring wells, up-gradient to Fermilab operations, continued to be utilized in 2008 to obtain samples representative of the upper Class I groundwater for chemical and radionuclide analysis. Ten monitoring wells at the Central Utility Building (CUB) Pipe and Clay Tile Field and eight at Meson Hill were sampled as part of ongoing RCRA Facility Investigation (RFI) corrective actions at these locations. During 2006, the Meson and Neutrino Soil Activation Areas was removed from the RFI as a Solid Waste Management Unit; however, five wells in this region continue to be monitored under the lab's environmental surveillance program with the results reported to the IEPA annually for informational purposes. In addition to the monitoring wells, seventy-six piezometers (pore-water pressure measuring apparatus) were used to gather information on the direction of groundwater flow site-wide. These data are used in modeling the transport of potential contaminants from past and present operational areas of concern. Piezometers that had been installed as part of the NuMI site characterization were monitored to assist Fermilab in planning for groundwater protection at that facility. One location is used to monitor for NuMI operational impacts to the Class I aquifer. Fermilab continued in 2008 to analyze groundwater associated with this project that resides within the dolomite aquifer.

Thirty-three of 118 on-site groundwater monitoring locations were sampled during the year for radionuclide and/or chemical parameters. The remaining locations were available exclusively for potentiometric surface (water level) monitoring.

### 5.4.1 Groundwater Characterizations

No groundwater characterizations were conducted in 2008

### 5.4.2 Monitoring Well Modification and Abandonment Activities

There were no monitoring well modifications or abandonment activities during 2008.

### 5.4.3 Radionuclides in Groundwater

The Department of Energy groundwater concentration guide and the Illinois Class I groundwater standard for tritium is 20 pCi/ml. 34 samples were taken from 16 locations for analysis. Radionuclides were not detected in any Class I groundwater samples during 2008.

## 5.4.4 Chemicals in Groundwater

Two rounds of groundwater samples were collected for chemical analysis in 2008 at two Solid Waste Management Units (SWMUs) as required by the Resource Conservation and Recovery Act Facility Investigation (RFI). (See Section 6.12.1 RFI Activities.)

Four samples were taken from four background monitoring wells for chemical analysis in 2008. These wells monitor groundwater migrating into the bedrock aquifer beneath Fermilab. As in previous years, chemical analysis of groundwater from monitoring well BMW1 showed total and dissolved sulfate slightly above the Class I Groundwater standard.

# 6.0 Compliance with Specific Environmental Requirements

Below is a summary of Fermilab compliance with key environmental requirements.

## 6.1 Clean Air Act

Open burn permits to allow prairie/land management burning, maintenance of Meson Hill, and fire extinguisher training were renewed by the IEPA in 2008. The annual air emissions report for 2008 was submitted to the IEPA in April 2009 and the annual radionuclide emissions report was submitted to the USEPA in June 2009.

In 2008 an estimated 136.6 Curies were released in conjunction with the operation of the Fermilab Anti-Proton Areas stack (used in Colliding Beam operations) and the MiniBooNE and NuMI Project stacks. The magnet debonding oven, a potential source of tritium, burned one radioactive magnet in 2008. The CAP-88PC2 dispersion model calculated the maximum dose equivalent delivered to a member of the public (at the boundary of the lab) to be 0.0364 mrem/year due to 2008 Fermilab operations. This approximate 2.3 fold increase from the 2007 maximum dose equivalent of 0.0158 mrem/year was due to primarily to a 3 fold increase in releases from the NuMI stacks and the installation of Main Injector collimators to preserve the optical quality of the beam.

Fermilab is registered with the Clean Fuel Fleet Program (CFFP); one of several programs the IEPA has implemented to help improve air quality in the Chicago ozone non-attainment area.

## 6.2 Underground Storage Tanks

No compliance issues were identified in 2007. The three Underground storage tanks (USTs) in use at Site 38 were operated and maintained per current UST standards set by the USEPA (40 CFR 280.80) and the Illinois State Fire Marshall (Illinois Administrative Code, Title 41, Sections 170.510(a), 170.510(b), 170.450, and 170.460). The Illinois State Fire Marshall conducted a Certification Audit of the Site 38 Fuel Dispensing Facility (January 2009) to determine compliance with state fire protection regulations listed above and found the facility compliant.

## 6.3 The Endangered Species Act of 1973

No compliance issues were identified in 2008.

## 6.4 Executive Order 11988, "Floodplain Management"

In 2008, one project, Main Injector Neutrino Upgrades, required review for compliance with11988. The project will require some minor construction within the floodplain of Indian Creek, a tributary of the Fox River. The project incorporated compensatory flood storage greater than that lost, and will not impair the ability of the stream to store flood waters

## 6.5 Clean Water Act Section 404 (and Executive Order 11990, "Protection of Wetlands")

Pre-evaluation of Fermilab activities in wetlands continued to be accomplished through the NEPA and construction design review processes. The Lab continued to use task manager/construction coordinator training to instruct participants in how to ensure that potential work areas are screened for the presence of wetlands and to be aware of all aspects of environmental compliance management.

During 2008, two projects (DWS Loop to Wilson Hall and Main Injector Neutrino Upgrades) required coverage under the NPDES General Storm Water Permit for Construction Activities. Storm Water Pollution Prevention Plans (SWPPP) were prepared and submitted to IEPA for both projects.

## 6.6 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

In 2008, the use of pesticides and herbicides at Fermilab was handled in accordance with FIFRA.

## 6.7 Illinois Department of Natural Resources "Rules for Construction and Maintenance of Dams"

Fermilab holds an Illinois Department of Natural Resources (IDNR) issued permit that classifies the Main Injector berm as a small *Class III* dam. The dam provides limited flood control to areas downstream from the Lab in the Indian Creek watershed. On a five-year cycle Fermilab is required to perform a comprehensive inspection and file a detailed report on the condition of this structure. The last comprehensive inspection was conducted in April of 2003. The required inspection of the dam was conducted in April of 2008 and transmitted to the IDNR by DOE on April 24, 2008. No non-routine action items were identified during the 2008 inspection

## 6.8 The Migratory Bird Treaty Act

Fermilab possesses a permit (Class C Nuisance Wildlife Control Permit) issued by the IDNR (acting for U.S. Fish and Wildlife Service) that allows for the destruction of Canada geese nests in the vicinity of the Children's Center, if they become a safety hazard. The permit allows the Lab to destroy up to ten nests each year. During 2008, five nests containing a total of six eggs were destroyed.

During 2008, in response to a number of injuries due to aggressive Canada Geese, Fermilab contracted with a firm to use dogs to harass geese in order to displace them from populated areas on the site. The firm holds a valid permit from the Illinois Department of Natural Resources to pursue the activity

## 6.9 National Environmental Policy Act (NEPA)

Fermilab met the requirements of this Act by continuing to implement a program of reviewing all activities for compliance as set forth in the Fermilab Environment, Safety and Health Manual (FESHM) Chapter 8060. FESHM Chapter 8060 – NEPA Review Procedure – was revised in 2003 to clarify when NEPA review was required and specifically what the review should entail; the approach to determining NEPA applicability was refined and several definitions were improved upon. DOE approved nine projects for Fermilab as being categorically excluded (CXs) from further review in 2008.

Categorical exclusions are categories of actions that do not individually or cumulatively have a significant effect on the human environment and for which, therefore, neither an environmental assessment nor an environmental impact statement is required; DOE's CXs are listed in Appendices A and B to Subpart D of its NEPA regulations found at 10 CFR Part 1021. In applying one of these CXs to a specific proposed action, DOE must determine that: (1) the proposed action fits within a class of actions listed in the regulations, (2) there are no extraordinary circumstances related to the proposal that may affect the significance of its environmental effects, and (3) the proposal is not connected to other actions with potentially significant impacts, related to other proposals with cumulatively significant actions, or an improper interim action. An Environmental Assessment is a concise public document for which a Federal agency is responsible that includes brief discussions of the need for the proposal, possible alternatives, environmental impacts of the proposal and alternatives, and a listing of agencies and persons consulted that serves to: (1) briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact; (2) aid an agency's compliance with the Act when no environmental impact statement is necessary; and (3) facilitate preparation of a statement when one is necessary.

## 6.10 National Historic Preservation Act (NHPA), Archaeological Resources Protection Act, Native American Graves Protection and Repatriation Act (NAGPRA) of 1990

Compliance with these Acts was accomplished through the NEPA review process that included an evaluation of all proposed land-disturbing projects in 2008 to assess any potential impacts on historic resources. No compliance issues were identified in 2008.

A DOE requested Cultural Resources Management Plan (CRMP) following guidelines outlined in DOE Publication DOE/EH-0501, was prepared and completed for Fermilab in 2002. The CRMP assures continued compliance with the above listed Acts by providing a comprehensive overview for the locations and status of all archaeological resources within the Fermilab site boundaries thereby facilitating future NEPA reviews.

Fermilab submitted its annual questionnaire on 2008 Federal archaeological activities to the Department of the Interior in December of 2008.

## 6.11 National Pollutant Discharge Elimination System (NPDES)

The following three IEPA issued National Pollutant Discharge Elimination System (NPDES) permits were active at Fermilab in 2008. The three permits are as follows:

1. General (covers several facilities that have the same type of discharge and are located in a specific geographic area) construction NPDES permit covering Domestic Water System Loop to Wilson Hall project.

2. Individual (specifically tailored to an individual facility) NPDES permit for combined stormwater and non-contact cooling water discharges associated with industrial activities; there are six outfalls linked with this permit (Outfall 001 to Ferry Creek, Outfall 002 to Kress Creek, and Outfalls 003, 004, 005, and 006 to Indian Creek). Outfalls 004, 005 and 006 were added to the permit during the last permit renewal. Outfall 006 covers potential discharges from the MINOS pond and Outfalls 005 and 006 cover discharges from the Main Injector pond system. The non-coal mine General NPDES permit for the NuMI tunnel construction project was closed August 1, 2008.

3. Individual NPDES pre-treatment permit that allows Fermilab to discharge wastewater effluent from operations occurring at the Central Utilities Building (CUB) to the city of Batavia sanitary sewer treatment works.

## 6.12 Resource Conservation and Recovery Act of 1976 (RCRA)

The Annual Hazardous Waste and Illinois Generator Non-Hazardous Special Waste Reports for 2008 were transmitted to the DOE Fermi Site Office in January and February 2009 respectively. DOE subsequently submitted these reports to IEPA.

The following volumes of non-radioactive waste were generated by Fermilab and managed for disposal by the Hazard Control Technology (HCTT) Team of the Environmental Protection Group in 2008.

| | |
|---|---|
| 12.4 $m^3$ | Non-Routine Hazardous Waste (RCRA + TSCA) |
| 4.2 $m^3$ | Routine Hazardous Waste (RCRA + TSCA) |
| 5.2 $m^3$ | Non-Routine Non-Hazardous (Special) Waste |
| 23.1 $m^3$ | Routine Non-Hazardous (Special) Waste |
| 6,746.8 $m^3$ | Dumpster/Landfill Waste |

### 6.12.1 RCRA Facility Investigation (RFI) Activities

As a condition of Fermilab's RCRA Hazardous Waste Management Part B permit that was initially issued in September 1991, the IEPA required Fermilab to undertake a RCRA Facility Investigation (RFI). The purpose of the RFI was to investigate whether hazardous constituents had been released to the environment from identified solid waste management units (SWMUs) located onsite. In addition to requiring the reporting of newly identified SWMUs, RCRA also required that IEPA be notified of any changes to previously identified SWMUs. A total of two SWMUs continue to be addressed in accordance with the corrective action requirements of Fermilab's RCRA permit: the CUB Pipe and Clay Tile Field and Meson Hill. The Meson and Neutrino Soil Activation Areas was removed from the RFI as a SWMU as part of the RCRA Part B permit renewal process. Further investigation is not required at the Village Machine Shop, the Railhead Storage Yard, and the IB2 Industrial Building so long as institutional controls remain in place.

## Village Machine Shop (SWMU# 5)

No new information was requested or generated at this unit during 2008.

## IB2 Industrial Building

No new information was requested or generated at this unit during 2008.

## CUB Pipe and Clay Tile Field (SWMU# 12)

The CUB Tile Field has previously been removed along with all chromate-contaminated soil and gravel. The soil was properly disposed of and the surrounding soil sampled and analyzed. Fermilab continues to monitor all of the CUB Tile Field wells semi-annually. Monitoring wells at SWMU 12 were sampled during the 2nd and 4th quarters of the calendar year. Well MW7B was dry during both rounds of sampling.

## Meson Hill (SWMU# 13)

Closure activities for Meson Hill were completed in 1998. This included moving concrete, grading, installing a clay cap, placing topsoil on the clay cap, hydroseeding the top of the hill, and a site inspection. Fermilab continues sampling of all monitoring wells installed at this unit on a semi-annual frequency. Analysis of groundwater from the monitoring wells screened within the upper Quaternary deposits has shown elevated concentrations of total dissolved sulfate and associated total dissolved solids above the 99% confidence level and Class II groundwater standards.

An Assessment Monitoring Plan was developed, reviewed and accepted by the IEPA in 2001 as a result of the continued monitoring results of elevated concentrations of total dissolved sulfates and associated total dissolved solids, and implemented and reported to the IEPA during 2002. The plan was developed to determine the source of the increase, concentrations and extent of sulfate migration, and assess any potential threat to human health and the environment. Results from the study indicated natural conditions were the source of the detected sulfate concentrations and that there was no potential threat to human health and the environment.

A directive was received from IEPA in August 2002 requiring the replacement of the background monitoring well at the RCRA unit. A post closure modification request was developed and forwarded to IEPA detailing the investigation, installation and sample process for the proposed background-monitoring well. IEPA responded in January 2003 approving the post closure modification request with conditions and modifications. The new background monitoring well was installed on May 22, 2003. Sampling of this monitoring point began with the 2nd quarter 2003 semi-annual monitoring and continued through the 4th quarter 2004. New 99% confidence levels were proposed in a modification request for Fermilab's post-closure care plan during 2005. New 99% confidence levels were received from IEPA in a directive to Fermilab during 2006.

Monitoring wells at SWMU 13 were sampled during the 2nd and 4th quarters of 2008. Statistical analyses demonstrated concentrations of dissolved ammonia in monitoring well G104 above the 99% confidence level during the 2nd quarter sampling, while concentrations of dissolved sulfate in monitoring well G101 exceeded the Class II groundwater standard during both the 2nd and 4th quarters.

## Railhead Storage Yard (SWMU #14)

No information was requested or generated at this unit during 2008.

## Meson and Neutrino Soil Activation Areas

This region was removed from the RFI as a SWMU during 2006 as part of the RFI Part B permit renewal. Fermilab continues to sample five monitoring wells in this region on a quarterly schedule for

accelerator-produced radionuclides. The results of samples from the Class I groundwater along with flow directions in the upper dolomite are reported annually to IEPA for informational purposes. No radionuclides above detection levels were reported in these monitoring wells during 2008.

## 6.13 Safe Drinking Water Act

During September 2005, Fermilab discontinued the use of onsite wells for domestic drinking water and secured a connection to the City of Warrenville public water supply. Fermilab retains four private wells at three sites (Site 29 [two wells], Site 53 [Buffalo Barn], and Site56). Private wells do not require any water treatment, sampling, or reporting.

## 6.14 Superfund Amendments and Reauthorization Act (SARA) TITLE III or Emergency Planning and Community Right-To-Know Act of 1986 (EPCRA)

Under these regulations Fermilab is required to provide the EPA, State, and local officials with an annual accounting of hazardous, toxic, and extremely hazardous chemicals used or stored onsite in quantities greater than a given threshold. Fermilab did not have to file a Toxic Chemical Release Inventory Report (TRI) for 2008 with the USEPA or IEPA because all usage of TRI chemicals was below reporting thresholds. As required by Section 312 of SARA Title III, Fermilab submitted a Tier II Emergency and Hazardous Chemical Inventory (2008) to state and local emergency services and disaster agencies in February 2009.

## 6.15 Oil Spill Prevention

In 2008, an ad hoc group of the Environmental Protection Subcommittee was formed to address the lab's compliance with 40 CFR 112 – Oil Pollution Prevention, and the upcoming final amendments to the regulation (January 2010). This US EPA regulation states that any facility that has the capacity to use or store more than 1,320 gallons of oil (petroleum, plant or animal oils and fats) must write and implement a Spill Prevention, Control and Countermeasures (SPCC) Plan that encompasses every oil source with the capacity of 55 gallons or more.

The SPCC Plan applies to oil-filled operational equipment such as transformers, as well as bulk storage containers such as 55 gallon drums. In 2008, a comprehensive inventory of oil sources was compiled. There are more than 300 bulk storage containers on site, and over 400 separate units of oil-filled operational equipment. Each source was reviewed by a consultant that was hired to write the SPCC Plan and provide the required Professional Engineer certification of the plan. This inventory will become part of the final SPCC Plan. While the SPCC Plan will address response to oil discharges, the overarching purpose is to prevent oil from entering Waters of the United States. Fermilab's cooling ponds are not waters of the United States. The ponds and other spillways can therefore be considered "environmental buffers" that provide protection of the U.S. waterways.

However, there are several locations on site where U.S. Waterways are vulnerable to an oil discharge from Fermilab equipment. Near the Indian Creek headwaters are three transformers and one back-up generator. The Giese Road transformer (at the corner of Giese Road and Kautz Road) contains 1,545 gallons of oil. This transformer sits in a secondary containment pit directly adjacent to the creek. The lab's current SPCC Plan addresses this vulnerability and mostly complies with the regulation and the upcoming amendments. Nearby, adjacent to the AP50 parking lot are the other three pieces of equipment. The equipment is not in secondary containment and does not comply with the regulations.

The next vulnerability is at the MiniBooNE Service Building. There are two small transformers (237 gallons each) that are installed adjacent to a wetland, and not in secondary containment. Wetlands must also be protected.

A final vulnerability at the Main Injector service buildings was revealed as a result of a November 2008 oil spill at MI-40. A transformer that provides power to the Main Injector bus failed and released 90 gallons of Shell Diala oil into the secondary containment structure underneath. However, the oil did not collect in the containment's sump pit as expected and its fate has not yet been completely determined. Some is known to have been absorbed into the clay liner at the bottom of the containment. Whether any escaped into the soil underlying the liner is not known, but the possibility cannot be discounted. No evidence of oil leaving the site has been found, and because of this and the relatively modest volume involved, the event was not reportable to either US EPA or DOE. Nearby drains have been dammed with oil absorbent material as a precaution against a delayed release. Soil profiles in the area will be examined for traces of the oil during a summer 2009 construction project immediately west of the MI-40 transformer yard. Due to this, the linings of all Main Injector secondary containments are suspect.

All of the vulnerabilities above (except the AP50 back-up generator) will be mitigated by implementing a Contingency Plan as part of the updated SPCC Plan. The contingency plan calls for monthly inspections of oil-filled operating equipment (i.e. transformers). Essentially, all transformers near Indian Creek will be inspected on a monthly basis in order to comply with the regulations.

The only vulnerability not mitigated by the Contingency Plan mentioned above is a back-up generator located at AP50. The generator's fuel tank is single walled, and does not meet the secondary containment requirements. Accelerator Division plans to either replace the fuel tank for this generator with a double-walled tank or replace the entire generator, which is quite old, with a new model having a double-walled tank. There are two other back-up generators on site that do not meet the secondary containment requirement; they are located at D0 and C4 Pumphouse. Particle Physics Division will likely replace the single-walled fuel tanks on the generators with double-walled fuel tanks.

## 6.16 Toxic Substance Control Act (TSCA)

Over the course of several years (1993 – 2002), Fermilab conducted a cleanup of Polychlorinated Biphenyl (PCB) contaminated soil resulting from past management practices at the transformer yards associated with various Tevatron service buildings. Groundwater that had seeped into the excavations after the 2002 remedial activities at B1 and B4 service buildings was found to be above the standard for unrestricted release. This water was properly disposed of prior to closing the excavations and very little water reentered the pits before they were backfilled. Consequently, although these locations met the standard for soil cleanup, they could not be declared "clean" at that time. Further groundwater sampling activities were conducted in July 2003. No remaining groundwater was detected at B1, so remediation there was declared complete. Conversely, groundwater samples collected at B4 again indicated contamination at levels slightly above the standards.

When PCB-contaminated groundwater is encountered, EPA regulations dictate that the owner will consult with the Agency and that the Agency decide, based upon risk, what further remediation, if any, is necessary. To obtain such a decision, Fermilab prepared a report on the results of its groundwater investigation and DOE transmitted it to the EPA on September 22, 2003. In the report, Fermilab concluded that the remaining contamination was very low-level and sufficiently localized that it did not pose any significant environmental threat. The Lab therefore, requested that the Agency classify the residual PCBs as "disposed in place." Discussions among EPA, Fermilab and the DOE Fermi Site Office staff have been held intermittently by phone; the most recent of which produced an EPA request for additional information on Fermilab's existing groundwater monitoring infrastructure in the vicinity of B4. A response was being developed at the time this report was in preparation.

Accelerator Division continued its program to phase out use of PCBs when opportunities arise. Small PCB capacitors were removed from 132 quadrupole power supplies in the Linac. This reduced the PCB inventory by 13 pounds. Further reductions are planned.

## 7.0 Pollution Prevention and Waste Minimization

Fermilab continued to make progress minimizing waste prior to generation and reducing pollution in 2008. Over one thousand metric tons of a wide variety of materials was recycled. This includes several new recycling initiatives also begun in 2008.

Comingled Materials Recycling – Fermilab has expanded its program to recycle comingled glass, plastic and metal containers across 80% of the buildings on site. Over the past year recycling volumes of these materials have doubled from approximately 2,000 pounds to over 5,000 pounds per month. The goal for 2009 is to provide similar recycling opportunities to the remaining buildings.

Alkaline Battery Recycling - Fermilab has implemented a site-wide alkaline battery recycling program. The program was instituted in the summer of 2008 following the success of a year-long pilot program in one of the larger organizational laboratory units. Batteries are collected at any one of 75 satellite areas and are transferred to a centralized location prior to shipment for recycling.

The moratorium, issued by the Secretary of Energy in July 2000, on recycling of scrap metals from posted radiological or radioactive materials areas, remained in effect throughout 2007. Measures were continued throughout the year at Fermilab to separate materials subject to this moratorium. Due to this, materials that were considered non-radioactive according to Fermilab's DOE-approved release criteria and which had been recycled prior to the moratorium continued to be accumulated.

At all levels of operation Fermilab continues to seek out opportunities to reuse materials whenever possible. From the reuse of materials to construct experimental apparatus, such as the 3,100 cesium iodide crystals reclaimed from KTev valued at over $6 million, to small-scale projects in the Computing Division where approximately 40 gallons of excess enamel paints found in our were used to paint and protect lead shielding material.

## 8.0 Conclusion

The operations at Fermilab during 2008 had no significant adverse impact on the environment or on public safety.

[1] Details of the Fermilab Environmental Monitoring Program (FEMP) can be found on the ES&H home page.
[2] Fermilab Annual Ecological Land Management Plan can be found on the Fermilab website by clicking *About Fermilab* and then *Nature/Ecology*.
[3] 35 IAC 620
[4] 35 IAC 620.210