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ANL-25/02

Argonne NATIONAL LABORATORY

SITE ENVIRONMENTAL REPORT

for Calendar Year 2024

Environment, Safety, and Health Directorate

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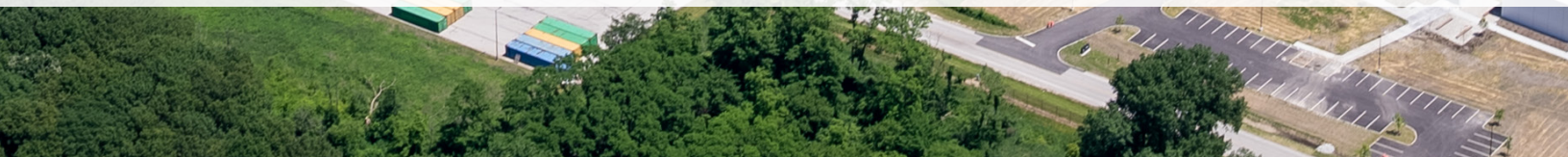


ANL-25/02

Argonne National Laboratory
Site Environmental Report
for Calendar Year 2024

Preceding Report in This Series: ANL-24/02

prepared by
M. Mesarch, C. Klimek, P. Lynch, M. Pfeiffer, and D. Vanek
Environment, Safety, and Health Directorate
Argonne National Laboratory

September 2025

A NOTE FROM THE AUTHORS

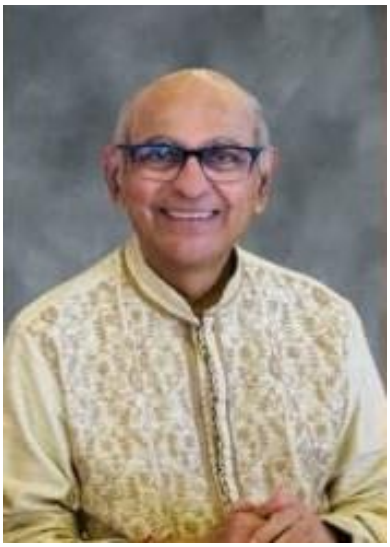
This Site Environmental Report (SER) was prepared by the Environment, Safety and Health, (ESH) Directorate at Argonne National Laboratory (Argonne) for the U.S. Department of Energy (DOE). The results of the environmental monitoring program and an assessment of the impact of site operations on the environment and the public are presented in this publication. This SER is available on the Internet at http://www.anl.gov/community/environmental-protection.

Many of the figures and tables were prepared by Jennifer Tucker (ESH). Some figures, however, were prepared by the authors and various staff members of Argonne's Environmental Science Division (EVS). Many members of the Environmental Protection Program, the Natural Resources and Efficiency Program, Industrial Hygiene Program, Radiological Operations Program, Emergency Management Program, Waste Management Program, and the Analytical Services Laboratory contributed to this report. Names are listed below.

Andrew Antoine	Pete Lynch	John Quinn
Karyn Andersen	Matt Mesarch	Terri Schneider
Gerald Baudino	Matt Nagrodski	Denise Seeman
Susan Bussey	Jeff Overby	Casey Sullivan
Taylor Downs	Nick Oudin	Anil Thakkar
John Dyer	Alessandra Panko	Larry Thompson
Jennifer Gomez	Ray Patchak	Jennifer Tucker
Jordan Jakubowski	Christina Perez	Matt Tuftedal
Collin Klimek	Mark Pfeiffer	Jim Ulrich
Mike Kuszewski	Jill Ptak	Dee Vanek

Members of Argonne's Communications and Public Affairs (CPA) division, Seth Hammond, Sydney Medema, and Lorenza Salinas provided support in graphic arts and document formatting.

Dedication



Kaushik Joshi

This Site Environmental Report is dedicated to Kaushik Joshi. Kaushik was an environmental engineer for the Department of Energy Argonne Site Office. Kaushik's long tenure of service at Argonne was characterized by his deep historical knowledge of Argonne's environmental history, as he was present for much of it. One of Kaushik's best qualities was how he valued relationships, and his belief that relationships were the biggest factor in good environmental stewardship. To this end, he constantly reminded everyone that Argonne and DOE were a team, working together to solve problems. He always had the time and patience to help his colleagues understand the environmental history of Argonne, and he was a valuable partner to Argonne's Environmental Protection Program in advocating environmental initiatives. His passing in January 2025 saddened all who worked with him. To meet Kaushik was to make a new friend. He will be missed by all who knew him.

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ACHP	Advisory Council on Historic Preservation
ACM	Asbestos-Containing Material
AEA	Atomic Energy Act of 1954
AGHCF	Alpha Gamma Hot Cell Facility
ALARA	As Low As Reasonably Achievable
APES	Argonne Property Excess System
APS	Advanced Photon Source
Argonne	Argonne National Laboratory
ASO	Argonne Site Office
ATLAS	Argonne Tandem Linac Accelerator System
BAT	Best Available Technology
BCG	Biota Concentration Guide
BMP	Best Management Practices
CAA	Clean Air Act
CAAPP	Clean Air Act Permit Program
CAP-88	Clean Air Act Assessment Package-1988
CAS	Chemical Abstracts Service
CEDE	Committed Effective Dose Equivalent
CEM	Continuous Emission Monitor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CHP	Combined Heat and Power
CNM	Center for Nanoscale Materials
CoCs	Contaminants of Concern
COE	U.S. Army Corps of Engineers
CP-5	Chicago Pile-Five
CPA	Communications and Public Affairs
CWA	Clean Water Act
CY	Calendar Year
DCS	Derived Concentration Standard
DMR	Discharge Monitoring Report
DMR-QA	Discharge Monitoring Report–Quality Assurance Program
DOE	U.S. Department of Energy
DOE-ASO	DOE Argonne Site Office
DOE-HQ	DOE Headquarters
EA	Environmental Assessment
ECHO	Enforcement and Compliance History Online
e-GRRT	EPA Electronic Greenhouse Gas Reporting Tool
EHS	Extremely Hazardous Substance
EIS	Environmental Impact Statement
EMS	Environmental Management System
ENE	East-Northeast
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act of 1973

ESHQ	Environment, Safety, Health, and Quality Assurance
ESPA	Illinois Endangered Species Protection Act
ESPC	Energy Savings Performance Contract
EVS	Environmental Science Division
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FFCA	Federal Facility Compliance Act of 1992
FRS	Facility Registry Service
FY	Fiscal Year
GAT	Green Action Team
GHG	Greenhouse Gas
GMZ	Groundwater Management Zone
GQS	Groundwater Quality Standard
GRO	Groundwater Remediation Objective
HAPs	Hazardous Air Pollutants
HFC	Hydrofluorocarbons
HSWA	Hazardous and Solid Waste Amendments of 1984
HTRL	Howard T. Ricketts Laboratory
IAC	*Illinois Administrative Code*
ICRP	International Commission on Radiological Protection
IDNS	Illinois Department of Nuclear Safety
IDPH	Illinois Department of Public Health
IEMA	Illinois Emergency Management Agency
IEPA	Illinois Environmental Protection Agency
IFB	Indistinguishable from Background
IPNS	Intense Pulsed Neutron Source
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
LEPC	Local Emergency Planning Committee
LINAC	Linear Accelerator
LLRW	Low-Level Radioactive Waste
LTS	Long-Term Stewardship
LUC	Land Use Control
LUCMOA	Land Use Control Memorandum of Agreement
LWTP	Laboratory Wastewater Treatment Plant
MAPEP	Mixed Analyte Performance Evaluation Program
MOU	Memorandum of Understanding
MW	Mixed Waste
MY	Model Year
NCRP	National Council on Radiation Protection & Measurements
NEPA	National Environmental Policy Act of 1969
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFA	No Further Action
NHPA	National Historic Preservation Act of 1966
NIST	National Institute of Standards and Technology
NNSS	Nevada National Security Site
NOx	Nitrogen Oxide

NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NRC	National Response Center
NRHP	*National Register of Historic Places*
ORPS	Occurrence Reporting Processing System
OSHA	Occupational Safety and Health Administration
P2	Pollution Prevention/Waste Minimization
PCB	Polychlorinated Biphenyl
PFAS	Per- and Polyfluoroalkyl Substances
PSTP	Proposed Site Treatment Plan
QA	Quality Assurance
QC	Quality Control
RACT	Reasonably Available Control Technology
RCRA	Resource Conservation and Recovery Act of 1976
RFI	RCRA Facility Investigation
RICE	Reciprocating Internal Combustion Engines
RQ	Reportable Quantity
SARA	Superfund Amendments and Reauthorization Act
SDS	Safety Data Sheet
SDWA	Safe Drinking Water Act of 1974
SER	Site Environmental Report
SERC	State Emergency Response Commission
SHPO	State Historic Preservation Officer
SME	Subject Matter Expert
SPCC	Spill Prevention Control and Countermeasures
SSP	Site Sustainability Plan
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
SWPPP	Stormwater Pollution Prevention Plan
SWTP	Sanitary Wastewater Treatment Plant
TACO	Tiered Approach to Corrective Action Objectives
TDS	Total Dissolved Solids
THMs	Trihalomethanes
TOC	Total Organic Carbon
TOX	Total Organic Halogens
TPQ	Threshold Planning Quantity
TRC	Total Residual Chlorine
TRI	Toxic Release Inventory
TRU	Transuranic Waste
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
T&E	Threatened and Endangered
USDA	United States Department of Agriculture
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WMO	Waste Management Operations

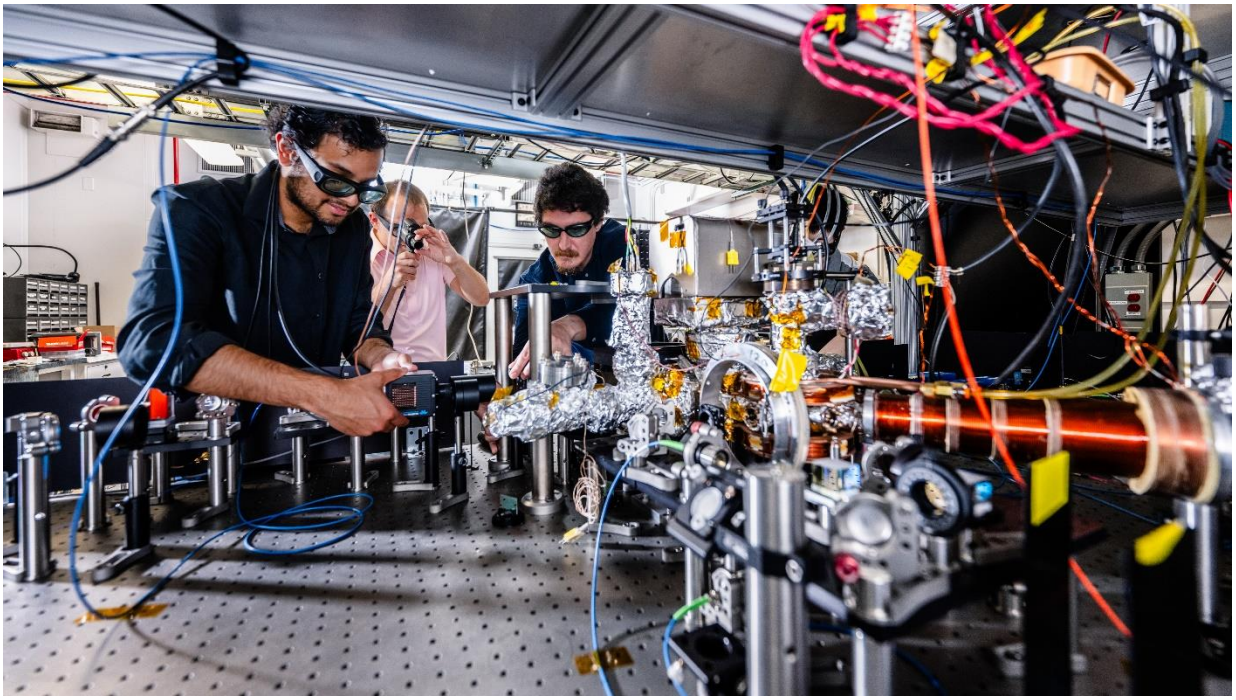
WQS Water Quality Standard
WWTP Wastewater Treatment Plant

ABSTRACT

This report discusses the status and accomplishments of the environmental protection program at Argonne National Laboratory for calendar year 2024. The status of Argonne environmental protection activities with respect to compliance with the various laws and regulations is discussed, along with environmental management, efficiency efforts, environmental corrective actions, and habitat restoration. To evaluate the effects of Argonne operations on the environment, samples of environmental media collected on the site, at the site boundary, and off the Argonne site were analyzed and compared with applicable guidelines and standards. A variety of radionuclides were measured in air, surface water, groundwater, and bottom sediment samples. In addition, chemical constituents in surface water, groundwater, and wastewater were analyzed. External penetrating radiation doses were measured, and the potential for radiation exposure to off-site population groups and on-site members of the public was estimated. Results are interpreted with respect to the origin of radioactive and chemical substances (i.e., natural, Argonne, and other) and are compared with applicable standards intended to protect human health and the environment. A U.S. Department of Energy (DOE) dose calculation methodology, based on International Commission on Radiological Protection (ICRP) recommendations and the U.S. Environmental Protection Agency's (EPA) CAP 88 computer code, was used in preparing this report.

ABSTRACT

1. INTRODUCTION



1.1. General Background Information

This annual report for calendar year (CY) 2024 of the Argonne National Laboratory (Argonne) environmental protection program was prepared to inform the U.S. Department of Energy (DOE), environmental agencies, and the public about the levels of radioactive and chemical pollutants in the vicinity of Argonne, as well as the amounts, if any, added to the environment by Argonne operations. It also summarizes the compliance of Argonne operations with applicable environmental laws and regulations and highlights significant accomplishments and issues related to environmental protection, sustainability, and remediation. The report was prepared in accordance with the guidelines of DOE Orders 436.1[1] and 231.1B[2] and supplemental DOE guidance.

Argonne is a research and development laboratory managed by UChicago Argonne, LLC, for the U.S. Department of Energy's Office of Science. Through its environmental monitoring program, Argonne monitors radioactive and chemical substances both on and near the site to determine their identity, magnitude, and origin in the environment. Monitoring of releases of such materials to the environment from Argonne operations is performed to verify the adequacy of the site's pollution control systems and ensure that these releases remain within acceptable limits.

The principal radiological facilities at Argonne are the Advanced Photon Source (APS), a superconducting heavy-ion linear accelerator (Argonne Tandem Linac Accelerator System [ATLAS]), a 22-MeV pulsed electron Linear Accelerator (LINAC), and several other charged-particle accelerators. The principal remaining nuclear facilities at Argonne are the Alpha Gamma Hot Cell Facility (AGHCF), the Waste Management Operations (WMO) Facility, and the Radioactive Waste Storage Facility. These nuclear facilities are non-reactor facilities and they involve material handling, management, storage, and disposition. The principal non-nuclear activities at Argonne that could potentially have measurable impacts on the environment include the steam boilers at the central heating plant and the discharge of wastewater from various sources.

The University of Chicago's Howard T. Ricketts Regional Biocontainment Laboratory, a state-of-the-art biocontainment facility intended to study infectious diseases, is also located on the Argonne site.

1.2. Description of Site

Argonne occupies the central 607 ha (1,500 acres) of a 1,514-ha (3,740-acre) tract in DuPage County, Illinois. The site is 43 km (27 mi) southwest of downtown Chicago and 39 km (24 mi) west of Lake Michigan. It is north of the Des Plaines River Valley, south of Interstate Highway 55, and west of Illinois Highway 83. Figures 1.1 and 1.2 are maps of the site and the surrounding areas that show some of the sampling locations associated with the monitoring program. Much of the 907-ha (2,240-acre) Waterfall Glen Forest Preserve surrounding the site was part of the Argonne site before it was deeded to the DuPage County Forest Preserve District

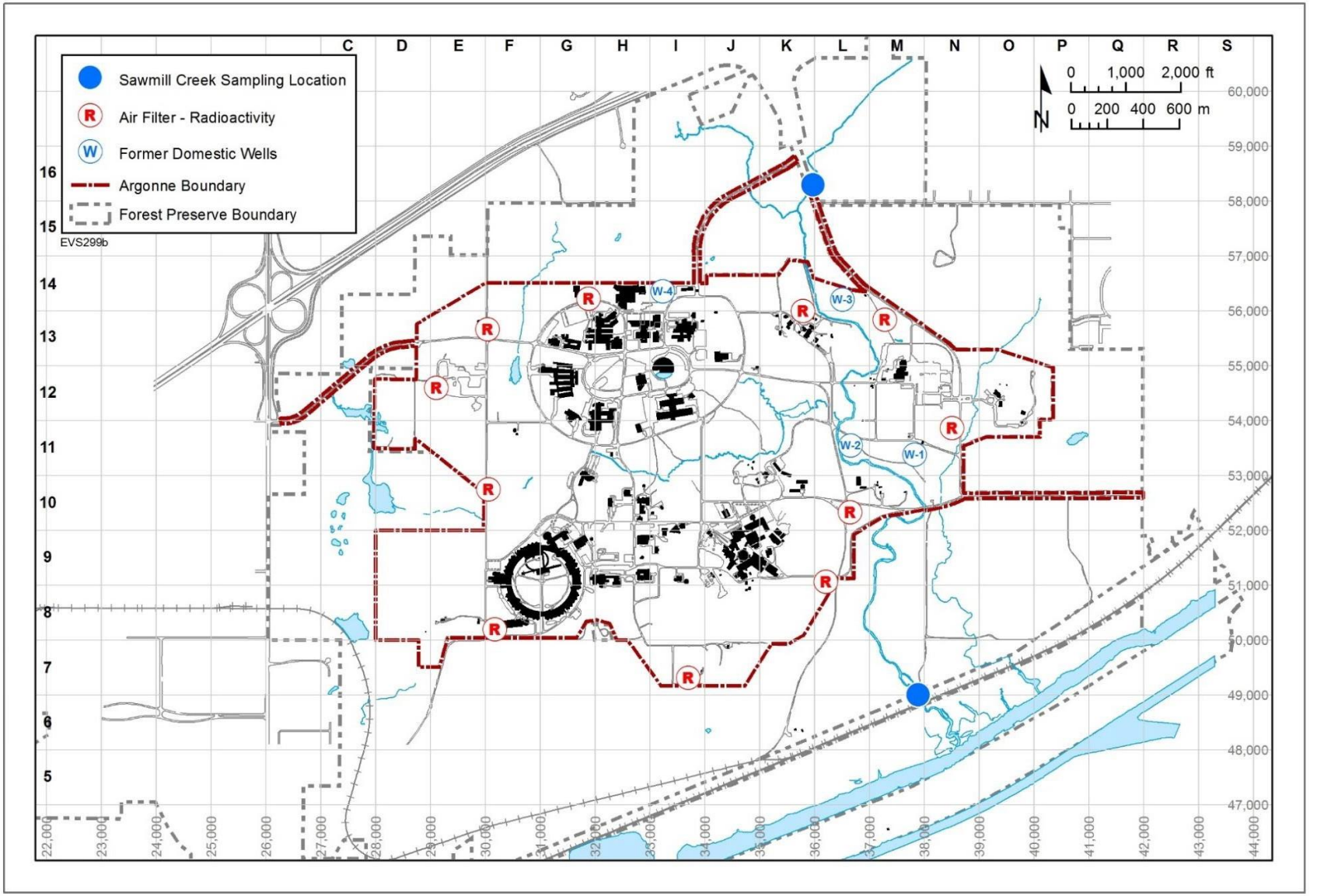


FIGURE 1.1 Sampling Locations at Argonne National Laboratory

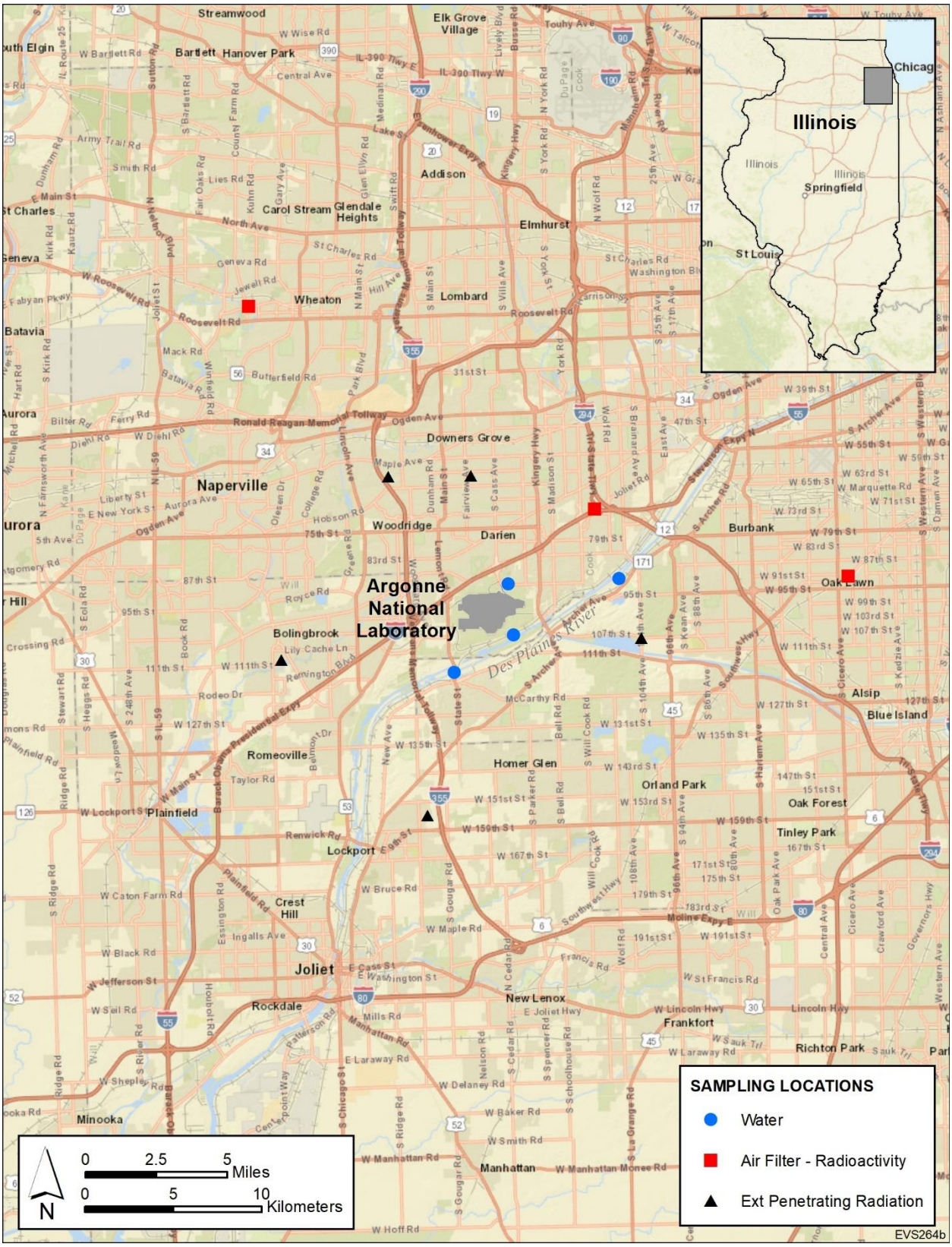


FIGURE 1.2 Sampling Locations Near Argonne National Laboratory

in 1973 for use as a public recreational area, nature preserve, and demonstration forest. In this report, facilities and some sampling locations are identified by the alpha-numeric row and column designations in Figure 1.1, to facilitate identification of their locations.

The terrain of Argonne is gently rolling, partially wooded, former prairie and farmland. The grounds contain a number of small ponds and streams. The principal stream is Sawmill Creek, which runs through the site in a southerly direction and enters the Des Plaines River about 2.1 km (1.3 mi) southeast of the center of the site. The land is drained primarily by Sawmill Creek, although the extreme southern portion drains directly into the Des Plaines River, which flows along the southern boundary of the forest preserve. This river flows southwest until it joins the Kankakee River about 48 km (30 mi) southwest of Argonne to form the Illinois River.

The largest topographical feature of the area is the Des Plaines River Valley, which is about 1.6 km (1 mi) wide. This valley contains the river, the Chicago Sanitary and Ship Canal, and the Illinois and Michigan Canal. The elevation of the channel surface of these waterways is 180 m (580 ft) above sea level. The bluffs that form the southern border of the site rise from the river channel at slope angles of 15 to 60 degrees and reach an average elevation of 200 m (650 ft) above sea level at the top. The land then slopes gradually upward and reaches the average site elevation of 220 m (725 ft) above sea level at 915 m (3,000 ft) from the bluffs. Several large ravines, oriented in a north-south direction, are located in the southern portion of the site. The bluffs and ravines generally are forested with mature deciduous trees. The remaining portion of the site changes in elevation by no more than 7.6 m (25 ft) in a horizontal distance of 150 m (500 ft).

1.3. Population

The area around Argonne has experienced significant population growth in the past 40 years as large areas of farmland have been converted into housing. Table 1.1 gives the directional and annular 80-km (50-mi) population distribution for the area, which is used to derive the population dose calculations presented later in this report. The population distribution, centered on the former Intense Pulsed Neutron Source (IPNS) was prepared by the Geospatial Computing, Innovation, and Sensing Department of the Environmental Science Division at Argonne and sourced from 2020 Census Redistricting Data Summary Files.

1.4. Climatology

The climate of the area is representative of the upper Mississippi Valley, as moderated by Lake Michigan. The most important meteorological parameters for the purposes of this report are wind direction, wind speed, temperature, and precipitation. Historic wind data were used to select air sampling locations. Data from the current year were used to calculate radiation doses from air emissions. Temperature and precipitation data are useful in interpreting some of the monitoring results. The 2024 data were obtained from the on-site Argonne meteorological station. The average wind direction usually varies from the west to the south, but with a significant northeast component.

TABLE 1.1

Population Distribution in the Vicinity of Argonne, 2020

	Miles[a]									
Direction	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50
N	0	955	3,028	5,741	9,298	47,845	180,887	361,186	246,447	337,600
NNW	0	1,019	2,717	5,637	8,062	40,344	218,297	284,715	196,616	151,957
NW	0	981	2,673	4,682	9,795	47,554	89,400	159,152	66,073	29,310
WNW	0	640	2,656	5,390	8,526	46,641	173,923	70,993	11,455	63,592
W	0	438	1,300	5,129	10,081	50,404	157,260	66,640	22,980	5,046
WSW	0	438	610	645	1,792	25,577	62,709	11,661	10,762	13,805
SW	0	440	1,192	1,593	1,044	17,228	125,841	29,384	19,725	6,514
SSW	0	446	2,132	2,793	1,990	23,012	86,900	11,262	19,104	9,179
S	0	448	1,737	2,437	1,696	11,826	48,356	7,333	41,906	31,884
SSE	0	447	593	1,133	1,929	23,981	66,219	11,754	20,305	13,808
SE	0	447	568	863	1,050	27,723	145,971	115,337	55,000	22,466
ESE	0	443	568	597	550	21,640	171,587	280,574	209,470	113,518
E	0	587	677	491	550	52,078	399,749	169,373	10,027	30,147
ENE	0	596	1,353	1,902	2,180	40,758	580,727	198,607	0	0
NE	0	814	1,486	1,549	2,471	42,116	692,591	961,770	0	0
NNE	0	1,267	3,253	4,729	5,080	46,584	329,384	530,793	89,302	1,626
Totals	0	10,405	26,545	45,311	66,095	565,311	3,529,802	3,270,534	1,019,170	830,452
Cumulative totals[b]	0	10,405	36,950	82,261	148,356	713,667	4,243,469	7,514,003	8,533,173	9,363,625

[a] To convert from miles to kilometers, multiply by 1.6.

[b] Cumulative totals = the total of this sector plus the totals of all previous sectors.

Table 1.2 provides 2024 precipitation and temperature data. The monthly precipitation data for 2024 was below the Argonne historical precipitation for ten months out of the year. The total precipitation for 2024 was less than the long-term total. Figure 1.3 presents the total precipitation each year over time. The 2024 monthly average temperature was below the long-term monthly average temperature for one month out of the year. The 2024 average temperature was above the long-term average. Figure 1.4 presents the average temperature each year over time. The climatology information was provided by the Climate and Atmospheric Science Department of the Environmental Science (EVS) Division.

TABLE 1.2

Argonne Weather Summary, 2024

	Precipitation (cm)			Temperature (°C)	
Month	Argonne 2024	Argonne Historical[a]		Argonne 2024	Argonne Historical[a]
January	7.26	7.28		-4.0	-4.1
February	1.32	5.56		3.3	-2.8
March	10.00	7.01		6.0	3.8
April	9.56	9.92		11.2	9.6
May	10.17	10.76		20.4	16.0
June	7.40	10.76		22.9	21.2
July	8.42	10.99		22.9	23.4
August	7.13	9.61		27.8	22.7
September	4.32	8.02		20.5	18.9
October	2.46	10.08		14.5	11.9
November	6.02	5.52		7.0	5.0
December	4.04	7.10		-0.6	-1.3
Total	78.10	101.51	Average	12.7	10.2

[a] Averages were obtained from the Argonne meteorological tower by using data from the last 20 years (2005–2024).

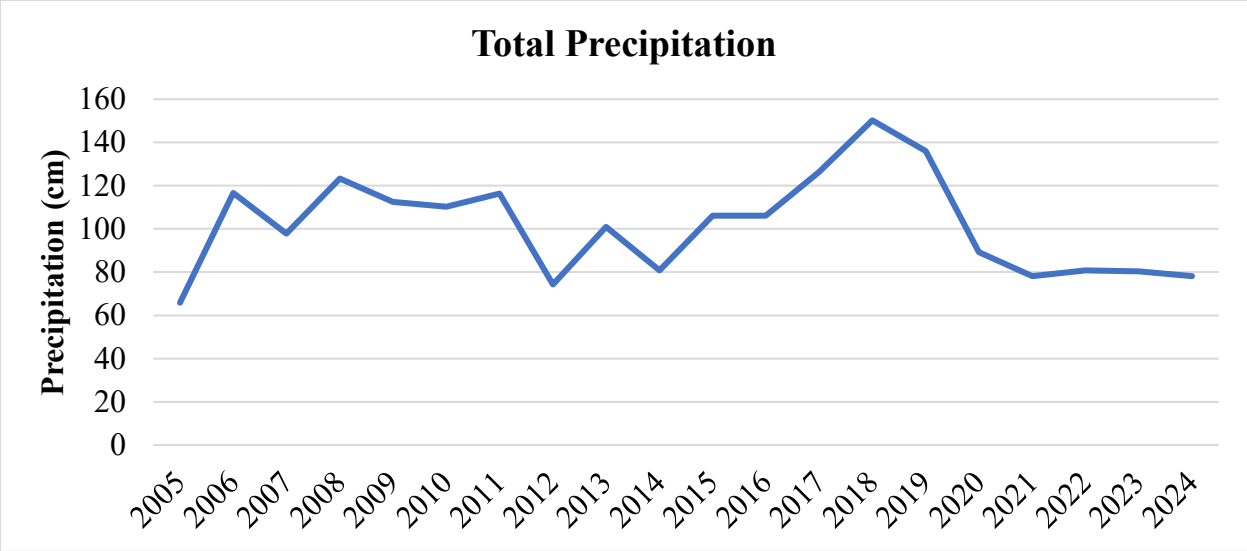
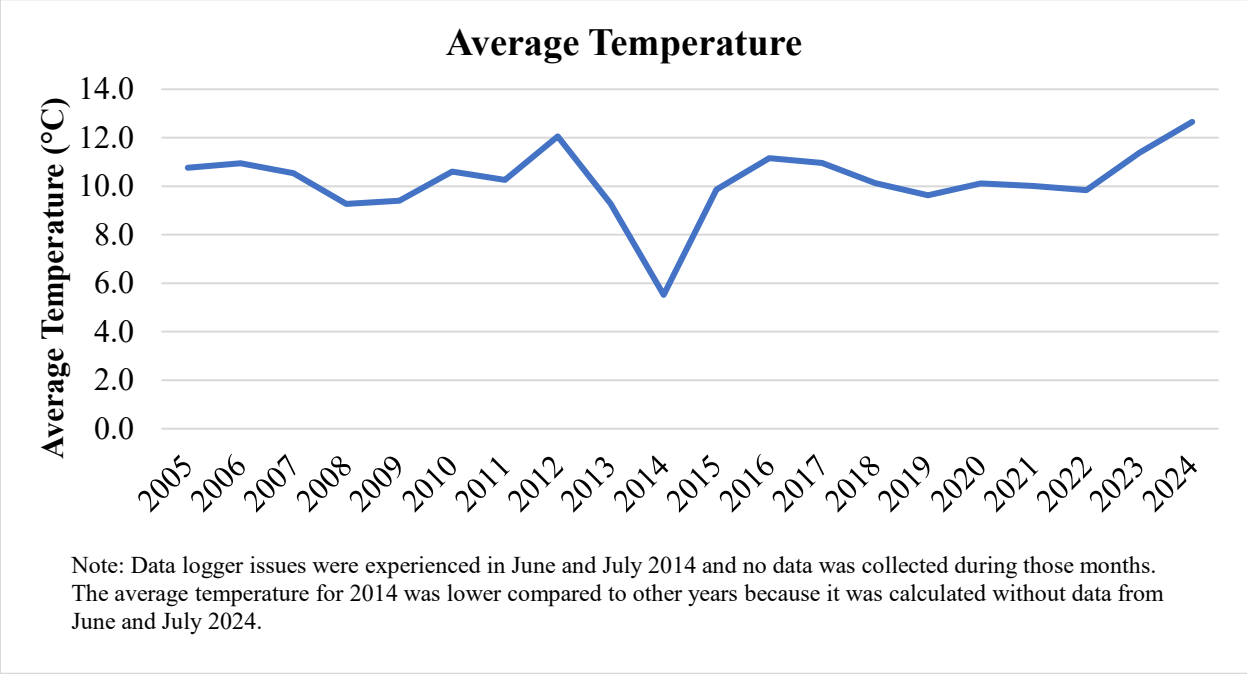


FIGURE 1.3 Total Precipitation, 2005 to 2024



Note: Data logger issues were experienced in June and July 2014 and no data was collected during those months. The average temperature for 2014 was lower compared to other years because it was calculated without data from June and July 2024.

FIGURE 1.4 Average Temperature, 2005 to 2024

1.5. Geology

The geology of the Argonne area consists of about 30 m (100 ft) of glacial drift on top of nearly horizontal bedrock consisting of Niagara and Alexandrian dolomite underlain by shale and older dolomites and sandstones of Ordovician and Cambrian age. The glacial drift sequence is composed of the Wadsworth and Lemont formations. Both are dominated by fine-grained drift units but also contain sandy, gravelly, or silty interbeds. Niagara and Alexandrian dolomite is approximately 60 m (200 ft) thick but has an irregular, eroded upper surface.

The southern boundary of Argonne follows the bluff of a broad valley, which is occupied by the Des Plaines River, the Chicago Sanitary and Ship Canal, and the Illinois and Michigan Canal. This valley was carved by waters flowing out of the glacial Lake Michigan about 11,000 to 14,000 years ago. The soils on the site were derived from glacial drift over the past 12,000 years and are primarily of the Morley series, that is, moderately well-drained upland soils with a slope ranging from 2 to 20%. The surface layer is a dark grayish-brown silt loam, the subsoil is a brown silty clay, and the underlying material is a silty clay loam glacial drift. Morley soils have a relatively low organic content in the surface layer, moderately slow subsoil permeability, and a large water capacity. The remaining soils along creeks, intermittent streams, bottomlands, and a few small upland areas are of the Sawmill, Ashkum, Peotone, and Beecher series, which are generally poorly drained. They have a black to dark gray or brown silty clay loam surface layer, high organic matter content, and a large water capacity.

1.6. Seismicity

No tectonic features within 100 km (62 mi) of Argonne are known to be seismically active. Although a few minor earthquakes have occurred in northern Illinois, none has been positively associated with particular tectonic features. Most of the recent local seismic activity is believed to be caused by isostatic adjustments of the earth's crust in response to glacial loading and unloading, rather than by motion along crustal plate boundaries.

Several areas of considerable seismic activity are located at some distance from Argonne. These areas include the New Madrid Seismic Zone, in the St. Louis area of southeast Missouri; the Wabash Valley Seismic Zone, along the southern Illinois-Indiana border; and the Anna Seismogenic Region of western Ohio.

According to United States Geological Survey's Earthquake Hazards Program, ground motion induced by seismic sources in northern Illinois is expected to be minimal. The probability that peak ground acceleration in the Argonne area will exceed 10% of gravity (the approximate threshold of major damage) is approximately 2% within a 50-year period.

1.7. Groundwater Hydrology

Two principal aquifers are used as water supplies in the vicinity of Argonne. The upper aquifer resides in the Niagaran and Alexandrian dolomite, which is approximately 60 m (200 ft) thick in the Argonne area and has a piezometric surface between 15 and 30 m (50 and 100 ft) below the ground surface for much of the site. The lower aquifer is in the Galesville sandstone, which lies between 150 and 450 m (500 and 1,500 ft) below the surface. Maquoketa shale separates the upper dolomite aquifer from the underlying sandstone aquifer. This shale retards the movement of groundwater between the two aquifers.

Until 1997, most groundwater supplies in the Argonne area were derived from the Niagaran, and to some extent, the Alexandrian dolomite bedrock. Delivery of Lake Michigan water to the nearby suburban areas began in 1992. Argonne currently obtains all of its domestic water from the DuPage Water Commission, which obtains Lake Michigan water from the City of Chicago water system.

1.8. Water and Land Use

Sawmill Creek flows through the eastern portion of the site. This stream originates north of the site, flows through the property in a southerly direction, and discharges into the Des Plaines River. Two small streams, one originating on-site and the other just off-site, combine to form Freund Brook, which discharges into Sawmill Creek. In addition to the streams, various ponds and marshes are present on the site. A network of ditches and culverts transports surface runoff toward these water bodies. Along the southern margin of the property, the terrain slopes abruptly downward, forming forested bluffs. These bluffs are incised by ravines containing intermittent streams that discharge some site drainage into the Des Plaines River.

The majority of the Argonne site is drained by Freund Brook. Two branches of Freund Brook flow from west to east discharging into Sawmill Creek. The larger south branch originates in a marsh adjacent to the western boundary line of the site. It traverses wooded terrain for a distance of about 2 km (1.5 mi) before discharging into the Lower Freund Pond. The Upper Freund Brook branch originates within the central part of the site and also discharges into the Lower Freund Pond.

Treated sanitary and laboratory wastewater from Argonne are combined and discharged into Sawmill Creek at location 7M, as depicted in Figure 1.1. In 2024, this effluent averaged 2.42 million L/day (0.64 million gal/day). The combined Argonne effluent consisted of 53% laboratory wastewater and 47% sanitary wastewater. This reflects an increase in both the proportion of laboratory wastewater and the total effluent volume compared to 2023. The likely cause of this increase is the higher cooling water demand following the deployment of Argonne's Aurora supercomputer in November 2023. Figure 1.5 illustrates the combined Argonne effluent each year over time. The water flow in Sawmill Creek upstream of the wastewater outfall averaged approximately 28.8 million L/day (7.6 million gal/day) during 2024.

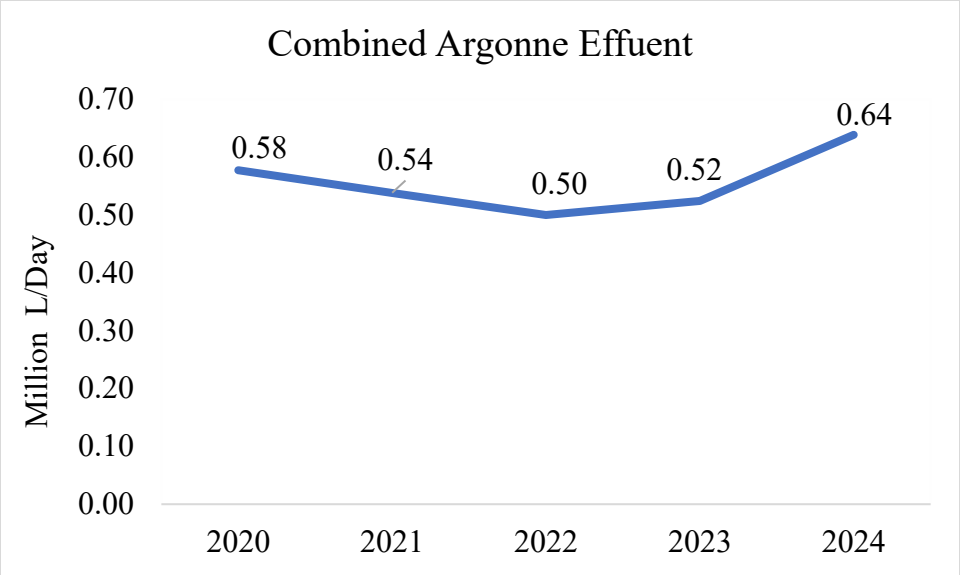


FIGURE 1.5 Combined Argonne Effluent, 2019 to 2024

Sawmill Creek and the Des Plaines River upstream of Joliet, Illinois, about 21 km (13 mi) southwest of Argonne, receive very little recreational or industrial use. Water from the Chicago Sanitary and Ship Canal is used by Argonne for cooling tower makeup water and by others for industrial purposes, such as hydroelectric generators and condensers. Argonne usage is approximately 3.10 million L/day (0.82 million gal/day). The canal, which receives Chicago Metropolitan Sanitary District effluent water, is used for industrial transportation and some recreational boating. Near Joliet, the river and canal combine into one waterway, which continues until it joins the Kankakee River to form the Illinois River about 48 km (30 mi) southwest of Argonne. The Dresden Nuclear Power Station is located at the confluence of the Kankakee, Des Plaines, and Illinois Rivers. This station uses water from the Kankakee River for cooling and discharges the water into the Illinois River. The first downstream location where river water is used as a community water supply is at Peoria, Illinois, which is on the Illinois River about 240 km (150 mi) downstream of Argonne. In the vicinity of Argonne, only subsurface water (from both shallow and deep aquifers) and Lake Michigan water are used for drinking purposes.

The principal recreational area near Argonne is the Waterfall Glen Forest Preserve, which surrounds the site (see Section 1.2 and Figure 1.1). The area is used for hiking, skiing, biking, and horseback riding. Sawmill Creek flows south through the eastern portion of the preserve on its way to the Des Plaines River. Several large forest preserves of the Forest Preserve District of Cook County are located southeast of Argonne and the Des Plaines River. The preserves include the McGinnis and Saganashkee Sloughs, as well as other smaller lakes. These areas are used for picnicking, boating, fishing, and hiking. A small park located in the eastern portion of the Argonne site (Location 12O in Figure 1.1) is for use by Argonne and DOE employees. A local municipality also has use of the park for athletic events. The park contains a day-care center for children of Argonne and DOE employees.

1.9. Vegetation

Argonne lies within the Prairie Peninsula of the Oak-Hickory Forest Region. The Prairie Peninsula is a mosaic of oak forest, oak openings, and tall-grass prairie occurring in glaciated portions of Illinois, northwestern Indiana, southern Wisconsin, and sections of other states. Much of the natural vegetation of this area has been modified by clearing and tillage. Forests in the Argonne region, which are predominantly oak and hickory, are somewhat limited to slopes of shallow, ill-defined ravines or low moraine like ridges. Gently rolling to flat intervening areas between ridges and ravines were predominantly occupied by prairie before their use for agriculture. The prevailing successional trend in these areas, in the absence of cultivation, is toward oak-hickory forest. Forest dominated by red oak and basswood may occupy more pronounced slopes. Poorly drained areas, streamside communities, and floodplains may support forests dominated by silver maple, elm, and cottonwood. Figure 1.6 shows the vegetation communities on the Argonne site.

Early photographs of the site indicate that most of the land that Argonne now occupies was actively farmed. About 75% was plowed field and 25% was pasture, open oak woodlots, and oak forests. Starting in 1953 and continuing for three seasons, some of the formerly cultivated fields were planted with jack, white, and red pine trees. Other fields are dominated by cool season pasture grasses.

The deciduous forests on the remainder of the site are dominated by various species of oak, generally as large, old, widely spaced trees, which often do not form a complete canopy. Their large low branches indicate that they probably matured in the open, rather than in a dense forest. Other upland tree species include hickory, hawthorn, cherry, and ash.

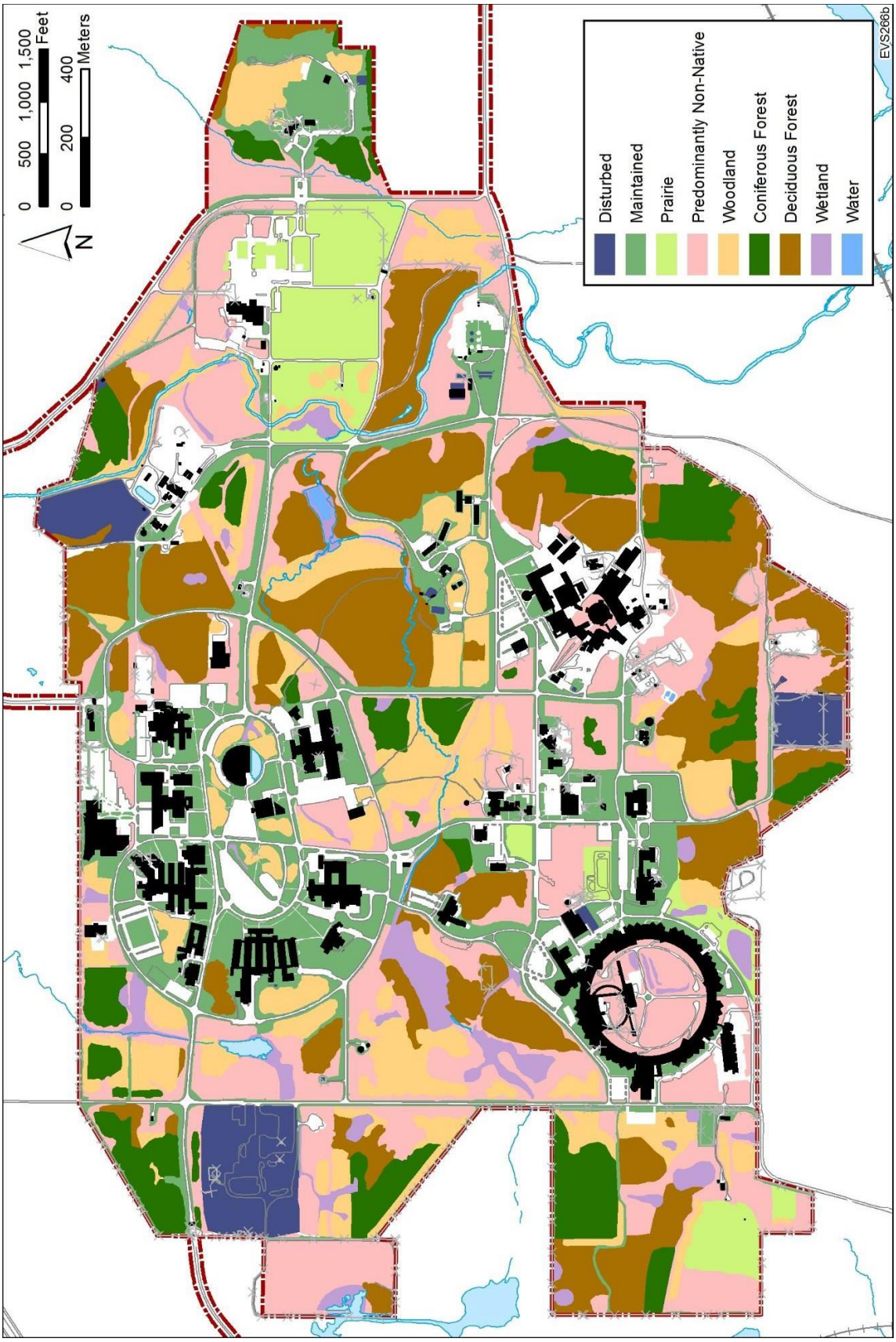


FIGURE 1.6 Argonne Vegetation Communities

1.10. Fauna

Terrestrial vertebrates that are commonly observed or likely to occur on the site include about 5 species of amphibians, 7 species of reptiles, 40 species of summer resident birds, and 25 species of mammals. More than 100 other bird species can be found in the area during migration or in winter; some migratory birds may nest on the site or in the surrounding region. An unusual species on the Argonne site was the fallow deer, a European species that was introduced to the area by a private landowner prior to government acquisition of the property in 1947. The fallow deer population is no longer present on the site. A population of native white-tailed deer inhabits the Argonne site. The deer population is maintained at a target density of 15 deer/mi^2 under an ongoing deer management program.

Freund Brook crosses the center of the site. The gradient of the stream is relatively steep, and riffle habitat predominates. The substrate is coarse rock and gravel on a firm mud base. Primary production in the stream is limited by shading, but diatoms and some filamentous algae are common. Aquatic macrophytes include common arrowhead, pondweed, duckweed, and bulrush. Invertebrate fauna consist primarily of dipteran larvae, crayfish, caddisfly larvae, and midge larvae. Few fish are present because of low summer flows and high temperatures. Other aquatic habitats on the Argonne site include beaver ponds, artificial ponds, ditches, and Sawmill Creek.

The biotic community of Sawmill Creek is relatively impoverished, which reflects the creek's high silt load, steep gradient, and historic release of sewage effluent from the Marion Brook sewage treatment plant north of the site. The fauna consists primarily of blackflies, midges, isopods, flatworms, segmented worms, and creek chubs. A few species of minnows, sunfish, and catfish are also present. Clean-water invertebrates, such as mayflies and stoneflies, are rare or absent. Fish species that have been recorded in Argonne aquatic habitats include black bullhead, bluegill, creek chub, golden shiner, goldfish, green sunfish, largemouth bass, stoneroller, and orange spotted sunfish.

2. COMPLIANCE SUMMARY

2. COMPLIANCE SUMMARY

Argonne is a U.S. government-owned, contractor-operated research and development facility that is subject to environmental statutes and regulations administered by the U.S. Environmental Protection Agency (EPA), the Illinois Environmental Protection Agency (IEPA), the Illinois Emergency Management Agency (IEMA), the U.S. Army Corps of Engineers (COE), and the State Fire Marshal, as well as numerous DOE Orders and Executive Orders (EOs). Argonne regularly reviews its compliance stature documented in US EPA's Enforcement and Compliance History Online (ECHO) Database for Facility Registry Service Number (FRS #) 110041963168. The primary areas of compliance covered include the Clean Air Act, Clean Water Act, and the Resource Conservation and Recovery Act. The status of Argonne during 2024 with regard to these authorities and regulatory programs is discussed in this chapter.

The Atomic Energy Act of 1954 (AEA) was enacted to assure the proper management of radioactive materials. Under the act, DOE regulates the control of radioactive materials under its authority. Sections of the act authorize DOE to set radiation protection standards for itself and its contractors. Accordingly, DOE promulgated a series of regulations (e.g., Title 10 of the Code of Federal Regulations, Parts 820[3], 830[4], and 835[5] [10 CFR Parts 820, 830, and 835]), and DOE Orders 435.1[6] , 436.1A (which was in effect for CY2024), and 458.1[7] to protect public health and the environment from potential risks associated with radioactive materials. This SER is also used to document compliance with these regulations and orders.

2.1. Clean Air Act

The Clean Air Act (CAA) is a federal statute that addresses the emission of regulated air pollutants, which include criteria pollutants such as carbon monoxide, sulfur dioxide, lead, nitrogen dioxide, particulate matter, and ozone, as well as hazardous air pollutants (HAPs), refrigerants, and ozone- depleting substances. The CAA also regulates greenhouse gases (GHG): CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6. The program for compliance with the requirements of the CAA is implemented by the individual states through a State Implementation Plan that describes how that particular state will ensure compliance with the air quality standards for stationary sources.

Under Title V of the Clean Air Act Amendments of 1990, on April 3, 2001, IEPA issued to Argonne a Clean Air Act Permit Program (CAAPP) operating permit to cover emissions of all regulated air pollutants at the facility. This permit supersedes the prior individual state air pollution control permits, with two exceptions for prior open-burning permits. The open-burning permits are renewed each year. Argonne meets the definition of a major source because of potential emissions of oxides of nitrogen in excess of 100 tons/yr and carbon monoxide in excess of 100 tons/yr at the Building 108 and 109 central heating plant.

A CAAPP permit renewal application was submitted to IEPA on September 24, 2024 and a Determination of Completeness was issued on October 1, 2024. The CAAPP permit has yet to be renewed, with the current permit effective as of June 29, 2020.

Facilities that are subject to Title V must characterize emissions of all regulated air pollutants, not only those that qualify as major sources. In addition to oxides of nitrogen, Argonne must evaluate emissions of carbon monoxide, particulates, sulfur dioxide, volatile organic compounds (VOCs), and HAPs — in all, a list of over 180 chemicals, including radionuclides, and ozone-depleting substances. In addition, since GHGs are also regulated air pollutants, carbon dioxide, methane, and nitrous oxide emissions must be evaluated and included as well. The air pollution control permit program requires that facilities pay annual fees on the basis of the total amount of regulated air pollutants (except carbon monoxide and GHGs) they are allowed to emit.

The Argonne Boiler House and Combined Heat and Power Plant (CHP) produce a majority of regulated air emissions from the Argonne site. The Boiler House consists of four natural gas boilers used to produce steam for use on site. The CHP consists of a stationary gas-fired turbine with a heat recovery steam generator and supplemental duct burners. The CHP is used to produce both steam and electricity for use on site. The remainder of regulated air emissions come from a variety of other emission units. These include radionuclide emitting facilities, a wastewater treatment plant, emergency generators, an engine test facility, fuel dispensing operations, and various research-related activities.

2.1.1. National Emission Standards for Hazardous Air Pollutants

The National Emission Standards for Hazardous Air Pollutants (NESHAP) constitute a body of federal regulations that set forth emission limits and other requirements, such as monitoring, recordkeeping, operational and reporting requirements, for activities generating emissions of HAPs. Significant NESHAPs affecting Argonne operations include those for radionuclides, asbestos, emissions from reciprocating internal combustion engines (RICE), and gasoline dispensing facilities.

2.1.1.1. Asbestos Emissions

Many buildings on the Argonne site contain large amounts of asbestos-containing material (ACM), such as insulation around pipes and tanks, spray-applied surfacing material for fireproofing, floor tile, and asbestos-cement (Transite) panels. This material is removed as necessary during renovations or maintenance of equipment and facilities. The removal and disposal of this material are governed by the asbestos NESHAP.

Argonne maintains an asbestos abatement program designed to ensure compliance with asbestos NESHAP and other regulatory requirements. ACM is removed from buildings either by Argonne personnel or by outside contractors who are licensed by the Illinois Department of Public Health (IDPH). All removal work is performed in accordance with both NESHAP and Occupational Safety and Health Administration (OSHA) requirements governing worker safety at ACM removal sites. A separate portion of the asbestos removal standards contains requirements for disposing of ACM. Off-site shipments are to be accompanied by completed shipping manifests.

Approximately 410.7 m^3 (14,501 ft^3) of ACM was generated from Argonne asbestos removal projects during 2024. The 101 small removal projects that were completed generated 27.2 m^3 (959 ft^3) of ACM waste. Nine large removal projects generated the remaining 383.5 m^3 (13,542 ft^3) of ACM waste. Table 2.1 provides asbestos abatement information for the large removal projects. The IEPA was notified during December 2024 that no more than 34 m^3 (1,200 ft^3) of ACM waste is expected to be generated from small-scale projects during 2025.

TABLE 2.1

Asbestos Abatement Projects
DOE/IEPA Notifications 2024

Completion Date	Asbestos Abatement Contractor	Notification Quantity			Material	Building	Disposal Quantity	Landfill
		ft	ft^2	ft^3			(ft^3)	
3/1/2024	Argonne Nuclear and Waste Management	0	882	0	Floor Tile and Mastic	361	70	Livingston Pontiac, IL
6/28/2024	Argonne Nuclear and Waste Management	268	0	0	Thermal System Insulation	361	298	Livingston Pontiac, IL
7/31/2024	Precision Environmental Co.	350	11,600	0	Thermal System Insulation and Transite Panels	115 and 116	7,916	Livingston Pontiac, IL
8/9/2024	Brock Industrial Services	60	0	1.75	Thermal System Insulation and Gaskets	205	1,056	Livingston Pontiac, IL
8/31/2024	Argonne Nuclear and Waste Management	0	27,400	0	Floor Tile and Mastic	200	864	Livingston Pontiac, IL
9/11/2024	Brock Industrial Services	0	3,600	0	Ceiling Tile, Floor Tile, and Mastic	362	1,056	Livingston Pontiac, IL
9/20/2024	Roofs, Inc.	0	2,900	0	Roofing Material	306	2,112	Livingston Pontiac, IL
9/30/2024	Argonne Nuclear and Waste Management	0	1,138	0	Floor Tile and Mastic	333	50	Livingston Pontiac, IL
9/30/2024	Argonne Nuclear and Waste Management	0	2,204	0	Floor Tile and Mastic	223	120	Livingston Pontiac, IL

2.1.1.2. Radionuclide Emissions

The NESHAP standard for radionuclide emissions from DOE facilities (40 CFR Part 61, Subpart H[8]) establishes the emission limits for the release of radionuclides other than radon to the air and the corresponding requirements for monitoring, reporting, and recordkeeping. A number of emission points at Argonne are subject to these requirements and are operated in compliance with them.

The amount of radioactive material released to the atmosphere from Argonne emission sources is extremely small, contributing little to the off-site dose. The maximum potential NESHAP-reported off-site dose to a member of the general public for 2024 was 0.0025 mrem/yr, which is approximately 0.025% of the 10 mrem/yr EPA standard. The 2024

NESHAP report contains more detailed discussions of these emission points and about compliance with the standard.

2.1.2. Conventional Air Pollutants

The Argonne site contains a number of sources of conventional air pollutants, including a steam plant, the CHP unit, gasoline and ethanol/gasoline blend fuel-dispensing facilities, waste handling facilities, an engine test facility, a surface treatment facility for etching research equipment, a number of diesel generators, and a wastewater treatment plant (WWTP). These facilities are operated and their associated activities are conducted in compliance with applicable regulations and permit conditions.

An annual compliance certification must be submitted to the IEPA and EPA each May 1 for the previous calendar year, detailing any deviation from the Title V permit and subsequent corrective actions. For calendar year 2024, two intermittent deviations were identified in the compliance certification report. Both deviations reflect a change in interpretation by IEPA of semiannual reporting requirements. New semiannual reports were submitted to the IEPA in September 2024. A compliance commitment agreement was issued by IEPA on October 31, 2024. All information in the semiannual reports had already been communicated to the IEPA in both the quarterly NOx reports for Boiler No. 5 as well as the annual compliance certifications. Semiannual reports will continue to be submitted for future reporting periods.

The Title V permit requires continuous emission monitoring for NOx at Boiler No. 5 when firing on gas. Boiler No. 5 has not burned coal since 2011 and was removed from the Title V permit in the most recent renewal.

Landfill gas monitoring is conducted quarterly at the 800 Area Landfill via 4 gas wells placed into the waste area and 10 gas wells at the perimeter of the landfill. Figure 2.1 shows their locations. In addition to the wells, ambient air is sampled in one nearby building and at three open-air locations to assess the presence of methane. The gas monitoring near the landfill provides information on whether methane is migrating from the landfill. In 2024, methane was not detected above the 2.5% action level in the landfill perimeter gas sampling wells. A fuel-dispensing facility is located at Building 46, Grounds and Transportation. This facility has VOC emissions typical of any commercial service station that dispenses gasoline and E85 (ethanol/gasoline 85%/15%).

Pursuant to *Illinois Administrative Code* (IAC), Title 35, Part 254 (35 IAC Part 254[9]), Argonne submits an emissions report to the IEPA each May 1, for the previous year. The summary for 2024 is presented in Table 2.2.

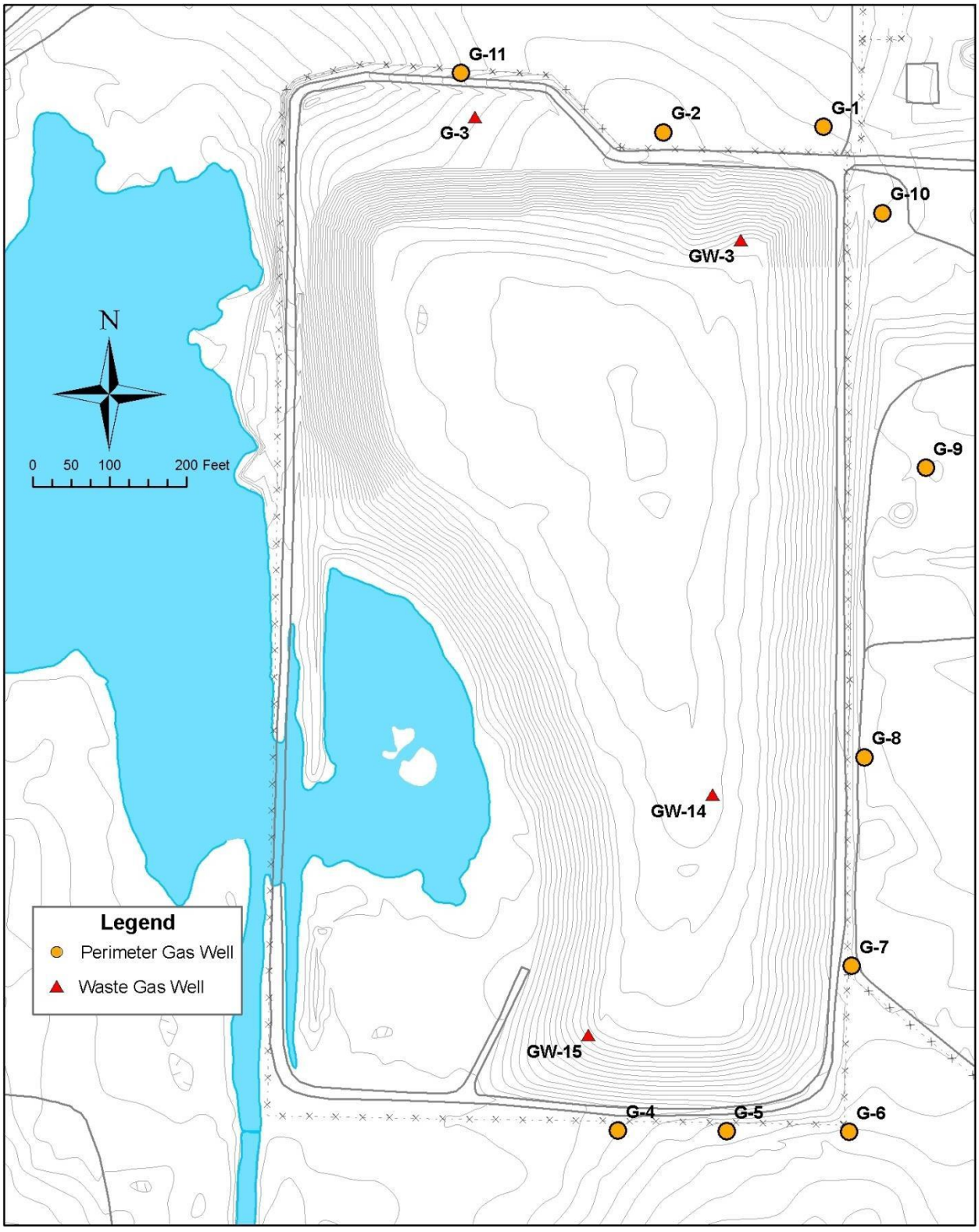


FIGURE 2.1 800 Area Landfill Gas Monitoring Wells

TABLE 2.2

Annual Emission Summary Report, 2024 (emissions in lbs/yr)

2024 ANNUAL EMISSION REPORT - EMISSION SUMMARY

Argonne CAAPP Permit #95090195

Source	CO[a]	NOx	PM/PM$_{10}$	PM$_{2.5}$[e]	SO$_2$	VOM	HAP[b]	NH$_3$[e]	CO$_2$[f]	CH$_4$[f,q]	N$_2$O[f,q]	CO$_2$e[f,q]
108 Boiler 1 (gas-fired)	11,171	13,299	1,011	253	80	731		65	15,980,516	301	30	15,997,033
108 Boiler 2 (gas-fired)	9,188	10,938	831	208	66	602		54	13,143,146	248	25	13,156,731
108 Boiler 4 (gas-fired)	6,448	7,676	583	146	46	422		38	9,223,563	174	17	9,233,096
108 Boiler 5 (gas-fired)	3,436	2,612	311	78	25	225		20	4,915,040	93	9	4,920,120
109 Combined Heat & Power (CHP)	1,953	21,597	10,076	10,076	114	600		8,687	54,812,398	4,069	1,415	55,336,346
400 APS Generator (Caterpillar)	236	1,228	43	43	102	33		0.9	25,944	1.1	0.2	26,033
400 APS Generators - Kohler (2)	448	2,333	83	83	193	75		1.0	29,004	1.2	0.2	29,104
Transportation Research Facility	1,016	4,195	297	55	275	781		2.0	31,099	1.27	0.25	31,207
PCB Tank Cleanout						0						
208 Surface Preparation Facility		1.1	0.0				1.3					
46 EtOH/gasoline Stg						1.3						
46 10K Gal Gasoline Stg						1.6						
308 Alkali Reaction Booth			2.2	2.2								
370 Alkali Reaction Booth[c]			-									
363 Central Shop Dust Collector[c]			-									
212 Building Exhausts[c]			-									
368 Woodshop Dust Collector[c]			-									
108 Sulfuric Acid Stg[c]			-									
Torch Cut Pb-Based Paint[c]			-									
206 Alkali Reaction Booth (R)[h]												
306 Building Vents (R)												
306 Chemical Photo-oxidation Unit (R)												
306 Waste Bulking Sheds (R)						0	0.0					
211 Linac (R)												
366 Wakefield Accelerator (R)												
205 Counting Area Ventilation (R)												
241 Materials Design Lab (R)												
211 Van de Graff Accelerator (R)												
211 D-024 Hot Cell (R)												
NAUTICAS Project (R)												
203 ATLAS (CARIBU) (R)												
200 M-Wing Hot Cells (R)												
400 APS Facility (R)		29										
212 Alpha Gamma Hot Cell (R)												
350 NBL P/U Hoods (R)												
Lab Rad Hoods (R)												
WM Portable HEPA - (6) (R)			0.000175	0.000175								
303 Mixed Waste Storage (R)												
331 Rad Waste Facility (R)												
595 Lab Wastewater Plant (R)						72						
315 MACE Project (R)	150											
Total (lb/yr)	**34,045**	**63,908**	**13,237**	**10,944**	**899**	**3,544**	**1**	**8867**	**98,160,711**	**4,889**	**1,497**	**98,729,669**
Total (ton/yr)	**17.0224**	**31.9542**	**6.6186**	**5.4718**	**0.4493**	**1.7718**	**0.0007**	**4.4337**	**49,080.3553**	**2.4443**	**0.7484**	**49,364.8345**
CAAPP Permit Limit (ton/yr)	(263.00)[d]	299.80	60.78	-----	9.50	27.73	10.00	-----	-----	-----	-----	

[a] Abbreviations: APS = Advanced Photon Source; ATLAS = Argonne Tandem Linac Accelrator System; CAAPP = Clean Air Act Permit Program; CARIBU = Californium Rare Isotope Breeder Upgrade; CH4 = Methane; CO = Carbon Monoxide; CO2 = Carbon Dioxide; CO2e = Carbon Dioxide Equivalents; EtOH = Ethanol; HAP = Hazardous Air Pollutant; HEPA = High Efficiency Particulate Air; MACE = Melt Attack Coolability Experiment; Linac = Linear Accelerator; N2O = Nitrous Oxide; NBL = New Brunswick Laboratory; NH3 = Ammonia; NOx = Oxides of Nitrogen; Pb = Lead; PCB = Polychlorinated Biphenyl; PM = Particulate Matter; PM10 = Particulate Matter less than 10 Microns; PM2.5 = Particulate Matter less than 2.5 Microns; P/U = Plutonium/Uranium; SO2 = Sulfur Dioxide; VOM = Volatile Organic Matter, WM = Waste Management

[b] Hazardous air pollutants (HAP) not included in VOM or Particulates (HCl, HF, methyl chloroform, methylene chloride).

[c] These sources designated as insignificant in the Clean Air Act Permit Program (CAAPP) Permit

[d] Not a permit limit, but is the maximum potential emission level for carbon monoxide.

[e] As of 2003 emissions of PM $_{2.5}$ and a precursor, ammonia (NH $_3$), must be included on the Annual Emission Report.

[f] As of 2011 greenhouse gas emissions (carbon dioxide, methane, nitrous oxide, carbon dioxide equivalents) are required on the Annual Emission Report.

[q] As of 2013 revised global warming factors pursuant to 40 CFR Part 98 Subpart A were used for methane and nitrous oxide.

[h] (R) = Radionuclide source - radionuclides except radon regulated by NESHAP (40 CFR 61 Subpart H)

NOTE: With the commencement of operation of the CHP unit, Boiler #3 was permanently decommissioned in May, 2016.

2.1.3. Clean Fuel Fleet Program

Although reporting requirements for the Clean Fuel Fleet Program are still in effect under the CAA and 35 IAC Part 241, the IEPA indicated that it no longer wanted reports to be filed for model year (MY) 2024 (September 1, 2023–August 31, 2024) vehicles because all current MY vehicles meet the clean fuel fleet standards. Nevertheless, because the requirements are still in effect, in lieu of a report, DOE/Argonne Site Office (DOE-ASO) submitted a letter to the IEPA prior to October 8, 2024, certifying that all vehicles acquired in MY 2024 meet federal emission standards.

2.1.4. Greenhouse Gas Reporting

There are three annual reporting requirements for GHG, with reports filed with DOE, IEPA, and USEPA. Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs) are reported to DOE in accordance with DOE Order 436.1A, Departmental Sustainability (which was in effect for CY2024). In November 2024, Argonne reported to DOE Headquarters (DOE-HQ) on its Scope 1 GHG emissions (direct emissions including fugitive emissions), Scope 2 GHG emissions (indirect emissions from electrical purchases), and Scope 3 GHG emissions (indirect emissions primarily from employee activities) for FY2024.

Argonne is required to report under 40 CFR Part 98[11] Subpart C on GHG emissions from combustion sources. The GHG report for calendar year (CY) 2024 required by EPA under 40 CFR Part 98 was submitted on March 18, 2025 on the EPA Electronic Greenhouse Gas Reporting Tool (e-GGRT) system.

Since 2011, as part of the Annual Emission Report to IEPA required under 35 IAC Part 254[10], Argonne also reports on CO2, CH4, N2O, and carbon dioxide equivalents (CO2e). These values are provided in Table 2.2.

Argonne evaluated HFC use on site in operational and research capacity. There was no use of HFC materials in our mission-critical scientific areas and equipment (e.g. Advanced Photon Source facility) where a replacement refrigerant was not available. As HFCs are phased out of the supply chain they will be replaced with non-HFC substitutes. As part of our commitment to sustainability and environmental responsibility, efforts are being made to reduce the use of HFCs in equipment procurements and encourage alternatives during the pre-construction planning phase moving forward. Argonne has developed green specifications that suggest/require alternative options be assessed and adopted. These specifications are integrated into the Argonne Project Management Organization (PMO) Division process, and applicable to all PMO managed projects.

2.2. Clean Water Act

The Clean Water Act (CWA) was established in 1977 as an amendment to the Federal Water Pollution Control Act of 1972 and was modified substantially by the Water Quality Act of 1987. Section 101 of the CWA provides for the restoration and maintenance of water quality in all waters throughout the country, with the ultimate goal of "fishable and swimmable" water quality. The act established the National Pollutant Discharge Elimination System (NPDES) permitting system as the regulatory mechanism designed to achieve this goal. The authority to implement the NPDES program has been delegated to those states, including Illinois, which have developed a program substantially equivalent and at least as stringent as the federal NPDES program.

2.2.1. Wastewater Discharge Permitting

The NPDES permitting process administered by the IEPA is the primary tool for enforcing the requirements of the NPDES program. Before wastewater can be discharged to any receiving stream, each wastewater discharge point (outfall) must be characterized and described in a permit application. The IEPA then issues a permit that, for each outfall, contains numeric limits and monitoring frequencies on certain pollutants likely to be present, and sets forth a number of additional specific and general requirements, including sampling and analysis schedules and reporting and recordkeeping requirements. NPDES permits are effective for five years and must be renewed by the submission of a permit application at least 180 days prior to the expiration of the existing permit.

Wastewater at Argonne is generated by a number of activities and consists of sanitary wastewater (from restrooms, cafeteria sinks, and sinks in certain buildings and laboratories), laboratory wastewater (from laboratory sinks and other industrial wastewater sources), and stormwater. Water from boiler house activities can be discharged into the DuPage County sewer system or the Argonne laboratory sewer system. Cooling water and cooling tower blowdown are sent to the laboratory wastewater sewer. A very small volume of steam condensate mixed with infiltrated storm water in underground steam vaults is discharged from a stormwater outfall monitored as part of the NPDES permit. The permit authorizes the release of wastewater or stormwater from 32 separate outfalls, most of which discharge directly or indirectly (via onsite drainages) into Sawmill Creek. Two of the outfalls are internal sampling points for wastewater treatment plant effluent that combine to form the main wastewater outfall, Outfall 001. Table 2.3 lists these outfalls, and Figure 2.2 shows the outfall locations.

TABLE 2.3

Characterization of National Pollutant Discharge Elimination System Outfalls at Argonne, 2024[a]

Outfall Number	Description	Average 2024 Flow[b]
A01	Sanitary Treatment Plant	0.343
B01	Laboratory Treatment Plant	0.298
001	Combined Outfall	0.639
D03	Steam trench discharge and stormwater	0.007
F03	South reach of Building 201, Building 201 fire pond overflow stormwater	Stormwater only
G03	Stormwater (Building 201 North), FPTD water	Stormwater only
J03	Building 213 and Building 213 parking lot stormwater, FPTD water	Stormwater only
N03	Stormwater, 212 East, FPTD water	Stormwater only
003	Watershed outfall for Lower Freund Brook System	Stormwater only
004	Stormwater, FPTD water	Stormwater only
005	Watershed outfall for Northwest 200 and 800 Areas	Stormwater only
006	Stormwater	Stormwater only
007	Stormwater, FPTD water	Stormwater only
008	Transportation and grounds stormwater	Stormwater only
011	North fence line marsh storm discharge	Stormwater only
012	100 Area stormwater discharge, FPTD water	Stormwater only
013	Southeast 100 Area stormwater	Stormwater only
014	Northern East Area stormwater discharge	Stormwater only
A15, B15	Building 40 stormwater discharge	Stormwater only
A16, B16	Southern East Area stormwater discharge	Stormwater only
018	Eastern 300 Area stormwater, compressor condensate, FPTD water	Stormwater only
020	Shooting range stormwater discharge	Stormwater only
021	319 Landfill and Northeast 317 Area	0.114
A22	Southern 317 Area	0.002
B22	Western 317 Area	0.091
023	Southern and Eastern 800 Area Landfill stormwater runoff	0.005
025	Buildings 314, 315, 316, southern APS stormwater, FPTD water	Stormwater only
026	Water Treatment Plant area stormwater	Stormwater only
027	CNM building stormwater, FPTD water	Stormwater only
028	Stormwater from HTRL building area (Building 204), FPTD water	Stormwater only

[a] Abbreviations: APS = Advanced Photon Source; CNM = Center for Nanoscale Materials; HTRL = Howard T. Ricketts Laboratory.

[b] Flow is measured in million gallons per day.

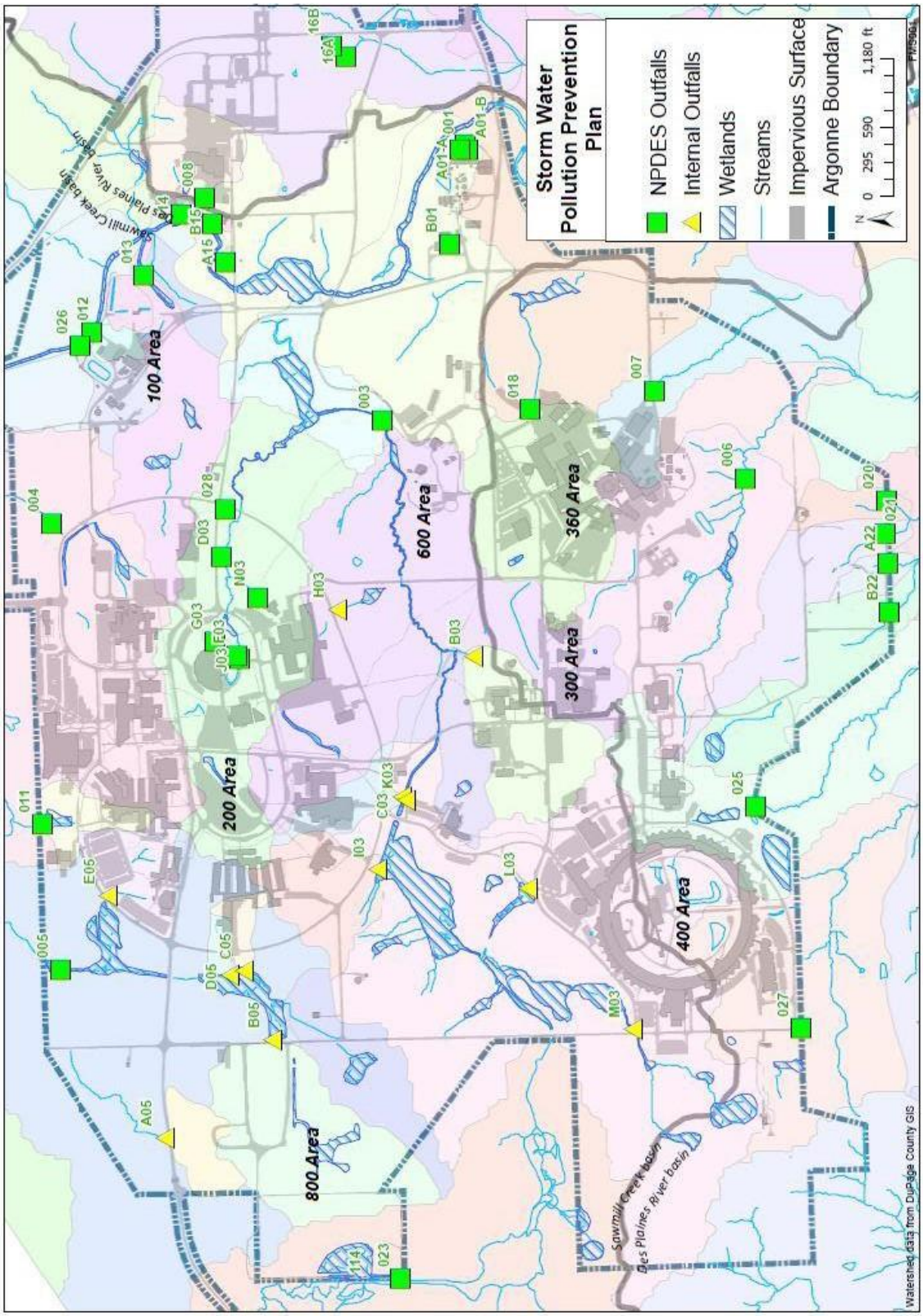


FIGURE 2.2 National Pollutant Discharge Elimination System Outfall Locations

2.2.1.1. NPDES Permit Activities

Wastewater discharge at Argonne is permitted by NPDES Permit No. IL 0034592. The IEPA issued a renewed permit effective September 1, 2023. The permit reflects Argonne's continuing efforts to reduce its NPDES "footprint" by the reduction in the number of outfalls requiring monthly sampling, the combination of several "internal" outfalls into more representative watershed outfalls, and the removal of select parameters from several outfalls due to their repeated absence or very low concentrations in discharges. One outfall, Outfall 006, was re-designated as a "stormwater only" outfall with the elimination of a once-through air compressor unit that discharged cooling water on an emergency basis. Quarterly sampling of the combined treatment plant outfall for 44 per- and-polyfluoro alkyl substances (PFAS) and a requirement to develop and implement a PFAS minimization program at Argonne were added to the permit.

2.2.1.2. Compliance with NPDES Permit

Wastewater is treated at Argonne in two independent treatment systems, the sanitary system and the laboratory system. The sanitary wastewater collection and treatment system collects wastewater from sanitation facilities, the cafeteria, office buildings, some of the small industrial discharges that cannot be routed to the laboratory sewer, and other portions of the site that do not contain radioactive or hazardous materials. This wastewater is treated in the sanitary wastewater treatment plant (SWTP), consisting of primary clarifiers, trickling filters, secondary clarifiers, and slow sand filters. Wastewater generated during research-related activities, including those that utilize radioactive materials, generally flows to a series of retention tanks located in each building and is pumped to the laboratory wastewater sewer after radiological analysis and release certification. Treatment in the LWTP consists of aeration, solids-contactor clarification, and pH adjustment. Additional steps can be added, including powdered-activated carbon addition for organic removal, alum addition, and polymer addition, if analysis demonstrates that any of these is required.

Figure 2.3 shows the two wastewater treatment systems. The volume of wastewater discharged from these facilities in 2024 averaged 1.3 million L/day (0.343 million gal/day) for the sanitary wastewater and 1.1 million L/day (0.298 million gal/day) for the laboratory process wastewater.

Results of the routine monitoring required by the NPDES permit are submitted monthly to the IEPA in a Discharge Monitoring Report (DMR). As required by the permit, any exceedance of permit limits or conditions is reported by telephone to the IEPA within 24 hours, and a written explanation of the exceedance is submitted with each DMR. During 2024, there were twelve exceedances of NPDES permit limits out of approximately 1,500 measurements as indicated in Table 2.4. All of the monitoring results, with the exception of those at Outfall 007 for reasons discussed below, are discussed in Chapter 5.

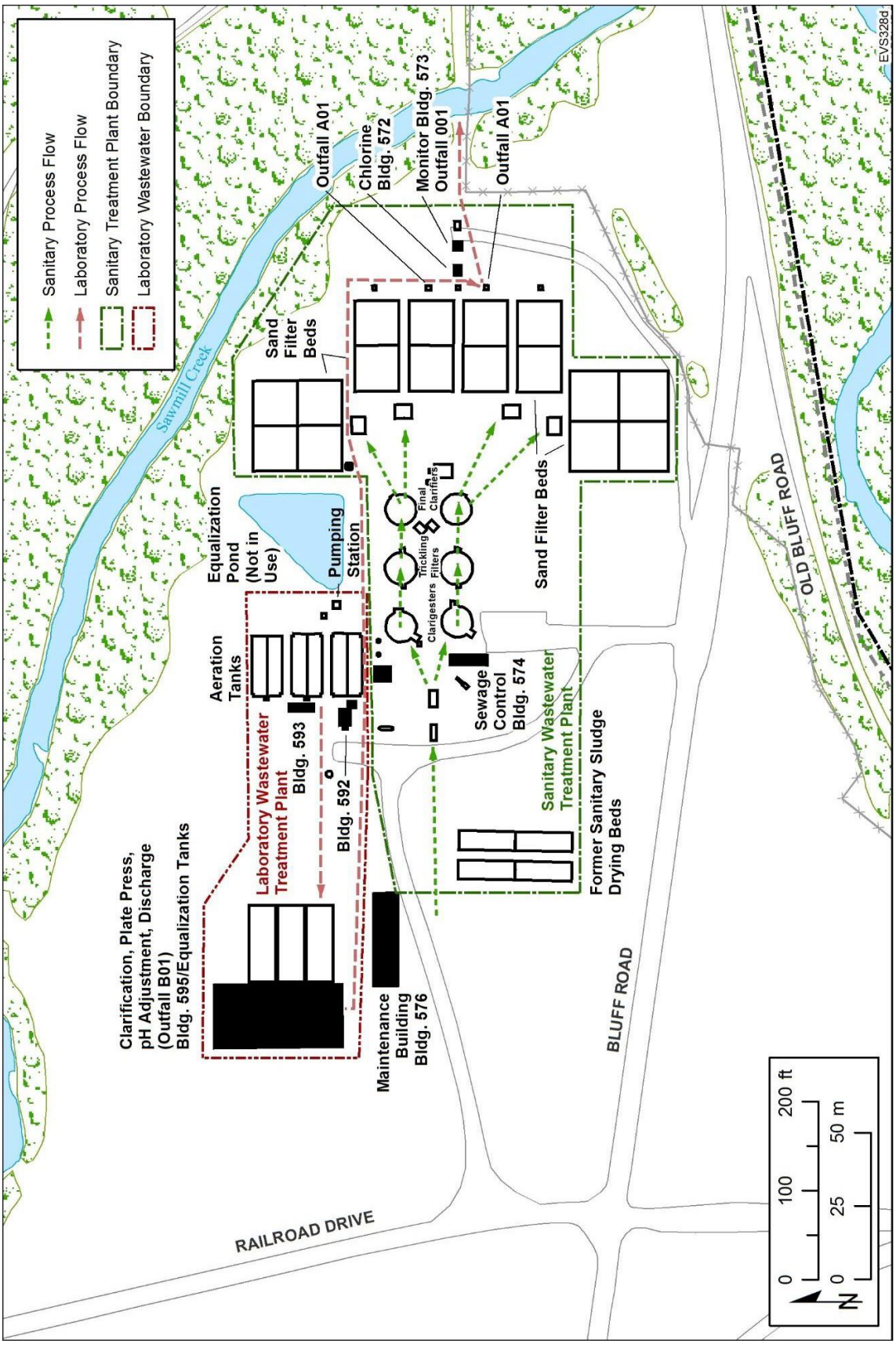


FIGURE 2.3 Argonne Wastewater Treatment Plants

TABLE 2.4

Summary of 2024 Water Effluent Exceedances

Date Reported	Outfall	Parameter	Cause
January 16	001	Chloride	Salt from deicing activities
January 23	001	Chloride	Salt from deicing activities
January 30	001	Chloride	Salt from deicing activities
February 6	001	Chloride	Salt from deicing activities
February 8	007	Chloride	No obvious cause
February 8	007	TSS	No obvious cause
February 13	001	Chloride	Salt from deicing activities
March 5	001	Chloride	Salt from deicing activities
November 6	B01	TSS	New polymer product testing and organic material introduction to the laboratory wastewater plant
November 6	B01	TSS – Mass Loading, Daily maximum	Exceedance caused by very high initial TSS concentration and exceedance reported on November 6 (see above)
November (month)	B01	TSS – 30-day average	See above
November (month)	B01	TSS – Mass Loading, 30-day average	See above

Seven of the 2024 exceedances were chloride at Outfall 001 and Outfall 007. Exceedances of the limit for this parameter at Outfall 001 (six total) are common during the winter season and can be attributed to on-site salt usage, increased boiler activity and associated high total dissolved solids (TDS) blowdown, and high wintertime chloride levels in Argonne's industrial source water, the Chicago Sanitary and Ship Canal. Argonne implements a Snow and Ice Control procedure, focusing on using alternative deicing compounds and reducing deicing compound application through not plowing or deicing lightly-used roadways to protect environmentally-sensitive areas. Argonne believes that continued implementation of the Snow Management Plan, through road and parking lot closures and increased use of organic additives, will significantly reduce chloride loading to site waterways.

Outfall 007 is a stormwater-only outfall that is no longer monitored. However, during an outfall inspection in February 2024, cloudy water was noted discharging from the outfall and notification of this apparent unnatural discharge was made to IEPA in accordance with the NPDES Permit. The catchment area for this outfall was inspected to identify the source of the cloudiness but no obvious source was identified. A sample of the discharge was collected and analyzed for chloride and total suspended solids (TSS), which represented the likely pollutants present in the water. Results showed regulatory limits for both parameters were exceeded; these results were included in the IEPA notification. Visual water quality conditions returned to normal within 24 hours.

Five exceedances for TSS, at Outfall 007 (one) and B01 (four, including two mass loading limit exceedances) were reported in 2024. The February 2024 TSS exceedance at Outfall 007 is discussed above. The exceedances at Outfall B01 occurred in November 2024 and included an initial volumetric limit exceedance and then one daily maximum mass loading limit exceedance and one 30-day average mass loading limit exceedance (determined in early December after required weekly sampling for the month of December). These were likely the result of operational activities in the laboratory wastewater treatment plant, where testing potential new polymer material was taking place at the time of sample collection. In addition, a new source of wastewater containing dilute organic acid is believed to have introduced organic material to the treatment plant clarifiers, which are not accustomed to this type of biological material. This discharge has since been routed to the sanitary wastewater treatment plant.

Figure 2.4 presents the total number of permit limit exceedances each year over time. Chloride continues to be a challenging issue for Argonne, as it is also a component (from regional road runoff) of the industrial water source (the nearby Chicago Sanitary and Ship Canal) used at the Laboratory for site cooling. Argonne continues to implement the Snow and Ice Control procedure and continuously explores methods to reduce chloride deicer usage and to identify chloride alternatives without compromising safety.

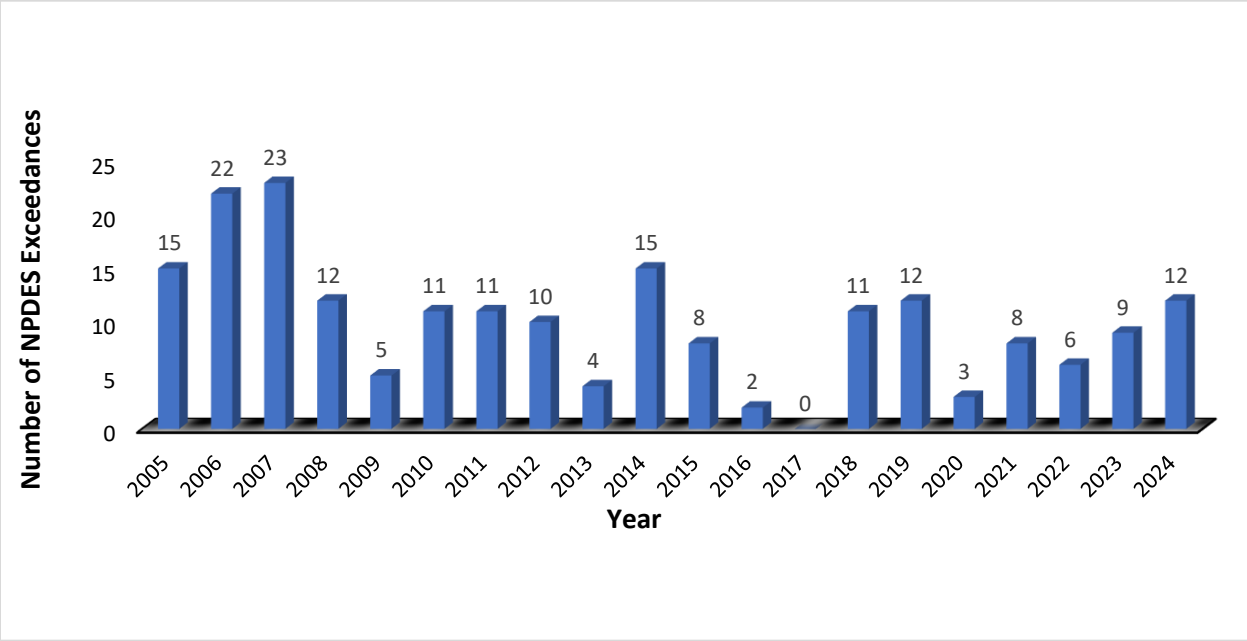


FIGURE 2.4 Total Number of NPDES Exceedances, 2005 to 2024

2.2.1.3 Priority Pollutant Analysis and Biological Toxicity Testing

The NPDES permit requires semiannual testing of Outfall B01 (the LWTP outfall) and annual testing of Outfall 021 (downstream of the 317 and 319 areas) for all the priority pollutants, 124 metals and organic compounds identified by the IEPA as being of particular concern. During 2024, the Outfall B01 samplings were conducted in June and December and the Outfall 021 sampling was conducted in March. Results are summarized in Table 2.5 and in Chapter 5.

TABLE 2.5

Summary of 2024 Priority Pollutant Results

Outfall	Results (mg/L)	Comments
B01	June:	Not Applicable
	Arsenic (0.0016 mg/L) Copper (0.0094 mg/L) Nickel (0.0052 mg/L) Zinc (0.02 mg/L)	Arsenic, copper, and lead were detected very near their detection limits.
	Bromoform (0.002 mg/L)	Bromoform is a trihalomethane-type compound resulting from de-chlorination of drinking water.
	December:	
	Arsenic (0.0013 mg/L) Cyanide (0.0067 mg/L)	Arsenic and cyanide were detected very near their detection limits
021	March:	
	Cyanide (0.0095 mg/L) Arsenic (0.0016 mg/L) Lead (0.0033 mg/L) Zinc (0.08 mg/L)	Cyanide, arsenic, lead, and zinc were detected very near their reporting limits.

In addition to the priority pollutant analysis, the permit requires annual biological toxicity testing of the combined effluent stream, Outfall 001. Samples were collected on June 4-5, 2024 and testing was conducted on June 6-10, 2024. The data indicate that the effluent was not acutely toxic to either the fathead minnow or the water flea.

2.2.1.4. Per- and-Polyfluoroalkyl Substances

The September 2023 reissued NPDES Permit included two Special Conditions related to wastewater effluent PFAS monitoring and PFAS materials management. Argonne is now required to sample wastewater effluent on a quarterly basis from the combined wastewater treatment plant outfall. The sample is collected using certified PFAS-free sampling equipment and is analyzed using EPA Method 1633, which analyzes for 44 PFAS compounds. In 2024, quarterly samples were collected in January, April, July, and October. Results are summarized in Figure 2.5 below and are reported in nanograms per liter (ng/L). Over this time period, up to 11 PFAS compounds were detected in Argonne treated wastewater effluent out of 44 compounds analyzed for. The monitoring limits in the NPDES Permit are the analytical method detection limit. At this time Argonne is not subjected to any enforceable PFAS limits for wastewater effluent.

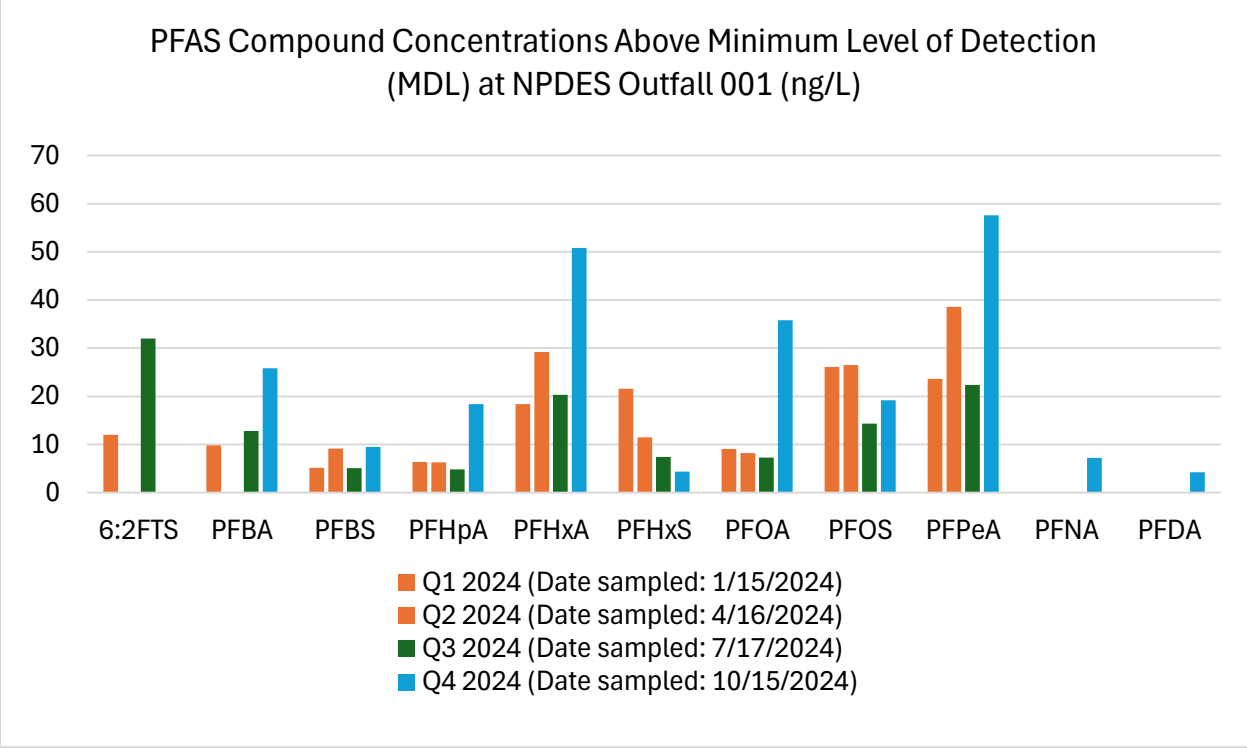


FIGURE 2.5 PFAS 2024 Quarterly Effluent Sample Results, Outfall 001

In addition to quarterly wastewater effluent PFAS monitoring, the reissued NPDES Permit requires Argonne to develop and implement a PFAS Minimization Program. The intent of the PFAS Minimization Program is to use best management practices (BMP) to reduce the risk of PFAS entering Argonne's wastewater system, which includes stormwater. Argonne began development of the PFAS Minimization Program by developing a description document (plan) with PFAS reduction, spill minimization, and if necessary, equipment decontamination or replacement in those processes releasing PFAS to Argonne wastewater systems. Reduction in PFAS use is a sitewide effort and will involve integrating PFAS reduction in procurement actions and construction contracts.

In 2024, the PFAS Minimization Program description document was communicated to various stakeholders, including DOE-ASO, Division Safety Managers, and ESH Coordinators (representing Research Divisions), and Operations Divisions responsible for site construction planning and building and utilities maintenance. More focused communication of the Plan's requirements took place through stakeholder workshops and presentations directly to Division Environmental Compliance Representatives. Finally, initial efforts were made to add purchase requirements requiring PFAS-free products and to add project contract requirements.

The reissued NPDES Permit also requires Argonne to submit an annual PFAS reduction report to IEPA no later than one year from effective date of the permit (September 1, 2023), and then annually no later than one year from the date of the previous year's report. The annual PFAS reduction report describes BMP effectiveness as well as progress towards implementing specific PFAS reduction efforts across the site. The 2023 report was submitted to IEPA on August 27, 2024.

2.2.1.5. Stormwater Regulations

In November 1990, the EPA promulgated regulations governing the permitting and discharging of stormwater from industrial sites. The Argonne site contains a large number of small-scale operations that are considered to be industrial activities under these regulations, and are, therefore, subject to these requirements. An extensive stormwater characterization and permitting program was initiated in 1991 and continues as required by the present NPDES permit. Argonne's NPDES permit includes stormwater with some industrial wastewater component (at one outfall) and stormwater-only discharges to surface water.

Argonne's currently active NPDES permit became effective on September 1, 2023. Special Condition 8 of Argonne's permit requires the Laboratory to maintain its Stormwater Pollution Prevention Plan (SWPPP), as well as to modify it as necessary to ensure compliance with all provisions of the stormwater regulations. Special Condition 9 also requires Argonne to inspect and report annually on the effectiveness of the site-wide SWPPP. The annual SWPPP assessment consists of tours of building exteriors residing in Argonne outfall watersheds to identify any potential pollutant sources and/or conditions that may lead to industrial discharges into the outfalls. Outfall watersheds are also inspected to verify that no changes have occurred that may affect the permitted discharges at the outfalls. Finally, SWPPP "best management practices" (BMPs) are evaluated to ensure that potential surface water pollution sources remain under good institutional control. The first annual inspection was required to take place one year

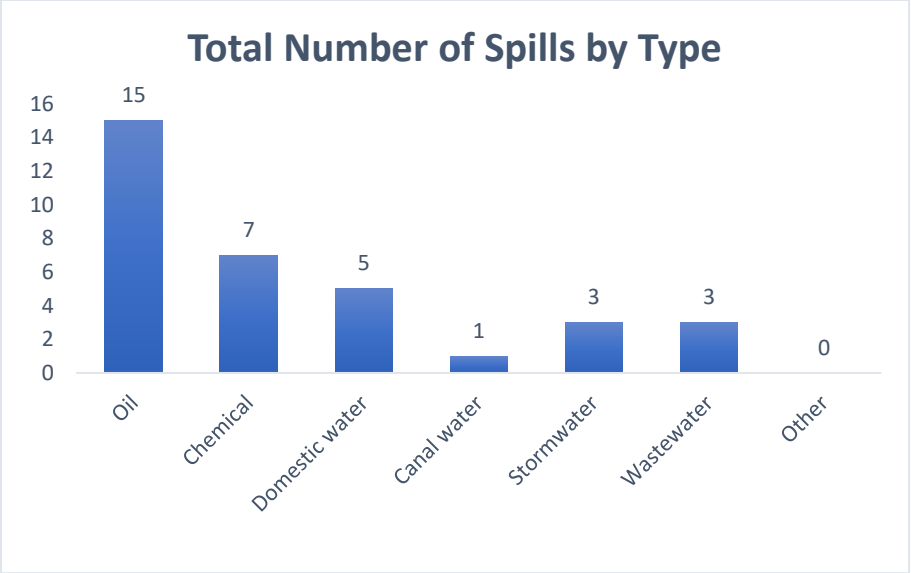
after the effective date of the permit, and the report must include information gathered during this one year time period. Subsequent inspections and reports are required on an annual basis thereafter.

The 2024 annual inspection was completed and a report was submitted to the IEPA in July 2024. The 2024 SWPPP assessment identified two instances where a best management practice was not being implemented, and one instance where a process could be improved. These findings were related to management of abandonment of construction demolition materials, waste, improper chemical or materials management resulting in materials being exposed to stormwater, drums and other containers of unknown contents and in varying states of deterioration, and unlabeled empty drums. These issues were brought to the attention of the responsible persons, documented in Argonne's issues tracking system, and were quickly resolved.

During 2024, Argonne continued a program of monthly and quarterly stormwater inspections. The general purpose of these inspections is to more frequently document water quality and general environmental conditions at Argonne's building exterior areas and stormwater outfalls. Each month, Argonne conducts an inspection of exterior building areas (referred to as "process areas") in a portion of the site, with the goal of visiting all areas of the site at least once annually. Once a quarter, Argonne conducts a "dry-weather" inspection of site outfalls in an effort to identify any non-permitted, non-stormwater discharges that may impact water quality in waterways on and adjoined to the Argonne property. Finally, the currently active NPDES permit requires Argonne to observe stormwater discharges once a quarter from outfalls at the beginning of large storm events. All inspections were conducted in accordance with requirements.

At Argonne, spills are reported to emergency responder personnel primarily via the on-site 911 alert system. Argonne's 911 system is now integrated with an on-line incident reporting system that tracks events and any corrective action (such as equipment repairs, spill cleanup activities, etc.) to completion. This has resulted in more spill (release) events being reported, particularly minor spill events.

During 2024 there were 34 spills reported, both indoors and outdoors, across the Argonne site. Argonne records metrics for spills and releases with a risk to environmental media so that negative trends can be identified, and process improvements put into place to reduce risk to the environment. Fifty-nine percent of spills were divided between oil and domestic water releases, while the remainder of the spills were distributed between Canal water, small chemical spills, small wastewater releases, and sediment-laden stormwater from construction sites.



- *Oil releases* were minor in nature, quickly contained, and remediated without any impact to surface water. These included releases of oil from oil-containing equipment, hydraulic oil from Argonne fleet vehicles, releases from miscellaneous contractor equipment and vehicles, and releases of unknown origin discovered in parking lots. One involved the discharge of oil into a site storm sewer that discharged into a wetland and therefore required notification of the IEPA as well as immediate corrective action.

- *Domestic water* releases took place both indoors and outdoors; most of these releases did not discharge through storm water conveyances or outfalls. One involved the discharge of substantial amounts of domestic water with entrained sediment from an underground water main break into site storm sewers that discharged directly into a waterway. Offensive conditions of the discharged water due to turbidity required notification of the IEPA.

- *Canal water* was released at one building, inside a high bay space when Canal water lines froze due to cold weather. The released water was confined to indoor spaces and did not enter any storm drain or sewer inlets.

- *Chemical releases* were varied in nature and involved releases of bleach, sodium hydroxide, a small amount of methylene chloride from a primary container into a secondary container on a building dock, pelletized thermal insulation from an abandoned cryogenic tank, benzene released from a container into the bed of a vendor delivery truck, debris from damaged fluorescent lamps, and abandoned paint and sodium hydroxide mixed with general refuse. None of these releases exceeded any reportable quantities or adversely impacted environmental media and were easily addressed by Argonne Fire Department personnel and Nuclear, Waste Management and

Site Services personnel and were not required to be reported to IEPA or any other regulatory agencies.

2.2.2. Spill Prevention Control and Countermeasures Plan

The Spill Prevention Control and Countermeasures (SPCC) plan regulations were finalized in 2002, and then amended in 2006, 2008, and 2009. The most recent requirements became effective in December 2015. Argonne maintains a SPCC Plan as required by the CWA and EPA regulations at 40 CFR Part 112[12]. This plan describes the planning, design features, and response measures that are in place to prevent oil or oil products from being released into navigable waters of the United States. Persons with specific duties and responsibilities in such situations are identified, as are reporting and recordkeeping requirements mandated by the regulations. Annual training is conducted on implementation of this plan and SPCC requirements are regularly communicated to Argonne research and operations divisions as needed. In 2024, only one spill required external notification as described in the SPCC Plan, discussed in Section 2.2.1.4 above.

2.2.3. General Effluent and Stream Quality Standards

In addition to specific NPDES permit-required monitoring, Argonne's discharges are monitored to determine if they conform to the general effluent limits contained in 35 IAC Part 30413. During 2024, the wastewater was found to be in conformance with these standards. Samples are also collected to determine if Sawmill Creek meets IEPA General Use Water Quality Standards (WQSs) found in 35 IAC Part 30214, Subpart B. None of the Sawmill Creek samples collected in 2024 exceeded the water quality standards. Chapter 5 of this report, which presents the results of the non-radiological environmental monitoring program, describes the general effluent limits and WQSs and discusses conformance with these limits.

2.2.4. Per- and Polyfluoroalkyl Substances (PFAS)

Like many regulated entities, Argonne is waiting for regulations to be issued on per- and polyfluoroalkyl substances (PFAS) chemicals in the environment. In 2022, the U. S. EPA issued draft drinking water standards for six PFAS compounds in accordance with the SDWA. Argonne is not likely to be impacted by any drinking water PFAS regulations since the facility purchases its drinking water from a third party. It is worth nothing that IEPA has developed draft groundwater standards for five PFAS chemicals, but these standards have not yet been finalized. In 2023, Argonne began sampling effluent from the combined wastewater treatment plant outfall. Details of this are provided in Section 2.2.1.4 of this report.

US EPA now requires consideration of 180 PFAS chemicals in Argonne's Toxic Release Inventory reports, which is discussed in Section 2.7.1 of this document. In addition, the Argonne Fire Department (AFD) had a supply of aqueous film forming foam (AFFF) for firefighting purposes that may contain trace amounts of PFAS chemicals and has the potential to further

break down into PFAS chemicals. However, the AFD has replaced this AFFF supply with a non-fluorinated foam.

In 2022, DOE issued the PFAS Strategic Roadmap: DOE Commitments to Action 2022-2025 (Roadmap), which describes a comprehensive approach, goals, and objectives to managing PFAS risks at DOE sites. The DOE approach is centered around four "pillars" that focus on the DOE commitment to protect human health and the environment.

Throughout 2023 and 2024, Argonne has been tasked to fulfill some of the goals of the Roadmap. This includes providing information on research performed at Argonne related to PFAS removal from water, PFAS detection techniques, and PFAS toxicology as well as providing input on future PFAS-related research needs. This aligns with Pillar 3 of the PFAS Roadmap (leverage experience at DOE's National Laboratories and collaborate with research partners to enhance PFAS knowledge and develop technological solutions).

In accordance with the September 16, 2022 memo from the Deputy DOE Secretary to Heads of Departmental Elements suspending PFAS waste shipments without approval of DOE, Argonne worked closely with DOE-ASO to request DOE-ASO approval for disposal of PFAS-bearing waste. The DOE approved two requests to ship PFAS-bearing, RCRA-regulated waste off site to a RCRA regulated landfill accepting PFAS waste in 2024.

2.3. Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act of 1976 (RCRA) and its implementing regulations are intended to ensure that facilities which generate, treat, store, or dispose of hazardous waste do so in a way that protects human health and the environment. The Hazardous and Solid Waste Amendments of 1984 (HSWA) created a set of restrictions on land disposal of hazardous waste. In addition, the HSWA requires that releases of hazardous waste or hazardous constituents from any Solid Waste Management Unit (SWMU) at a RCRA-permitted facility be remediated, regardless of when the waste was placed in the unit or whether the unit originally was intended as a waste disposal unit.

The RCRA program also includes regulations governing the management of underground storage tanks (USTs) containing hazardous materials or petroleum products. The IEPA has been authorized to administer most aspects of the RCRA program in Illinois. The IEPA issued a RCRA Part B permit to Argonne and DOE on September 30, 1997. The permit was renewed in April 2010, and it is effective for 10 years. In 2019, Argonne submitted an application to renew the RCRA Part B Permit to the IEPA within the required timeframe, allowing Argonne to operate within the existing permit's requirements until a new permit is issued by the IEPA. The IEPA issued a Notice of Completeness letter on May 12, 2020, indicating that the permit application was complete. As of the end of 2024, the permit application was still under review by the IEPA.

In 2022, Argonne completed RCRA closure of a RCRA-permitted hazardous waste management unit called the Building 306 Portable Storage Units (PSU). The Building 306 PSU consists of four skid-mounted prefabricated structures used to store hazardous and mixed waste

containers and conduct lab packing activities. In 2020, Argonne's NWS Division determined that this unit was no longer required and advised that it be disconnected from Argonne's fire protection system and maintenance schedule. This decision required that the unit undergo RCRA closure and the IEPA was therefore notified of the intent to close the Building 306 PSU in accordance with the RCRA Part B Permit. A closure plan was submitted to the IEPA in 2021 and was approved on December 8, 2021. Implementation of the closure plan began in June 2022 and involved disconnecting electrical service from the unit, removing and decontaminating internal structures (floor grating), decontaminating the interior floors and walls of the units, and inspecting the units by a professional engineer. All waste generated during closure activities was containerized, characterized to determine waste disposition, and then disposed of offsite. Closure activities were documented in a closure documentation report which was submitted to IEPA on November 22, 2022. To-date, IEPA has not approved this closure documentation report.

The corrective action portion of the RCRA Part B permit provided the primary regulatory vehicle for cleaning up contamination from former waste management areas. The Argonne remediation program achieved compliance with all applicable corrective action requirements related to assessing and cleaning up releases of hazardous materials from inactive waste sites in 2003. However, seven SWMUs could not be remediated to No Further Action (NFA) status. The long-term maintenance and monitoring of these inactive waste sites is carried out by the Argonne Long-Term Stewardship (LTS) Program. Quarterly, semi-annual, or annual reports are transmitted to the IEPA describing ongoing monitoring of these inactive sites. The LTS Program is described in greater detail in Chapter 6.

One new SWMU was identified by Argonne (SWMU No. 747 [Building 310]) and was added by the IEPA to the Argonne corrective action program. Following an IEPA-approved soil investigation of SWMU No. 747, IEPA granted a determination of NFA in 2016 for soils north and west of the former building, since contaminants in these soils (metals) were below IEPA soil remediation objectives. The IEPA also requested that an institutional control be developed for soils south of the former building (which were not sampled because the asphalt serves as an effective engineered barrier) to ensure the engineered barrier is maintained and soils remain undisturbed. In July 2017, Argonne and DOE Argonne Site Office (DOE-ASO) submitted to the IEPA a Land Use Control Implementation Plan (LUC Plan) for SWMU No. 747 as part of a broader RCRA Part B Permit Modification request, so that this SWMU can be incorporated into the existing Land Use Control Memorandum of Agreement (LUCMOA) between IEPA and DOE. To date, IEPA has not formally approved addition of SWMU No. 747 to the LUCMOA.

As part of the RCRA Part B Permit Modification request submitted in July 2017, Argonne also requested that the phytoremediation system in the 317 and 319 Areas, installed in the late 1990's to contain migration of a VOC-contaminated plume, be removed from the RCRA Part B permit due to an observed lack of effectiveness of the trees as a groundwater plume containment method. Argonne determined after a review of several years of groundwater data that the trees were decreasing in effectiveness and continued efforts to replace them would not contribute to groundwater plume containment. The contaminated groundwater plume is already contained using an existing mechanical groundwater extraction system. The permit modifications discussed above, related to SWMU No. 747 and the discontinuation of the phytoremediation

system, were also requested by Argonne in the 2019 application to renew the RCRA Part B Permit.

The LUCMOA discussed above was signed by IEPA and DOE in 2003 and includes a requirement to conduct an annual inspection of solid waste management units and areas of concern for which soil or groundwater remediation objectives were not achieved during earlier corrective action activities. The purpose of the LUCMOA inspection is to ensure that administrative and engineering land use controls at these units, put into place to isolate and control contaminated media, have been implemented and are being properly maintained. Eight solid waste management units and areas of concern (including SWMU No. 747 discussed above) were inspected by Argonne and DOE-ASO on November 25, 2024. All land use controls at LUCMOA units were found to be adequately implemented and maintained and no findings were identified.

In late 2020 and early 2021, soil borings in support of a planned helium recovery system identified the presence of several volatile organic compounds (VOC) in subsurface soils near Building 203. In May 2021, Argonne formally notified the IEPA that an area of soil contamination was identified, characterized by a soil interval of undetermined extent contaminated with trichloroethylene and its degradation products. IEPA was notified of this potential area of concern in accordance with the RCRA Part B permit Corrective Action requirements. To date, no written acknowledgement of this area of soil contamination has been received from the IEPA. Nonetheless, in 2022 Argonne proactively prepared and implemented a detailed soil and groundwater investigation work plan to evaluate the nature and extent of subsurface contamination. The results of the investigation did not identify any groundwater contamination, but successfully delineated an area of soil contamination and a small area of soil gas, with VOCs in excess of IEPA remediation objectives. Argonne submitted a final report documenting the results of this investigation and proposed covering the contaminated soils with an impermeable barrier and incorporating this area into the LUCMOA. To-date, IEPA has not approved Argonne's investigation report and proposals for addressing the known contaminated soils in the area.

2.3.1. Hazardous Waste Generation, Storage, Treatment, and Disposal

The nature of the research activities conducted at Argonne results in the generation of small quantities of a large number of waste chemicals. Many of these materials are classified as hazardous waste under RCRA. Argonne has 18 Hazardous Waste Management Units: 12 container storage areas, 1 tank storage unit, 3 miscellaneous treatment units, and 2 tank chemical treatment units. Table 2.6 provides descriptions of these units (note the 3 miscellaneous treatment units and 2 tank treatment units are listed under the "Treatment" category). Figure 2.6 shows the locations of the major active hazardous waste treatment, storage, and disposal areas at Argonne.

TABLE 2.6

Permitted Hazardous Waste Treatment and Storage Facilities, 2024

Description	Location	Purpose
Container Storage (12)		
Concrete Storage Pad	Building 331	Storage of solid radioactive waste and solid mixed waste (MW) in the form of steel-encased lead shielding containers and containerized solid MW.
Container Storage Area	Building 303 Storage Facility	Storage of liquid and/or solid ignitable, corrosive, oxidizing, reactive, toxic, radiological, MW and non-RCRA regulated wastes in containers.
	Building 331 Radioactive Waste Storage Facility	Storage of containers of flammable, toxic, corrosive, oxidizing hazardous, radiological, or MW.
Portable Storage Units[a]	Building 306	Storage of hazardous, radiological, or MW (3 of 4 units).
		Bulking operations to consolidate and reduce the volume of lab-packed waste in containers (1 of 4 units).
MW Storage	Building 306 – Storage Room A-142	Storage of ignitable MW.
	Building 306 – Storage Room A-150	Storage of solid and liquid MW.
	Building 306 – Storage Room C-131	Storage of ignitable, corrosive, and reactive hazardous waste.
	Building 306 – Storage Room C-157	Storage of corrosive and oxidizing MW
	Building 306 – Storage Room D-001	Storage of solid MW containing toxic metal constituents
Tank Storage (1)		
Waste Storage Tank[a]	Building 306	Storage of corrosive and toxic MW and radiological liquid wastes (4,000 gal).
Treatment (5)		
Alkali Metal Passivation Booth	Building 206	Destruction of water reactive alkali metals possibly contaminated with radionuclides.
Alkali Metal Passivation Booth	Building 308	Destruction of water reactive alkali metals.
Chemical/Photooxidation Unit[a]	Building 306	Treatment of ignitable liquid MW containing organic contaminants.
Metal Precipitation System[a]	Building 306	Treatment of aqueous, corrosive LLRW, some of which is contaminated with heavy metals.
MW Immobilization/ Macroencapsulation Unit[a]	Building 306	Treatment of solid, semisolid, and organic liquid MW containing RCRA metals.

[a] These portable storage unit underwent RCRA Closure in 2022. However, IEPA has not yet approved the RCRA closure documentation report. As such, they remain as part of Argonne's RCRA permit.

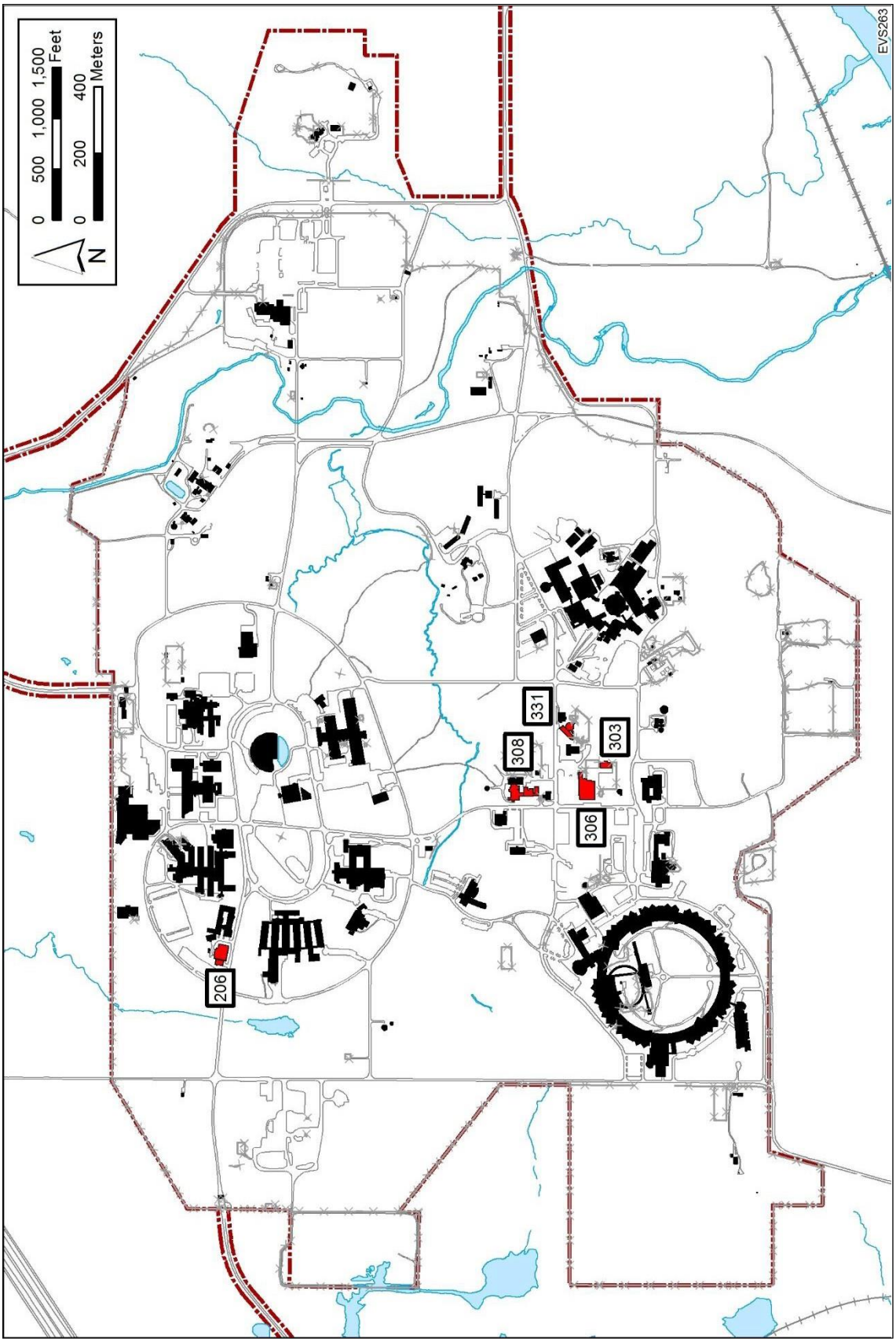


FIGURE 2.6 Permitted Treatment and Storage Areas at Argonne

Argonne prepares an annual Hazardous Waste Report. The report is submitted to the IEPA by March 1 of each year and it describes the activities of the previous year. It is a summation of all RCRA waste activities, including on-site storage and off-site disposal. The report describing such activities during 2024 was submitted to the IEPA. The RCRA-permitted storage facilities, designed and operated in compliance with RCRA requirements, allow for accumulation and storage of waste pending off-site disposal. The wastes consist mostly of labpacks, with a small amount of bulk toxic liquids and solids, bulk flammable solids, bulk corrosive liquids, and bulk aerosols. Off-site treatment and disposal take place at approved hazardous waste treatment and disposal facilities. RCRA hazardous and non- RCRA regulated waste totals that were shipped by NWM during 2024 are included in Table 2.7.

TABLE 2.7

Non-Rad Waste Shipped, 2024

Type	Quantity (lbs)
RCRA Hazardous	274,413
Non-RCRA Regulated	421,445
Recycle/Reuse	26,162
Total	722,020
	Volume (ft^3)
RCRA Hazardous	12,884
Non-RCRA	17,089
Recycle/Reuse	979
Total	30,952

2.3.2. Hazardous Waste Treatability Studies

The IEPA requires that Argonne submit a report by March 15 of each year that estimates the number of hazardous waste treatability studies and the amount of waste expected to be used in the studies during the current year. No treatability studies were conducted in 2024.

TABLE 2.8

Radioactive Low-Level and Mixed Waste, 2024

Type	Volume (ft^3)
Generated	
Low-Level	6,480
Mixed Low-Level	1,566
TRU	151
Total	8,196.26
Shipped	
Low-Level	6,698
Mixed Low-Level	1,424
TRU	120
Total	8,242

2.3.3. Low Level, Transuranic, and Mixed Waste Generation, Storage, Treatment, and Disposal

The hazardous component of MW is governed by RCRA regulations, while the radioactive component is subject to regulation under the AEA as implemented by DOE. Accordingly, facilities storing or disposing of MW must comply with both DOE requirements and RCRA permitting and facility standards. Argonne generates several types of MW, including acids, solvents, and lead-containing debris contaminated with radionuclides. The RCRA Part B permit provides for on-site treatment in five mixed-waste treatment systems. These systems include neutralization of low-level radioactive waste (LLRW) and stabilization of sludge and soil. MW and LLRW that were generated and disposed of during 2024 are included in Table 2.8.

DOE Order 435.1 and its implementing manual also require that radioactive wastes be characterized and certified to meet the requirements of the facility where they will be managed. Argonne maintains waste certification programs for the types of radioactive waste generated at the site. The waste certification program for LLRW and MW meets the requirements specified in DOE O 435.1. The waste certification program for Transuranic Waste (TRU) meets the requirements of the DOE deep geologic repository facility used for TRU disposal. Radioactive

waste that was generated and disposed of during 2024 is described in Table 2.8. Radioactive waste generated in 2024, but not shipped off-site for disposal, is stored on-site pending future off-site shipment.

2.3.4. Federal Facility Compliance Act Activities

The Federal Facility Compliance Act of 1992 (FFCA) amended RCRA to clarify the application of its requirements and sanctions to federal facilities. The FFCA also requires that DOE prepare mixed-waste treatment plans for DOE facilities that store or generate MW. The Proposed Site Treatment Plan (PSTP) for MW generated at Argonne was submitted to the IEPA and the Illinois Department of Nuclear Safety (IDNS) in March 1995. The PSTP is updated annually. Argonne's RCRA Part B permit provides for on-site treatment of certain MW as required by the PSTP. An update to the PSTP is provided by DOE to IEPA and IEMA in March of each year showing the MW at Argonne in storage over one year.

2.3.5. Underground Storage Tanks

Argonne currently has 11 Underground Storage Tanks (USTs) on site. The vehicle maintenance facility (Building 46) uses five underground tanks to store diesel, gasoline, used oil, antifreeze, and an ethanol/gasoline blend (E85). An additional six USTs are located across the site for bulk storage of diesel fuel used for emergency generators. The Illinois Office of the State Fire Marshal conducts UST inspections approximately every two years. There was no inspection performed by the Illinois Office of the State Fire Marshal in 2024.

2.3.6. Solid Waste Disposal

Argonne generates a large volume and variety of wastes. Table 2.7 lists the non-rad hazardous and nonhazardous waste shipped during 2024. All non-recycled nonhazardous special wastes generated at Argonne in 2024 were disposed of at permitted off-site landfills.

2.4. National Environmental Policy Act

The National Environmental Policy Act of 1969 (NEPA) established a national environmental policy that promotes consideration of impacts to the environment that could result from federal or federally-sponsored projects. NEPA requires that the environmental impacts of proposed actions with potentially significant effects be considered in an Environmental Assessment (EA) or in an Environmental Impact Statement (EIS). DOE has promulgated regulations in 10 CFR Part 1021[16] that list classes of actions that ordinarily require those levels of documentation or that are categorically excluded (CX) from further NEPA review. No EISs or EAs were prepared during 2024. Argonne utilizes an Environmental Review Form to document the NEPA review of all proposed projects.

2.5. Safe Drinking Water Act

The Safe Drinking Water Act of 1974 (SDWA) established a program to ensure that public drinking water supplies are free of potentially harmful materials. This mandate is carried out through the institution of national drinking water quality standards[17], including maximum contaminant levels and maximum contaminant level goals, as well as through the imposition of wellhead protection requirements, monitoring requirements, treatment standards, and regulation of underground injection activities. The regulations implementing the SDWA set forth requirements to protect human health (primary standards) and provide aesthetically acceptable water (secondary standards).

In January 1997, Argonne incorporated Lake Michigan water as its only source of domestic water, thereby replacing the dolomite groundwater that formerly constituted its source of drinking water. Because the Lake Michigan water is purchased from the DuPage Water Commission, Argonne is a customer, rather than a supplier of water. Annual Confidence Reports on drinking water quality are available from the DuPage Water Commission on their website at www.dpwc.org.

In late 2015, all former potable groundwater wells at Argonne were formally taken out of service and sealed in accordance with Illinois Department of Public Health and DuPage County Health Department requirements. Accordingly, since 2016 Argonne no longer conducts the informational monitoring program of site potable groundwater.

2.6. Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates the use of pesticides. FIFRA delegates significant regulatory control for the use of pesticides to states. The Illinois Department of Public Health (IDPH) controls the use of non-crop insecticides and rodenticides. Argonne uses an IDPH-licensed contractor to apply general-use pesticides to control nuisance insects in and around buildings.

Argonne coordinates the contractor's activities and ensures that the chemicals used are EPA-approved, and are used and disposed properly. Also, general-use herbicides are applied to various landscape, utility, and habitat areas by both contractors and in-house staff with licenses from the Illinois Department of Agriculture. Argonne does not utilize restricted-use herbicides.

Argonne initiated an Integrated Pest Management (IPM) program in 2018. Integrated pest management is a coordinated system of technology and management practices to control pests in a safe, environmentally sound, and economical manner. Argonne embeds IPM principles into daily practices, reserving pesticide use as a last resort and prioritizing alternative methods. Mechanical control often used at the beginning or as part of an integrated control approach to manage invasive species. For example, Argonne employs seed culling to control the expansion of existing populations. When dealing with large populations, Argonne supplements mechanical control with herbicide treatments for better results. Successive effort will continue to have the remaining largest populations addressed through herbicide applications until their numbers are reduced to a level where seed control alone suffices. This is based on the plant's biology where it is a biennial that has some perennial tendency. Seed control reduces population expansion and future population.

2.7. Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) addresses the cleanup of hazardous waste disposal sites and the response to hazardous substance spills. Under CERCLA, the EPA collects site data regarding sites subject to CERCLA action through generation of a Preliminary Assessment report, followed by a Site Screening Investigation. Sites are then ranked, on the basis of the data collected, according to their potential for affecting human health or causing environmental damage. The sites with the highest rankings are placed on the National Priority List (NPL) and are subject to mandatory cleanup actions. No Argonne sites are included in the NPL. All Argonne cleanup actions were performed under the RCRA corrective action program rather than CERCLA.

2.7.1. Emergency Planning and Community Right to Know Act (Superfund Amendments and Reauthorization Act, Title III)

Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA) amendments to CERCLA is the Emergency Planning and Community Right to Know Act (EPCRA), a freestanding provision. EPCRA requires providing federal, state, and local emergency planning authorities with information regarding the presence and storage of hazardous substances and their planned and unplanned environmental releases, including plans for responding to emergency situations involving hazardous materials. Under EPCRA, Argonne submits reports pursuant to Sections 302, 304, 311, 312, and 313, which are discussed in the following paragraphs. Table 2.9 gives Argonne's status in regard to EPCRA.

TABLE 2.9

Status of EPCRA Reporting, 2024

EPCRA Section	Description of Reporting	Status
Section 302	Planning Notification	Not Required
Section 304	Extremely Hazardous Substance Release Notification	Not Required
Section 311	Safety Data Sheet/Chemical Inventory	Required
Section 312	Annual Tier II Report	Required
Section 313	Toxic Release Inventory Reporting	Required

Section 302 of SARA Title III, Planning Requirements, addresses notifying and updating the Local Emergency Planning Committee (LEPC) and the State Emergency Response Commission (SERC) as to the presence of extremely hazardous substances (EHSs) at Argonne, including laboratory usage chemicals, that exceed threshold planning quantities (TPQs).

Reporting under Section 302 is necessary when the EHS is initially brought on-site, and when the EHS storage information changes. The Section 302 report of chemicals exceeding threshold planning quantities was last updated in February 2023 and included the chemicals listed on Table 2.10. The list of chemicals exceeding the threshold planning quantities did not change for CY 2024.

Section 304 of SARA Title III, Extremely Hazardous Substances Release Notification, requires that the LEPC and state emergency management agencies be notified of accidental or unplanned releases of Section 302 hazardous substances to the environment. Also, the National Response Center (NRC) is notified if a release exceeds the CERCLA Reportable Quantity (RQ) for that particular hazardous substance. No such releases occurred in 2024, thus no notifications were made.

TABLE 2.10

SARA, Title III, Section 302, EHS Chemical List

CAS[a] No.	Name
7664-39-3	Hydrofluoric Acid
7697-37-2	Nitric Acid
10102-43-9	Nitric Oxide
7664-93-9	Sulfuric Acid

[a] Chemical Abstracts Service

Under SARA Title III, Section 311, Safety Data Sheet (SDS)/Chemical Inventory, Argonne is required to provide the SERC, LEPC, and Argonne Fire Department with SDSs, or a list of hazardous chemicals grouped into hazard categories, for EHSs above 500 lbs or their TPQ, whichever is lower, and all other OSHA defined hazardous chemicals stored above 10,000 lb. Chemicals used in research laboratories under the direct supervision of a technically qualified individual are exempt from Section 311 reporting. A Section 311 update for CY 2024 was provided to the SERC, LEPC, and Argonne Fire Department in February 2024. The list of reported substances in the Section 311 update is set out in Table 2.11.

TABLE 2.11

SARA, Title III, Section 311 and 312 Chemical List

CAS No.	Name
10043-01-3	Aluminum sulfate
NA[a]	Ash
NA[a]	BIOMELT® 4.5 Anti-Icing/Deicing Fluid
NA[a]	Bituminous Coal
10043-52-4	Calcium chloride
75-45-6	Chlorodifluoromethane
306-83-2	Dichlorotrifluoroethane
68476-34-6	Diesel Fuel #2
NA[a]	E85 Ethanol/Gasoline
NA[a]	Gasoline
NA[a]	Lead/acid batteries
NA[a]	Oil (multi-purpose)
74-98-6	Propane
NA[a]	Sand
7647-14-5	Sodium chloride
7681-52-9	Sodium hypochlorite
NA[a]	STABREX ST70
7664-93-9	Sulfuric acid
811-97-2	Tetrafluoroethane
NA[a]	Transformer oil
7699-45-8	Zinc bromide
NA[a]	3D TRASAR 3DT230

[a] NA = No Chemical Abstracts Service (CAS) Number. Substance is a mixture.

Pursuant to SARA Title III Section 312, Argonne is required to report annually information regarding inventories, locations, and quantities of EHSs above 500 lb or their TPQ, whichever is lower, and all other OSHA defined hazardous chemicals stored above 10,000 lb to the SERC, LEPC, and Argonne Fire Department. Chemicals used in research laboratories under the direct supervision of a technically qualified individual are exempt from Section 312 reporting. The Section 312 (Tier II) report for 2024 was provided to the SERC, LEPC, and Argonne Fire Department in February 2025. Table 2.11 lists the Section 312 substances that were reported.

Section 313 of SARA Title III, Toxic Release Inventory (TRI) Reporting, requires certain facilities to prepare an annual report entitled "Toxic Chemical Release Inventory, Form R," if annual usage of listed toxic chemicals exceeds certain thresholds. No PFAS chemicals exceeded their threshold at Argonne. Argonne filed a report under Section 313 for activities in 2024 for both lead and mercury. Use of lead included machining of various types of lead articles in excess of the 100-lb reporting threshold. Disposal of mercury exceeded the 10-lb reporting threshold.

2.8. Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) was enacted to require chemical manufacturers and processors to develop adequate data on the health and environmental effects of their chemical substances. The EPA has promulgated regulations to implement the provisions of TSCA. These regulations provide specific authorizations and prohibitions on the manufacturing, processing, and distribution in commerce of designated chemicals. The principal impact of these regulations at the Argonne site concerns the handling of asbestos and polychlorinated biphenyls (PCBs). Suspect PCB-containing items that are subject to TSCA regulation are identified through the Argonne PCB Item Inventory Program. Argonne has a procedure to comply with the import/export of TSCA materials requirements.

2.8.1. Polychlorinated Biphenyls in Use at Argonne

Polychlorinated biphenyl (PCB) items in use or in storage for reuse are tracked in the Argonne PCB Document Log. All PCB items identified by the PCB Document Log have been labeled appropriately with a unique number for inventory and tracking purposes. The Argonne Annual PCB Document Log describes the location, quantity, manufacturer, and unique identification number for all PCBs on-site. This Log is not submitted to regulatory agencies, but is kept on file at Argonne. The Annual PCB Document Log for CY 2024 was completed by July 1, 2024. The PCBs in use at Argonne are contained in capacitors and power supplies. NWM processes PCB-contaminated equipment and oil for disposal. The regulations governing the use and disposal of PCBs can be found in 40 CFR Part 761.

2.8.2. Disposal of Polychlorinated Biphenyls

Disposal of PCBs from Argonne operations includes materials from lab-packed, bulked, and aggregated solids shipped off-site through NWM. This includes PCB-containing materials

that also contain radioactive substances, the combination of which is known as TSCA MW. Tables 2.8 and 2.9 include PCB wastes, which are also regulated under RCRA, in the RCRA Hazardous and Mixed Low-Level categories. PCB wastes, which are not also RCRA regulated, are included in the Non-RCRA and LLW categories.

2.8.3. TSCA Impacts on Workplace Safety and Health

The 2016 update to the TSCA regulations allows retroactive regulation of chemicals in the workplace based on risk assessments that determine an unreasonable risk to health or the environment. The update includes identifying workers as a sub-population at greater risk than the general population for adverse health effects. Subsequently, 33 chemicals were initially identified as priority chemicals for risk evaluation and regulation under risk management rules. Currently, risk evaluations with final risk management rules have been issued for 5 of the 33 chemicals identified.

The Industrial Hygiene group in WSE is developing an on-going implementation plan to address impacts to Argonne in both the operational and research areas resulting from the regulation of these chemicals. The implementation plan includes elements of identification of affected chemical inventory, outreach and education of stakeholders, impact assessments on operations and research, exposure assessments, worker protections, training, waste disposal and recordkeeping.

Inventory tracking has been initiated to identify chemical containers and products affected by the final and proposed regulation of the 33 prioritized chemicals. Outreach has begun through meetings with management and lab-wide communications. Impact assessment is being accomplished through surveying chemical owners. The worker safety elements of the plan are being developed by the Industrial Hygiene group in preparation for future compliance dates for Federal Contractors to consume or dispose of regulated chemicals for prohibited uses, or the implementation of workplace chemical protection programs for limited allowed uses.

2.9. Endangered Species Act

The Endangered Species Act of 1973 (ESA) is federal legislation intended to protect plant and animal species from extinction. The Act is administered by the United States Fish and Wildlife Service (USFWS). Section 7 of the Act describes the role other Federal agencies take to comply with the ESA. Federal agencies have the responsibility to protect threatened and endangered species and are required to assess all of their actions to determine if any threatened or endangered (T&E) species or critical habitats of such species will be adversely affected.

At Argonne, the applicable requirements of the ESA are identified and satisfied through the NEPA project review process. All proposed projects must provide a statement describing the potential impact to threatened or endangered species and their critical habitats. This statement is included in the general Environmental Review Form. If the potential exists for an adverse impact, the cause of the impact will be assessed further in consultation with the U.S. Fish and Wildlife Service for an effects determination and, if necessary, the preparation of a more detailed

NEPA document, such as an EA or an EIS. Where appropriate, this information is shared with affected state and federal stakeholders, so that potential adverse impacts are assessed fully and any steps to minimize these impacts are identified.

One federal-listed species is known to occur on the Argonne site. The Hine's emerald dragonfly (*Somatochlora hineana*), which is federal- and state-listed as endangered, was found to be present on the Argonne site in 2016 and 2017. Surveys conducted in 2021 reaffirmed the species' presence. Wetlands on the site provide habitat for adults and early life stages of the dragonfly. This species also occurs in the Waterfall Glen Forest Preserve that surrounds the Argonne property, in locations with spring-fed wetlands along the Des Plaines River floodplain. Critical habitat for the Hine's emerald dragonfly is located along the Des Plaines River and does not occur on the Argonne site.

To date, no other federal-listed T&E species are known to occur on the Argonne site. No critical habitats of other federal-listed species known to occur in DuPage County exist on the site. However, recent changes to the hypothetical range of the rusty-patch bumble bee includes three fourths of the Argonne site. This species has not been observed to date. Some operations, such as controlled burns and mowing, have been suspended, reduced, or conducted seasonally to eliminate impact until further field investigation can determine its presence. The northern long-eared bat, which has been reportedly observed in the neighboring Waterfall Glen Forest Preserve, was recently re-listed as endangered. This has caused a recalibration of lab operations in relation to tree management.

Three federal-listed threatened and endangered species inhabit Waterfall Glen Forest Preserve. The Leafy prairie-clover (*Dalea foliosa*), federal-and state-listed as endangered, and the Prairie bush-clover (*Lespedeza leptostachya),* federal-listed as threatened and state-listed as endangered, are associated with prairie remnants of the Des Plaines River Valley and are present in small populations within the Waterfall Glen Forest Preserve. In addition, there are recent reports of the presence in Waterfall Glen Forest Preserve of the Northern long-eared bat (*Myotis septentrionalis*), which is federal- and state-listed as threatened. There are five other federal threatened and endangered (T&E) species known to occur in DuPage County. These species are not known to occur at or near the Argonne site: Eastern prairie fringed orchid (*Platanthera leucophaea*), Mead's milkweed (*Asclepias meadii*), Eastern massasauga (*Sistrurus catenatus*), Snuffbox mussel (*Epioblasma triquetra*), and rusty-patch bumble bee (*Bombus affinis*).

The State of Illinois has declared additional authority over species threatened or endangered within the state under the Illinois Endangered Species Protection Act (ESPA) of 1972. The Illinois ESPA, similar to the Endangered Species Act, protects threatened or endangered species determined imperiled by the State. Federal T&E species are often state listed and all of the species discussed above are Illinois State listed as well. Although species that are state-listed (but not federal-listed) that occur in the area are not regulated by the Federal ESA, the following state-listed species have been found on the Argonne site or within the vicinity of Argonne:

- Endangered
  - Black-crowned night heron (*Nycticorax nycticorax*)
  - Blanding's turtle (*Emydoidea blandingii*)

  - Bulrush (*Scirpus hattorianus*)
  - Tennessee milkvetch (*Astragalus tennesseensis*)
  - Tuckerman's sedge (*Carex tuckermanii*)
  - Pursh's bulrush (*Schoenoplectus purshianus*)
  - Yellow-crowned night heron (*Nyctanassa violacea*)
  - Northern oak fern (*Gymnocarpium dryopteris*)

- Threatened
  - Banded killifish (*Fundulus diaphanus*)
  - Black-billed cuckoo (*Coccyzus erythropthalmus*)
  - Buffalo clover (*Trifolium reflexum*)
  - Kirtland's snake (*Clonophis kirtlandi*)
  - Marsh speedwell (*Veronica scutellata*)
  - Osprey (*Pandion haliaetus*)
  - Shadbush (*Amelanchier interior*)

Among these species, the Kirtland's snake, Bulrush, Pursh's bulrush, northern oak fern, and Black-crowned night heron have been observed on Argonne property. Any impacts on these species would also be assessed during the NEPA process. No activity in 2024 required a consultation with either the US Fish and Wildlife Service or the Illinois Department of Natural Resources.

2.10. National Historic Preservation Act

Section 106 (54 U.S.C. 306108) of the National Historic Preservation Act (NHPA) of 1966 (54 U.S.C. 300101 et seq.), as amended, requires each federal agency to identify and assess the effect of its actions on historic properties and allow the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment. The goal of this process is to seek ways to avoid, minimize, or mitigate any adverse effect on historic properties. At Argonne, the Section 106 requirements are integrated with the NEPA review process, as well as the Argonne digging permit process. DOE will consult with the Illinois State Historic Preservation Officer and the ACHP if proposed actions may adversely affect properties considered eligible for listing or listed on the National Register of Historic Places (NRHP).

Argonne evaluated its structures built prior to 1989 for potential listing on the NRHP in 2001. The survey identified the Building 200 M-Wing Caves, as well as Buildings 203, 205, 212, 315/316, and 350, as individually eligible for listing on the NRHP. The Main Campus District (Buildings 200, 202, 203, 205, 208, 211) and the Freund Estate Historic District (Buildings 600, 604 and properties 603 [pool], 606 [pavilion], and 616 [tennis courts]) were established as part of the evaluation. Separate evaluations conducted as part of decommissioning and demolition efforts established the Chicago Pile-5 Reactor (Building 330), the Argonne Thermal Source Reactor (Building 301), the Physics and Metallurgy Hot Laboratory, the High Voltage Electron Microscopy Facility, the Alpha-Gamma Hot Cell Facility, and Zero Power Reactors VI and IX as eligible for listing on the NRHP.

Cultural resources include both archaeological sites and historic structures. Roughly 240 ha (593.6 acres) or, nearly 40 percent, of the Argonne site has been examined through Phase I Archaeological surveys for the presence of cultural resources. Past surveys identified archaeological sites at Argonne, three of which were determined eligible for listing on the NRHP, while 35 were determined ineligible. The remaining 20 sites are yet to be evaluated for NRHP eligibility. Three projects were sent to State Historic Preservation Officers (SHPO) for review under Section 106 of the NHPA in 2024. The Community Research on Climate and Urban Science project had five different installation locations for review, UIC, Chicago, Humboldt Park, Chicago, Shedd Aquarium and Caruthers Center, Chicago, and the Villa Park Public Library, Villa Park. All received concurrence of no adverse effect to historic properties from Illinois SHPO. The Scaling Up Decarbonization and Sustainability project located in Monroe County, Iowa received concurrence of no historic properties affected from Iowa SHPO. Additionally, the Atmospheric Research and Monitoring project closed out the consultation process for the AMF3 (Third Mobile Facility) installations in Alabama. The final Cultural Resources reports were sent to Alabama SHPO with recommendation for no further study.

2.11. Floodplain Management

Federal policy on managing floodplains is contained in EO 11988[18], *Floodplain Management* (May 24, 1977). In addition, 10 CFR Part 1022[19] describes DOE's implementation of this EO. The EO requires federal facilities to avoid, to the extent possible, adverse impacts associated with the occupancy and modification of floodplains. To construct a project in a floodplain, DOE must demonstrate that there is no reasonable alternative to the floodplain location. No project in 2024 caused an assessment of impact to the site's floodplains.

The Argonne site is located approximately 46 m (150 ft) above the nearest large body of water (Des Plaines River); thus, it is not subject to major flooding. The 100- and 500-year floodplains are limited to low-lying areas of the site near Sawmill Creek, Freund Brook, Wards Creek, and other small streams and associated wetlands and low-lying areas. These areas are delineated in Argonne's site development plan and are generally contained within areas designated for conservation, not intended for development. No significant structures are located in these areas, although an existing pumping station and inlet structure for securing canal water as a cooling tower feedstock is situated in the floodplain of the Des Plaines River south of the site. To ensure that floodplain areas are not adversely affected, new facility construction is not permitted within these areas, unless there is no practical alternative. Any impacts on floodplains would be fully assessed in a floodplain assessment and, as appropriate, documented in the NEPA documents prepared for a proposed project. Appropriate permits from the U.S. Army Corps of Engineers (COE) are needed to conduct work inside floodplains.

2.12. Protection of Wetlands

Federal policy on wetland protection is contained in EO 11990, *Protection of Wetlands* (May 24, 1977). In addition, 10 CFR Part 1022 describes DOE's implementation of this EO. The EO requires federal agencies to identify potential impacts to wetlands resulting from proposed

activities and to minimize these impacts. Where impacts cannot be avoided, mitigating action must be taken by repairing the damage or replacing the wetlands with an equal or greater amount of a restored wetland or a man-made wetland as much like the original wetland as possible.

Section 404 of the CWA establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands with a connection to waters of the United States. The COE administers this program. Activities regulated under this program include disturbance of wetlands for development projects, infrastructure improvements, and drainage of wetlands to uplands for farming and forestry. The COE uses a permit system to identify and enforce wetland mitigation efforts.

Argonne completed a site-wide wetland delineation in 2024. All wetlands present on-site were identified and mapped following the 1987 *Corps of Engineers Wetlands Delineation Manual*.[20] and rule changes brought about by the Sackett v. Environmental Protection Agency decision. The delineation map shows the areal extent of all wetlands present at Argonne down to 500 m^2 (1/8th acre). Thirty-five individual wetland areas were identified; their total area is approximately 20 ha (50 acres). The larger wetlands are illustrated in Figure 1.3. There were no actions in 2024 that adversely impacted site wetlands.

2.13. Natural Resources Management and Invasive Species Control

The Argonne site hosts a number of habitats that are interspersed and surround the research campus. The quality of the habitats are significant, contributing to the welfare of migratory birds, pollinators, and other wildlife. The goal of Argonne's land management and the habitat restoration effort is to retain these resources, improve degraded habitats, and control the proliferation of invasive species. These goals are found in Argonne's Natural Resources Management Plan.

Executive Order 13751[21]- Safeguarding the Nation from the Impact of Invasive Species in 2016 amends EO 13112[22]- Invasive Species, 1999. These orders require all agencies with land holdings to control the proliferation of invasive species. Argonne annually attempts to convert 1–2 ha (3–5 acres) of pasture grass to prairie and to control 12–24 ha (30–60 acres) of invasive species in woodlands. Several species of invasive plants are monitored and controlled every year throughout the site, and most habitat sites have demonstrated improvement from the control effort. Argonne's invasive species control is described in the Natural Resources Management Plan.

2.14. Wildlife Management and Related Monitoring

DOE and the Forest Preserve District of DuPage County coordinate wildlife management efforts to preserve and enhance biodiversity at Argonne and the surrounding Waterfall Glen Forest Preserve. DOE manages the deer population at the site through an interagency agreement with the U.S. Department of Agriculture (USDA). In 1995, DOE initiated the deer management program to alleviate traffic safety hazards and ecological damage caused by very high deer population. White-tailed deer are removed as needed to achieve target population of 15 deer/mi^2

to reduce deer and vehicle collisions, allow oak trees to regenerate, and allow deer-sensitive herbaceous species to recover.

The USDA-Wildlife Service has been monitoring and recording species of migratory birds that are protected under the Migratory Bird Treaty Act, (Title 16, United States Code [USC], Sections 703–712) of 1918. The act implements agreements the United States has with Canada, Japan, Mexico, and the former Soviet Union for the protection of shared migratory bird resources. The act makes it illegal to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid Federal permit. The bird species protected can be found in Title 50, CFR, Part 10.13.

In 2001, the President issued Executive Order 13186[23], *Responsibilities of Federal Agencies to Protect Migratory Birds.* The Department of Energy responded with a memorandum of understanding (MOU) of its role in the protection of migratory birds. That MOU was updated on September 12, 2013. Bird surveys are conducted by the USDA-Wildlife Service twice per month between May and October as opportunity allows. It has been confirmed that many migratory bird species pass through or nest on the site. The surveys and Argonne's invasive species control and habitat improvement efforts are fulfilling the commitments agreed to in 2013 as well as Executive Order 13751 from 2016.

2.15. Environmental Permits

Table 2.12 lists all the environmental permits in effect at the end of 2024. Other portions of this chapter discuss special requirements of these permits and compliance with those requirements.

TABLE 2.12

Environmental Permits in Effect, 2024

Permit Name	Permit ID	Permit Type	Start Date	End Date
B-203 CARIBU Project Construction Permit	05120055	Construction (Air)	3/20/2006	–[a]
Advanced Protein Crystallization Facility	2011-HB-1916	Construct, own, operate	9/30/2011	–
Building 108 Boiler #5 NO_x RACT Control	11030020	Construction	4/5/2011	–
Building 108 Temporary Boiler	11060051	Construction	7/22/2011	–
Building 211 Hot Cell D-024	18100018	Construction	11/21/2018	--
Building 211 Linac	11030026	Construction	3/30/2011	–
Building 211 Upgrade to VanDeGraaf Accelerator	18030003	Construction	4/13/2018	–
Building 308 Alkali Metal Reaction Booth	88120046[b]	Construction	1/6/2012	–
Building 366 Wakefield Accelerator	11080020	Construction	8/17/2011	–
CAAPP Title V Permit	95090195	Operating	6/29/2020	6/29/2025
Combined Heat and Power (CHP) Plant	12120033	Construction	6/28/2013	–
Energy Sciences Building	2011-HB-1277	Construct, own, operate	4/22/2011	–
Equalization Pond Effl. Discharge to DuPage County	2001-HC-3788	Construct, own, operate	8/10/2001	–
General NPDES Permit for Pesticide Application Point Source Discharges	ILG87	General NPDES	9/1/2023	8/31/2028
Howard T. Ricketts Laboratory Construction Project	2006-EN-6007	Construction	1/12/2006	–
Long Beamline Building	2020-EN-65773	Construct, own, operate	11/5/2020	–
NAUTICAS Project	19030005	Construction (Air)	3/20/2019	–
NPDES Wastewater Discharge Permit	IL0034592	Operating	9/1/2023	8/31/2028
Open Burn Permit – Ecological Management	B2302148	Operating	3/17/2023	3/17/2024
Open Burn Permit – Ecological Management	B2402093	Operating	2/13/2024	2/13/2025
Open Burn Permit – Fire Training	B2301551	Operating	2/24/2023	2/24/2024
Open Burn Permit – Fire Training	B2402119	Operating	3/21/2024	3/21/2025
Pesticide-Producing Establishment	13754-IL-001	Pesticide Production	12/12/2002	–
RCRA Part B Permit (RCRA Log No. B-75R-M-1)	IL3890008946	Operating	6/21/2011	5/6/2020
Theory and Computing Science Building-West Addition	ILR10ZCFV	General NPDES	2/16/2023	8/31/2028
400 Area Roadway Improvements Phase 2 and 3 (Kearney and Bluff Roads)	ILR10ZBXP	General NPDES	8/7/2022	8/31/2028
Theory and Computing Sciences (TCS) Building	2009-EN-4482	Construction, own, operate	10/8/2009	–
Eastwood Drive and Access Road Upgrades	ILR10ZEOS	General NPDES	9/25/2024	8/31/2028
Materials Design Laboratory	2016-EN-61239	Construct, own, operate	9/1/2016	–
Activated Materials Laboratory	22020011	Construction (Air NESHAPS)	3/18/2022	–
Wastewater Treatment Plant Land Application Permit	2020-SC-64995	Operating	3/2/2020	1/31/2025
Replacement of Two Failing Culverts in Headwaters Area of Upper Freund Brook	LRC-2024-00212	Nationwide Permit Authorization	8/21/2024	3/14/2026

[a] A dash indicates that the permit continues to be in effect with no expiration date.

[b] Revision of the original construction/operating permit. Converted from insignificant to significant emission unit in CAAPP permit.

2.16. EPA/IEPA/DOE Inspections/Appraisals

Various inspections and appraisals were conducted during 2024. A short description of external assessments conducted by regulatory agencies is included in Table 2.13. Any identified issues are documented in an Argonne issues management system and tracked to completion.

TABLE 2.13

EPA/IEPA/DOE Environmental Compliance Inspections/Appraisals, 2024

Agency	Type	Date
U.S. EPA/IEPA	RCRA Part B Permit Compliance Evaluation Inspection	2/26/2024
IEPA	CAAPP Compliance Evaluation Inspection	3/21/2024
IEPA	RCRA Corrective Action – Groundwater Monitoring Program Inspection	7/10/2024

3. ENVIRONMENTAL MANAGEMENT SYSTEM

3. ENVIRONMENTAL MANAGEMENT SYSTEM

The Environmental Management System (EMS) is a tool that the management team at Argonne uses to effectively manage and monitor the impacts that operations and processes may have on the environment and to continually improve its environmental stewardship performance. The UChicago Argonne, LLC, Board of Governors; the Laboratory Directorate; and the Laboratory Operations Council are committed to ensuring that environment, safety, and health considerations are integrated into the performance of all work.

3.1. EMS Certification

DOE Order 436.1A, *Departmental Sustainability* (which was in effect for CY2024), required sites to have an established and implemented EMS. According to the DOE Order, sites must maintain their EMS as being certified to or conforming to International Organization for Standardization (ISO) 14001, in accordance with the accredited registrar provisions of the International Standard or the self-declaration instructions provided by DOE Office of Environment, Health, Safety and Security (EHSS).

The EMS program at Argonne originally received accreditation and was recognized as being fully compliant with ISO 14001:2004 in May of 2009. Since that time the EMS has helped Argonne improve facility operations resulting in improved environmental performance and a decrease in environmental risks. For the most part this was accomplished by improving the understanding and recognition of environmental issues at all levels of the organization. This resulted in the environmental program's increased communication and partnering with stakeholders to help avoid potential noncompliance with regulatory requirements.

More recently, the ISO Registrar recommended Argonne for ISO 14001:2015 certification, which was most recently issued on May 17, 2024 (see Figure 3.1). On September 12, 2024 the U.S. Department of Energy-Argonne Site Office (DOE-ASO) declared that Argonne had fully implemented its EMS, consistent with the requirements of DOE Order 436.1A.

In parallel with the ISO 14001:2015 certification, Argonne also holds an ISO 9001:2015 certification for its Quality Management System and an ISO 45001:2018 certification for its Safety Management System.

3.2. EMS Effectiveness

The effectiveness of the EMS in managing and monitoring potential environmental impacts is demonstrated in several ways. This includes Argonne's excellent environmental compliance record as described in Chapter 2 of this SER, reduction in environmental risk through identification of environmental aspects and controlling subsequent potential impacts of activities as described in Chapter 3 of this SER, identification and implementation of environmental objectives and targets as described in Chapter 3 of this SER, and evaluation of compliance with environmental regulations. To evaluate compliance, Argonne has an established audit program that evaluates the facility's compliance with environmental regulatory requirements. A schedule for these audits is established at the beginning of each year and assigned to qualified personnel. In addition, inspections by US EPA and IEPA as discussed in Chapter 2 of this SER are a means for Argonne to gain an independent assessment of compliance with environmental regulations.

TÜVNORD

CERTIFICATE

Management system as per

EN ISO 14001:2015

The Certification Body TÜV NORD CERT GmbH hereby confirms as a result of the audit, assessment and certification decision according to ISO/IEC 17021-1:2015, that the organization

Argonne National Laboratory
9700 South Cass Avenue
Lemont, IL 60439
United States

Operates a management system in accordance with the requirements of ISO 14001:2015 and will be assessed for conformity within the 3 year term of validity of the certificate

Scope

Facilities and ancillary activities supporting the R&D mission on behalf of the Department of Energy at Argonne National Laboratory, within the Scope of Prime Contract DE-AC02-06CH11357.

Certificate Registration No. 44 104 18560109
Audit report No. 23-5910

Valid from 2024-05-17
Valid until 2027-05-16

Deann Minamino
Certification Body
at TÜV NORD CERT GmbH

Salem, 2024-04-30

TÜV NORD CERT GmbH Am TÜV 1 45307 Essen www.tuev-nord-cert.com

IAF MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT
DAkkS Deutsche Akkreditierungsstelle D-ZM-12007-01-00

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FIGURE 3.1 Argonne ISO 14001:2015 Certificate

The EMS program includes a process for employees to make recommendations to implement environmental improvements. The commitment to continual improvement has established a process where employees are asked for their ideas on how to decrease environmental impacts. For example, this has resulted in the establishment of a laboratory wide recycling program, a composting program, a bike share program, a free on-campus taxi service, etc. The EMS program also provides training courses to stakeholders on environmental topics such as managing hazardous waste, making waste determinations, identifying environmental aspects and impacts, creating environmental objectives and targets, proper use of laboratory sinks, and fulfilling NEPA requests.

Annually, Argonne submits an EMS compliance report to the DOE via the Department of Energy Environmental Management System Site Information Database. This report summarizes the EMS program's compliance with four DOE established metrics during the prior fiscal year. The metrics included maintaining ISO 14001:2015 certification, identifying environmental aspects and controlling impacts, identifying and implementing environmental objectives and targets, and evaluating compliance with environmental regulations. Following their DOE's review of Argonne's metrics for Fiscal Year (FY) 2024, the DOE reported that Argonne fulfilled all established criteria, and that the Argonne's EMS was awarded a "Green" score, indicating the facility was in full compliance.

3.3. Integration of the EMS with the Integrated Safety Management System

The Integrated Safety Management System (ISMS) is the DOE umbrella of environment, safety, and health programs and systems that provides the necessary structure for any work activity that could potentially affect a worker, the public, or the environment. The EMS is integrated into the ISMS through the Argonne Work Planning and Control process. As part of the work planning process, the NEPA Environmental Review Form is completed to indicate potential environmental issues associated with the work so that the appropriate environmental subject matter expert (SME) can be engaged to assess environmental impacts.

3.4. EMS Elements

The ISO 14001:2015 standard contains requirements that define and document the EMS program. The EMS is designed around the plan-do-check-act cycle, an interactive four-step management method used for the control and continuous improvement of processes. The most critical planning stage elements are discussed below. Other aspects of the plan-do-check-act cycle are discussed in other portions of this report.

3.4.1. Environmental Policy

The Argonne environmental policy is captured in LMS-POL-2 and is available to all Argonne employees and to the public via the Argonne public website (https://www.anl.gov/environmental-protection). In addition, the environmental policy is

included in all employee onboarding training and annual refresher training. The policy states "Argonne must conduct activities in an environmentally safe and sound manner according to the existing DOE contract, Argonne permit conditions, and applicable regulations. Argonne must:

- Minimize environmental impacts caused by activities and services by preventing pollution, minimizing waste, and protecting the natural environment.
- Operate in compliance with applicable federal, state and local regulations, environmental permits, and contractual requirements related to environmental performance; and
- Continually improve the Environmental Management System to enhance environmental performance."

This environmental policy applies to all Argonne activities that could or do have a potential impact on the environment or compliance with applicable environmental regulations.

3.4.2. Environmental Aspects and Impacts

Argonne evaluates its operations to identify those aspects of its operations that can impact the environment and to determine which of those impacts are significant. When operations have the potential for significant environmental impacts, Argonne implements the EMS to minimize or eliminate potential adverse impacts. Most of the aspects are discussed in Chapter 2. The list of environmental aspects is reviewed and updated annually.

Through the identification of the significant environmental aspects, those operations with the highest risks were identified allowing facility personnel to help ensure effective control of the applicable activities, products, and services. This directly improved Argonne's compliance with both DOE and Regulatory requirements while achieving its mission. Identification of aspects and impacts contributes to compliance with all requirements stated in Argonne's RCRA, NPDES and CAAPP Title V Permits. IEPA issued a notice of violation letter to Argonne in 2024. The violation involved no harm to the environment. Rather, it related to semi-annual reporting and the matter has been resolved to IEPA's satisfaction. No fines were levied against Argonne by external environmental agencies in 2024.

Regulatory and organizational roles and responsibilities are delineated in the EMS Description Document to address the management of the aspects and impacts. To determine which environmental aspects are significant, a scoring methodology is applied that rates each against the four criteria of regulatory compliance, environmental consequence, mission consequence, and the likelihood of occurrence. Four aspects have been identified as being significant: regulated air emissions, regulated water effluent, waste management, and pollution prevention/waste minimization. All facilities that have significant aspects are required to have controls in place to minimize or eliminate their negative impacts.

3.4.3. Legal and Other Requirements

Argonne monitors the environmental regulations to ensure that Argonne staff is aware of proposed changes in regulations and new regulations. A number of sources of information are reviewed to identify new or changing regulations, including: monitoring *Federal Register* and *Illinois Register* notices, EPA, IEPA, and DOE websites, and newsletters; attending workshops and seminars; and participating in professional organizations and conferences.

New requirements are communicated to the appropriate managers, supervisors, and stakeholders by SMEs. Evaluations are conducted to determine the impacts of proposed and final regulations on Argonne activities.

In addition to new or revised DOE Orders and regulations that prescribe requirements, Argonne uses other sources to identify opportunities for environmental improvements. These include lessons-learned reports, interaction with other DOE sites, participation in working groups and professional societies, Occurrence Reporting and Processing System (ORPS) reports, management and independent assessments, assessments by stakeholders, and feedback from public interest groups and others.

3.4.4. Environmental Objectives and Targets

Another mechanism to improve environmental performance is the annual establishment of EMS objectives and targets. Objectives describe Argonne's goals for environmental performance. The objectives are a set of measurable or qualitative goals concerning how Argonne will address each significant environmental aspect. Targets are specific measurable interim steps to be taken to meet objectives. Targets are documentable actions with due dates. All organizations are encouraged to establish and implement environmental targets where applicable to individual programs.

For FY 2024, 17 objectives/targets were established and have been accomplished within the established time frame. This is similar to the number identified in past fiscal years. Identified objectives/targets are documented and tracked to completion by the assigned point of contact. Efficiency practices are a large component of Argonne's environmental objectives and targets. Efficiency practices are discussed in the following sections.

3.5. Efficiency Practices

For more than a decade, Argonne has implemented efficiency programs that resulted in measurable progress toward optimizing energy and environmental performance, reducing waste, and cutting costs. Argonne's Efficiency Program supports world-class science and engineering breakthroughs, addresses deferred maintenance, and improves operations.

Argonne's efficiency efforts align with Argonne's long-term site planning and infrastructure modernization efforts as outlined in the Annual Laboratory Plan and the Facility and Infrastructure Strategic Investment Plan. To ensure alignment with these campus-level plans,

Argonne developed the Efficiency Program Strategy as the framework for developing the annual Site Sustainability Plan (SSP). This strategy encompasses three pillars: (1) to optimize and upgrade infrastructure; (2) to engage the laboratory community; and (3) to institutionalize energy efficiency across the laboratory. These pillars are supported by an underlying foundation that aligns with DOE's efficiency and resilience goals.

Supported by these pillars, Argonne plans and implements activities around four key focus areas that drive results to achieve DOE's comprehensive efficiency goals: resource conservation, net zero buildings, mobility, and clean and renewable energy. This integrated approach to Argonne's Efficiency Program and infrastructure affords Argonne the opportunity to leverage synergies from efficiency strategies that benefit multiple goals, most notably reducing overall repair needs and deferred maintenance.

The FY 2025 SSP documents Argonne's plans and current progress toward meeting federal sustainability requirements outlined in DOE Order 436.1A, "Departmental Sustainability" (which was in place in CY2024), relevant Executive Orders (E.O.s), and other statutory requirements in accordance with the FY 2025 SSP guidance. Performance data, progress, and plans are tracked using the DOE's online Sustainability Dashboard tool (DOE Dashboard) and through Argonne's ISO 14001 certified EMS.

The impacts of Argonne's efficiency efforts reach every corner of the laboratory. In 2024, Argonne achieved numerous accomplishments, including the following:

- Performance Contracting: In FY 2024, Argonne requested Nicor Gas / Southern Company complete a Preliminary Assessment (PA) of five (5) buildings to identify energy and water conservation opportunities that could be further developed and implemented under a Utility Energy Service Contract (UESC). The buildings assessed include Building 200, Building 203, Building 242, Building 362 and Building 440. The PA results indicate this UESC project will leverage energy and operational savings to implement over $18 million in modernization, resiliency, and infrastructure upgrades while reducing energy consumption at targeted buildings by an estimated 12 percent. The total annual GHG reduction estimated for this project is 7,064 metric tons.

- Geothermal Feasibility Study: In FY 2024, the Efficiency Program partnered with Salas O'Brien to update and expand the 2012 geothermal feasibility study. The updated study considers system changes and enhancements on the Argonne campus and includes the latest advancements in geothermal technology in efforts to reduce the Laboratory's reliance on natural gas derived steam heating.

- Onsite Solar Design: In FY 2024, Argonne completed the final design for a 1.9 MW solar installation, set to be installed in the 400 Area of campus, east of Building 450. This asset is expected to be funded via the UESC performance contract currently in progress.

- EVSE Upgrades: Argonne operates 64 Level 2 charging ports and four DC Fast Chargers on campus. In summer 2024, several aging charging stations were replaced with upgraded units. New stations were installed at Buildings 212, 241, 363, 370, 371, 446, and 450 to support new ZEV fleet vehicles and expected reporting requirements.

3.5.1. Site Resilience

Argonne continued the multiyear effort to evaluate resilience of our site, facilities and infrastructure. We leveraged the technical assistance from DOE's Federal Energy Management Program (FEMP) and worked with the online Technical Resilience Navigator (TRN) tool to continue resilience planning for energy and water infrastructure.

Argonne continues to execute the DOE required Vulnerability Assessment and Resilience Plan (VARP). The VARP identified 85 potential solutions to improve site resilience to climate change; 12 were further prioritized for implementation and tracking via the DOE Dashboard. Argonne continues to incorporate climate adaptation and resilience into our infrastructure design process through our Guiding Principles Workbook, which is being leveraged for all major renovations, new facility construction, and large-scale utility projects.

Argonne will continue to unite, adapt, and lead in making the Laboratory and the region more sustainable. The Efficiency Program will develop new partnerships to leverage campus infrastructure as a living laboratory and accelerate the science and technology that drive U.S. prosperity and security.

3.5.2. Pollution Prevention and Waste Reduction

Argonne operates a site-wide Pollution Prevention/Waste Minimization (P2) program in accordance with its RCRA Part B Permit and DOE Order 436.1. The P2 program is embedded into the Efficiency Program and tracks the generation of waste and recyclable material at Argonne and monitors progress toward meeting goals established in Argonne's SSP.

Argonne management fosters a work environment that promotes the development and implementation of P2 activities. Annual P2 activities are built into the implementation strategy for the Efficiency Program and funding is provided to deliver P2 projects. In addition, Argonne uses the ISMS to promote and institutionalize P2 strategies across the site. For example, in late CY2024 Argonne re-launched its composting program at its employee cafeteria.

3.5.2.1. Municipal Solid Waste and CCDD Diversion

Argonne's Efficiency Program team identifies, develops, and conducts assessments to evaluate the feasibility of pollution prevention (P2) programs, projects, and initiatives aimed at reducing or eliminating waste and pollution. These assessment activities are integrated into the roles of Argonne's Environmental Compliance Representatives and the core Efficiency Program team.

To address municipal solid waste and construction and demolition debris (CCDD), Argonne has implemented key initiatives, including single-stream recycling, food scrap and paper towel composting, battery recycling, scrap metal recycling, electronics recycling, and compliance with CCDD requirements for construction projects. In FY 2024, Argonne achieved a non-hazardous solid waste diversion rate of 47.2%, excluding construction and demolition debris.

Table 3.1 presents a summary of recycled material for 2024. Argonne continues to utilize programs such as the Argonne Property Excess System (APES) and the Chemical Management System to minimize waste and reuse available materials. The APES program was developed to assist Argonne employees in recycling and reusing surplus equipment, supplies and materials by promoting the availability or need for items via the Argonne email system. The Chemical Management System enables surplus chemicals to be used rather than purchasing new chemicals.

TABLE 3.1

Recycled Materials, 2024

Material	Amount Recycled (tons)
All-in-One	93
Composting	11
Scrap Metal	170
Electronics	86
Batteries	9
Construction Debris	4712
Toner Cartridges	1
Light Bulbs	1

The resource conservation strategy is to minimize landfill waste and protect the natural environment using a whole-systems approach to materials management. Argonne continues to implement our food-scrap and paper towel composting program (composting program), which is a key waste diversion strategy employed by the laboratory. As of September 30, 2024, the composting program had diverted 121.06 metric tons of compostable materials from landfills since the program's launch in July of 2018. In FY 2024, the composting program diverted 11.46 metric tons of compostable materials.

3.6. Employee/Community Awareness

The Argonne Communications and Public Affairs (CPA) organization assists Argonne's Environmental Protection Program and Efficiency Program with promotion of environmental achievements, programs, and best practices, both within Argonne and in the local and regional communities. Staff keep Argonne's neighbors apprised of programs and activities through a variety of strategies described below.

- Community Leaders Round Table: Elected and appointed leaders of public and private community organizations meet quarterly for an informal update on Argonne activities that affect the surrounding communities.

- Argonne Advances E-Newsletter: Issued every month, this digital newsletter contains brief articles about the world-class discoveries, researchers, and developments at Argonne. The newsletter is emailed to more than 9,000 members of the surrounding Argonne community. Interested parties can subscribe at http://www.anl.gov/subscribe.

- Argonne OutLoud: This public lecture series highlights the cutting-edge research taking place at Argonne and topics of interest to the community at large. Lectures are free and open to the public. Advance registration is required.

- Argonne Now: Issued biannually, this informational science publication features stories about research and breakthroughs at Argonne and what it means for our everyday lives. It includes news, interviews with scientists and engineers, pieces about the challenges facing researchers today, and more. Interested parties can subscribe at http://www.anl.gov/subscribe.

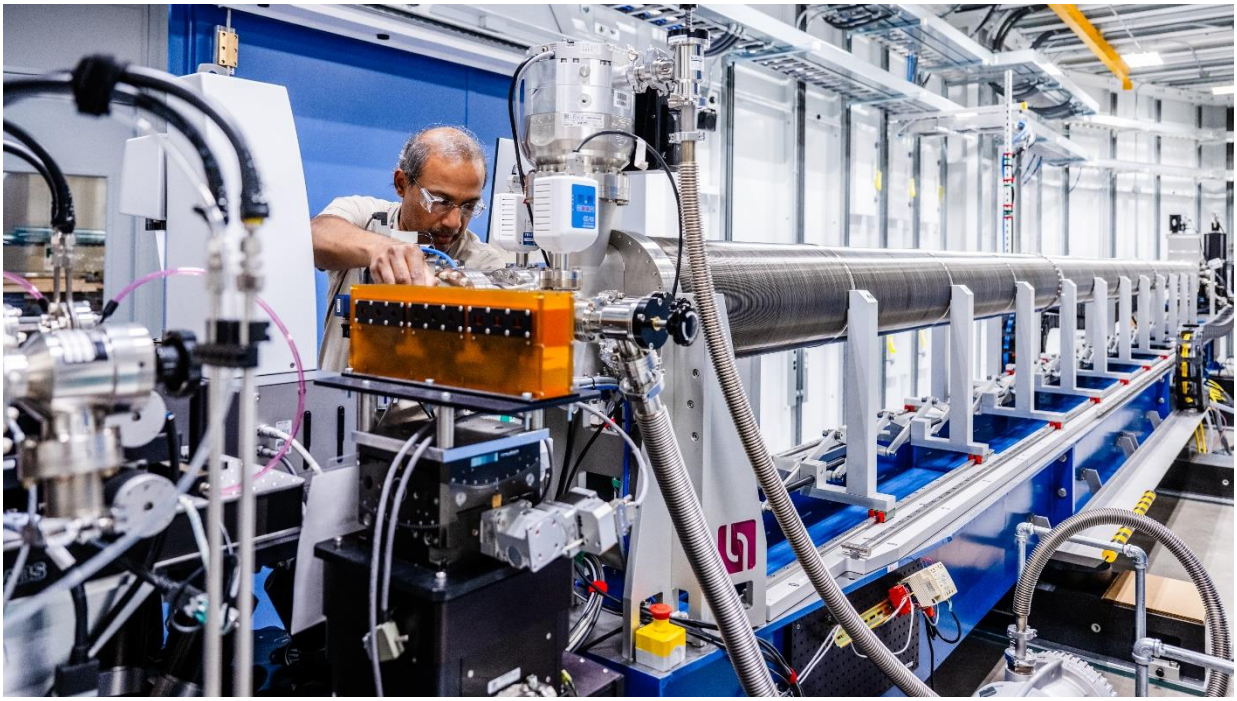
- Tours: Each year, staff lead dozens of tours of Argonne's grounds and scientific facilities for high school, college, business, professional, and community groups. Efficiency and environmental protection efforts are often highlighted through tours.

- Argonne Speakers Bureau: Argonne provides community and business groups with speakers about a variety of topics related to Argonne activities.

- Social Media: Members of the community can follow Argonne on Facebook, Flickr, Instragram, LinkedIn, X (formerly Twitter), Threads, and YouTube.

In addition to these services, Argonne maintains a public website (www.anl.gov) which contains environmental information, including the Argonne environmental policy, the SER, and other current environmental information.

4. ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION



4. ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

4.1. Description of Monitoring Program

The radioactivity of the environment around Argonne in 2024 was determined by measuring the radionuclide concentrations in the air, surface water, groundwater, and sediment as well as by measuring the external photon penetrating radiation exposure. Sample collections and measurements were made on site, at the site perimeter, and offsite for comparative purposes.

Because radioactivity is primarily transported by air and water, the sample collection program concentrates on these media. In addition, sediment samples from Sawmill Creek are analyzed. The program follows the guidance provided in DOE-HDBK-1216-2015, *Environmental Radiological Effluent Monitoring and Environmental Surveillance Guide.*[24] The results of radioactivity measurements are expressed in terms of pCi/L for water, fCi/m^3 for air, and pCi/g or fCi/g for bottom sediment. Penetrating radiation measurements are reported in units of mrem/yr, and population dose is reported in units of person-rems.

DOE has provided guidance[7] for effective dose equivalent calculations for members of the public based on International Commission on Radiological Protection (ICRP) Publications 60 and 101.[25,26] Those procedures have been used in preparing this report. The methodology requires that three components be calculated: (1) the committed effective dose equivalent (CEDE) from all sources of ingestion, (2) the CEDE from inhalation, and (3) the direct effective dose equivalent from external radiation. These three components were summed for comparison with the DOE effective dose equivalent limits for environmental exposure. To ensure that at least 90% of the total CEDE is accounted for, the DOE guidance requires that sufficient data on exposure to radionuclide sources be available. For 2024, approximately 90% of the samples that were scheduled were collected. This represents enough samples to estimate dose to the public. Circumstances preventing sample collection include dry wells, dry surface water locations, weather, or equipment failures/upgrades. The primary radiation dose limit for members of the public is 100 mrem/yr. The effective dose equivalents for members of the public from all routine DOE operations (natural background and medical exposures excluded) shall not exceed 100 mrem/yr and must adhere to the as low as reasonably achievable (ALARA) process or be as far below the limits as is practical, taking into account social, economic, technical, practical, and public policy considerations. Routine DOE operations are normally planned operations and exclude actual or potential accidental or unplanned releases.

The measured or calculated environmental radionuclide concentrations were converted to a 50-year CEDE with the use of the committed effective dose coefficients found in Appendix A of DOE Standard 1196-2022[27]. These CEDEs were compared with the annual dose limits for uncontrolled areas. The numerical values of the committed effective dose coefficients used in this report are provided later in this chapter (Table 4.16). Occasionally, other standards are used, and their sources are identified in the text.

4.2. Air

The radioactive content of particles in ambient air was determined by collecting and analyzing air filter samples. The sampling locations are shown in Figures 1.1 and 1.2. Argonne

uses continuously operating air samplers to collect samples for the measurement of concentrations of airborne particles contaminated by radionuclides. Currently, nonradiological air contaminants in ambient air are not monitored. Samples are collected at the site perimeter to determine whether a statistically significant difference exists between perimeter measurements and measurements taken from samples collected at various off-site locations. The off-site samples establish the local background concentrations of naturally occurring or ubiquitous man-made radionuclides, such as from nuclear weapons testing fallout. Higher levels of radioactivity in the air measured at the site perimeter may indicate radioactivity releases from Argonne, provided that the perimeter sample results are greater than the background sample results by an amount greater than the relative error of the measurement. The relative error is a result of natural variation in background concentrations as well as sampling and measurement error. This relative error is typically 5 to 20% of the measurement value for most of the analyses, but approaches 100% at values near the detection limit of the instrument.

The sensitivity of the measurements are not sufficient to measure routine radionuclide emissions from operations. These measurements are only intended for use during unintentional releases involving elevated activities. The potential radiation exposures by the inhalation pathway would be calculated by the methodology specified in DOE Order 458.1.[7] The total quantity for each radionuclide inhaled, in microcuries (μCi), is calculated by multiplying the annual average air concentrations by the general public breathing rate of 7,373 m^3/yr.[15] This annual intake is then multiplied by the CEDE conversion factor for the appropriate lung retention class.[5] The CEDE conversion factors are in units of rem/μCi; this calculation gives the 50-year CEDE. Table 4.16 lists the applicable CEDE factors. Doses calculated using this method are presented in Table 4.2 as an example. The values in Table 4.2 are not used to demonstrate compliance with DOE Order 458.1 as the sensitivity of the air activity measurements is not sufficient to differentiate site emissions from background. Determination of the potential dose from routine radionuclide emissions is discussed in Section 4.7.1.

Airborne particle samples for measurement of total alpha, total beta, and gamma-ray emitters are collected continuously at 11 perimeter locations and at 3 off-site locations on glass fiber filter media. The average flow rates for all samplers, which utilize 2-in. diameter filter media, are 2.55 m^3/hr (90 ft^3/hr). Argonne staff members change the filters on on-site samplers. Filters on off-site samplers are changed and mailed to Argonne by cooperating local agencies. The sampler airflow rates are recalibrated annually, and the units are serviced as needed. Each air filter sample is analyzed twice. The first time each individual sample is mounted in a 5-cm (2-in.) low-lip stainless-steel planchet and analyzed to determine alpha and beta activity. The individual samples from each week of the year are then composited together and analyzed for gamma-ray activity.

Table 4.1 summarizes the monthly total alpha and beta activities for the individual weekly air filter sample analyses. These measurements were made in low-background gas-flow proportional counters and the efficiencies used to convert count rates to activity were those measured for a 0.51-MeV beta and a 5.15-MeV alpha on filter paper. The results were obtained by measuring the samples at least four days after they were collected to avoid counting the natural activity due to short-lived radon decay products. This activity is normally present in air and disappears within four days by radioactive decay.

TABLE 4.1

Total Alpha and Beta Activities in Air-Filter Samples, 2024
(Concentrations in fCi/m^3)

			Alpha Activity			Beta Activity		
Month	Location	No. of Samples	Avg.	Min.	Max.	Avg.	Min.	Max.
January	Perimeter	39	0.82	< 0.10	2.24	21.16	9.95	39.42
	Off-Site	12	1.43	0.64	2.50	16.35	7.65	28.53
February	Perimeter	40	1.32	0.18	2.36	21.17	2.79	36.86
	Off-Site	11	1.74	0.78	3.38	17.29	11.34	27.81
March	Perimeter	44	1.00	< 0.10	1.58	17.27	4.77	28.76
	Off-Site	10	1.07	0.45	1.88	13.16	9.00	19.35
April	Perimeter	44	0.73	< 0.10	1.81	12.64	3.71	23.58
	Off-Site	10	1.37	0.63	1.94	13.62	8.60	22.37
May	Perimeter	54	0.72	0.07	2.22	10.30	3.13	23.94
	Off-Site	10	1.91	0.51	5.04	16.38	9.09	43.38
June	Perimeter	43	0.62	< 0.10	1.67	14.71	3.41	28.53
	Off-Site	8	1.39	0.79	2.39	14.13	9.86	16.88
July	Perimeter	55	0.88	0.13	2.39	13.73	2.93	28.35
	Off-Site	11	1.17	< 0.10	2.48	11.50	< 0.10	18.09
August	Perimeter	43	1.25	< 0.10	2.70	19.15	3.36	41.85
	Off-Site	11	1.41	< 0.10	3.04	13.56	0.10	25.11
September	Perimeter	44	1.35	0.06	3.72	24.01	2.41	61.20
	Off-Site	10	2.57	1.18	5.81	23.18	15.84	35.78
October	Perimeter	55	1.24	< 0.10	2.84	26.94	< 0.10	56.70
	Off-Site	12	1.91	0.23	3.83	18.69	3.50	31.05
November	Perimeter	42	1.05	0.24	2.45	22.99	9.32	35.10
	Off-Site	9	1.63	1.22	1.88	21.4	13.14	30.33
December	Perimeter	33	1.73	0.46	3.52	34.49	22.46	46.35
	Off-Site	11	3.48	1.58	5.13	27.74	19.71	37.44
Annual Summary	Perimeter	536	1.04 ± 0.3	< 0.10	3.72	19.40 ± 0.9	< 0.10	61.20
	Off-Site	125	1.77 ± 0.4	< 0.10	5.81	17.30 ± 0.8	< 0.10	43.38

The average concentrations of gamma-ray emitters, as determined by gamma-ray spectrometry performed on weekly composite samples, are given in Table 4.2. The gamma-ray detector is a shielded high purity germanium detector calibrated for each gamma-ray-emitting nuclide measured.

TABLE 4.2

Gamma-Ray Activity in Air-Filter Samples, 2024
(Concentrations in fCi/m^3)

Month	Location	Beryllium-7	Lead-210
January	Perimeter	46	20
	Off-Site	46	16
February	Perimeter	89	19
	Off-Site	68	16
March	Perimeter	93	13
	Off-Site	77	11
April	Perimeter	88	9
	Off-Site	101	11
May	Perimeter	82	20
	Off-Site	134	10
June	Perimeter	93	9
	Off-Site	102	12
July	Perimeter	92	10
	Off-Site	84	10
August	Perimeter	96	15
	Off-Site	77	14
September	Perimeter	99	19
	Off-Site	100	21
October	Perimeter	95	20
	Off-Site	83	18
November	Perimeter	46	18
	Off-Site	48	17
December	Perimeter	40	26
	Off-Site	51	20
Annual	Perimeter	81	17
Summary	Off-Site	81	15
Dose(mrem)	Perimeter	(0.00009)	(0.50)
	Off-Site	(0.00009)	(0.44)

The gamma-ray emitters listed in Table 4.2 are those that have been present in the air during past years and are of natural origin. The beryllium-7 concentration usually increases in the spring, which indicates its stratospheric origin. The concentration of lead-210 in the air is due to the radioactive decay of gaseous radon-222 and is similar to the concentration in past years.

The annual average off-site alpha and beta activities since 2000 are displayed in Figure 4.1. Alpha and beta activities have been consistent over this time period. Figure 4.2 presents the annual average off-site concentrations of the two major gamma-ray-emitting radionuclides in air. The changes in the beryllium-7 air concentrations have been observed worldwide by the DOE Environmental Measurements Laboratory's Surface Air Sampling Program and are attributed to changes in solar activity.[28]

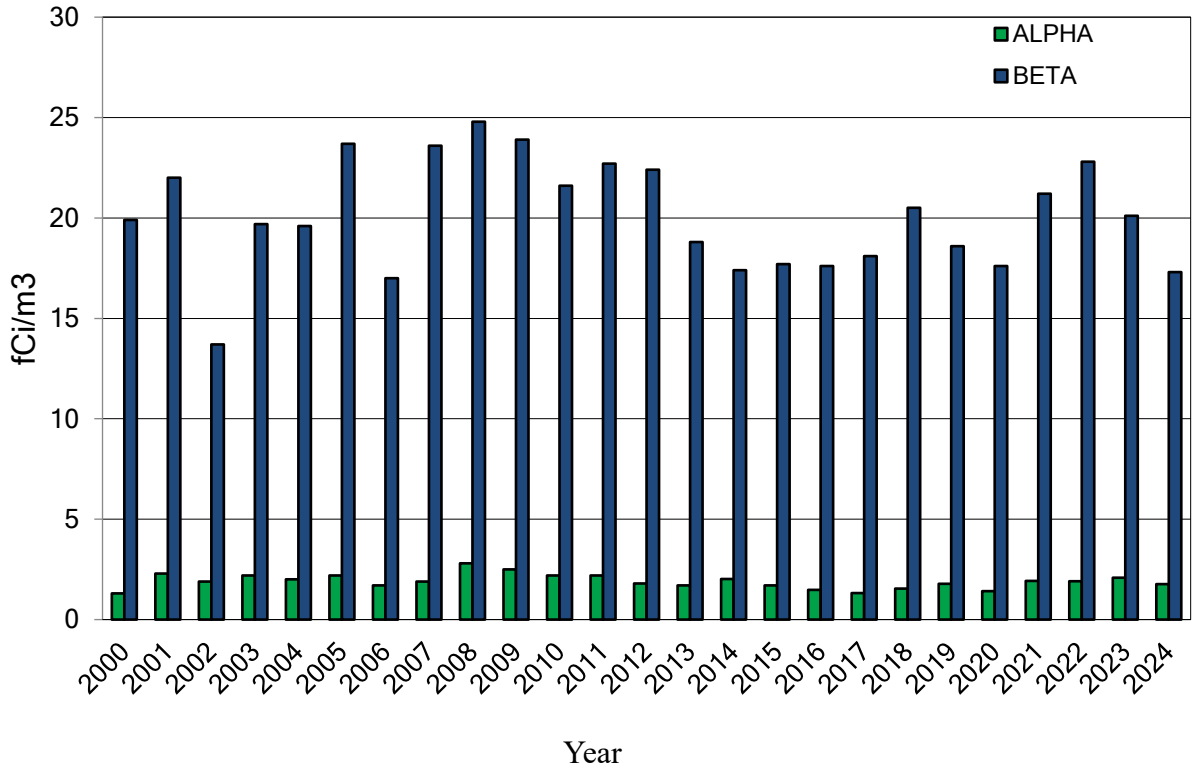


FIGURE 4.1 Comparison of Total Alpha and Beta Activities in Air Filter Samples, 2000 to 2024

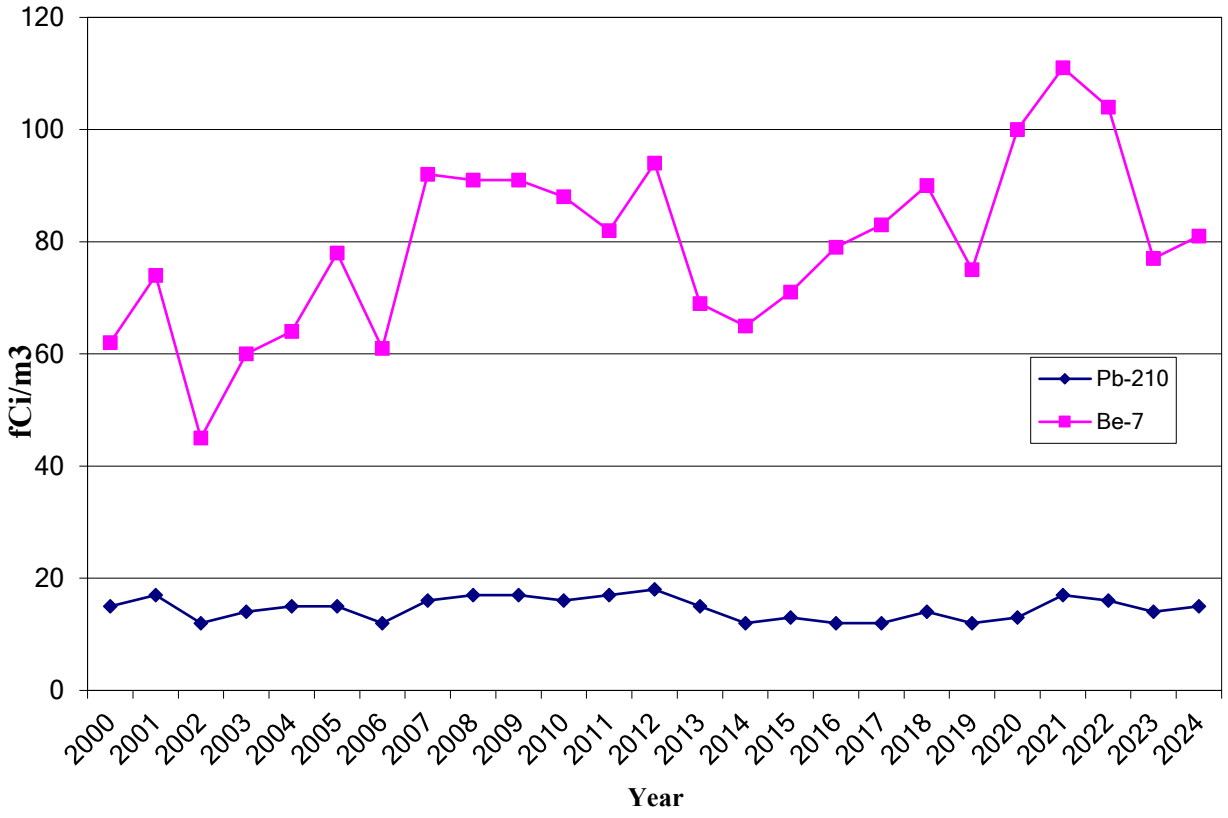


FIGURE 4.2 Comparison of Gamma-Ray Activity in Air Filter Samples, 2000 to 2024

The major airborne effluents released at Argonne during 2024 are listed by radionuclide and facility in Table 4.3. The principal facilities at Argonne that emit radionuclides are a major hot-cell facility undergoing deactivation and previously devoted to the handling of nuclear fuel (Alpha Gamma Hot Cell Facility [AGHCF]) located in Building 212, a high-charge linac used for high-energy gain dielectric and metallic structure wakefield accelerator R&D (Argonne Wakefield Accelerator [AWA]) located in Building 366, a major synchrotron radiation source (Advanced Photo Source [APS]), and a linear accelerator (Linac) located in Building 211. Other sources of emission include the waste handling operation in Building 306, fission product gases in Building 203, chemical and metallurgical laboratories at various locations, e.g., Building 212 and the Building 242 Materials Design Laboratory (MDL), and hot cells capable of handling multicurie quantities of the actinides and other radionuclides, e.g., in Buildings 200 and 205. Estimates of airborne radionuclides from the Argonne site are determined by summing two types of information (calculated emissions and inventory of radionuclides). The results of these estimates are used to estimate the annual off-site dose using the required EPA CAP-88 (Clean Air Act Assessment Package-1988)[29] atmospheric dispersion computer code and dose conversion method as discussed in Section 4.7.1.

TABLE 4.3

Summary of Airborne Radioactive Emissions from Argonne Facilities, 2024

Total Emissions by Radionuclide

Radionuclide	Halflife	Amount Released (Ci)	Amount Released (Bq)
H-3	12.3 yr	5.00E+01	1.85E+12
N-13	10 min	1.17E+01	4.32E+11
Cl-39	56 min	1.81E+00	6.68E+10
O-15	122 s	1.29E+00	4.79E+10
C-11	20 min	2.32E-01	8.59E+09
Tc-99m	6 hrs	1.87E-02	6.92E+08
Mo-99	65.9 hrs	1.87E-02	6.92E+08
Xe-138	14 min	5.71E-03	2.11E+08
C-14	5,730 yr	5.00E-03	1.85E+08
Ar-41	109 min	1.01E-03	3.74E+07
Cl-38	37 min	4.86E-04	1.80E+07
Cs-137	30.2 years	3.56E-04	1.32E+07
N-16	7 s	2.30E-04	8.51E+06
Pu-241	14.3 year	2.29E-04	8.49E+06
Sr-90	28.9 year	1.89E-04	7.01E+06
Cm-244	18.1 year	7.68E-05	2.84E+06
Y-95	10.3 min	5.73E-05	2.12E+06
Y-94	18.7 min	5.53E-05	2.05E+06
S-37	5.05 min	5.42E-05	2.01E+06
Rb-89	15.2 min	4.40E-05	1.63E+06
Pu-238	87.7 years	3.52E-05	1.30E+06
Sr-92	2.7 hrs	2.99E-05	1.10E+06
Kr-87	76.3 min	2.12E-05	7.84E+05
Kr-88	2.8 hrs	2.02E-05	7.47E+05
Other	---	2.30E-04	8.51E+06
	Total	6.51E+01	2.41E+12

Total Emissions by Emission Source

Emission Source	Amount Released (Ci)	Amount Released (Bq)
Building 412 (APS)	1.28E+01	4.74E+11
Building 200	2.47E-07	9.14E+03
Building 203	5.00E+01	1.85E+12
Building 203 (CARIBU)	1.07E-02	3.96E+08
Building 205	3.38E-06	1.25E+05
Building 205 K-Wing	1.09E-05	4.02E+05
Building 211	4.63E-04	1.71E+07
Building 211 (D-024)	3.70E-02	1.37E+09
Building 211 (LINAC)	2.20E+00	8.15E+10
Building 212	2.63E-07	9.72E+03
Building 212 (AGHCF)	8.98E-04	3.32E+07
Building 242 (MDL)	1.83E-07	6.78E+03
Building 306	2.72E-06	1.00E+05
Building 315	4.32E-06	1.60E+05
Building 366 (AWA)	8.05E-03	2.98E+08
Building 367	1.83E-10	6.76E+00
Total	6.51E+01	2.41E+12

Phytoremediation is being performed in the 317/319 Area to complete the cleanup of the groundwater in the area, which was contaminated in the past by the disposal of liquid wastes to the soil in French drains. The system consists of shallow-rooted willow and special deep-rooted poplar trees. Approximately 800 poplar trees were planted in the fall of 1999. Most of the trees have reached their natural lifespan. In 2016, discussions with IEPA resulted in the decision to allow the trees to die off naturally without replacement. One of the groundwater contaminants in the 317/319 Area is hydrogen-3, as tritiated water. The phytoremediation process translocates hydrogen-3 from groundwater to the air as water vapor. Since the hydrogen-3 is released over an area of approximately 2 ha (5.5 acres), traditional point source monitoring for airborne hydrogen-3 water vapor is of little value to determine the quantity of hydrogen-3 released to the air. The annual inventory of hydrogen-3 released to the air can be estimated from the hydrogen-3 content of the groundwater and the extraction rate at which various aged trees remove groundwater. On the basis of the age and type of tree, estimates are available on the average evapotranspiration rate of groundwater per tree per month of the growing season. For this estimate, it is assumed that all the groundwater that is extracted is transpired.

Quarterly monitoring is conducted at the 13 wells that are within the phytoremediation plantation. The average hydrogen-3 concentration for 2024 for all the wells was 111 pCi/L. The estimated annual amount of hydrogen-3 released is then the product of the annual volume of water released for 800 trees multiplied by the hydrogen-3 concentration in the groundwater. The estimated total hydrogen-3 released was approximately 0.002 Ci. Applying the CAP-88 code, an estimate of the annual dose to the maximally exposed individual was approximately 0.00000002 mrem. This estimated dose is extremely small compared with the 10-mrem annual dose limit of NESHAP.

4.3. Surface Water

All water samples collected in the radiological monitoring program were filtered immediately after collection and acidified with concentrated nitric acid, except for the hydrogen-3 samples. Total nonvolatile alpha and beta activities were determined by counting the residue remaining after evaporation of the water and then applying weight-dependent counting efficiency corrections determined for plutonium-239 (for alpha activity) and cesium-137 (for beta activity) to obtain disintegration rates. Hydrogen-3 was measured from a separate aliquot. This activity does not appear in the results for total nonvolatile beta activity. Analyses for the radionuclides were performed by specific radiochemical separations followed by appropriate counting. One-liter aliquots were used for all analyses except for hydrogen-3 and the transuranium nuclides. Hydrogen-3 analyses were performed by liquid scintillation counting of 9 mL (0.3 oz) of a distilled sample in a nonhazardous cocktail. Analyses for transuranium nuclides were performed on 10-L (3-gal) samples with chemical separation methods followed by alpha spectrometry. Plutonium-236 was used to determine the yields of plutonium and neptunium, which were separated from the sample together. A group separation of a fraction containing the transplutonium elements was monitored for recovery with an americium-243 tracer. Isotopic uranium concentrations were determined by alpha spectrometry by using uranium-232 as an isotopic tracer.

Wastewater from buildings or facilities that use or process radioactive materials is collected in retention tanks. When a tank is full, it is sampled and analyzed for alpha and beta

radioactivity. If the radioactivity exceeds the release limits, the tank is processed as radioactive waste. The release limits are based on the DCSs for plutonium-239 (0.40 pCi/mL) for alpha activity and for strontium-90 (1.7 pCi/mL) for beta activity. These radionuclides were selected because of their conservative allowable limits in the environment. If the radioactivity is below the release limits, the wastewater is conveyed to the LWTP in dedicated pipes. Based on analytical results, no retention tanks were required to be treated as radioactive waste. The effluent monitoring program documents that no liquid releases above the DCSs have occurred and reinforces demonstration of compliance with the use of the best available technology (BAT) as required by DOE Order 458.1.[7]

Another component of the radiological effluent monitoring program is the radiological analysis of the main wastewater treatment plant discharge (Outfall 001). Metals have also been analyzed at this location for many years. The same radiological constituents that are determined in Sawmill Creek are also analyzed at this location. Samples are collected daily and then equal daily portions are combined to produce a weekly composite that is analyzed to obtain an average weekly concentration. Table 4.4 gives the radiological results for 2024. Historical analysis of the Argonne domestic water, which is obtained from Lake Michigan, indicated the presence of strontium-90 at about 0.3 pCi/L, thus the strontium-90 found in these samples appears to be present in the domestic water and was not introduced by Argonne. In any case, the radionuclide concentrations are well below the DOE limits. These findings confirmed Argonne compliance with DOE Order 458.1 for use of BAT for releases of liquid effluents. The total annual quantity of each radionuclide released to the environment was estimated by taking the product of the monthly average concentration for each radionuclide and the monthly volume of water discharged. These results are given in Table 4.5. In previous reports the values given in Table 4.5 were based on annual average concentrations and discharge volumes.

TABLE 4.4

Radionuclides in Effluents from the Argonne Wastewater Treatment Plant, 2024

		Concentrations in pCi/L			Dose (mrem)		
Activity	No. of Sample	Avg.	Min.	Max.	Avg.	Min.	Max.
Alpha	52	1.19	< 0.1	2.81	-[a]	-	-
Beta	52	18.83	9.50	29.61	-	-	-
Hydrogen-3	52	< 100	< 100	< 100	< 0.0116	< 0.0116	<0.0116
Strontium-90	52	< 0.25	< 0.25	0.32	< 0.017	< 0.017	0.022
Cesium-137	52	< 2.0	< 2.0	< 2.0	< 0.058	< 0.058	< 0.058
Uranium-234	52	0.45	0.15	0.88	0.0427	0.0141	0.0848
Uranium-238	52	0.40	0.14	0.79	0.0336	0.0118	0.0667
Neptunium-237	52	< 0.0010	< 0.0010	< 0.0010	< 0.00009	< 0.00009	< 0.00009
Plutonium-238	52	< 0.0010	< 0.0010	0.0044	< 0.0003	< 0.0003	0.0012
Plutonium-239	52	< 0.0010	< 0.0010	0.0011	< 0.0003	< 0.0003	0.0003
Americium-241	52	< 0.0010	< 0.0010	0.0010	< 0.00016	< 0.00016	0.0002
Curium-242 and/or Californium-252	52	< 0.0010	< 0.0010	0.0011	< 0.00001	< 0.00001	0.00002
Curium-244 and/or Californium-249	52	< 0.0010	< 0.0010	< 0.0010	< 0.0001	< 0.0001	< 0.0001

[a] A hyphen indicates no Committed Effective Dose Equivalents (CEDEs) for alpha and beta.

Treated Argonne wastewater is discharged into Sawmill Creek (Location 7M in Figure 1.1). The creek runs through the Argonne grounds, drains surface water from much of the site, and flows into the Des Plaines River about 500 m (1,600 ft) downstream from the Argonne wastewater outfall. Sawmill Creek was sampled upstream from the Argonne site and downstream from the wastewater discharge point to determine whether radioactivity was added to the stream by Argonne wastewater or surface drainage. The sampling locations are shown in Figure 1.1. Samples were collected several times per day by an automatic sampler below the wastewater outfall. A composite sample was analyzed to obtain an average weekly concentration. Grab samples were collected upstream of the site monthly and analyzed for the same radionuclides measured in the below-outfall samples.

TABLE 4.5

Total Radioactivity Released to Surface Water, 2024

Radionuclide	WWTP Outfall (Ci)
Hydrogen-3	0.0322
Strontium-90	0.0002
Uranium-234	0.0004
Uranium-238	0.0004
Cesium-137	0.0002
Other transuranics	<0.0001
Total	0.0334

Table 4.6 gives the annual summaries of the results obtained for Sawmill Creek. Comparison of the results and 95% confidence intervals for the two sampling locations show that the only radionuclide found in the creek water that can be attributed to Argonne operations is strontium-90, with possibly low levels of americium-241 and curium-242. The concentrations are similar to previous years' results. All annual averages were well below the applicable DOE Derived Concentration Standards (DCSs)[27].

On the basis of the results of an earlier stormwater characterization study, two perimeter surface water locations that contained measurable levels of radionuclides were identified. They were south of the 319 Area, Location 7J (317/#111), and south of the 800 Area Landfill, Location 11D (NPD/113). The sampling locations are shown in Figure 1.1. Samples were scheduled to be collected quarterly and analyzed for hydrogen-3, strontium-90, and gamma-ray emitters at Location 7J and hydrogen-3 at Location 11D. The results are presented in Table 4.7.

TABLE 4.6

Radionuclides in Sawmill Creek Water, 2024

Activity	Location[a]	No. of Samples	Concentrations (pCi/L) Avg.	Min.	Max.	Dose (mrem) Avg.	Min.	Max.
Alpha	16K	11	1.07	0.31	1.77	-[b]	-	-
(Nonvolatile)	7M	50	0.86	< 0.10	1.81	-	-	-
Beta	16K	11	4.14	2.89	5.45	-	-	-
(Nonvolatile)	7M	50	12.92	2.78	26.78	-	-	-
Hydrogen-3	16K	11	< 100	< 100	< 100	< 0.0116	< 0.0116	< 0.0116
	7M	50	< 100	< 100	149	< 0.0116	< 0.0116	< 0.0173
Strontium-90	16K	11	< 0.25	< 0.25	< 0.25	< 0.017	< 0.017	< 0.017
	7M	50	< 0.25	< 0.25	0.36	< 0.017	< 0.017	0.025
Cesium-137	16K	11	< 2.0	< 2.0	< 2.0	< 0.058	< 0.058	< 0.058
	7M	50	< 2.0	< 2.0	< 2.0	< 0.058	< 0.058	< 0.058
Uranium-234	16K	11	0.54	0.24	1.05	0.051	0.023	0.101
	7M	50	0.39	0.15	0.75	0.037	0.014	0.072
Uranium-238	16K	11	0.48	0.19	0.96	0.041	0.016	0.081
	7M	50	0.35	0.13	0.68	0.030	0.011	0.057
Neptunium-237	16K	11	< 0.0010	< 0.0010	< 0.0010	< 0.0001	< 0.0001	< 0.0001
	7M	50	< 0.0010	< 0.0010	< 0.0010	< 0.0001	< 0.0001	< 0.0001
Plutonium-238	16K	11	0.0012	< 0.0010	0.0040	0.0003	< 0.0003	0.0011
	7M	50	< 0.0010	< 0.0010	0.0031	< 0.0003	< 0.0003	0.0008
Plutonium-239	16K	11	< 0.0010	< 0.0010	< 0.0010	< 0.0003	< 0.0003	< 0.0003
	7M	50	< 0.0010	< 0.0010	0.0010	< 0.0003	< 0.0003	0.0003
Americium-241	16K	11	< 0.0010	< 0.0010	< 0.0010	< 0.0002	< 0.0002	< 0.0002
	7M	50	< 0.0010	< 0.0010	0.0011	< 0.0002	< 0.0002	0.0002
Curium-242 and/or	16K	11	< 0.0010	< 0.0010	< 0.0010	< 0.00001	< 0.00001	< 0.00001
Californium-252	7M	50	< 0.0010	< 0.0010	0.0023	< 0.00001	< 0.00001	0.00003
Curium-244 and/or	16K	11	< 0.0010	< 0.0010	< 0.0010	< 0.0001	< 0.0001	< 0.0001
Californium-249	7M	50	< 0.0010	< 0.0010	< 0.0010	< 0.0001	< 0.0001	< 0.0001

[a] Location 16K is upstream from the Argonne site, and location 7M is downstream from the Argonne wastewater outfall.

[b] A hyphen indicates no CEDEs for alpha and beta.

TABLE 4.7

Radionuclides in Stormwater Outfalls, 2024
(concentrations in pCi/L)

Date Collected	Location 7J			Location 11D
	Hydrogen-3	Strontium-90	Cesium-137	Hydrogen-3
January 26	< 100	0.20	0.27	< 100
April 1	< 100	0.28	0.77	< 100
July 10	< 100	0.30	0.13	Dry
4th Quarter	Dry	Dry	Dry	Dry

The source of the radionuclides at Location 7J appears to be past releases of leachate from the 319 Area Landfill. A subsurface barrier wall and leachate collection system were constructed south of the 319 Landfill in November 1995 and became operational in 1996. The final cap was installed in 1999. Since the construction and operation of the leachate collection system and cap, radionuclide concentrations in surface water at Location 7J have decreased substantially. These concentrations are well below their respective DOE Derived Concentration Standards (DCSs)[27]. Additionally, it would be extremely conservative to assume use of stormwater runoff as a sole source of drinking water.

One of the Argonne waste management locations is within the fenced 398A radioactive waste storage area (Location 8J in Figure 1.1). Surface water drainage from this area is collected in a small pond at the south (downhill) end of the 398A Area. To evaluate whether any radionuclides are being transported by stormwater flow through the 398A Area, quarterly sampling is conducted from the 398A Area pond and analyzed for hydrogen-3 and gamma-ray-emitting radionuclides. All hydrogen-3 results were at or below the detection limit of 100 pCi/L. Gamma-ray spectrometric analysis detected no radionuclides associated with Argonne activities above the detection limit of 2 pCi/L, other than a result of 2.6 pCi/L in the first quarter of 2024.

Because Sawmill Creek empties into the Des Plaines River, data about the radioactivity in this river is important in assessing the contribution of Argonne wastewater to environmental radioactivity. The Des Plaines River was sampled twice per month downstream and once per month upstream of the mouth of Sawmill Creek to determine whether the radioactivity in the creek had any effect on the radioactivity in the river. Table 4.8 gives the annual summaries of the results obtained for these two locations. The average nonvolatile alpha, beta, and radionuclide concentrations in the river were very similar to past averages and remained in the normal range. Average results were similar above and below the creek for all radionuclides, indicating that a measurable amount of radiation was not released.

TABLE 4.8

Radionuclides in Des Plaines River Water, 2024

Activity	Location[a]	No. of Samples	Concentrations (pCi/L) Avg.	Min.	Max.	Dose (mrem) Avg.	Min.	Max.
Alpha	A	11	0.65	0.15	1.24	-[b]	-	-
(Nonvolatile)	B	21	0.83	0.28	1.34	-	-	-
Beta	A	11	7.43	4.82	11.97	-	-	-
(Nonvolatile)	B	21	9.65	5.40	19.26	-	-	-
Hydrogen-3	A	11	< 100	< 100	< 100	< 0.0116	< 0.0116	< 0.0116
	B	21	< 100	< 100	< 100	< 0.0116	< 0.0116	< 0.0116
Strontium-90	A	11	< 0.25	< 0.25	< 0.25	< 0.017	< 0.017	< 0.017
	B	21	< 0.25	< 0.25	0.27	< 0.017	< 0.017	0.019
Uranium-234	A	11	0.35	0.12	0.58	0.033	0.011	0.056
	B	21	0.37	0.13	0.73	0.036	0.012	0.070
Uranium-238	A	11	0.31	0.09	0.49	0.026	0.007	0.041
	B	21	0.32	0.10	0.63	0.027	0.008	0.054
Neptunium-237	A	11	< 0.0010	< 0.0010	< 0.0010	< 0.0001	< 0.0001	< 0.0001
	B	11	< 0.0010	< 0.0010	0.0010	< 0.0001	< 0.0001	0.0001
Plutonium-238	A	11	< 0.0010	< 0.0010	0.0015	< 0.0003	< 0.0003	0.0004
	B	11	< 0.0010	< 0.0010	0.0018	< 0.0003	< 0.0003	0.0005
Plutonium-239	A	11	< 0.0010	< 0.0010	0.0011	< 0.0003	< 0.0003	0.0003
	B	11	< 0.0010	< 0.0010	0.0011	< 0.0003	< 0.0003	0.0003
Americium-241	A	11	< 0.0010	< 0.0010	< 0.0010	< 0.0002	< 0.0002	< 0.0002
	B	11	< 0.0010	< 0.0010	0.0031	< 0.0002	< 0.0002	0.0005
Curium-242 and/or	A	11	< 0.0010	< 0.0010	< 0.0010	< 0.00001	< 0.00001	< 0.00001
Californium-252	B	11	< 0.0010	< 0.0010	< 0.0010	< 0.00001	< 0.00001	< 0.00001
Curium-244 and/or	A	11	< 0.0010	< 0.0010	< 0.0010	< 0.0001	< 0.0001	< 0.0001
Californium-249	B	11	< 0.0010	< 0.0010	< 0.0010	< 0.0001	< 0.0001	< 0.0001

[a] Location A, near Willow Springs, is upstream; location B, near Lemont, is downstream from the mouth of Sawmill Creek. See Figure 1.2.

[b] A hyphen indicates no CEDEs for alpha and beta.

4.4. Bottom Sediment

The radioactive content of bottom sediment was measured in Sawmill Creek. A set of sediment samples was collected on September 25, 2024, from the Sawmill Creek bed, above the outfall point where Argonne discharges its treated wastewater (Location 7M in Figure 1.1), at the outfall, and at several locations below the outfall. In addition, a sediment sample was collected at location 16K, upgradient of the entire site. A grab sample technique was used to obtain bottom sediments. After the drying and grinding, the samples were analyzed by the methods described in prior reports[30] for air filter residues. The plutonium and americium were separated from the same 10-g (0.35-oz) aliquot of sediment. Results are given in terms of the oven-dried (110°C [230°F]) weight.

The results, as listed in Table 4.9, show that the concentrations in the samples collected above the outfall at Location 7M are similar to those of the off-site samples collected in past years.[30] The cesium, plutonium, and americium concentrations are elevated below the outfall, which indicates that their origin may have been past discharges of Argonne wastewater. Results from 2024 are, in general, comparable to those from historic sampling. Elevated concentrations of plutonium-238, plutonium-239, and americium-241 were found in sediment at Argonne's outfall at Location 7M. While these results are elevated compared to past results, they are still well below screening values given in DOE Technical Standard, A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota.[32]

4.5. External Penetrating Gamma Radiation

Levels of external penetrating gamma radiation at and near the Argonne site were measured with Optically Stimulated Luminescence (OSL) Dosimeters provided and read by a commercial vendor. Dosimeters were deployed at 145 locations across interior locations and along the site boundary. Readings were also taken at five off-site locations (Figure 1.2) for comparative purposes.

Prior to 2024, the ASER included data from 17 on-site dosimeters and 5 off-site dosimeters deployed by the Environmental Protection Program. Starting in 2024, results from dosimeters deployed by the Radiological Protection Division were also included to assess potential radiation dose to members of the public across the site. Differences in reported dose values compared to previous years are primarily attributed to the implementation of occupancy factors. These factors account for the fraction of time an area is occupied and are applied to applicable on-site dosimeters to calculate more realistic estimates of potential public exposure.

The results are summarized in Table 4.10 and 4.11, with the site boundary and on-site readings shown in Figure 4.3. Measurements were taken during the four successive exposure periods, and the results were calculated in terms of annual dose.

The off-site results averaged 11 mrem/yr. Prior to 2012, gross dose measurements had been reported, whereas net dose measurements began being reported in 2012. Therefore, reported historical results, prior to 2012, are higher. Some individual OSLs located at the Argonne site showed a measurable dose. However, the average dose to on-site individuals, whether indoors or outdoors, was lower than the off-site dose.

TABLE 4.9

Radionuclides in Bottom Sediment, 2024

	Concentration (pCi/g)					Concentration (fCi/g)		
Location	Potassium-40	Cesium-137	Radium-226	Thorium-228	Thorium-232	Plutonium-238	Plutonium-239	Americium-241
Sawmill Creek at 16K	19.67 ± 0.58	0.03 ± 0.01	1.51 ± 0.06	0.84 ± 0.03	0.68 ± 0.08	0.00 ± 0.35	1.80 ± 0.88	0.45 ± 0.35
Sawmill Creek 25 m above outfall	12.85 ± 0.49	0.03 ± 0.01	0.73 ± 0.05	0.60 ± 0.03	0.56 ± 0.07	0.23 ± 0.35	1.17 ± 0.71	0.77 ± 0.71
Sawmill Creek at outfall	9.00 ± 0.41	0.11 ± 0.02	0.88 ± 0.05	0.23 ± 0.02	0.60 ± 0.07	18.81 ± 3.35	633 ± 82.2	129.8 ± 17.55
Sawmill Creek 50 m below outfall	14.75 ± 0.65	0.01 ± 0.02	0.66 ± 0.07	0.80 ± 0.06	0.30 ± 0.13	0.05 ± 0.18	2.61 ± 1.15	0.95 ± 0.53
Sawmill Creek 100 m below outfall	17.27 ± 0.91	0.49 ± 0.04	0.85 ± 0.09	0.90 ± 0.05	0.69 ± 0.13	1.40 ± 0.79	152.8 ± 22.49	20.30 ± 3.18
Sawmill Creek at Des Plaines River	18.30 ± 0.53	0.10 ± 0.02	1.28 ± 0.05	0.75 ± 0.03	0.78 ± 0.07	0.14 ± 0.18	7.92 ± 1.85	2.30 ± 1.24

TABLE 4.10

Onsite Environmental Penetrating Radiation Monitoring Results Inside Buildings, 2024

Location	Number of Dosimeters	Average Dose (mrem)	Maximum Dose (mrem)
200	5	4	16
202	7	0	1
203	7	2	19
205	13	2	16
211	3	4	12
212	40	2	12
216	1	0	0
242	5	0	0
306	3	1	2
315	1	11	17
350	3	7	23
363	3	0	0
366	4	0	0
398	6	0	4

TABLE 4.11

Summarized Environmental Penetrating Radiation Monitoring Results, 2024

Location	Number of Dosimeters	Average Dose (mrem)	Maximum Dose (mrem)
Building Dosimeters (Indoor)	101	2	23
Onsite Outdoor (non-perimeter)	6	0	1
Perimeter	10	0	0
Off-site	5	11	15

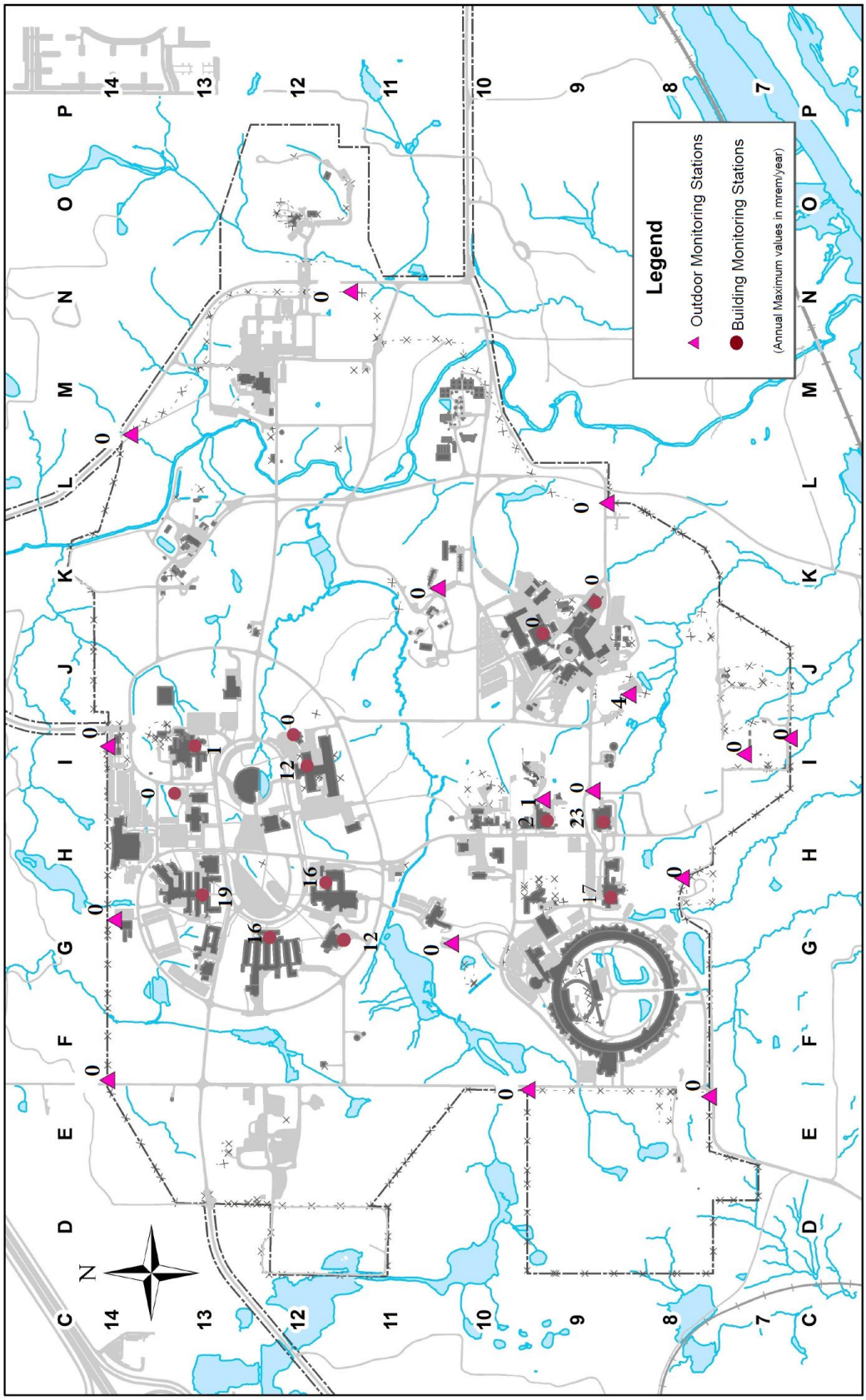


FIGURE 4.3 Penetrating Radiation Measurements at the Argonne Site, 2024

4.6. Compliance with DOE Orders 435.1 and 458.1, DOE Standard 6004-2016

DOE Order 435.1, "Radioactive Waste Management," requires that an environmental monitoring and surveillance program be conducted to determine any releases or migration from low-level radioactive waste treatment, storage, or disposal sites. Compliance with these requirements is an integral part of the Argonne site-wide monitoring and surveillance program. Waste management operations are monitored by the perimeter air monitoring network and monitoring of the liquid effluent streams and Sawmill Creek as discussed in previous sections.

During 2024, Argonne used the criterion from RS-TBD-005, Clearance of Potentially Activated Lead at the Advanced Photon Source, to release approximately 93 lead bricks for recycling or reuse. The TBD uses an indistinguishable from background (IFB) release criteria following the methodology outlined in the U.S. Department of Energy's Standard DOE-STD-6004-201631, Clearance and Release of Personal Property from Accelerator Facilities. All property that contained residual radioactivity, based on the criteria in DOE Order 458.1, "Radiation Protection of the Public and the Environment", was disposed of in an off-site low-level radioactive disposal facility.

Additionally in 2024, Argonne utilized the same IFB criterion, following guidance in HPP-3.0, Performing Radiological Surveys, HPP 3.2, Clearance of Materials with the Potential for Activation, RS-TBD-003, Clearance Protocol for Potentially Activated Material Technical Basis Document, and facility specific technical basis documents as applicable, to clear approximately 356,000 pounds of mixed metals, including iron, steel, and copper.

In January 2022 DOE-ASO approved Argonne's Clearance Protocol for Laboratory Wastewater Treatment Plant Filter Cake Technical Basis Document. The document was developed to ensure that laboratory wastewater treatment plant filter cake was evaluated for radioactivity and released in accordance with DOE Order 458.1. In the TBD, Argonne articulated an approach for releasing filter cake using the IFB approach outlined in DOE-STD-6004-2016, which implements the property release requirements in DOE Order 458.1. Background values for filter cake were developed in 2020-2021 through comprehensive radiological sampling program involving Argonne's process water sources and water treatment chemicals. A mass balance model was then developed to determine background radionuclide conditions of filter cake and to which analytical data for filter cake can be compared to.

Following DOE-ASO approval of the filter cake TBD, Argonne began reviewing analytical data for roll off boxes of filter cake accumulating on site during the TBD development, and for newly generated filter cake. In 2024, Argonne released 9 roll off boxes of filter cake, equaling about 135 cubic yards, as nonradiological special waste. Sample results for one roll off box (15 cubic yards) contained anomalously high gross beta concentrations, which could not be accounted for by the beta/gamma emitters that were also analyzed for. As such, this roll off box was managed as a low-level radioactive waste in accordance with the release criteria in the TBD.

4.7. Estimates of Potential Radiation Doses

Calculations were performed for three exposure pathways—airborne, water, and direct radiation from external sources. The biota dose was also assessed.

4.7.1 Airborne Pathway

DOE facilities with airborne releases of radioactive materials are subject to 40 CFR Part 61, Subpart H,[8] which requires the use of the EPA's CAP-88 code to calculate the dose for radionuclides released to the air and to demonstrate compliance with the regulation. The dose limit applicable for 2024 for the air pathway is a 10-mrem/yr effective dose equivalent. The CAP-88 computer code uses a modified Gaussian plume equation to estimate both horizontal and vertical dispersion of radionuclides released to the air from stacks or area sources. For 2024, doses were calculated for various radionuclides. A summary of the radionuclides and annual releases are listed in Table 4.3. Separate calculations were performed for each release point. Doses were calculated for an area extending out to 80 km (50 mi) from Argonne. The population distribution of the 16 compass segments and 10 distance increments given in Table 1.1 was used. The dose rate was calculated at the midpoint of each interval and integrated over the entire area to give the annual population cumulative dose.

Distances from the specific facilities that exhaust radiological airborne emissions (Table 4.3) to the fence line (perimeter) and nearest resident were determined in the 16 compass segments. These values were used to calculate the perimeter and resident doses for each facility. Individual dose contributions from each facility were summed to establish the dose at the perimeter and to the nearest resident in the aforementioned 16 compass segments. Those results are given in Table 4.12. The maximum dose contributed from each facility to the perimeter and nearest resident are given in Table 4.13. The doses given in these tables are the committed whole body effective dose equivalents.

The doses from each of the CAP-88 dose assessments were combined based on the assumption that the former IPNS facility is the central point for the site. The 16 compass directions from the former IPNS facility were established for each perimeter and actual resident location. The individual building assessments were then overlaid on the IPNS grid, and the estimated dose was summed according to which values fell within the IPNS segments. This approach provides an estimated dose to an actual individual and is not just the sum of the maximum doses from the individual building runs. Calculations also were performed to evaluate the major airborne pathways (ingestion, inhalation, immersion, ground surface, internal, and external). A summary of the major airborne pathway dose for total airborne radionuclide emissions is given in Table 4.14.

TABLE 4.12

Summary of Individual Dose, 2024

Direction	Perimeter Dose (mrem/yr)	Nearest Resident Dose (mrem/yr)
N	1.23E-02	2.51E-03
NNW	6.16E-03	2.37E-03
NW	8.01E-03	2.17E-03
WNW	4.48E-03	2.08E-03
W	2.72E-03	1.22E-03
WSW	3.39E-03	1.52E-03
SW	7.24E-03	1.54E-03
SSW	4.86E-03	9.71E-04
S	2.19E-03	5.49E-04
SSE	6.51E-03	1.55E-03
SE	8.37E-03	1.52E-03
ESE	2.55E-03	1.06E-03
E	1.55E-03	8.46E-04
ENE	3.02E-03	9.34E-04
NE	5.45E-03	1.34E-03
NNE	1.06E-02	2.02E-03

TABLE 4.13

Emission Source Dose Summary

Emission Source	Distance to Perimeter in Meters (Direction)	Perimeter Dose (mrem)	Distance to Nearest Resident in Meters (Direction)	Resident Dose (mrem)
Building 412 (APS)	350 (SE)	6.47E-03	1200 (WSW)	6.87E-04
Building 200	500 (NNE)	1.79E-05	800 (N)	6.65E-06
Building 203	150 (N)	8.11E-03	650 (N)	1.09E-03
Building 203 (CARIBU)	150 (N)	7.97E-05	650 (N)	1.07E-05
Building 205	750 (SW)	2.91E-05	1150 (N)	1.11E-05
Building 205 K-Wing	750 (SW)	4.07E-05	1150 (N)	1.58E-05
Building 211	750 (SW)	5.38E-07	1150 (N)	2.11E-07
Building 211 (D-024)	750 (SW)	2.22E-05	1150 (N)	8.77E-06
Building 211 (LINAC)	750 (SW)	1.13E-03	1150 (N)	3.26E-04
Building 212	850 (NNE)	1.94E-07	1550 (NNE)	7.73E-08
Building 212 (AGHCF)	850 (NNE)	3.18E-03	1550 (NNE)	1.30E-03
Building 242 (MDL)	250 (NNE)	5.75E-06	650 (NNW)	2.14E-06
Building 306	450 (SSW)	4.77E-05	1400 (SE)	1.02E-05
Building 315	350 (SSE)	4.14E-06	1250 (SSE)	1.97E-06
Building 366 (AWA)	350 (ESE)	4.26E-06	1050 (SE)	6.57E-07
Building 367	350 (ESE)	1.50E-09	1050 (SE)	3.00E-10

TABLE 4.14

Summary of Dose by Pathway for Nearest Residents

Pathway	Selected Individual (mrem)	Collective Population (Person-rem)
Ingestion	5.42E-05	1.52E-02
Inhalation	6.53E-04	1.54E-01
Air Immersion	3.05E-04	1.34E-02
Ground Surface	1.65E-04	5.09E-02
Internal	7.07E-04	1.69E-01
External	4.70E-04	6.43E-02
Total	1.18E-03	2.34E-01

Note: Doses in this table are derived by modeling all Argonne emissions as a single emission point at the center of the site.

The highest perimeter dose was in the north direction, with a maximum value of 0.012 mrem/yr (Location 14G in Figure 1.1). A majority of this dose can be attributed to laboratory work in Building 203 and waste operations in the Building 212 AGHCF. The full-time resident who would receive the largest annual dose (0.0025 mrem/yr), if they were outdoors during the entire year, is located approximately 650 m (0.4 mi) north of Building 203. The major contributor to the dose is the bone surface dose from curium-244 (0.0012 mrem/yr).

It should be noted that Argonne operates a lodging facility (Argonne Guest House) approximately 500m north of the APS. This facility houses visiting researchers while they conduct work at Argonne. For an individual living at the facility year-round, a potential effective dose equivalent of 0.0079 mrem/yr was calculated using the same methods as detailed above. The maximum stay at the facility is estimated at no more than 6 months. However, the methods used to model the effective dose assume the individual resides at the facility year-round. Therefore, the potential effective dose equivalent of 0.0079 mrem/yr at the Argonne Guest House is highly conservative.

Figure 4.4 shows the individual dose to the maximally-exposed members of the public since 2011. Variation in dose is largely due to changes in the operating mode and time of Argonne accelerator facilities.

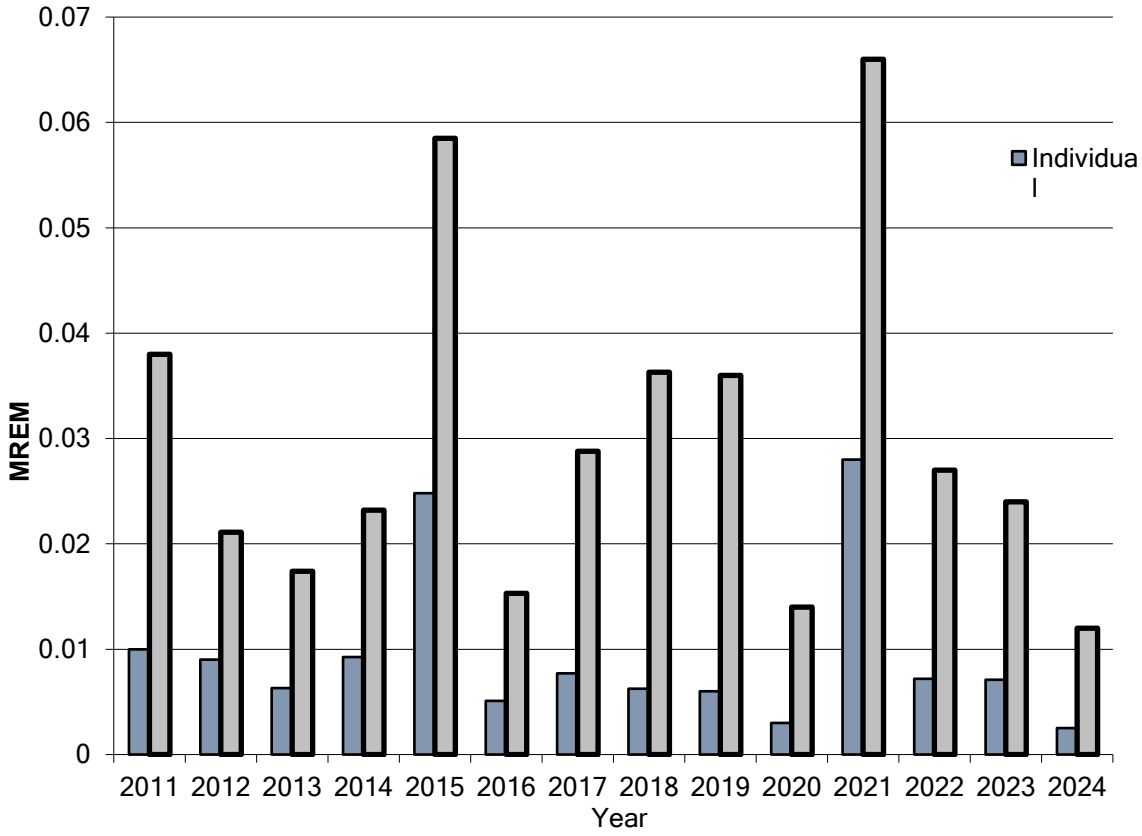


FIGURE 4.4 Individual and Perimeter Doses from Airborne Radioactive Emissions

The cumulative population dose from airborne radioactive effluents from Argonne operations are given in Table 4.15, along with the natural external radiation dose. The natural radiation dose listed is the product of the 80-km (50-mi) population and the natural radiation dose of 311 mrem/yr.[14] It is assumed that this dose is representative of the entire area within an 80-km (50-mi) radius. The population dose resulting from Argonne operations is shown in Figure 4.5.

TABLE 4.15

Population Dose within 80 km (50 mi), 2024

Radionuclide	Collective Population (Person-rem)
H-3	4.46E-02
N-13	5.28E-03
Cm-244	5.55E-02
Pu-238	4.50E-02
Ba-137m	4.32E-02
Cl-39	9.84E-03
Am-241	9.00E-03
Pu-241	5.81E-03
Y-90	4.52E-03
Pu-240	2.49E-03
Other Radionuclides	8.44E-03
Total	2.34E-01
Natural	2.90E+06

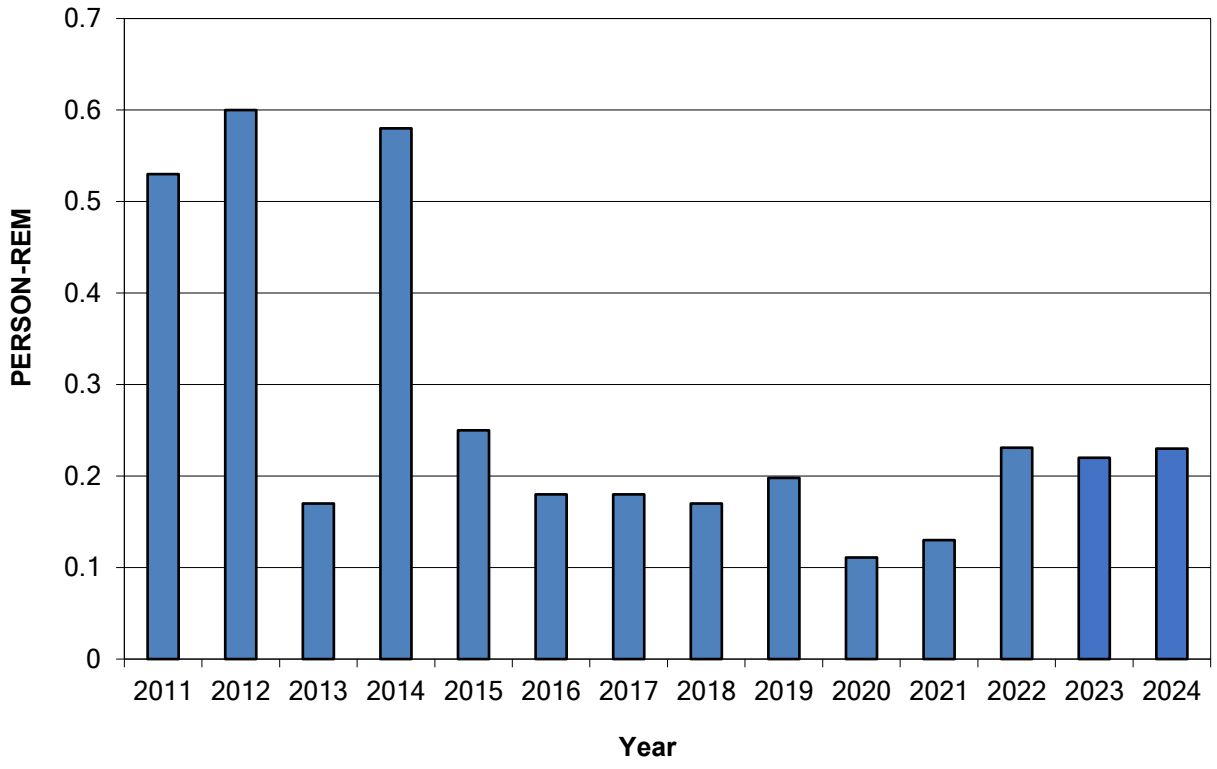


FIGURE 4.5 Population Dose from Airborne Radioactive Emissions

4.7.2. Water Pathway

Following the methodology outlined in DOE Order 458.1[7], the annual intake of radionuclides (in μCi) ingested with water is obtained by multiplying the concentration of radionuclides in microcuries per milliliter (μCi/mL) by the average annual water consumption of a member of the general public (5.8×10^5 mL)[15]. This annual intake is then multiplied by the CEDE conversion factor for ingestion (Table 4.16) to obtain the dose received in that year. This procedure was carried out for all detected radionuclides and the individual results were summed to obtain the total ingestion dose.

TABLE 4.16

50-Year Committed Effective Dose Equivalent Conversion Factors (rem/μCi)

Nuclide	Ingestion	Inhalation
Hydrogen-3	2.00E-04	--[a]
Beryllium-7	--	3.53E-04
Strontium-90	1.20E-01	--
Cesium-137	4.99E-02	--
Lead-210	--	6.22E+01
Radium-226	7.21E-01	--
Uranium-234	1.65E-01	--
Uranium-235	1.51E-01	--
Uranium-238	1.46E-01	--
Neptunium-237	1.47E-01	--
Plutonium-238	4.70E-01	--
Plutonium-239	5.11E-01	--
Americium-241	2.75E-01	--
Curium-242	2.55E-02	--
Curium-244	1.95E-01	--
Californium-249	2.37E-01	--
Californium-252	1.28E-01	--

[a] A dash indicates that a value is not required.

The only significant location where radionuclides attributable to Argonne operations could be found in off-site water was Sawmill Creek below the wastewater outfall (see Table 4.6). Although this water is not used for drinking purposes, the 50-year effective dose equivalent was calculated for a hypothetical individual ingesting water at the radionuclide concentrations measured at that location. The radionuclides added to Sawmill Creek by Argonne wastewater, their net average concentrations in the creek, and the corresponding dose rates (if water at these concentrations was used as the sole water supply by an individual for an entire year) are given in Table 4.17. The dose rates were all well below the standards for the general population. It should be emphasized that Sawmill Creek is not used for drinking, swimming, or boating. Inspection of the area shows that there are fish in the stream; however, they do not constitute a significant source of food for any individual. Figure 4.6 is a plot (2004-2024) showing the estimated dose that a hypothetical individual would receive if ingesting only Sawmill Creek water.

TABLE 4.17

Radionuclide Concentrations and Dose Estimates for Sawmill Creek Water, 2024

Nuclide	Total Released (Ci)	Net Avg. Conc. (pCi/L)	Dose (mrem)
Strontium-90	1.94E-04	7.07E-02	4.93E-03
Americium-241	2.05E-07	3.36E-05	5.37E-06
Curium-242	1.32E-07	1.37E-04	2.04E-06
Other isotopes	3.32E-02	--	--
Total	3.34E-02	--	4.94E-03

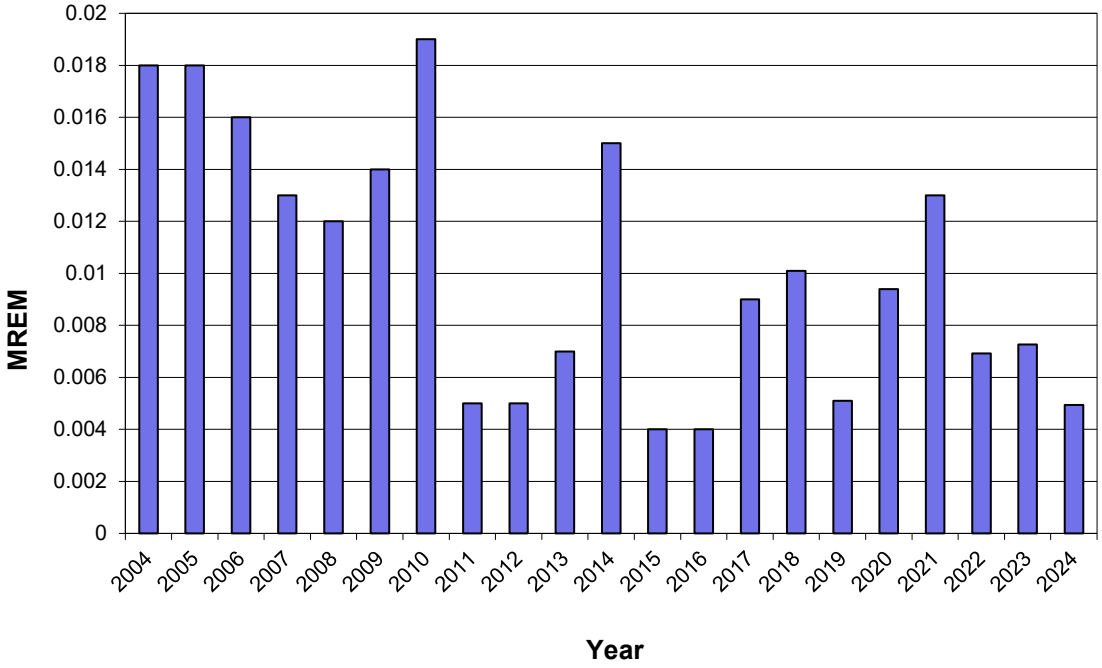


FIGURE 4.6 Comparison of Yearly Dose Estimates from Ingestion of Sawmill Creek Water, 2004–2024

As indicated in Table 4.6, occasional Sawmill Creek samples contained traces of hydrogen-3, strontium-90, cesium-137, uranium-234, uranium-238, neptunium-237, plutonium-238, plutonium-239, americium-241, curium-242, and/or curium-244; however, the averages (and, in many cases individual sample results) were generally below the detection limit. The annual dose to an individual consuming water at these concentrations can be calculated with the same method used for those radionuclides more commonly found in the creek water. This method of estimation, however, probably overestimates the true dose. Annual doses based on the difference between upstream and downstream samples range from 5×10^{-3} to 2×10^{-6} mrem/yr for these radionuclides.

Argonne wastewater was also evaluated against the DOE Derived Concentration Standards (DCSs)[27]. The average concentration for each radionuclide in Argonne wastewater was used as shown in Table 4.4. Summing the ratios of their respective DCSs for each radionuclide resulted in a ratio of 0.0008. This is well below a ratio of one and demonstrates compliance with the limit in DOE Order 458.1.

Sawmill Creek flows into the Des Plaines River. The flow rate of Sawmill Creek (see Section 1.8) is about 0.33 m^3/s (11.8 ft^3/s). The flow rate of the Des Plaines River in the vicinity of Argonne is about 28.2 m^3/s (995 ft^3/s). Applying this ratio to the concentration of radionuclides in Sawmill Creek, as listed in Table 4.17, the dose to a hypothetical individual ingesting water from the Des Plaines River at Lemont would be about 0.000058 mrem/yr. Significant additional dilution occurs farther downstream. Very few people, either directly or indirectly, use the Des Plaines River as a source of drinking water. If 100 people used Des Plaines River water at the hypothetical concentration at Lemont, the estimated population dose would be about 6×10^{-6} person-rem.

4.7.3. Biota Dose Assessment

DOE Order 458.1[7] requires an evaluation of the dose to aquatic organisms from liquid effluents. The dose limit is 1 rad/day, or 365 rad/yr. The location that could result in the highest dose to aquatic organisms is in Sawmill Creek downstream of the point where Argonne discharges its treated wastewater. Inspection of the creek at this location indicates the presence of small bluegill and carp. The aquatic dose assessment of species similar to these was conducted by using the DOE Technical Standard, A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota.[32] The assessment used the general screening approach which compares maximum water and sediment radionuclide concentrations to biota concentration guides (BCGs). Maximum water concentrations for radionuclides were obtained from Table 4.6, while maximum sediment concentrations for radionuclides were obtained from Table 4.9. Summing the ratios of their respective BCGs for each radionuclide resulted in a ratio of 0.04 to aquatic biota. This is well below a ratio of one and demonstrates compliance with the limit in DOE Order 458.1.

Additionally, RESRAD-BIOTA Version 1.8 was utilized to evaluate dose to aquatic organisms. A level 1 (screening) model was used with the same surface water and sediment concentrations as detailed above. A summed ratio of 0.04 was found, demonstrating compliance with the limit in DOE Oder 458.1.

4.7.4. External Direct Radiation Pathway

The OSL dosimeter measurements given in Section 4.5 were used to calculate the radiation dose from external sources. Average dose data in Table 4.11 were used to compare dose at the fence-line and on-site locations to off-site locations. No statistically significant dose was found at the Argonne fence-line or on-site locations accessible to the public due to direct radiation as compared to the off-site results.

4.7.5. Dose Summary

The total effective dose equivalent received by off-site residents during 2024 was a combination of the individual doses received through the separate pathways. Radionuclides that contributed through the air pathway are listed within Table 4.3. The highest dose from the air pathway was approximately 0.0025 mrem/yr to individuals living north of the site. Radionuclides that contributed through the water pathway are listed in Table 4.6. The dose from the water pathway was approximately 0.0049 mrem/yr to individuals using Sawmill Creek, below Argonne's outfall, as their sole source of drinking water. No dose was attributed to direct radiation as Argonne fence-line and on-site readings accessible to the public were indistinguishable from background (i.e., off-site) readings. The dose pathways are presented in Table 4.18 and are compared with the applicable standards.

TABLE 4.18

Summary of the Estimated Dose to a Hypothetical Individual, 2024 (mrem/yr)

Pathway	Argonne Estimate	Applicable Standard
Air total	0.002	10 (EPA)
Water	0.0049	4 (EPA)[a]
Direct radiation	--	25 (NRC)[b]
Maximum dose	0.0074	100 (DOE)

[a] The 4-mrem/yr EPA value is not an applicable standard, since it applies to community water systems.[17] It is used here for illustrative purposes.

[b] NRC = U.S. Nuclear Regulatory Commission.

The total annual population dose to the entire area within an 80-km (50-mi) radius was 0.23 person-rem through the air pathway. The surface water contribution to population dose was 6×10^{-6} person-rem for individuals using the Des Plaines River as their sole source of drinking water. No population dose was attributed to direct radiation as Argonne fence-line readings were indistinguishable from background.

To receive the hypothetical maximum public dose, an individual would need to live at the point of maximum air and direct radiation exposure and use only water from Sawmill Creek, below the Argonne wastewater discharge. This is a very conservative and unlikely situation. To put the hypothetical maximum individual dose from all pathways of 0.0074 mrem/yr attributable to Argonne operations into perspective, comparisons can be made with annual average doses (624 mrem) from natural or accepted sources of radiation received by an average American who could be living anywhere in the United States. These values are listed in Table 4.19. These site-related doses are in addition to the background doses. The magnitude of the doses received from Argonne operations is insignificant compared to these sources. Therefore, the monitoring program results establish that the radioactive emissions from Argonne are very low and do not endanger the health or safety of those living in the vicinity of the site.

TABLE 4.19

Annual Average Dose Equivalent in the U.S. Population[a]

Source	Dose (mrem)
Natural	
Radon	228
Internal (^{40}K and ^{226}Ra)	29
Cosmic	33
Terrestrial	21
Medical	
Computed Topography	147
Nuclear Medicine	77
Interventional Fluoroscopy	43
Conventional Radiography & Fluoroscopy	33
Consumer	13
Building Materials	
Commercial Air Travel	
Cigarette Smoking	
Mining and Agricultural	
Combustion of Fossil Fuels	
Highway and Road Construction Materials	
Glass and Ceramics	
Industrial	0.3
Nuclear-power Generation	
DOE Installations	
Decommissioning and Radioactive Waste	
Industrial, Medical, Educational, and Research Activities	
Contact with Nuclear-medicine Patients	
Security Inspection Systems	
Occupational	0.5
Medical	
Aviation	
Commercial Nuclear Power	
Industrial and Commercial	
Education and Research	
Government, DOE, and Military	
Total	624

[a] National Council on Radiation Protection & Measurements (NCRP) report No. 160.[33]

5. ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION

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5.1. Introduction

Argonne's environmental monitoring program encompasses both radioactive and non-radiological sample collection and analysis. In addition to tracking the release of radioactive materials, Argonne conducts monitoring to detect the release of specific chemicals and changes in environmental conditions. The non-radiological monitoring program includes the assessment of point-source air discharges, as well as the collection and analysis of surface water and groundwater samples from various locations across the site. This chapter focuses on the monitoring of chemicals released into the air and surface water, while Argonne's groundwater monitoring program is detailed separately in Chapter 6.

5.2. Air Discharges

Argonne operations and research activities utilize numerous non-radioactive volatile chemicals, fuels, and combustion products. However, most of these materials are used in small quantities and the potential impact is negligible, should a release to the environment occur. Because of the nature and quantity of these air emissions, Argonne is not required to monitor the ambient air for chemical pollutants. Rather than monitoring, the amounts of chemicals discharged to the atmosphere are estimated each year. These estimates are shown in Table 2.2 in Chapter 2. The vast majority of air releases in 2024 were combustion products discharged from the on-site natural gas-fueled steam boilers.

Other significant air discharges include combustion products from several backup power generators, which operate periodically for maintenance reasons, and a transportation research facility that studies internal combustion engines. The pollutants discharged are similar to those released from the boiler house, however the pollutant quantities discharged are comparatively small.

Methane gas, generated by the decomposition of solid waste in the 800 Area Landfill, is one nonradioactive air pollutant that is monitored. The primary purpose of this monitoring is to determine if a potential safety concern exists due to combustible gas migrating into areas or structures around the landfill. Monitoring in 2024 indicated that the gas within the landfill waste mound contained up to 67% methane. However, methane was not detected above the 2.5% action level in any of the perimeter gas wells. While the quantity of gas generated by the landfill is not measured, it is thought to be very low, based on gas pressure and observations made during routine quarterly sampling and landfill inspections.

Small amounts of research-related volatile organic chemicals (VOCs) are released into the air when laboratory wastewater is treated in the laboratory wastewater treatment plant (LWTP). The amount of VOCs released to the air from the LWTP wastewater is calculated each month based on the analysis of a monthly sample of wastewater flowing into the plant. The total amount released to the air is discussed in Chapter 2. The individual results from analysis of the influent wastewater samples are shown in Table 5.1. The 2024 results are similar to those from recent years. Low concentrations of bromodichloromethane, bromoform, chloroform, and dibromochloromethane were found in the samples. These compounds are trihalomethane (THM)

organic chemicals that are produced when chlorine is added to the water supply during treatment. Some of these compounds remain in the wastewater and are detected in the influent samples. The drinking water limit for the sum of all of the THM compounds is 80 µg/L. The sum of the concentrations detected in Argonne's water, provided by the City of Chicago and purchased from the DuPage Water Commission, is below this limit.

TABLE 5.1

Laboratory Influent Wastewater, 2024
(concentrations in µg/L)

Compound	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Chlorination By-Products												
Bromodichloromethane	1	1	< 1[a]	< 1	0.5[b]	0.6	0.8	0.7	0.5	< 1	0.5	1
Bromoform	24	58	0.8	2	4	3	14	15	41	3	4	12
Chloroform	1	0.9	0.7	0.5	0.9	0.9	1	1	1	0.8	0.9	1
Dibromochloromethane	2	3	< 1	< 1	0.9	1	1	1	1	0.8	0.7	1
Laboratory Chemicals												
1,1 Dichloroethane	< 1	< 1	< 1	0.5	0.8	< 1	0.5	< 1	< 1	< 1	< 1	< 1
2-Propanol	55	154	74	37	25	18	56	91	46	392	93	36
Ethanol	-[c]	146	6	-	-	242	-	-	5	19	8	10

[a] A "less than" (<) sign indicates this compound was not found above analytical reporting limits. The number after the "<" sign is the reporting limit.

[b] Values less than 1.0 in this table are estimated since they are less than the reporting limit of 1 µg/L.

[c] A dash indicates the compound was not detected in the sample. Detection limits ranged from 1 to 5 µg/L. Reporting limits for this compound were not determined.

In addition to the THMs, 1,1 dichloroethane, 2-propanol, and ethanol were also measured in the monthly LWTP samples, with 2-propanol and ethanol being measured at higher concentrations. These values were similar to previous years' data in terms of number of detections and concentrations of analytes. The presence of these chemicals is likely the result of equipment cleaning. Since 1998, concentrations of chemicals in the wastewater have been consistently low, largely due to educational efforts to minimize the use and discharge of chemicals into the laboratory sinks.

5.3. Surface Water

Samples of wastewater discharged into on-site streams and Sawmill Creek are routinely collected and analyzed for a number of parameters. Most of the sampling performed is required by the site's NPDES wastewater discharge permit. Sampling frequency and analyses conducted are determined by permit-mandated monitoring requirements for each outfall. The results of the analyses are compared with the permit limits for each outfall to determine whether they comply with the permit. The results are transmitted monthly to the IEPA in a DMR.[34]

Besides the NPDES permit-required sampling, surface water is sampled at several locations near the site as part of the environmental surveillance program. The overall effect of Argonne site discharges on Sawmill Creek and the Des Plaines River is monitored by sampling downstream of the site and comparing the results with samples collected upstream of the site. The results from radiochemical analysis of these samples are discussed in Chapter 4.

5.3.1. Treated Wastewater Discharges

Wastewater from Argonne is treated in two on-site wastewater treatment facilities before it is discharged to Sawmill Creek. Sanitary wastewater is generated at Argonne by the cafeteria, sanitary facilities, and custodial operations. Wastewater from these activities is conveyed to the sanitary wastewater treatment plant (SWTP) through dedicated sanitary sewers. A separate laboratory wastewater system collects wastewater generated in laboratories, other research operations, and the 317/319 groundwater extraction system. This wastewater is treated in the LWTP. Section 2.2 contains a description of the wastewater treatment facilities. In addition wastewater in several areas which does not require treatment prior to discharge (i.e., steam condensate, non-contact cooling water, and air compressor condensate), is discharged directly into storm drains.

The treated wastewater from the SWTP is known as Outfall A01. The treated wastewater from the LWTP is Outfall B01. These outfalls are internal monitoring points; their flows combine before they discharge into Sawmill Creek. The combined discharge is known as Outfall 001, which is also located at the WWTP. The combined wastewater flows through an outfall pipe that discharges into Sawmill Creek approximately 1,100 m (3,500 ft) south of the WWTP, at the southeastern location designated as “Sawmill Creek Sampling Location” in Figure 1.1. This location is known as 7M and is in Building 518.

The Argonne NPDES permit requires monitoring of the direct discharge outfalls. These outfalls also contain stormwater after a rain event. However, the permit limits and monitoring requirements apply only to the process wastewater discharges; therefore, the outfalls associated with those discharges are not sampled during periods when stormwater is also flowing, when no flow is visible, or when an outfall is completely frozen.

Four stormwater-only outfalls convey stormwater from potentially contaminated areas in the 800 Area and the 317/319 Area. For these outfalls, stormwater runoff is sampled after a rain event. If no runoff occurs during the sampling period, no samples are collected. Sixteen stormwater samples were collected in 2024 with radiological data displayed in Table 4.7 and nonradiological and monitor-only hydrogen 3 data displayed in Table 5.6.

5.3.2. Sample Collection and Analysis

Wastewater samples are collected from Argonne outfalls as specified by the current NPDES permit. Sample collection, preservation, holding times, and analytical methods utilized are consistent with those approved by the EPA. All samples are collected in specially cleaned and labeled sample bottles with appropriate preservatives added. Custody seals and

chain-of-custody sheets are used as needed. Samples are submitted to the appropriate testing laboratory for analysis. Testing is completed within the required holding time.

Samples are analyzed by using EPA-approved analytical methods found in 40 CFR Part 136, "Test Procedures for the Analysis of Pollutants under the Clean Water Act"[35], "Test Methods for Evaluating Solid Waste" (EPA-SW-846)[36], and Standard Methods.[37] Analyses are conducted by the Argonne Analytical Services laboratory, as well as by commercial laboratories. Field measurements, including pH, temperature, and dissolved oxygen, are performed by Argonne personnel.

5.3.3. Wastewater Treatment Facility Outfall Monitoring

Outfall A01. This outfall consists of treated sanitary wastewater from the SWTP. The monitoring requirements and the range of individual results from monitoring during 2024 are shown in Table 5.2. This table also lists the permit limits in effect during 2024 and the number of instances when these limits were exceeded. Two sets of limits are listed; one is a maximum limit for any single sample (daily maximum limit) and the other is for the average of all weekly samples collected during the month (30-day average limit). There were no exceedances during 2024.

TABLE 5.2

Outfall A01 Effluent Limits and Monitoring Results, 2024
(concentrations mg/L except where noted)

NPDES Permit Requirements			Monitoring Results	
Constituent	30-Day Average Limit	Daily Maximum Limit	Range	2024 Exceedances
Flow (MGD)[a]	NA[b]	NA	0.168–1.387 (0.342 Average)	NA
pH (pH units)	NA	6.0–9.0	7.05–7.81	0
BOD, 5 Day	10.0	20.0	<2[c]–6.0	0
TSS	12.0	24.0	<1.0–3.4	0

[a] MGD = Million Gallons per Day.

[b] NA indicates that there is no limit or value of the type shown.

[c] A concentration value shown with a "less than" (<) sign indicates that the constituent was not present above the detection limits of the analytical method. The value shown is the method detection limit.

Outfall B01. This outfall consists of treated wastewater from the LWTP. Table 5.3 lists monitoring requirements, effluent limits, and a summary of the 2024 monitoring results for this outfall. This outfall is subject to both concentration limits and mass discharge limits. A mass discharge limit is the maximum weight of material that can be discharged per day. The mass discharge amount is calculated by using the constituent concentration and the flow rate measured the day the sample was collected. There were four exceedances in 2024: one for TSS concentration, one for the monthly average TSS concentration, one for TSS mass loading (lb/day), and one for monthly average TSS mass loading (lb/day).

Outfall B01 is also monitored semiannually (June and December) for priority pollutants. Priority pollutants are 124 organic and inorganic constituents that the EPA has determined deserve special attention in monitoring programs as listed in Appendix A to 40 CFR Part 423 (note that IEPA does not require Argonne to analyze for dioxin or asbestos). The June sample is to be collected at the same time as the sample for aquatic toxicity testing at Outfall 001. Table 5.4 gives the results for those constituents found to be above the analytical detection limits during 2024. Both samples contained very low concentrations of one THM (Bromoform), which result from the chlorination of drinking water, and a trace amount of Arsenic, Cyanide (December only), Copper (June only), Nickel (June only), and Zinc (June only). The results for the other priority pollutants not shown in this table were less than their respective detection limits. In general, these results indicate that the treated wastewater is free of measurable amounts of toxic chemicals on the priority pollutant list.

Outfall 001. This outfall contains the combined wastewater effluent from both treatment plants. Composite and grab samples of the combined effluent are collected weekly or monthly, as required by the permit. Table 5.5 lists the monitoring requirements, the permit limits, and the range of values recorded during 2024. The number of permit limit exceedances during 2024 is also shown. There were six chloride exceedances, down from eight in 2023, at this outfall during 2024. The source of the chloride is road salt (sodium chloride) used on the roads in the winter that enters the sanitary sewer system after freeze-thaw cycles. There were three exceedances of the low-level mercury discrete limit that were reported on the appropriate DMR's; however, the rolling annual average limit of 0.000012 mg/L was not exceeded during 2024.

The permit requires annual biological toxicity testing of Outfall 001. This test was performed using a composite sample collected on June 4-5, 2024. Two types of organisms, water fleas (*Ceriodaphnia dubia*) and fathead minnows (*Pimephales promelas),* were introduced into samples consisting of various ratios of Argonne effluent and dilution water. Survival was measured over two to four days and mortality was reported as a function of effluent concentration. An off-site contract laboratory performed the analyses. This testing concluded that the concentration of wastewater that produces 50% mortality in the test population (i.e., the median lethal concentration [LC50]) was greater than 100%, meaning that even the undiluted effluent is not toxic to these species. All previous toxicity tests conducted since 2001 have concluded that the combined effluent is not toxic to these species.

TABLE 5.3

Outfall B01 Effluent Limits and Monitoring Results, 2024
(concentrations in mg/L except where noted)

	NPDES Permit Requirements		Monitoring Results	
Constituent	30-Day Average Limit	Daily Maximum Limit	Range	2024 Exceedances
Flow (MGD)	NA[a]	NA	0.109–0.864 (0.297 Average)	NA
pH (pH units)	NA	6.0–9.0	7.31–8.22	0
BOD, 5 Day concentration	10	20	<2–7.3[b]	0
BOD, 5 Day mass (lb/day)	41.9	83.7	<3.02–17.96[c]	0
TSS concentration	12	24	<1.0–80.0	2
TSS mass (lb/day)	50.2	100.5	<1.51–160.8[c]	2
Oil and grease concentration	15	30	<5	0
Oil and grease mass (lb/day)	62.8	125.6	7.4–25.4[c]	0
Iron	NA	NA	<0.5	NA
COD	NA	NA	<20–36[c]	NA
Priority pollutants	NA	NA	–[d]	NA

[a] NA = Not applicable; this indicates that there is no limit or value of the type shown.

[b] A concentration value shown with a "less than" (<) sign indicates that the constituent was not present above the detection limits of the analytical method. The value shown is the method detection limit.

[c] A calculated value shown with a "less than" (<) sign indicates that one or more values used in the calculation was not present above the detection limits of the analytical method. The value used in the calculation was the method detection limit.

[d] Priority Pollutant summary results are presented in Table 5.4.

TABLE 5.4

Outfall B01 Effluent Priority Pollutant Monitoring Results, 2024

Element or Compound[a]	June	December
Cyanide (Total) (mg/L)	< 0.005	0.0067
Arsenic (mg/L)	0.0016	0.0013
Copper (mg/L)	0.0094	< 0.025
Nickel (mg/L)	0.0052	<0.05
Zinc (mg/L)	0.02	< 0.02
Bromoform (µg/L)	2	< 1

[a] All 124 priority pollutants were analyzed. Only those found are shown in this table.

TABLE 5.5

Outfall 001 Monitoring Results and Effluent Limits, 2024
(concentrations in mg/L except where noted)

NPDES Permit Requirements		Monitoring Results	
Constituent	Limits	Range	2024 Exceedances
Flow (MGD)	NA[a]	0.340–2.161 (0.638 Average)	NA
pH (pH units)	6.0–9.0	7.53–8.05	0
Dissolved oxygen	March—July: Weekly Avg. Min.=6 Daily Min.=5.5 August—February: 30 Day Avg. Min.=5.5 Weekly Avg. Min.=4 Daily Min.=3.5	Monthly Avg.: 7.48–10.32 Weekly Avg.: 7.29–11.19	0
Ammonia nitrogen	March—May: 30 Day Avg.=1.6 Weekly Avg.=4.1 Daily Max.=9.1 June—August: 30 Day Avg.=1.6 Weekly Avg.=4.1 Daily Max.=14.7 September—October: 30 Day Avg.=1.6 Weekly Avg.=4.1 Daily Max.=9.1 November—February: 30 Day Avg.=4.8 Daily Max.=10.9	Monthly Avg.: <0.12–<0.30[b] Weekly Avg.: <0.10–1.03	0
Chloride	Daily Max.=500	200–750	6
Total Nitrogen	NA	5.0–17.0	NA
Phosphorus	NA	0.37–0.63	NA
Beta radioactivity (pCi/L)	NA	9.45–23.76	NA
Low-level mercury	Annual Avg. Max= 0.000012	Discrete Values Measured: 0.0000027–0.000029	0

[a] NA = Not applicable.

[b] A concentration value shown with a “less than” (<) sign indicates that the constituent was not present above the detection limits of the analytical method. The value shown is the method detection limit.

5.3.4. Direct Discharge Outfalls

In addition to the three outfalls at the wastewater treatment plant, five other outfalls were monitored in 2024. Four of the five outfalls discharge only stormwater. The sampling requirements and the 2024 monitoring results are summarized in Table 5.6. There was flow at all five outfalls in 2024 during at least one sampling period. Subsequently, samples were collected from each location.

There were no permit exceedances at the five monitored direct discharge outfalls in 2024. Prior to 2024, Outfall 006 required sample collection and analysis only when a certain piece of emergency back-up process equipment operated. This equipment discharged cooling water (potable water) into storm drains, necessitating monitoring. This unit has been replaced with an air-cooled emergency compressor and the discharge has been eliminated. As a result, sample collection is no longer required at this outfall when this equipment operates. The renewed NPDES permit, effective September 1, 2023, re-designated outfall 006 as a 'stormwater only' outfall following the elimination of the air compressor unit that discharged cooling water on an emergency basis. Monitoring of outfall 006 continued until September 2023. Under the new NPDES permit, monitoring is no longer required at Outfall 006, so no discussion of this outfall will be included after this year's report.

TABLE 5.6

Summary of Monitored Direct Discharge NPDES Outfalls, 2024

			Sample Results	
Outfall	Constituent	Permit Limit	Range	2024 Exceedances
D03	Flow (MGD)	NA[a]	0.001–0.029	NA
	pH	6–9	7.41–7.82	0
	Temperature (°C)	<2.8°C rise	6.5–25.1	0
021	Flow (MGD)	NA	<0.001–0.528	NA
	Hydrogen-3 (pCi/L)	Monitor only	<100	NA
	Iron (mg/L)	Monitor only	0.56–2.48	NA
	Priority pollutants	Monitor only	–[b]	NA
A22	Flow (MGD)	NA	0.002	NA
	Hydrogen-3 (pCi/L)	Monitor only	<100	NA
B22	Flow (MGD)	NA	<0.001–>0.181	NA
	Hydrogen-3 (pCi/L)	Monitor only	<100	NA
023	Flow (MGD)	NA	0.002–0.009	NA
	Hydrogen-3 (pCi/L)	Monitor only	<100	NA

[a] NA = Not applicable. The parameter is a monitor-only constituent and the limit exceedance is not applicable.

[b] A dash indicates that priority pollutant results are discussed in Section 5.3.4.

Stormwater at Outfall 021 is analyzed annually for priority pollutants. Because of ongoing remedial actions in the 317 and 319 Areas, the potential for release of toxic organic chemicals into stormwater runoff exists. The 2024 sample was collected on March 14, 2024. Only three out of the 124 compounds contained on the priority pollutant list were detected in this sample above analytical reporting limits. Lead was detected at 3.3 μg/L, Zinc was detected at 80 μg/L, and Arsenic at 1.6 μg/L. These results are similar to last year's, with the exception that cyanide was not detected in 2024. Lead and zinc were detected at low concentrations, whereas they were non-detects last year.

5.4. Surface Water Surveillance

To supplement the permit-required monitoring, other analyses are voluntarily conducted on samples collected from the combined treatment plant effluent (Outfall 001), and Sawmill Creek upstream and downstream of the site. These samples are analyzed for a number of parameters. The results of the radiological analyses are discussed in Chapter 4. The results of the inorganic analyses are presented in this chapter. The results for Outfall 001 and Sawmill Creek (7M) are compared with the IEPA's Water Quality Standards listed in IAC, Title 35, Subtitle C.[14] While Argonne is not required to meet these standards in the effluent or Sawmill Creek, they provide a useful standard against which the effluent and stream quality can be compared.

Combined treatment plant effluent. Composite samples were collected from Outfall 001 each week and analyzed for inorganic constituents. The results of the analysis are shown in Table 5.7. As shown in this table, the pH was within the acceptable range throughout the year. All 52 samples contained low, but detectable, levels of fluoride and several contained detectable levels of arsenic. None of the parameters exceeded the IEPA's General Effluent Limits as listed in IAC, Title 35, Subtitle C.[13]

Sawmill Creek (7M). To determine the impact that Argonne wastewaters have on Sawmill Creek, composite samples of the creek downstream of all Argonne discharge points were collected weekly and analyzed. Samples were not collected for two of the 52 weeks in 2024 due to access issues to the sampler and/or the creek being frozen. The results were compared with IEPA General Use Water Quality Standards found in 35 IAC, Subtitle C, Part 302.[14]

The results obtained for 2024 are shown in Table 5.8. The pH was in the appropriate range throughout the year. Low levels of detectable fluoride and arsenic were present in many of the samples. None of the results were higher than the General Use Water Quality Standards.

TABLE 5.7

Chemical Constituents in Effluents from the Argonne Wastewater Treatment Plant, 2024

Constituent	No. of Samples	Concentration (mg/L except pH) Average	Maximum	IEPA Limit
Arsenic	52	0.0015	0.0021	0.36[a]
Barium	52		<0.5[b]	5.0[c]
Beryllium	52		<0.003	–[d]
Cadmium	52		<0.0025	0.024[a]
Chromium	52		<0.05	1.15[a]
Cobalt	52		<0.25	–
Copper	52		<0.025	0.040[a]
Fluoride	52	0.962	2.31	16.3[a]
Iron	52		<0.5	1.0[c]
Lead	52		<0.09	0.20[a]
Manganese	52		<0.075	8.2[a]
Mercury	52		<0.0002	0.0022[a]
Nickel	52		<0.05	0.18[a]
Silver	52		<0.0025	0.005[c]
Thallium	52		< 0.002	–
Vanadium	52		<0.025	–
Zinc	52		<0.5	0.26[a]
pH	52	NA[e]	7.49–8.05[f]	6.5–9.0[g]

[a] Value is the acute standard for protection of aquatic organisms calculated from equations given in 35IAC302.208, using a hardness value of 246 mg/L.

[b] If all values were less than the detection limit for a constituent, only the detection limit is given.

[c] Value is the general surface water standard given in 35IAC302.208 g.

[d] A dash indicates that there is no effluent limit for this.

[e] NA = Not applicable. pH values are not averaged since they are log functions.

[f] The lowest and highest pH values are given.

[g] Value is the general surface water standard in 35IAC302.404.

TABLE 5.8

Chemical Constituents in Sawmill Creek, Location 7M[a], 2024

Constituent	No. of Samples	Concentration (mg/L except pH) Average	Maximum	IEPA Limit
Arsenic	50	0.0014	0.0021	0.36[b]
Barium	50		<0.5[c]	5.0[d]
Beryllium	50		<0.003	–[e]
Cadmium	50		<0.0025	0.024[b]
Chromium	50		<0.05	1.15[b]
Cobalt	50		<0.25	–
Copper	50		<0.025	0.040[b]
Fluoride	50	0.679	1.20	16.3[b]
Iron	50		<0.5	1.0[d]
Lead	50		<0.09	0.20[b]
Manganese	50		<0.075	8.2[b]
Mercury	50		<0.0002	0.0022[b]
Nickel	50		<0.05	0.18[b]
Silver	50		<0.0025	0.005[d]
Thallium	50		<0.002	–
Vanadium	50		<0.025	–
Zinc	50		<0.5	0.26[b]
pH	50	NA[f]	7.38–8.34[g]	6.5–9.0[h]

[a] Location 7M is downstream of the Argonne wastewater outfall.

[b] Value is the acute standard for protection of aquatic organisms calculated from equations given in 35IAC302.208, using a hardness value of 246 mg/L.

[c] If all values were less than the detection limit for a constituent, only the detection limit is given.

[d] Value is the general surface water standard given in 35IAC302.208 g.

[e] A dash indicates that there is no effluent limit for this.

[f] NA = Not applicable. pH values are not averaged since they are log functions.

[g] The lowest and highest pH values are given.

[h] Value is the general surface water standard in 35IAC302.404.

5.5. Additional Stormwater Monitoring

The Postclosure Care Plan[38] for the 800 Area Landfill requires the quarterly sampling of stormwater discharges from the landfill site. Stormwater flows from the landfill area through two outfalls, 023 and 114. These two outfalls are monitored for TDS, TSS, and pH. No limits are included in the plan. Two stormwater samples were collected from Outfall 023 on March 14 and May 9 during 2024 but no samples were collected from Outfall 114 due to the absence of flow during all of 2024. The 2024 results for Outfall 023 are shown in Table 5.9. Comparing these values to previous years' values suggests no indication of stormwater contamination from landfill operations.

TABLE 5.9

Monitoring Results for 800 Area Landfill Stormwater (Outfall 023), 2024

Date	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	pH
March 14	230	19	8.06
May 9	228	87	7.83

The Argonne Long-Term Stewardship (LTS) Program monitors stormwater downstream of the 317 Area and 319 Landfill to determine if any contaminants from the remediation area are being released into surface water. Because of the characteristics of the drainage area, flow is present only immediately after a major storm event. Three stormwater samples were collected during 2024. The results are summarized in Table 5.10. The January 26 results show 1,1,1 Trichloroethane at the detection limit of 1 ug/L. The April 3 results show Carbon Tetrachloride and Chloroform just above the detection limit of 1 ug/L. The hydrogen-3 results are all below the detection limit of 100 pCi/L. The compounds detected are also present in the soil and groundwater in these areas. The presence of these compounds in stormwater indicates that small amounts of these chemicals are migrating from the soil into rainwater runoff.

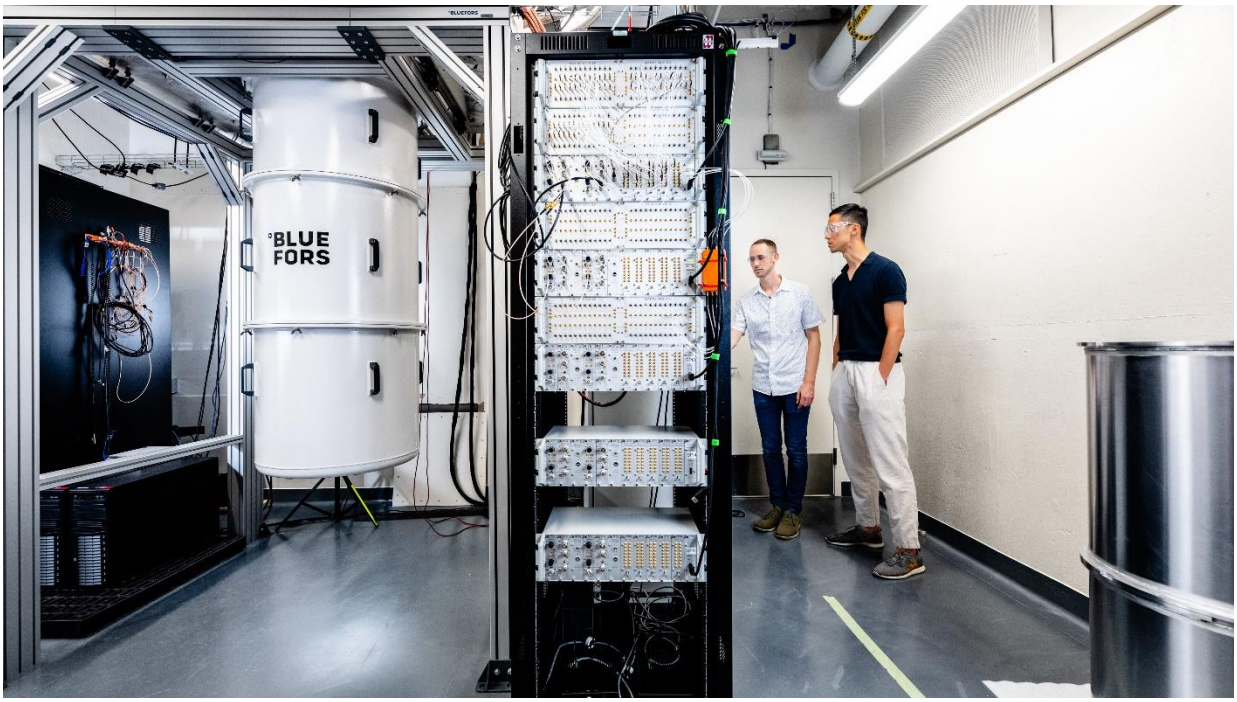
TABLE 5.10

Results for 319 Landfill Surface Water, 2024

Analyte	January 26	April 3	July 10
Organic Compounds (µg/L)			
1,1,1 Trichloroethane	1	<1	<1
Carbon Tetrachloride	<1 [a]	1	<1
Chloroform	<1	2	<1
Radionuclides (pCi/L)			
Hydrogen-3	<100	<100	<100

[a] Values in this table that are less than 1 µg/L are estimated values since they are less than the detection limit for the VOC analytical method used.

6. GROUNDWATER PROTECTION



6. GROUNDWATER PROTECTION

6.1. Groundwater Protection at Argonne

Groundwater at the Argonne site is found in two main aquifers, or water-saturated layers of porous soil, sand, and rock. Protecting the quality of this groundwater is a high priority for Argonne. The uppermost geologic materials beneath the site consist of glacial drift - a mixture of clay, silt, sand, and gravel. Although the glacial drift is primarily composed of fine-grained, low-permeability clay and silt, certain regions contain higher proportions of permeable sand and gravel saturated with groundwater. Some of these regions are interconnected, providing pathways for groundwater migration, while others are isolated with limited potential for water movement. Dolomite bedrock underlies the glacial drift throughout the site. The dolomite contains numerous cracks, fissures, and solution cavities that facilitate groundwater movement through the stone. The bedrock constitutes the uppermost aquifer used near Argonne as a source of drinking water for low-capacity wells. Several hundred feet below the dolomite is a layer of porous sandstone that contains the most commonly used aquifer in this region. The sandstone aquifer is isolated from groundwater in shallower units by a thick layer of shale. Argonne monitors the quality of groundwater in the glacial drift and in the dolomite. The sandstone aquifer is too deep to be affected by Argonne operations.

Regulatory standards intended to protect groundwater resources are contained in IEPA Groundwater Quality Standards (GQS), 35 IAC, Subtitle F, Part 620.[39] Argonne groundwater is considered Class I (potable resource groundwater) under these regulations. The IEPA's approach to determining remediation objectives for cleaning up contaminated groundwater is contained in the Tiered Approach to Corrective Action Objectives (TACO) regulations found at 35 IAC 742. The TACO Tier 1 groundwater standards are standards established for Class I groundwater. Most of these standards are identical to the Class I GQSs. In addition, DOE Order O 458.1 contains radiological groundwater protection requirements for DOE sites, including the need for a groundwater monitoring program. This chapter documents Argonne's compliance with these requirements. Both radiological analysis results and non-radiological analysis results are discussed in this chapter.

Groundwater quality is maintained and monitored through Argonne's environmental protection efforts. These efforts include the proper handling and disposal of chemical waste from Argonne's research and support operations, a prohibition on the disposal of chemicals into the laboratory sewer system, the reporting and rapid clean-up of any spills or releases of chemicals, and periodic inspection of outdoor storage areas. Groundwater beneath several closed waste disposal units is protected by the placement and maintenance of impermeable covers over the waste and monitored by routine monitoring of groundwater near the units. In the 317/319 Area, groundwater quality has been compromised due to the disposal of liquid wastes into a unit known as a French drain during the 1950s. To address the contamination of soil and groundwater in this area, several remedial technologies have been or are being employed, as detailed in Section 6.3.

Groundwater quality is monitored by collecting and analyzing samples from groundwater monitoring wells on and adjacent to the Argonne site. A critical element of this program involves permit-required groundwater monitoring at several former waste management units, including

the former 800 Area Landfill, the 317/319 Area remedial action site, and the former East-Northeast (ENE) Landfill. Argonne is also voluntarily conducting groundwater monitoring around the perimeter of the 317/319 Area and near the former Chicago Pile-Five (CP-5) reactor. Samples are also collected from an artesian well located in the Waterfall Glen Forest Preserve, south of the site.

Monitoring wells are sampled in accordance with EPA protocols described in the *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document*.[40] Prior to collecting samples, stagnant water is removed from the well. For those wells that recharge rapidly, at least three well volumes are purged by using dedicated submersible pumps or bailers. Shallow wells in the 800 Area and several near the ENE Landfill are sampled using a low-flow purging and sampling technique which minimizes disturbance of the groundwater, resulting in samples that are more representative of in situ groundwater. During well purging, field parameters (pH, specific conductivity, turbidity, oxidation-reduction potential, and temperature) are measured. Sampling is conducted after field parameters have stabilized. Some wells in the glacial drift recharge slowly; in this case the well is emptied completely and allowed to refill. After the well refills, samples are collected using a dedicated Teflon® bailer or pump. Samples for VOCs, Semi volatile Organic Compounds (SVOCs), PCBs, pesticides, metals, inorganics, and radionuclides are collected in that order. The samples are placed in precleaned bottles, labeled, and preserved in accordance with EPA guidance. Groundwater samples are analyzed for parameters that are determined by the various permits and objectives of the sampling program. Analyses are conducted using analytical methods approved by the EPA. Radiological analysis methods are based on methods developed by the DOE.

6.2. Groundwater Monitoring at Former Waste Management Areas

During the early years of operation at the present site, some wastes were disposed in a number of on-site disposal units. In the 1950s, pits and ditches were filled with construction and demolition debris. A sanitary landfill was later established for nonhazardous solid waste disposal, operating until 1992. Several on-site disposal units were used to dispose of chemically hazardous wastes. Although no radioactive waste was knowingly disposed of in these units, some radiologically contaminated equipment and debris were placed in them and several areas were contaminated with radioactive materials as they were being used for temporary storage of waste.

Extensive site characterization and remediation of these units was conducted under Argonne's RCRA Corrective Action program administered by the IEPA. Two RCRA Facility Investigations (RFIs) and a number of similar studies were completed. For those sites where contamination was found, a list of Contaminants of Concern (CoCs) and remediation objectives for soil and groundwater were established. Most of the sites were closed by the removal of buried waste and contaminated soil, and no further action was required. However, several waste units were closed with waste or contamination still in place, requiring ongoing remedial actions and monitoring. These units are managed and monitored as part of Argonne's Long-Term Stewardship (LTS) Program. Units that require routine monitoring include the 317/319 Area, the

800 Area Landfill, and the ENE Landfill. The LTS Program and related groundwater monitoring are integrated with the Argonne Environmental Monitoring Program.

6.3. Groundwater in the 317/319 Area

The 317/319 Area contained seven units that were used for handling or disposal of various types of waste. The 317 Area is currently used for storage of empty radioactive waste containers. It also contains the North Vault, an empty in-ground radioactive material container storage vault. Five similar waste storage vaults in this area were cleaned and demolished in place during remedial actions. Low levels of hydrogen-3 are present in the groundwater below this area as a result of past radioactive waste-management practices. General features of the 317 and 319 Areas are shown in Figure 6.1.

During the 1950s, various non-radioactive liquid chemical wastes were disposed of in a unit known as a French drain. The 317 French drain consisted of a shallow trench filled with gravel into which an unknown quantity of liquid waste was poured. The wastes were primarily petroleum products and chlorinated solvents. Because of these past disposal practices, there is a region of contaminated soil in the northern half of the 317 Area. The most highly contaminated sections of the 317 French Drain Area were treated by using a deep soil mixing, steam stripping, and metallic iron treatment technique in 1998. However, areas of untreated soil remain and groundwater below and downgradient of this area contains significant amounts of these chemicals.

To prevent the migration of contaminated groundwater away from the 317 French Drain Area, an underground footing drain pipe associated with the North Vault and four of the five former vaults was sealed by injecting grout into and around the pipe. A groundwater collection system was then installed in the southern end of the 317 Area. This system consists of 15 groundwater extraction wells that remove contaminated groundwater so it does not migrate off-site. Contaminated groundwater collected by this system is discharged to the laboratory treatment side of the WWTP for treatment and disposal.

The 319 Area contains a closed landfill that was used for disposal of a variety of solid wastes generated on-site prior to 1969. It was not intended for disposal of radioactive waste; however, a small amount of radioactive material, most notably hydrogen-3, was detected in the soil and leachate during site characterization activities. The 319 Area consists of two distinct segments: the waste mound, where the bulk of the waste was buried, and an adjacent burial trench, which contains a much smaller amount of inert waste. This landfill also contained a French drain that was used for several years after the French drain in the 317 Area was closed. The levels of chemical contamination in the 319 Area are lower than the levels in the 317 Area; however, hydrogen-3 levels are higher.

In the 319 Area, remedial actions included constructing a subsurface clay barrier wall to prevent migration of leachate, installing a leachate and groundwater collection system to remove leachate and contaminated groundwater from under the waste mound, and installing a multi-layered impermeable cap over the landfill mound and a clay cap over the burial trench.

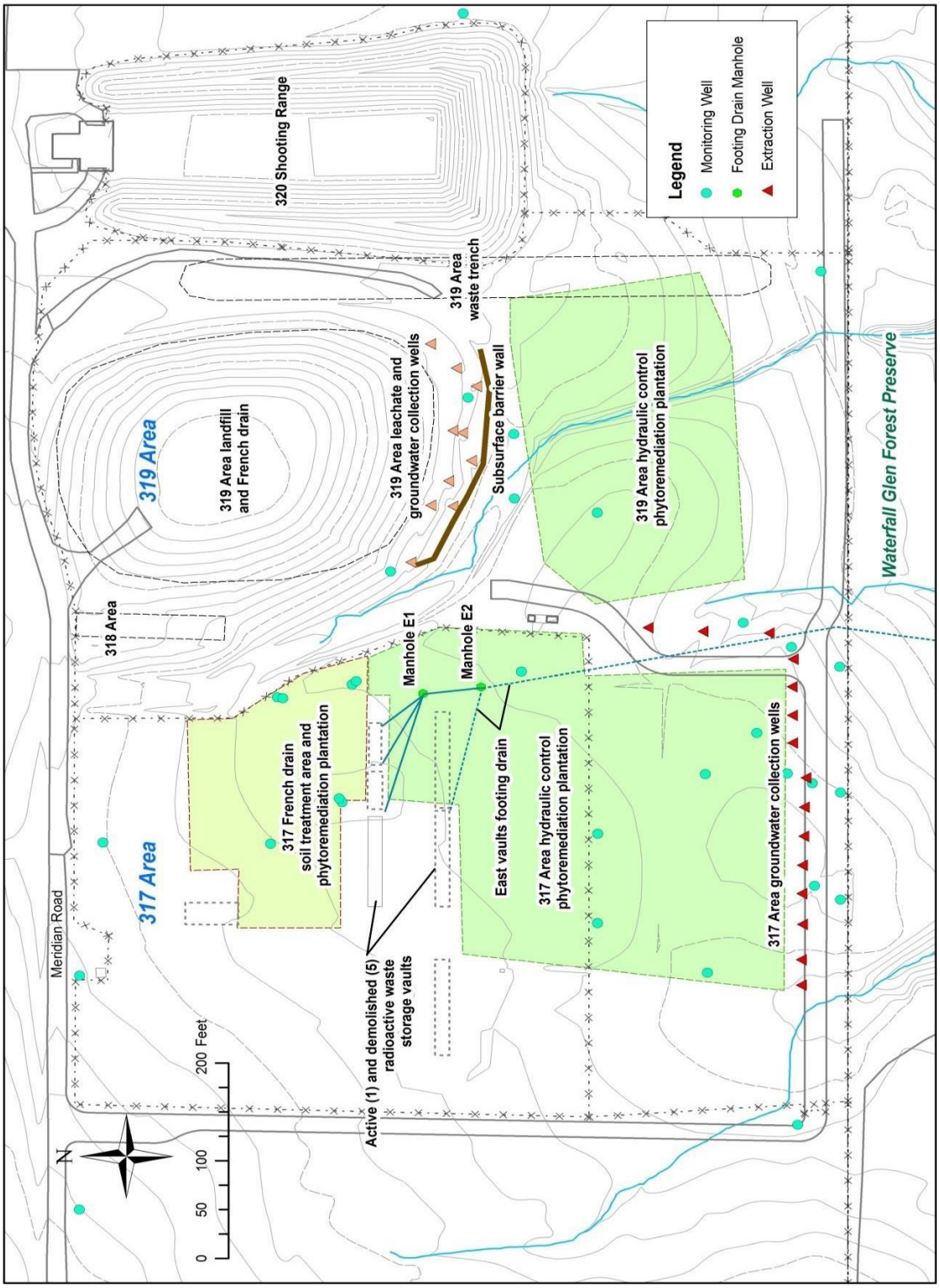


FIGURE 6.1 Locations of Components within the 317/319/ENE Area

Beneath the 317/319 Area, groundwater is found within a network of shallow sand and gravel units, which can be up to 6 meters (20 feet) thick, within the glacial drift, as well as in the upper portion of the dolomite bedrock. The disposal of chemical wastes in the 317 and 319 French Drains, along with the presence of hydrogen-3 in the 319 Area Landfill, has resulted in the formation of a plume of contaminated groundwater. This extends to the south at least 200 m (600 ft). Most of the contamination is present in a porous zone 6 to 10 m (20 to 30 ft) deep in the glacial drift; however, low levels of contamination have been found in the dolomite aquifer. A small amount of contaminated groundwater from the 317/319 Area comes to the surface approximately 360 m (1,200 ft) south of the 319 Landfill in several small groundwater seeps located at the base of a ravine in the Waterfall Glen Forest Preserve. The seeps are sampled quarterly and contain low levels of several VOCs.

A phytoremediation system was installed in 1999 to address the contamination in the 317 French Drain Area and groundwater plume south of the 317/319 Area. Phytoremediation is a technology that uses green plants to remove contaminated groundwater by evapotranspiration. The Argonne system consists of a dense planting of willows and other trees in the vicinity of the 317 French drain and a larger planting of hybrid poplar trees downgradient of the 317/319 Area. Approximately 950 poplar and willow trees were planted. Most of the poplar trees were installed in special lined boreholes designed to guide the tree roots toward the contaminated zones. Starting in 2012, it was observed that a large number of trees had died or were nearly dead. By the end of 2024, less than 15% of the trees were still alive and many of these were sickly. The likely cause of the tree death is the trees reaching their natural life span. A majority of the poplars have died in the last several years and have been chopped down and chipped in place. A partial replanting effort was completed in 2015. In 2016, discussions with IEPA resulted in the decision to allow the trees to die off naturally without replacement. In an April 28, 2025 letter, IEPA approved of the removal of the phytoremediation system from the RCRA Part B Permit given the following conditions are met:

- The groundwater extraction system must continue to be operated, following guidance from applicable IEPA letters,
- Groundwater monitoring must continue to be operated at the GMZ based on applicable IEPA letters, and
- Corrective action activities in the 317/319 Area of the Argonne facility must continue to be carried out in accordance with provisions of Corrective Action Section of the RCRA Part B Permit and associated modifications.

Argonne plans to continue to meet the above conditions and report their progress within quarterly reports.

An extensive groundwater monitoring program is required by the IEPA in the 317/319 Area. In addition to the permit-required monitoring, Argonne also voluntarily conducts groundwater surveillance in the 317/319 Area. The groundwater surveillance well network was established during the early years of the site remediation program and it has allowed Argonne to monitor changes in contaminant levels as remedial actions have progressed and it provides information about background levels of groundwater constituents upgradient of the area.

6.3.1. Permit-Required Groundwater Monitoring at the 317/319 Area

The LTS monitoring program involves the collection of groundwater data from an extensive network of monitoring wells and other sampling points located throughout the 317/319 Area. The current set of LTS wells is shown in Figure 6.2. The purpose of this monitoring network is to track the movement of contaminated groundwater, to determine the rate at which contaminant levels are changing, and to monitor the performance of the various remedial actions constructed in the 317 and 319 Areas. During 2024, the LTS wells were sampled quarterly, as specified in the RCRA Permit, and they were analyzed for VOCs and hydrogen-3. The results of the LTS groundwater monitoring were transmitted to the IEPA on a through the submittal of Quarterly Progress Reports.

Because of the number of wells and other monitoring points that are sampled in this area, the volume of analytical data generated is substantial. To simplify the presentation of the monitoring data in this report, only a summary of the most significant results is presented. Table 6.1 shows the average VOC concentrations from the 2024 quarterly samples of four of the most highly contaminated wells in the French Drain Area. Wells 317321 and 317331 are constructed in the uppermost saturated zone (4 to 5 m [13 to 16 ft] deep) and wells 317332 and 317342 are constructed in the deeper saturated zone (9 to 10 m [29 to 33 ft] deep). VOCs that were below the method detection limit in all samples from these four wells are not shown in this table. Values that exceed the applicable GQS for Class 1: Potable Resource Groundwater are shown in bold type. A number of constituents that were found are not contaminants of concern and do not have a GQS.

The data presented in Table 6.1 indicates that elevated concentrations of VOCs remain in the French Drain Area. The contaminants present and their concentrations in these wells vary tremendously from well to well, illustrating the heterogeneity and complexity of the hydrogeology in this area. Figure 6.3 shows the long-term trend in annual average total VOC concentrations (the concentrations of all detected VOCs added together) in the two most contaminated wells in the 317 French Drain Area since 1999. This chart indicates that the contaminant levels vary from year to year. A slight increase was observed in well 317321 in 2023 but has since reversed, whereas well 317321 has seen a gradual downward trend since 2019. Table 6.2 summarizes the 2024 results for detected VOCs in four downgradient wells south of the French drain. Two wells (317151 and 317351) are approximately midway between the French drain and the southern fence line. Wells 317492 and 317811 are immediately north of the fence line and south of the groundwater extraction system (Figure 6.2). The concentrations found in these wells are much lower than in the French Drain Area; however, several of the constituents in the two wells midway between the French drain and southern fence line are present above GQS for Class 1: Potable Resource Groundwater.

Figure 6.4 is a chart showing contaminant levels in well 317811 since 1997. This chart shows that contaminant levels have been consistently decreasing since 1999 at this fence line well. The contaminant levels in 2024 continue to be very low for this well. Other monitoring wells in the vicinity of the Argonne property line exhibit similar decreasing contaminant levels.

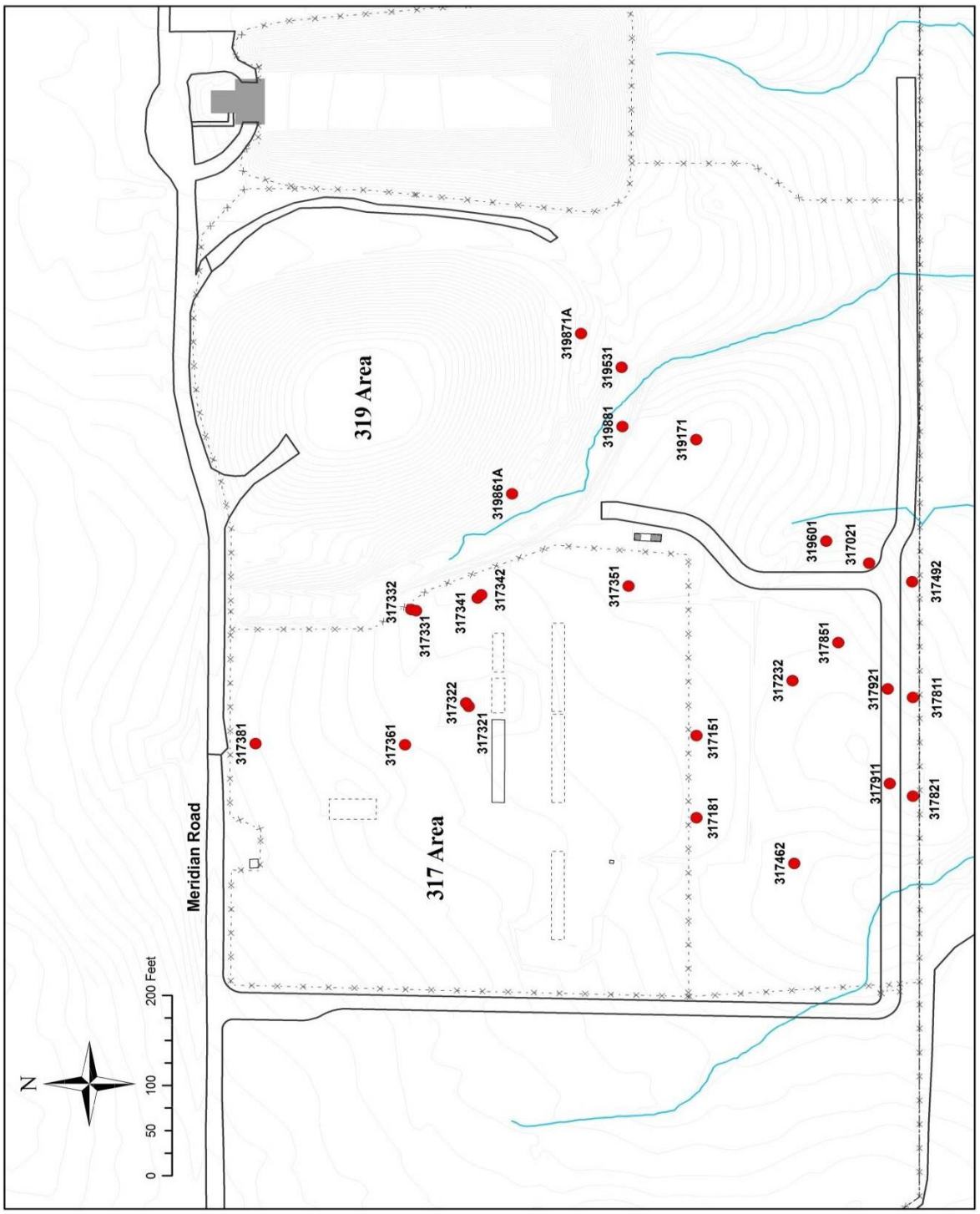


FIGURE 6.2 317/319 Area LTS Monitoring Wells

TABLE 6.1

Annual Average Contaminant Concentrations of 317 French Drain Well Water Constituents, 2024

	Well No.				
Parameter	317321	317331	317332	317342	Class 1 GQS[a]
VOC (µg/L)					
1,1 Dichloroethane	-[b]	**17,800**[c]	1,128	543	1,400
1,1 Dichloroethene	-	**3,000**	**18**	**11**	7
1,1,1 Trichloroethane	-	**123,600**	**1,254**	**202**	200
1,2 Dichloroethane	-	**2,200**	**34**	**20**	5
1,4 Dioxane	**5,000**	-	**1,540**	**243**	7.7
4-Methyl-2Pentanone	15,667	-	-	-	NA[d]
Benzene	**12,250**	-	-	-	5
Carbon Tetrachloride	**270,500**	-	-	-	5
Chloroform	**66,250**	-	10	5	70
cis 1,2 Dichloroethene	1,000	**20,000**	**264**	26	70
Nitrobenzene	**9,000**	-	-	-	14
Tetrachloroethene	**1,000**	-	-	-	5
Toluene	1,000	-	-	-	1000
trans 1,2 Dichloroethene	-	**1,500**	20	-	100
Trichloroethene	**37,750**	**34,400**	**136**	**23**	5
Radioactivity (pCi/L)					
Hydrogen-3	186	<100	<100	132	20,000

[a] Title 35 of the Illinois Administrative Code: Environmental Protection, Subtitle F, Chapter I, Part 620, Section 620.410 Groundwater Quality Standards for Class 1: Potable Resource Groundwater, 2012.

[b] Dashes denote a result below the detection limit, which was raised as a result of dilution performed due to high concentrations of other VOC compounds in the same sample. The quarterly electronic data submittal has these exact detection limits listed, as they relate to the GRO.

[c] Bold type indicates that the value exceeds applicable standards.

[d] NA = Not applicable. Indicates that no GQS standard exists for this compound.

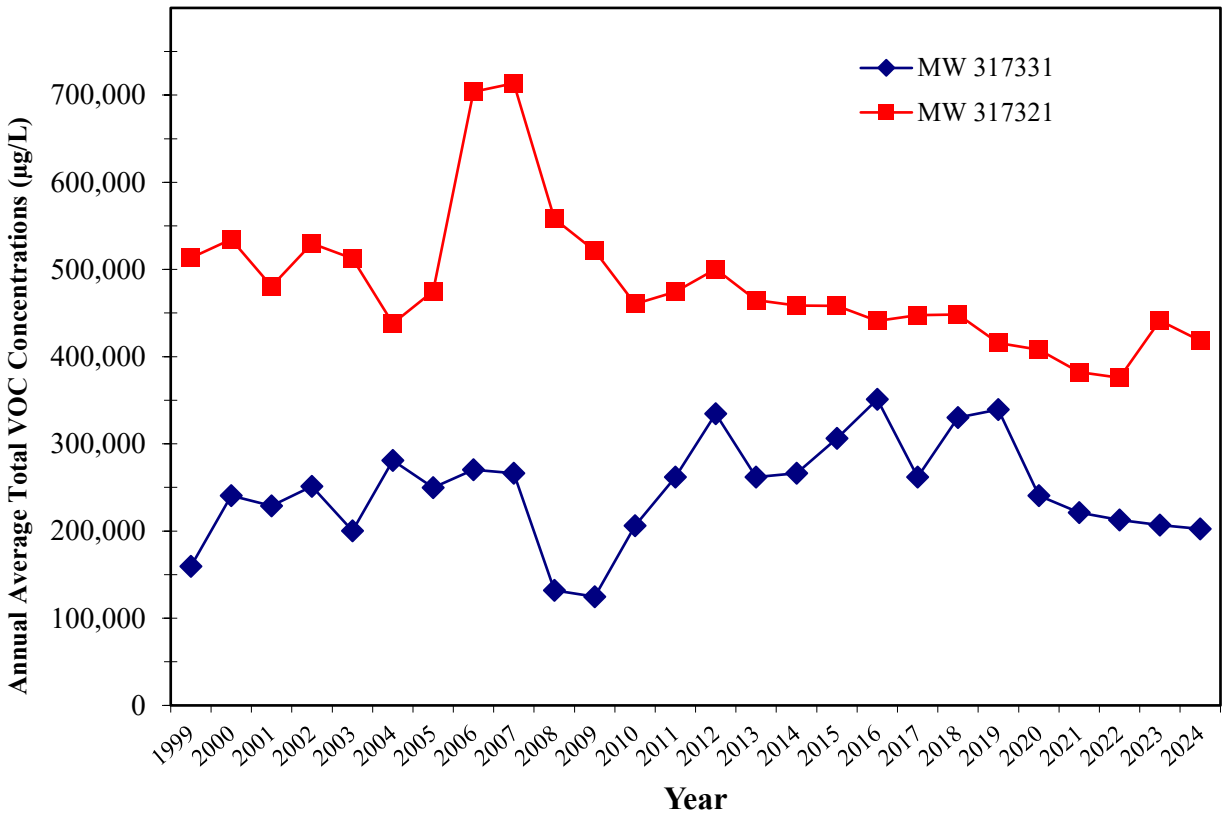


FIGURE 6.3 Annual Average Total VOC Concentrations in 317 Area French Drain Wells

TABLE 6.2

Annual Average Concentrations of Downgradient 317 French Drain Well Water Constituents, 2024

	Well No.				
	Wells Midway to Fence		Wells Near Fence Line		
Parameter	317151	317351	317492	317811	Class 1 GQS[a]
VOC (µg/L)					
1,1 Dichloroethane	14	<1[b]	<1	2	1400
1,1,1 Trichloroethane	62	<1	<1	2	200
1,4 Dioxane	7	<1	<1	<1	7.7
Carbon Tetrachloride	<1	**210**[c]	<1	<1	5
Chloroform	<1	137	<1	<1	200
cis 1,2 Dichloroethene	3	12	<1	<1	70
Tetrachloroethene	**31**	**143**	<1	<1	5
Trichloroethene	**20**	4	<1	1	5
Radioactivity (pCi/L)					
Hydrogen-3	<100	<100	<100	<100	20,000

[a] Title 35 of the Illinois Administrative Code: Environmental Protection, Subtitle F, Chapter I, Part 620, Section 620.410 Groundwater Quality Standards for Class 1: Potable Resource Groundwater, 2012.

[b] Detection limit estimated at 1 *µg/L*.

[c] Bold type indicates that the value exceeds applicable standards.

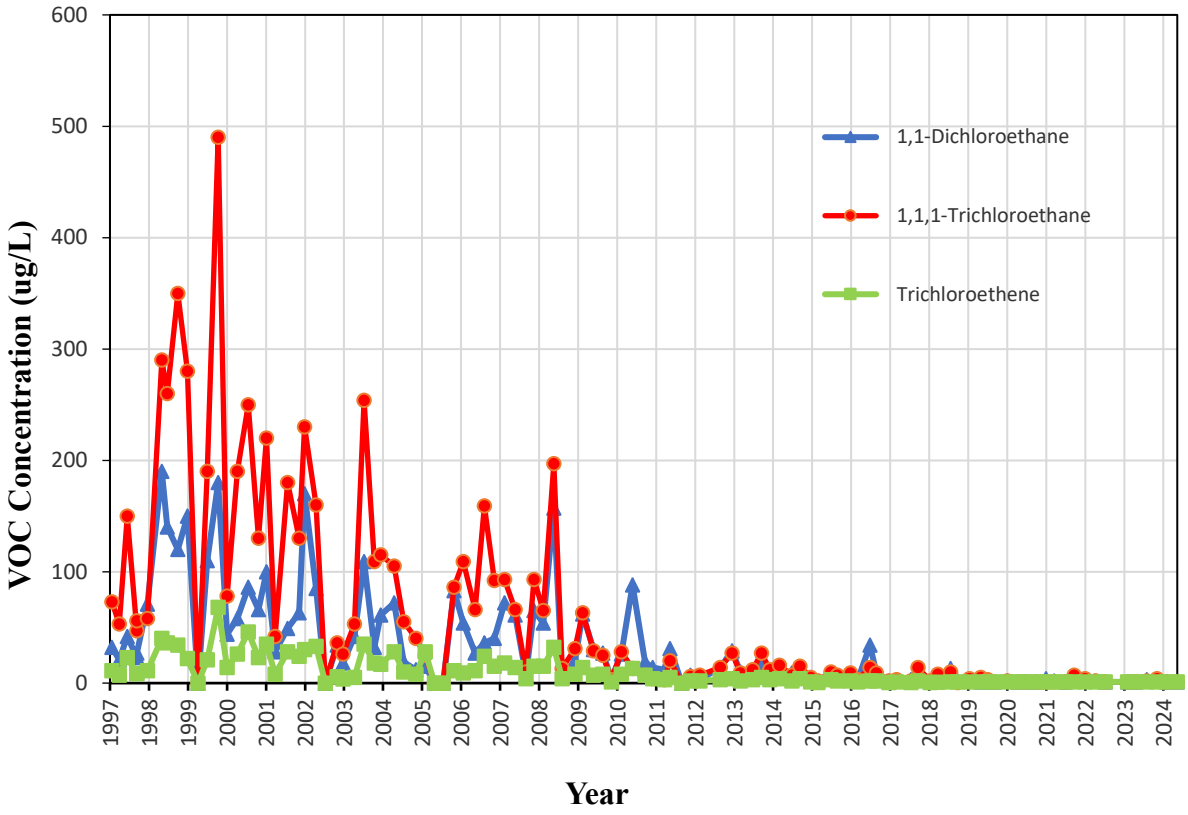


FIGURE 6.4 VOC Concentrations in Well 317811 since 1997

Figure 6.5 is a map showing the approximate location of the region of impacted groundwater within the contaminated aquifer, based on 2024 data. The core of the contaminated plume extends from the French Drain Area to the southwest. The edge of the plume extends a small distance off-site into Waterfall Glen Forest Preserve, though the extent of the plume off-site is poorly understood since there are a limited number of monitoring wells in this area. Compared with similar plume maps prepared for previous SERs, the plume has decreased in size to the south and southeast of the 317 French drain. The main change in the plume from previous years is the eastern edge of the 100 mg/l contour now excludes well 319861. The most highly contaminated part of the plume emanates from the 317 French Drain Area; however, compared to several years ago, the core of the plume has receded north, in the direction of the French drain. The contaminant levels in wells south and east of the 317 French Drain Area continue to decrease. Contaminant concentrations at the Argonne fence line are very low.

Table 6.3 summarizes the 2024 results for five wells near the 319 Landfill. Two of the wells are located upgradient of the subsurface clay barrier wall and the other three are downgradient of the barrier wall. The VOC concentrations are much lower in the 319 Area than the 317 French Drain Area; however, the hydrogen-3 levels are higher as a result of past disposal of hydrogen-3 contaminated equipment. In all cases, hydrogen-3 levels are still far below their GQS. 1,4 Dioxane was detected in four of the five wells in Table 6.3. Only two wells, 319861A and 319881, exceeded the Class 1 GQS for 1,4 Dioxane. Well 319861A is located upgradient of the barrier wall and well 319881 is located downgradient of the barrier wall.

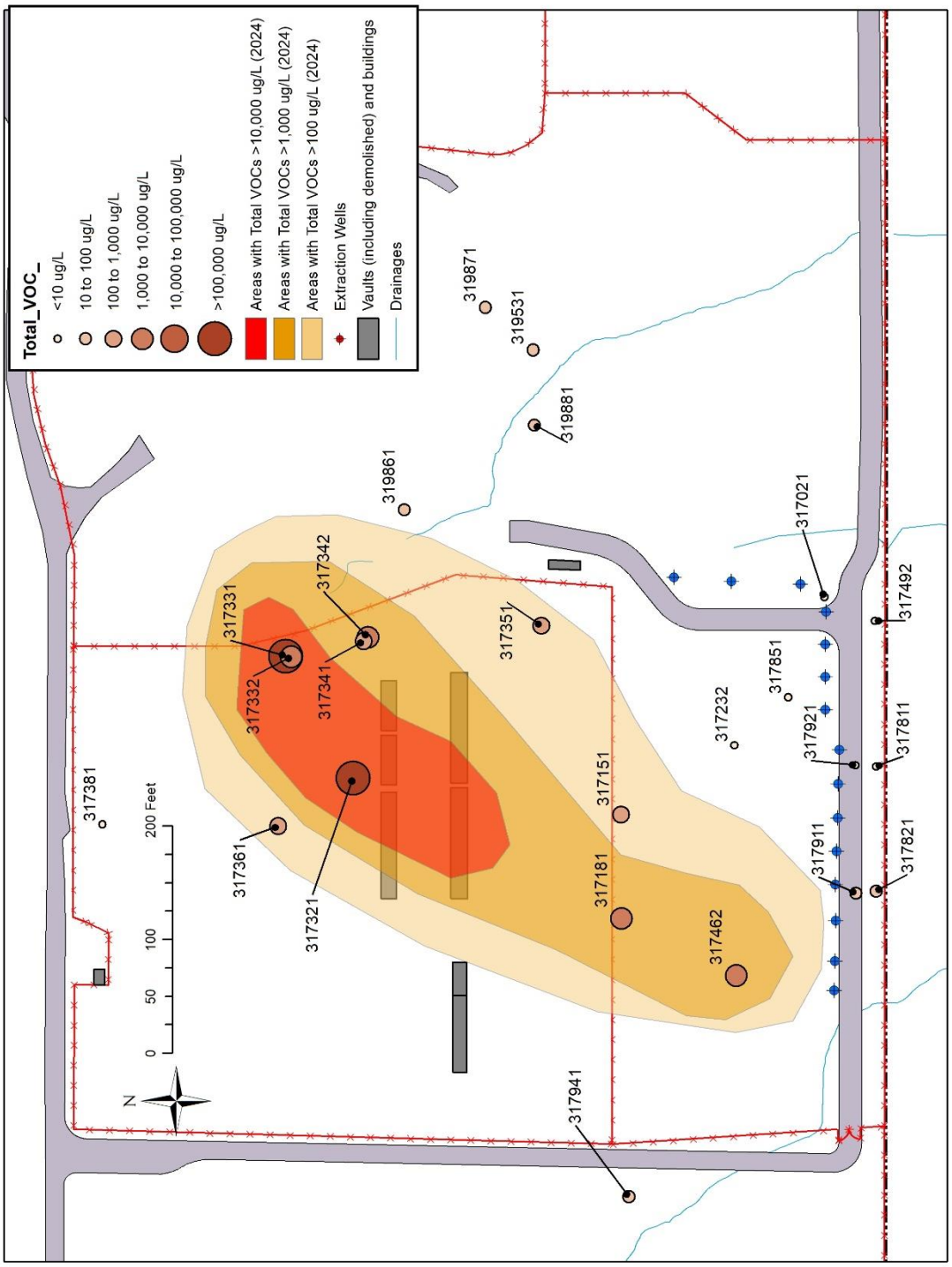


FIGURE 6.5 Region of Contaminated Groundwater in the 317/319 Area during 2024

TABLE 6.3

Annual Average Concentrations of 319 Area Landfill Well Water Constituents, 2024

	Well No.					
	Upgradient of Barrier Wall		Downgradient of Barrier Wall			
Parameter	319861A	319871A	319171	319531	319881	Class 1 GQS[a]
VOC ((μg/L)						
1,1 Dichloroethane	16	<1	DRY	<1	4	1400
1,1 Dichloroethene	2	<1	DRY	<1	<1	7
1,1,1 Trichloroethane	26	<1	DRY	<1	7	200
1,2 Dichloroethane	2	<1	DRY	<1	1	5
1,4 Dioxane	**19**[b]	9	DRY	6	**19**	7.7
2-Butanone	ND[c]	ND	DRY	5	ND	4200
Acetone	ND	ND	DRY	11	ND	6300
cis 1,2 Dichloroethene	<1	2	DRY	12	1	70
trans 1,2 Dichloroethene	<1	<1	DRY	2	<1	100
Trichloroethene	<1	1	DRY	3	<1	5
Radioactivity (pCi/L)						
Hydrogen-3	<100	852	DRY	779	302	20,000

[a] Title 35 of the Illinois Administrative Code: Environmental Protection, Subtitle F, Chapter I, Part 620, Section 620.410 Groundwater Quality Standards for Class 1: Potable Resource Groundwater, 2012.

[b] Bold type indicates that the value exceeds applicable standards.

[c] ND = Not detected. Indicates this compound was not detected. Detection limits do not exist.

6.3.2. Monitoring of the Seeps South of the 300 Area

In 1996, during the RFI of the 317/319 Area, three groundwater seeps were discovered in two steeply eroded ravines located off-site in the Waterfall Glen Forest Preserve 360 m (1,200 ft) southeast of the 317 and 319 Areas. The ravines carry stormwater drainage from the 317 and 319 Areas. An exposed sandy layer of soil contains groundwater that comes to the surface in the ravine, forming three seeps. A shallow hand-dug well of unknown age is located near seep SP04. Approximately 30 m (100 ft) downstream, the water from the seeps is usually no longer visible because it drains back into the soil in the bed of the ravine, or it evaporates. During extended dry weather conditions, the seeps disappear completely. The water in these seeps was found to contain VOCs and low levels of hydrogen-3, likely from the 317 and 319 Areas.

Shallow monitoring wells were installed near the seeps. The locations of these wells are shown in Figure 6.6. SP04 is located adjacent to the hand-dug well. All three seeps have been monitored on a regular basis since their discovery. During 2024, the seeps were sampled quarterly for VOCs and hydrogen-3. Only hydrogen-3 and three VOCs (carbon tetrachloride, chloroform, and tetrachloroethene) have been consistently found, with some others occasionally but inconsistently appearing above detection limits. 1,4-Dioxane is occasionally detected at very low concentrations at SP01 and SP02. In 2024, 1,4 Dioxane was also detected in SP04. Table 6.4 summarizes the results. VOCs were noted in all three seeps, but levels of VOCs in SP04 were higher in 2024. The VOC concentrations observed at SP02 were very low, most below analytical quantitation limits (less than 1 µg/L). Seep SP04 has consistently showed the highest levels in all four quarters. Figure 6.7 contains a series of charts showing fluctuating annual average concentrations for these three constituents since 1996. These fluctuations have been consistent since the seep sampling started in 1996. Overall VOC concentrations in all three seeps have remained at consistent levels for several years.

The hydrogen-3 concentrations in the seeps have decreased from approximately 2,000 pCi/L when they were first discovered. Since 2006, the hydrogen-3 concentrations have been at or below detection levels. None of the 2024 samples had detectable amounts of hydrogen-3. Therefore, it appears that the remedial actions implemented in the 1990s were effective at preventing any further discharge of hydrogen-3. The samples were also analyzed for cesium-137, but none was detected.

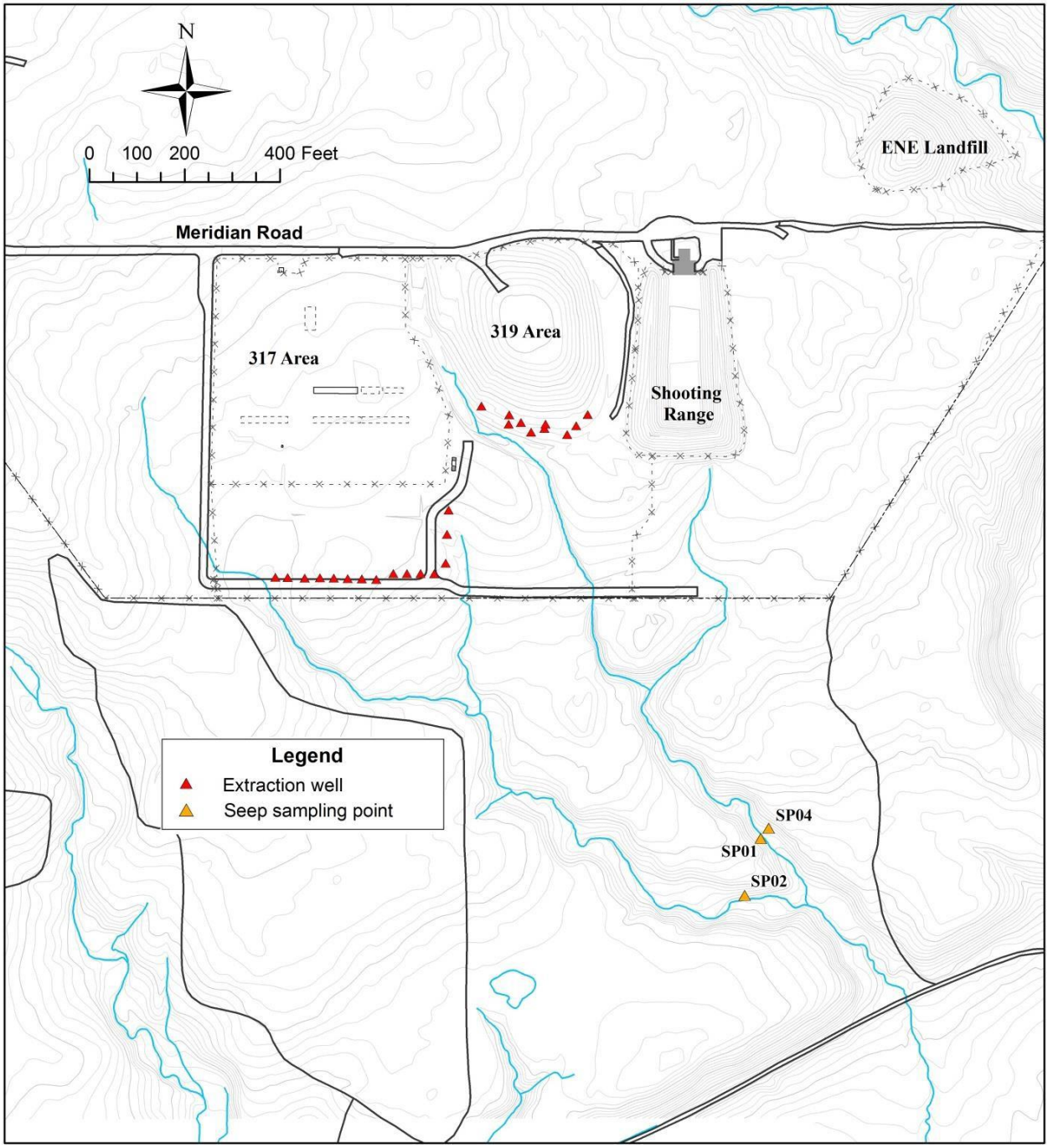


FIGURE 6.6 Seep Locations South of the 317/319 Area

TABLE 6.4

Average Contaminant Concentrations in Offsite Seep Water, 2024

Parameter	Sampling Location SP01	SP02	SP04	Class 1 GQS[a]
Volatile Organic Compounds (µg/L)				
1,4 Dioxane	0.4	0.5	0.4	7.7
Carbon Tetrachloride	2.3	1	**72**[c]	5
Chloroform	< 1[b]	< 1	11	200
Tetrachloroethene	< 1	< 1	4	5
Radionuclides (pCi/L)				
Hydrogen-3	< 100	< 100	< 100	20,000
Cesium-137	< 2	< 2	< 2	NA[d]

[a] Title 35 of the Illinois Administrative Code: Environmental Protection, Subtitle F, Chapter I, Part 620, Section 620.410 Groundwater Quality Standards for Class 1: Potable Resource Groundwater, 2012.

[b] A concentration value shown with a "less than" (<) sign indicates that the constituent was not present above the detection limits of the analytical method. The value shown is the method detection limit.

[c] Bold type indicates that the value exceeds applicable standards.

[d] NA = Not applicable. Indicates that no GQS standard exists for this compound.

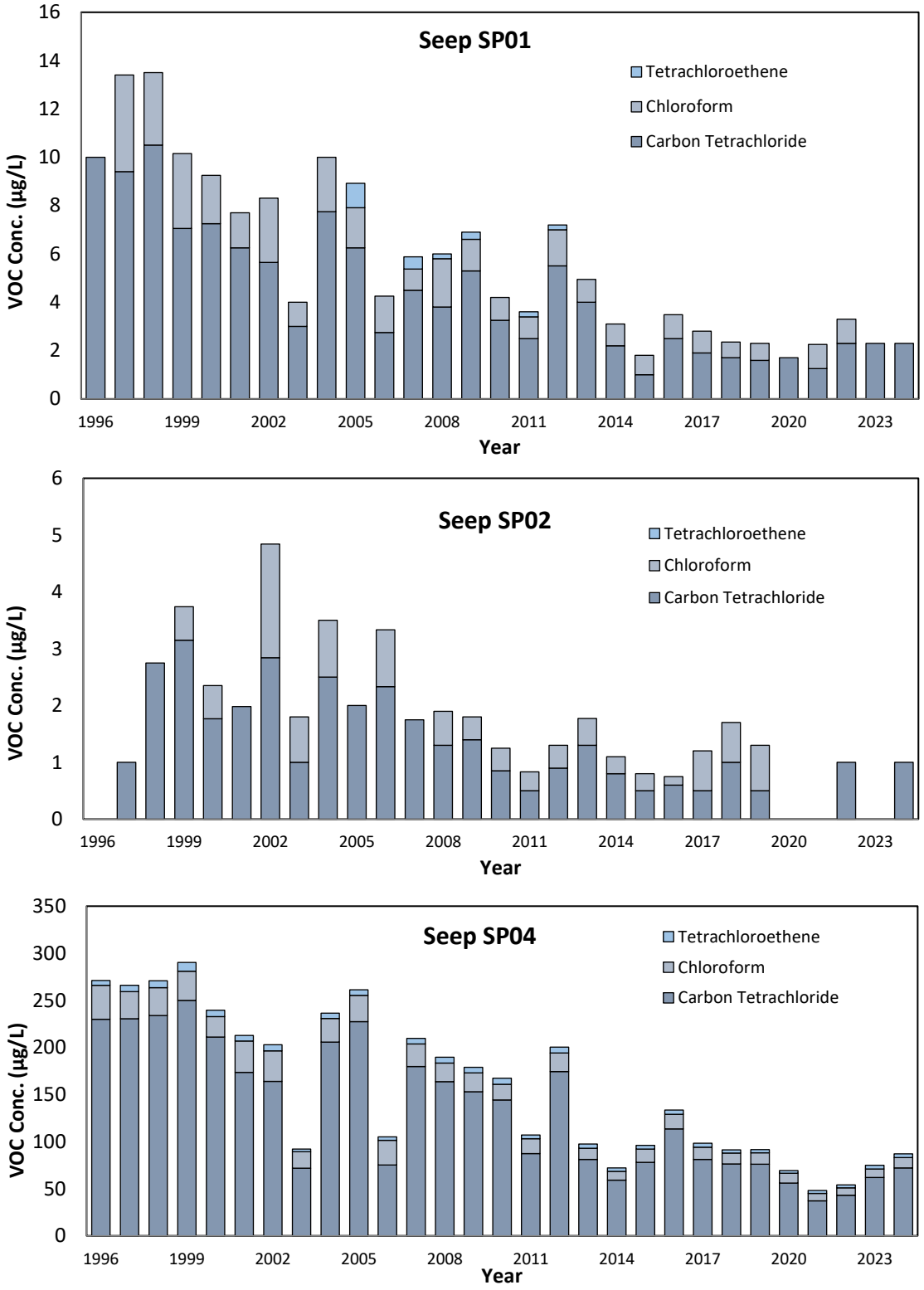


FIGURE 6.7 Groundwater Seeps Annual Average VOC Concentrations since 1996

6.3.3. Monitoring the Groundwater Management Zone

Because of the nature, extent, and depth of contamination and site constraints, it was not feasible to remove all contaminated soil or groundwater from the 317/319 Area. The remedial systems in place are intended to contain residual contamination and slowly reduce contaminant levels until the GROs are attained. The regulatory tool the IEPA utilizes to oversee such a remedial process is a Groundwater Management Zone (GMZ). A GMZ is a three-dimensional region that contains groundwater that exceeds one or more applicable GQS's, but is being actively remediated. For a GMZ to be sustained, the groundwater within the GMZ must be managed properly to ensure that cleanup continues until GQS's are achieved. A GMZ was approved for this area by the IEPA on November 22, 2000. The GMZ encompasses the 317 Area, the 319 Area, and the area extending to the seeps.

The boundaries of the GMZ are delineated by a set of nine monitoring wells that are located on the outer boundary of the region of contaminated groundwater, both laterally and vertically. These wells are intended to be in clean groundwater, unaffected by past releases. Figure 6.8 shows the locations of these boundary wells.

Samples from the GMZ wells were collected semiannually. The samples were analyzed for the list of Contaminants of Concern for the 317 and 319 Areas and hydrogen-3. The results of the samples collected in 2024 are shown in Table 6.5. These results indicate that 1,4-dioxane was present above the GQS in one deep GMZ well (317951D). The presence of 1,4-dioxane above the GRO in one of the two deepest GMZ wells indicates that the vertical extent of the contaminated region is not yet defined near this well. In late 2012, a replacement well (317981D) was drilled near and deeper than existing well 317951D. This well was installed to better delineate the bottom of the contaminated region. Monitoring of this well in 2024 indicated that 1,4-dioxane levels were 6 µg/L. Therefore, the vertical extent of the GMZ is still uncertain.

Following approval on November 6, 2024 of a 2017 GMZ Letter sent to the IEPA from Argonne, Argonne has added well 317061R to the GMZ program and will begin sampling and reporting it in Q2 and Q4 of each calendar year starting in calendar year 2025. An extension to implement this addition by May 1, 2025 was granted by IEPA due to Argonne personnel not receiving the letter until December of CY2024. This well was added to better delineate the southwestern extent of contamination.

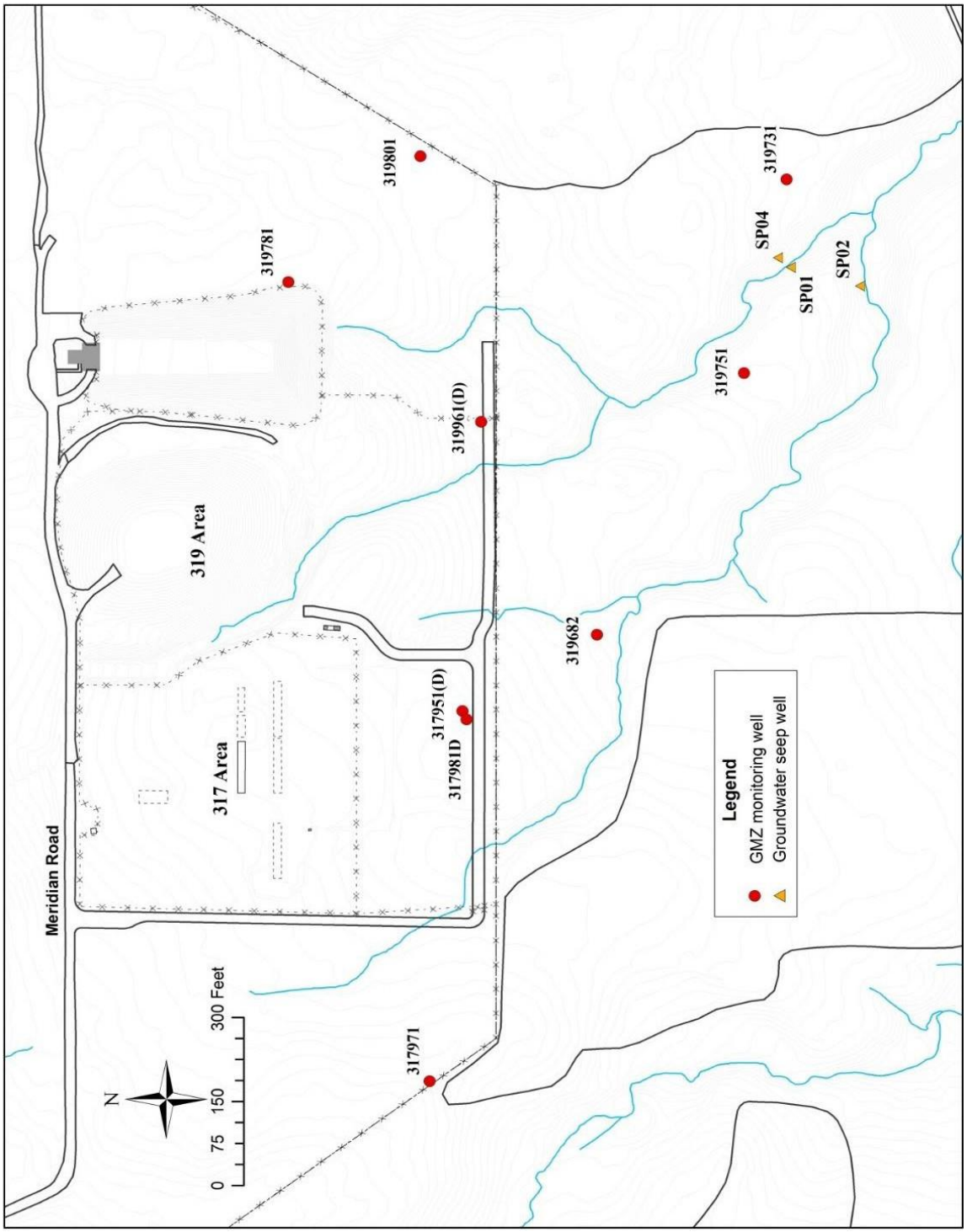


FIGURE 6.8 Locations of GMZ Monitoring Wells

TABLE 6.5

Annual Average Results from the GMZ Monitoring Wells, 2024

Parameter	Well No. 317971	319682	319731	319751	Class 1 GQS[a]
Volatile Organic Compounds (µg/L)					
1,1-Dichloroethane	<1[b]	<1	<1	<1	1400
1,1-Dichloroethene	<1	<1	<1	<1	7
1,1,1-Trichloroethane	<1	<1	<1	<1	200
1,1,2-Trichloroethane	<1	<1	<1	<1	5
1,2-Dichloroethane	<1	<1	<1	<1	5
1,4-Dioxane	<1	<1	<1	<1	7.7
Benzene	<1	<1	<1	<1	5
Carbon Tetrachloride	<1	<1	<1	<1	5
Chloroform	<1	<1	<1	<1	200
cis-1,2-Dichloroethene	<1	<1	<1	<1	70
Methylene Chloride	<1	<1	<1	<1	5
Nitrobenzene	<3.5	<3.5	<3.5	<3.5	3.5
Tetrachloroethene	<1	<1	<1	<1	5
Trichloroethene	<1	<1	<1	<1	5
Vinyl Chloride	<2	<2	<2	<2	2
Radionuclides (pCi/L)					
Hydrogen-3	<100	<100	<100	<100	20,000

Parameter	Well No. 319781	319801	317951D	317981D	319961D	Class 1 GQS[a]
Volatile Organic Compounds (µg/L)						
1,1-Dichloroethane	<1	<1	41	2	<1	1400
1,1-Dichloroethene	<1	<1	<1	<1	<1	7
1,1,1-Trichloroethane	<1	<1	<1	<1	<1	200
1,1,2-Trichloroethane	<1	<1	<1	<1	<1	5
1,2-Dichloroethane	<1	<1	1	<1	<1	5
1,4-Dioxane	<1	<1	**26**[c]	6	1	7.7
Benzene	<1	<1	<1	<1	<1	5
Carbon Tetrachloride	<1	<1	<1	<1	<1	5
Chloroform	<1	<1	<1	<1	<1	200
cis-1,2-Dichloroethene	<1	<1	<1	<1	1	70
Methylene Chloride	1	<1	<1	<1	<1	5
Nitrobenzene	<3.5	<3.5	<3.5	<3.5	<3.5	3.5
Tetrachloroethene	<1	<1	<1	<1	<1	5
Trichloroethene	<1	<1	<1	<1	<1	5
Vinyl Chloride	<2	<2	<2	<2	<2	2
Radionuclides (pCi/L)						
Hydrogen-3	<100	<100	<100	<100	406	20,000

[a] Title 35 of the Illinois Administrative Code: Environmental Protection, Subtitle F, Chapter I, Part 620, Section 620.410 Groundwater Quality Standards for Class 1: Potable Resource Groundwater, 2012.

[b] A concentration value shown with a "less than" (<) sign indicates that the constituent was not present above the detection limits of the analytical method. The value shown is the method detection limit.

[c] Bold type indicates that the value exceeds applicable standards.

6.3.4. Supplementary Groundwater Surveillance at the 317/319 Area

In addition to the groundwater monitoring required by the RCRA permit, Argonne has conducted additional groundwater surveillance monitoring in and around the 317 and 319 Areas since the 1980s. This monitoring started prior to the remedial actions. The current groundwater surveillance monitoring well network in this area is shown in Figure 6.9. Wells 317101 and 317111 are upgradient of the 317 Area, and Well 319011 is upgradient of the 319 Area Landfill. These serve as background reference wells for the downgradient wells.

The surveillance wells are analyzed for a more extensive list of analytes than the LTS wells. With one exception, Well 317052, the wells are not located in the contaminated groundwater plume associated with the 317/319 Area as depicted in Figure 6.5, and thus, the contaminants and concentrations are not representative of the degree of groundwater contamination in other parts of the 317/319 Area.

To determine if groundwater quality at these locations has been impacted, the analytical results were compared to the Class I GQS. The 2024 average results of the filtered chloride and soluble metals analyses, as well as the radionuclides cesium-137, hydrogen-3, and strontium-90 are summarized in Table 6.6. The average results for those VOCs that were detected in at least one of the quarterly samples are shown in Table 6.7. All of the wells were analyzed once per year for SVOCs, PCBs, and pesticides; however, none of the samples had detectable amounts of any of these compounds. To simplify the tables, these results are not shown.

Hydrogen-3 was detected in one well; however, the concentration was far below the GQS of 20,000 pCi/L. The only detection was found in 319961D, which is downgradient of the 319 landfill. A small amount of strontium-90 was found in 317941, the well closest to a series of demolished radioactive waste storage vaults. No cesium-137 was found in any of the downgradient wells. These values are consistent with concentrations from previous years.

The only organic chemicals detected were several VOCs shown in Table 6.7. The compounds found were very similar to those found in the 317 Area remediation site; however, the concentrations found were much lower than many of the wells associated with that site. The GQS for 1,4-dioxane was exceeded in two downgradient wells during 2024: 319032 and 317951D.

In general, the number of compounds detected and their concentrations were comparable to, or lower than, the previous years' results. Figure 6.10 shows the 1,1,1-trichloroethane and 1,1-dichloroethane concentrations in Well 317021 since 1988, a period that spans all the remediation activities completed in this area. The levels were low and relatively consistent until 1991, at which time the concentrations increased. During 1995 a rapid decrease in concentrations began. This period includes the time when active remediation of the 317/319 Area was underway. The remedial actions, completed in 1999 are likely responsible for the rapid decrease in VOC concentrations in this well. Since 1999, only very low levels of VOCs have been present in the supplemental monitoring wells.

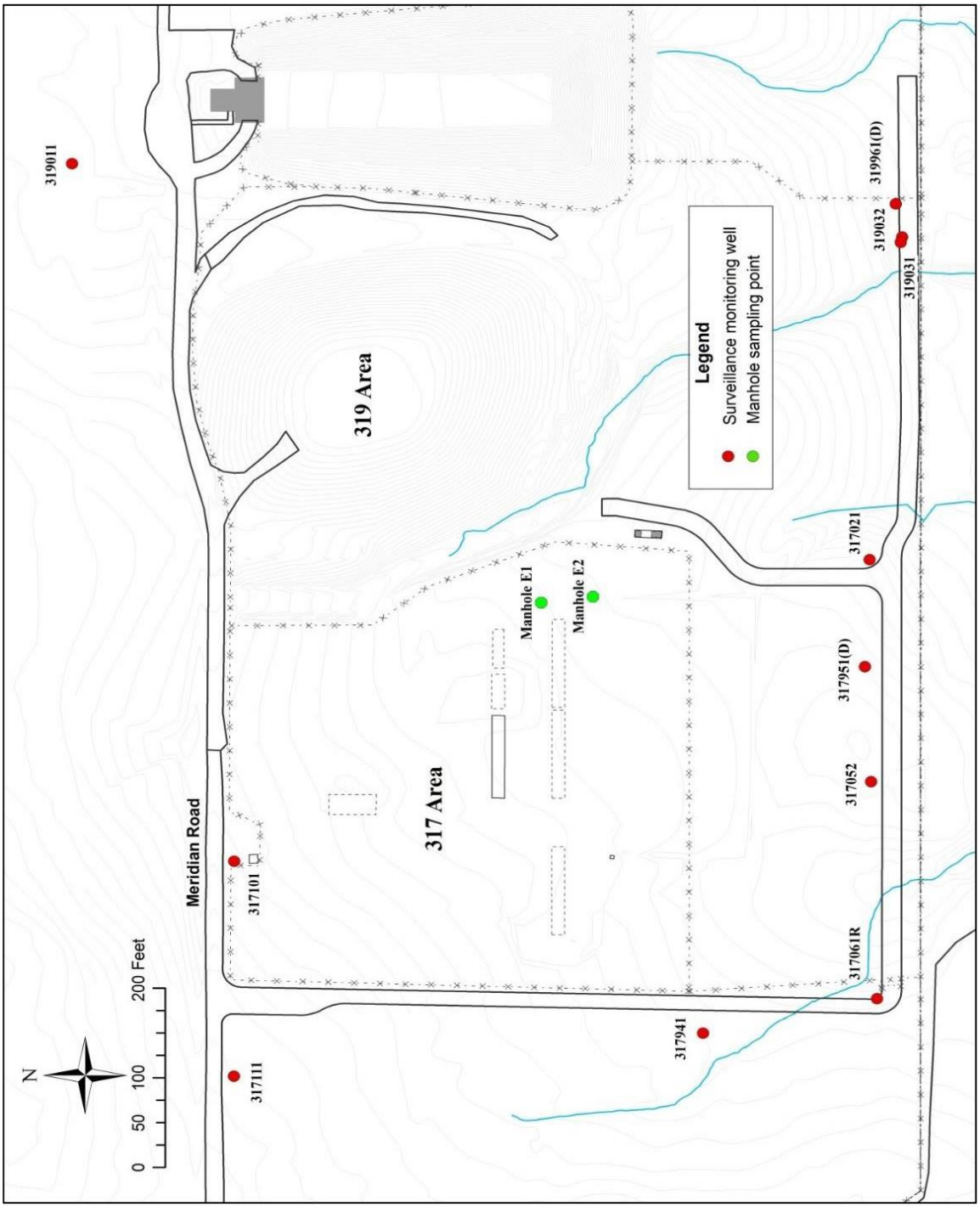


FIGURE 6.9 Groundwater Surveillance Sampling Locations in the 317/319 Area

TABLE 6.6

Annual Average Results from the 317/319 Surveillance Wells, 2024

		Upgradient Background Wells			Downgradient Wells							
Parameter	Class 1 GQS[a]	317101	317111	319011	317021	319031	319032	317052	317061R	317941	317951D	319961D
Filtered Chloride (mg/L)	200	**622**[b]	196	84	84	DRY	7	12	**328**	**230**	71	70
Filtered Metals (mg/L)												
Arsenic	0.01	<0.001	<0.001	<0.001	<0.001	DRY	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
Barium	2	<0.5	<0.5	<0.5	<0.5	DRY	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Beryllium	0.004	<0.0025	<0.0025	<0.0025	<0.0025	DRY	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025
Cadmium	0.005	<0.0025	<0.0025	0.0032	<0.0025	DRY	0.0025	<0.0025	0.0028	<0.0025	0.0026	<0.0025
Chromium	0.1	<0.05	<0.05	<0.05	<0.05	DRY	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cobalt	1	<0.25	<0.25	<0.25	<0.25	DRY	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Copper	0.65	<0.025	<0.025	<0.025	<0.025	DRY	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Iron	5	<0.5	<0.5	<0.5	<0.5	DRY	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Lead	0.0075	<0.0005	<0.0005	<0.0005	<0.0005	DRY	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Manganese	0.15	<0.075	<0.075	<0.075	<0.075	DRY	<0.075	<0.075	<0.075	<0.075	<0.075	<0.075
Mercury	0.002	<0.0002	<0.0002	<0.0002	<0.0002	DRY	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.1	<0.05	<0.05	<0.05	<0.05	DRY	<0.05	<0.05	0.06	<0.05	<0.05	<0.05
Silver	0.05	<0.0005	<0.0005	<0.0005	<0.0005	DRY	<0.0005	<0.0005	<0.0005	<0.0025	<0.0005	<0.0005
Thallium	0.002	<0.002	<0.002	<0.002	<0.002	DRY	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Vanadium	0.049	<0.025	<0.025	<0.025	<0.025	DRY	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Zinc	5	<0.5	<0.5	<0.5	<0.5	DRY	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Radionuclides (pCi/L)												
Cesium-137	NA[c]	<2	<2	DRY	<2	DRY	<2	<2	<2	<2	<2	<2
Hydrogen-3	20,000	<100	<100	DRY	<100	DRY	<100	<100	<100	<100	<100	376
Strontium-90	8	<0.25	<0.25	DRY	<0.25	DRY	<0.25	<0.25	<0.25	1.07	<0.25	<0.25

[a] Title 35 of the Illinois Administrative Code: Environmental Protection, Subtitle F, Chapter I, Part 620, Section 620.410 Groundwater Quality Standards for Class 1: Potable Resource Groundwater, 2012.

[b] Bold type indicates that the value exceeds applicable standards.

[c] NA = Not applicable. Indicates that no GQS standard exists for this compound.

TABLE 6.7

Annual Average VOC Results from the 317/319 Surveillance Wells, 2024

		Upgradient Background Wells			Downgradient Wells							
Parameter	Class 1 GQS[a]	317101	317111	319011	317021	319031	319032	317052	317061R	317941	317951D	319961D
VOCs Detected (µg/L)												
1,1-Dichloroethane	1400	–[b]	–	–	–	DRY	–	–	–	1	34.4	–
1,1,1-Trichloroethane	200	–	–	–	–	DRY	–	–	–	–	–	–
1,2-Dichloroethane	5	–	–	–	–	DRY	–	–	–	–	–	–
1,4-Dioxane	7.7	–	–	–	–	DRY	**11**[c]	–	–	–	**25.8**	–
Acetone	6300	–	20	–	–	DRY	–	–	–	6.5	–	–
cis 1,2 Dichloroethene	70	–	–	–	–	DRY	–	–	2	20	–	1
Methylene Chloride	5	–	–	–	–	DRY	–	–	–	–	–	–
Tetrachloroethene	5	–	–	–	–	DRY	–	–	–	–	–	–
trans-1,2-Dichloroethene	100	–	–	–	–	DRY	–	–	–	1	–	–
Trichloroethene	5	–	–	–	–	DRY	–	–	–	–	–	–
Trichlorofluoromethane	2100	–	–	–	–	DRY	–	–	–	–	–	–
Vinyl Chloride	2	–	–	–	–	DRY	–	–	–	–	–	–

[a] Title 35 of the Illinois Administrative Code: Environmental Protection, Subtitle F, Chapter I, Part 620, Section 620.410 Groundwater Quality Standards for Class 1: Potable Resource Groundwater, 2012.

[b] A dash indicates this compound was not detected above the instrument detection limit in any of the samples from this well

[c] Bold font indicates this average result exceeded the GQS for this compound.

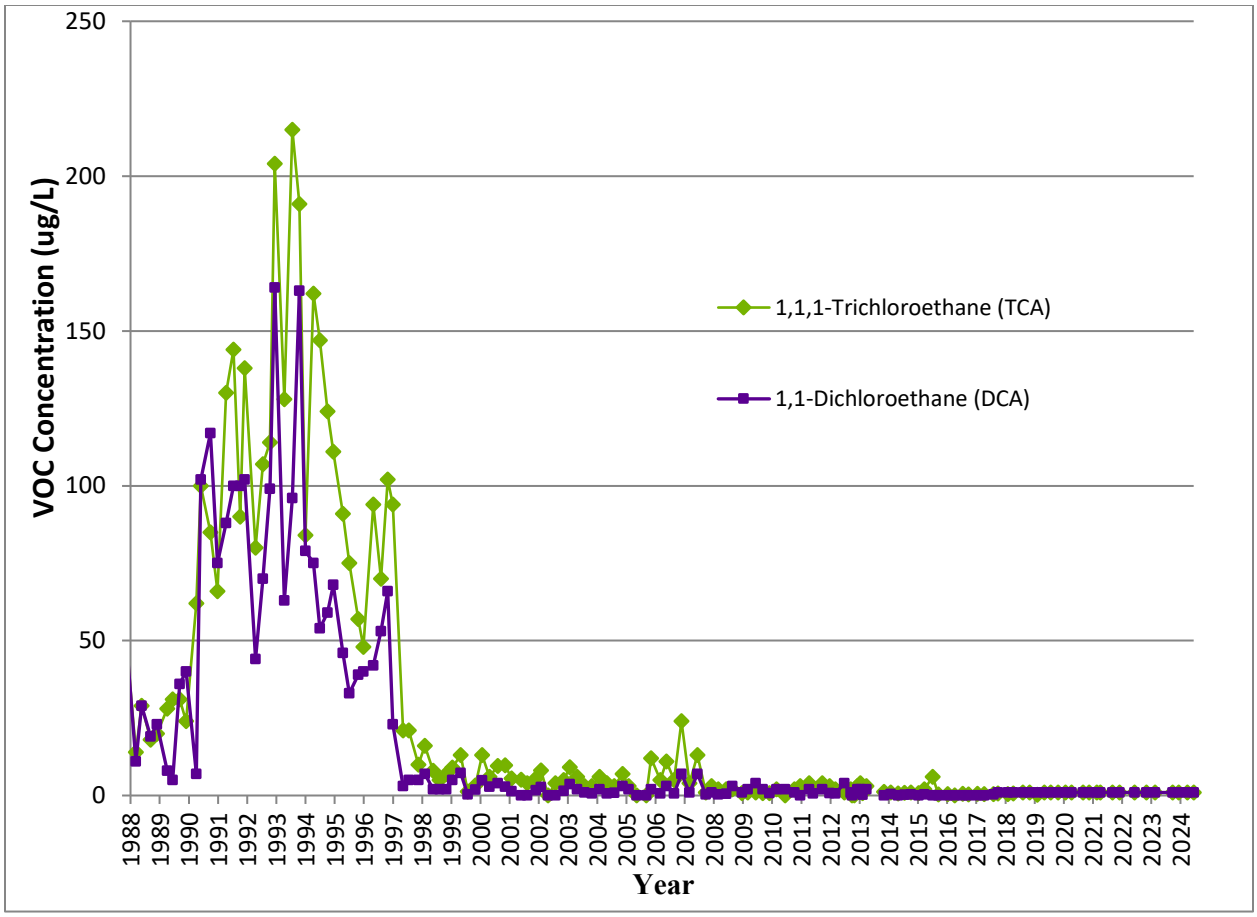


FIGURE 6.10 VOC Concentrations in Well 317021 since 1988

6.3.5. 317 Area Manhole Sampling

In addition to the wells in this area, two manholes associated with the waste storage vault footing drain system are monitored monthly. Figure 6.9 shows the location of these two manholes. This system conveys water from an interior drain in the North Vault and footing drains around several of the now-demolished vaults (the footing drains were left in place when the vaults were demolished), through Manhole E1, and on to Manhole E2. A pump located in Manhole E2 pumps the water to the on-site LWTP. It is treated and discharged into Sawmill Creek. Since 1997, water collected by the 317 and 319 leachate and groundwater collection systems has also been discharged to Manhole E2, from where it is pumped to the laboratory wastewater treatment plant. Thus, the water in these manholes, particularly Manhole E2, is a mixture of groundwater from footing drains around the vaults in the 317 Area, leachate and groundwater from the 319 Area Landfill, and groundwater from the 317 Area groundwater collection system. Monitoring contaminant concentrations in these manholes provides additional information about the progress of remedial actions in the 317 French Drain Area, as well as contaminants discharged to the LWTP.

Manholes E1 and E2 were sampled monthly and analyzed for VOCs, cesium-137, and hydrogen-3. The results for 2024 are summarized in Table 6.8. Some of the VOC concentrations in Manhole E1 were higher than in Manhole E2 and some were lower. The different concentrations are due to the fact that groundwater from the 319 and 317 Area groundwater extraction systems is mixed with footing drain water in Manhole E2, changing the composition of water in this manhole. The VOC concentrations found during 2024 were similar to results from the last few years. Hydrogen-3 and cesium-137 were not detected above the detection limit in any of the samples during 2024.

TABLE 6.8

Annual Average VOC Results from the 317/319 Manholes, 2024

	Manhole E1	Manhole E2
VOCs (µg/L)		
1,1 Dichloroethane	66.9	80.8
1,1,1 Trichloroethane	5.3	6.1
1,2 Dichloroethane	4.8	1.5
1,4 Dioxane	6.5	6.5
Carbon Tetrachloride	24.7	10.4
Chloroform	25.3	8.6
cis 1,2 Dichloroethene	11.4	11.3
Methylene Chloride	5.2	ND[a]
Tetrachloroethene	5.2	3.6
Trichloroethene	13.7	7.3
Radionuclides (pCi/L)		
Cesium-137	<2	<2
Hydrogen-3	<100	<100

[a] ND = Not detected.

6.4. ENE Landfill Groundwater Monitoring

The ENE Landfill was used in the early years of the site for the disposal of demolition debris, discarded equipment, and other items. In 2001, the waste material was consolidated and a clay cap was constructed over the waste mound. In April 2003, the IEPA issued a RCRA corrective action determination covering post-closure care and groundwater monitoring for the ENE Landfill. As required by the IEPA, monitoring at the ENE Landfill is being conducted twice per year throughout the 15-year post-closure care period, which started in December 2002. The 15-year post-closure period ended in December 2017. Until further guidance is received from the IEPA, ANL will continue to monitor and report the results.

Seven monitoring wells are currently used to collect groundwater samples from near the landfill. Figure 6.11 shows the well locations. The purpose of groundwater monitoring at the ENE Landfill is to verify that contaminants found in the landfill are not migrating to shallow groundwater. The contaminants which were found above Tier 1 soil remediation objectives include metals and the PCB Aroclor 1254. Hydrogen-3 is also monitored at this location.

Parameters analyzed twice in 2024 included total PCBs and five soluble (filtered) metals (arsenic, chromium, lead, manganese, and nickel). The same metals are analyzed once per year in unfiltered samples. Some of the wells are equipped with low flow pumps to reduce the impact of suspended sediment in the samples and to produce a more representative groundwater sample. Samples are collected using these pumps whenever possible; however, typically, groundwater levels are too low or site conditions are too poor to allow this type of pump to be used. In such a situation, the pump is removed from the well and the sample is collected with a bailer. In these instances, the amount of silt in the sample is much higher, which results in elevated levels of total metals. During 2024, only well ENE051 had sufficient water to use the low flow sampling pump. In quarter 4 of 2024, ENE031 had sufficient water for low flow sampling, so a pump was used.

The 2024 results from this program are summarized in Table 6.9. In this table, the two semiannual filtered metals results are averaged. As shown in Table 6.9, the GQS for total (unfiltered) manganese was exceeded in three of the downgradient wells that are sampled (i.e., ENE012, ENE031, and ENE041). The total (unfiltered) GQS's for chromium, lead, and nickel were exceeded in well ENE041. Total (unfiltered) arsenic's GQS was exceeded in wells ENE031 and ENE041. The filtered sample from Well ENE031 was the only filtered sample from ENE in 2024 that exceeded the GQS for manganese. All of the other wells were below GQS for the filtered samples. The elevated levels of unfiltered metals are likely natural in origin and may be due to the large amount of silt found in these wells. No PCBs were detected in any of the wells. Hydrogen-3 was not detected in any wells at concentrations above the detection limit of 100 pCi/L.

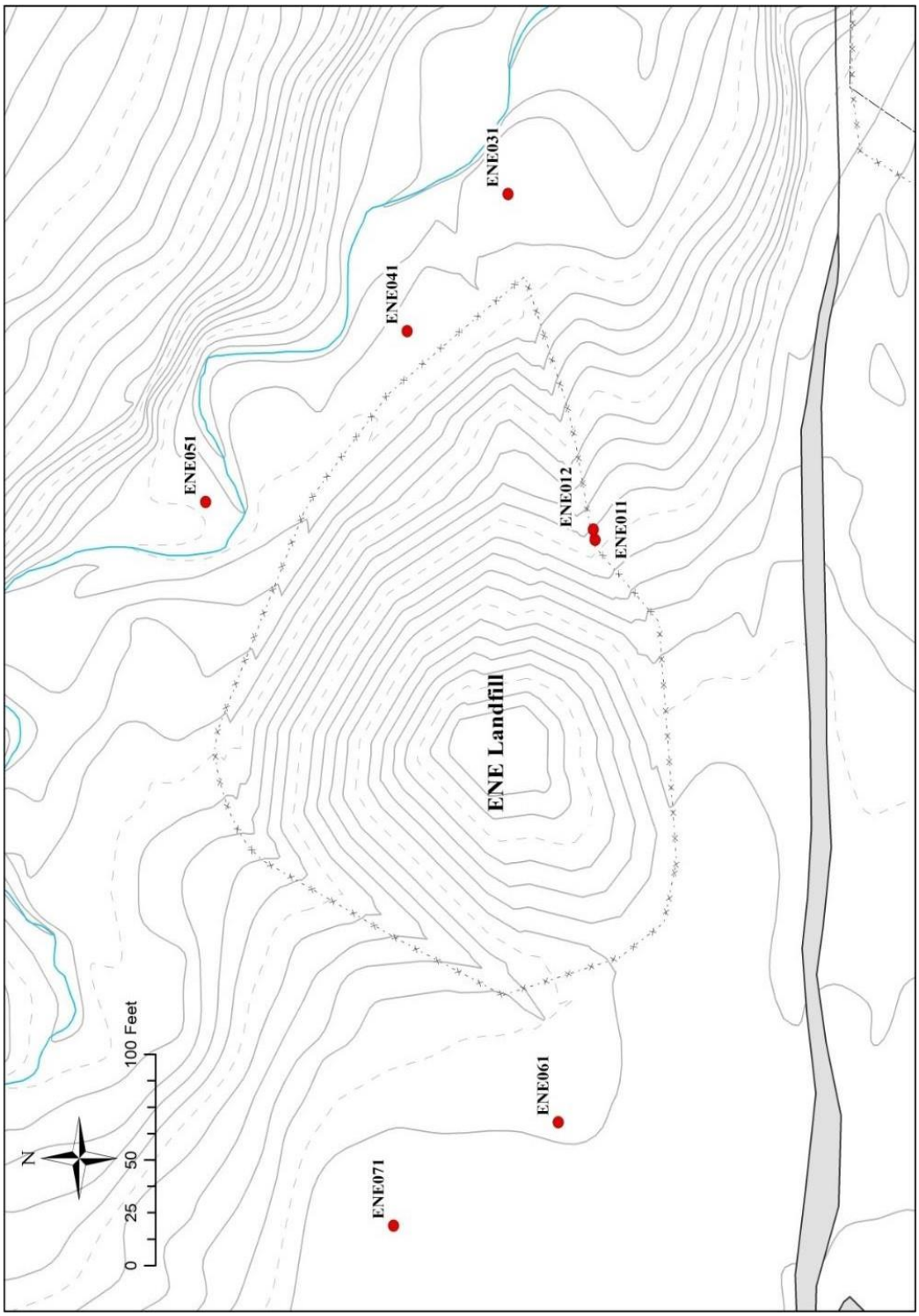


FIGURE 6.11 Locations of ENE Area Groundwater Monitoring Wells

TABLE 6.9

Annual Average Concentrations of ENE Landfill Groundwater Constituents, 2024

Parameter[a]	Well No. ENE011	ENE012	ENE031[b]	ENE041	ENE051[b]	ENE061[c]	ENE071[c]	Class 1 GQS[d]
Unfiltered Metals (mg/L)								
Arsenic	<0.001	<0.001	**0.01**[e]	**0.025**	<0.001	DRY	0.0012	0.01
Chromium	<0.05	0.07	0.08	**0.13**	<0.05	DRY	<0.05	0.1
Lead	0.00078	0.0013	0.0013	**0.023**	<0.0005	DRY	0.0012	0.0075
Manganese	<0.075	**0.89**	**2.58**	**8.265**	<0.075	DRY	0.12	0.15
Nickel	<0.05	<0.05	0.07	**0.21**	<0.05	DRY	<0.05	0.1
Filtered Metals (mg/L)								
Arsenic[e]	<0.001	<0.001	0.0044	<0.001	<0.001	<0.001	<0.001	0.01
Chromium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.1
Lead	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0075
Manganese	<0.075	<0.075	**0.263**	<0.075	<0.075	<0.075	<0.075	0.15
Nickel	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.1
PCB–total (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Hydrogen-3 (pCi/L)	<100	<100	<100	<100	<100	DRY	<100	20,000

[a] Concentrations in mg/L except where noted otherwise.

[b] Well ENE051 was sampled using low-flow sampling techniques. Well ENE031 was sampled using low-flow sampling techniques in Quarter 4 of 2024. All other wells were sampled with a bailer.

[c] Wells ENE061 and ENE071 are upgradient, background wells.

[d] Title 35 of the Illinois Administrative Code: Environmental Protection, Subtitle F, Chapter I, Part 620, Section 620.410 Groundwater Quality Standards for Class 1: Potable Resource Groundwater, 2012.

[e] Bold type indicates that the value exceeds the GQS.

6.5. 800 Area Sanitary Landfill Monitoring

The former 800 Area sanitary landfill is located on the western edge of the site (see Figure 1.1). The 8.8-ha (21.8-acre) landfill received solid waste from 1966 until September 1992 and was operated under IEPA Permit No. 1981-29-OP, which was issued in 1981. The landfill received general refuse, construction debris, boiler house ash, and other nonradioactive solid waste. The landfill was also used for the disposal of approximately 109,000 L (29,000 gal) of liquid waste consisting of used oil or used machining coolant (an oil-water emulsion), though small quantities of chemical wastes that would be considered hazardous waste by current regulations were also placed in the landfill.

The landfill was closed in 1992, in accordance with the closure plan established under the operating permit. Closure included the installation of a 0.6-m (2-ft) thick compacted clay cap over the waste mound. A RFI was conducted in 1997 under the RCRA Corrective Action Program to determine if any hazardous materials had migrated from the landfill. Measurable amounts of several hazardous materials were identified in leachate in the waste mound. The most common contaminants in the landfill were PCBs and pesticides (Aroclor 1260, DDE, and DDT), several VOCs (toluene, acetone, and methylene chloride), and SVOCs (several phthalates). The VOCs and SVOCs were thought to be laboratory artifacts and likely not actually present in the waste. None of these compounds were found in groundwater near the landfill during the RFI. A No Further Action (NFA) determination was received from the IEPA in 2003. This letter specified that post-closure groundwater monitoring activities would be carried out for the 15-year post-closure care period, which began in 1999. This section discusses the groundwater monitoring results for 2024.

The 15-year post-closure care period was completed in September 2014. As required by the IEPA, a report was prepared that summarized the monitoring results throughout the 15-year period and assessed the results in relation to GQS and background concentrations. The report was submitted to the IEPA in January of 2015. The report concluded that exceedances of GQS occurred throughout the 15-year post-closure care period, although the causes of the exceedances were not known and additional monitoring is needed. Thus, a request was made to extend the post-closure care monitoring period for an additional 10 years. Several changes to the monitoring program were also requested based on the past monitoring results. As of the writing of this report, there has not yet been a response from the IEPA. Until a response is received, the monitoring and post closure care practices currently in place will continue.

The current monitoring well network is shown in Figure 6.12. The network consists of two types of wells. Fifteen shallow wells are screened in glacial till between 4 and 14 m (13 and 46 ft) deep. These wells have well screens situated in porous sandy zones within the glacial till. They provide samples of the uppermost layers of groundwater adjacent to the landfill. Six deep wells are screened in the top of the dolomite limestone bedrock underlying the glacial till. Five of these wells are situated near five of the shallow wells, forming five well clusters. Two wells are considered background wells (Wells 800271 and 800273D) and they are located approximately 670 m (2,200 ft) to the northeast of the landfill mound. These wells are out of the influence of the landfill and provide information on the background level of groundwater constituents.

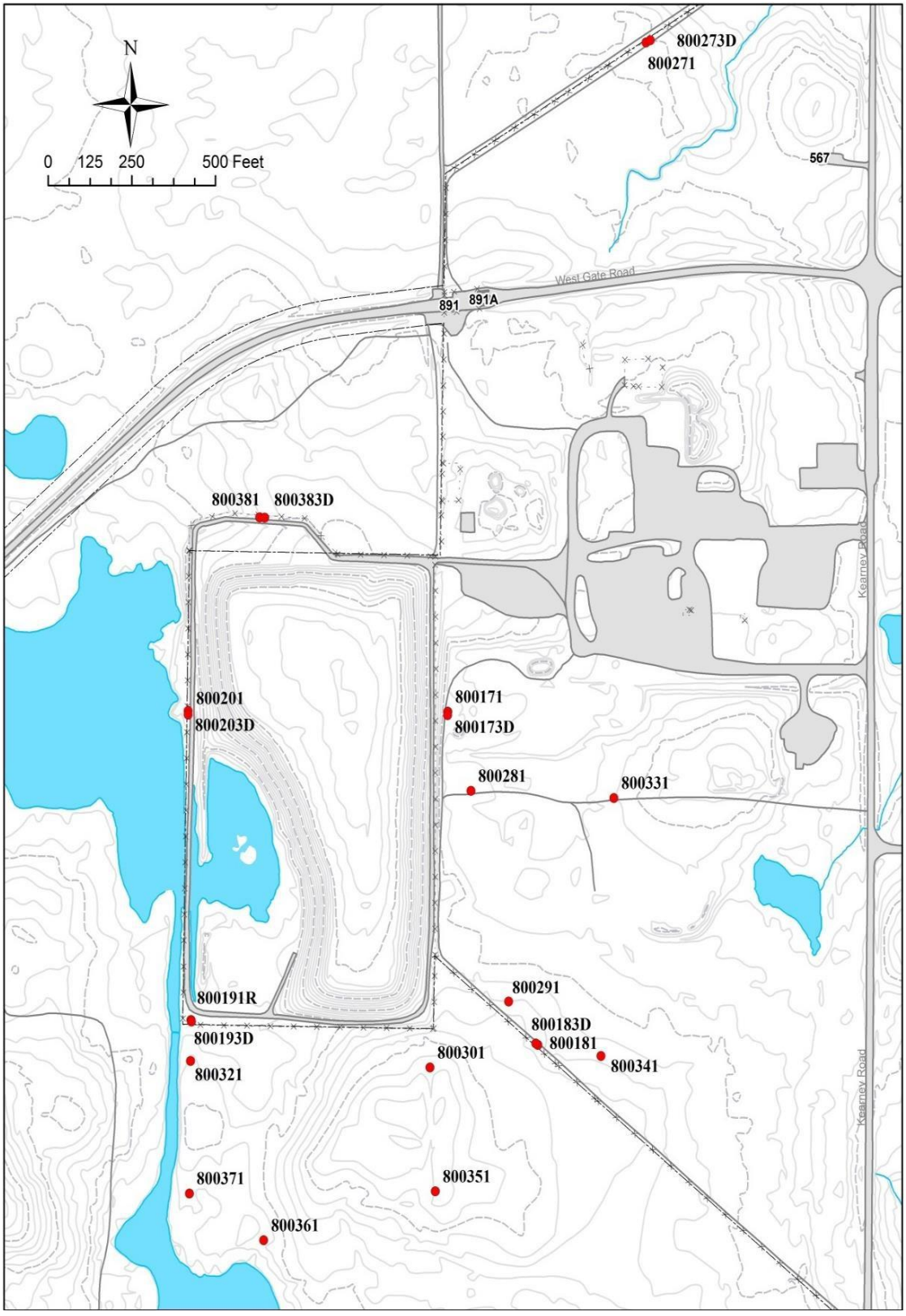


FIGURE 6.12 Locations of 800 Area Landfill Groundwater Monitoring Wells

Since 2009, all shallow wells have utilized low-flow pumps for purging and sample collection. These pumps improve the quality and representativeness of the samples recovered from these wells since they do not disturb the sediment in the wells during sampling. A bailer agitates the water in the well which disturbs sediment, resulting in silty samples and elevated values of some metals. Samples from the dolomite wells are collected by using an electronic submersible pump. These wells are screened in fractured rock that does not produce as much sediment as the glacial drift. Thus, low-flow pumps are not necessary in these wells.

Each well is sampled quarterly for permit-required parameters. During the first, third, and fourth quarters, only the List 1 (field parameters of groundwater depth, pH, specific conductivity, and temperature) and List 2 constituents (filtered metals, sulfate, chloride, TDS, cyanide, phenols, total organic carbon [TOC], and total organic halogens [TOX]) are measured. During the second quarter, additional samples are collected and analyzed for List 3 and 3A parameters (unfiltered metals and certain VOCs, SVOCs, PCBs, pesticides, and herbicides). In addition to the required annual analyses, VOCs and hydrogen-3 are monitored voluntarily by Argonne during all quarters to provide better documentation of conditions around and under the landfill.

6.5.1. Basis for Evaluation of Analytical Results

In 2005, the IEPA approved a set of background concentrations for groundwater constituents monitored at the landfill. The background values were developed from five years of monitoring results from the two upgradient monitoring wells, Well 800271 in the shallow glacial drift, and Well 800273D in the dolomite bedrock. The quarterly monitoring results are evaluated by comparing the results with either the IEPA-approved background values or the GQS for each constituent, where such limits exist. For routine indicator parameters (Lists 1 and 2), the permit requires the comparison of the individual results with background values. For unfiltered metals and organic constituents, the results are compared with the GQSs for Class I Potable Resource Groundwater (35 IAC Part 620.410), where such standards exist. Where GQS values do not exist, the results are compared with two times the practical quantitation limit for that compound, as listed in the permit. Table 6.10 lists the applicable permit limits for the 800 Area Landfill. Footnotes to this table explain the source of the individual groundwater quality limits. To simplify the table, the limits for the long list of organics (two times the PQL) are not shown. In the data tables that follow, values that exceed applicable limits are shown in bold print.

TABLE 6.10

Permit Limits for 800 Area Landfill Groundwater

Parameter	Unit	Permit Limit Shallow Wells	Source[a]	Permit Limit Deep Wells	Source[a]
Field Parameters					
Conductivity	µS/cm	703	4	1,306	1
pH	pH	6.57–7.88	1	6.48–7.74	1
Filtered Samples					
Ammonia nitrogen	mg/L	0.90	4	1.0	4
Chloride	mg/L	20	4	140	1
Sulfate	mg/L	58	1	150	1
TDS	mg/L	428	1	880	1
Arsenic	mg/L	0.010	2	0.0048	4
Cadmium	mg/L	0.001	2	0.001	2
Iron	mg/L	0.099	4	1.60	1
Lead	mg/L	0.01	2	0.01	2
Manganese	mg/L	0.097	4	0.021	4
Mercury	mg/L	0.002	2	0.002	2
Unfiltered Samples					
Chloride	mg/L	200	3	200	3
Cyanide (total)	mg/L	0.011	4	0.04	2
Fluoride	mg/L	4.0	3	4.0	3
Nitrate	mg/L	10.0	3	10.0	3
Phenols	mg/L	0.033	4	0.033	4
Sulfate	mg/L	400	3	400	3
TOC	mg/L	2.71	5	5.3	4
TOX	mg/L	0.086	4	0.041	4
Arsenic	mg/L	0.010	3	0.010	3
Barium	mg/L	2.0	3	2.0	3
Boron	mg/L	2.0	3	2.0	3
Cadmium	mg/L	0.005	3	0.005	3
Chromium	mg/L	0.10	3	0.10	3
Cobalt	mg/L	1.0	3	1.00	3
Copper	mg/L	0.65	3	0.65	3
Iron	mg/L	5.0	3	5.0	3
Lead	mg/L	0.0075	3	0.0075	3
Manganese	mg/L	0.15	3	0.15	3
Mercury	mg/L	0.002	3	0.002	3
Nickel	mg/L	0.10	3	0.10	3
Selenium	mg/L	0.05	3	0.05	3
Silver	mg/L	0.05	3	0.05	3
Zinc	mg/L	5.0	3	5.0	3

[a] The various permit limits were generated in the following manner:

1 = Calculated from 95% upper confidence interval of the data set. Calculation used one-half the detection limits for values less than the detection limits.

2 = Background values equal the PQL. All measured values in background wells were below PQLs.

3 = IEPA's Class I Groundwater Quality Standard.

4 = Background value based on nonparametric statistical methods for data sets with more than 15%, but less than 100% of measured values below detection limits.

5 = Calculated from 95% upper confidence interval for data set that was first transformed by calculating the natural log of the measured values.

6.5.2. Results of Analyses — Shallow Wells

Field parameters and the results of chemical and radiological analyses for the shallow wells are summarized in Table 6.11. This table lists the average of the quarterly results that were above detection limits. It also lists the individual results for those parameters that were analyzed only once during 2024. Only results for constituents that were above detection limits in one or more samples during 2024 are shown. None of the VOCs, SVOCs, PCBs, and pesticides were detected. To simplify the data tables, results for these constituents are not shown.

The monitoring results for the shallow wells in the 800 Area Landfill during 2024 were similar to previous years' results. Many of the downgradient wells exhibited levels of dissolved inorganic matter (expressed by conductivity, TDS, sulfate, and chloride concentrations) higher than the background values. These elevated parameters are thought to result from the proximity of the downgradient wells to roadways and parking areas that are salted in the winter. It is thought that the salt in road runoff has migrated to the shallow wells, increasing the concentration of salt in the groundwater which results in elevated readings for these parameters. The background wells are far from roadways or paved areas and no roadway runoff passes near these wells; thus, these parameters are much lower in the background wells than the wells near the developed areas around the landfill.

In addition to the dissolved salts, several naturally-occurring metals were found to be present above the background levels. Soluble iron and manganese were found to be higher than background values in several of the wells. These elevated levels are thought to result from the natural variation in soil composition around the landfill as well as from the influence of the nearby wetland area, immediately west of the landfill. The organic matter in the wetland soil generates acidic water which can solubilize naturally occurring metals, increasing their concentrations in groundwater. Several of the wells with elevated levels of metals are near this wetland area. These wells also exhibited higher than the background level of TOC, and one of these wells (800201) was also elevated in ammonia, which may also be related to the close proximity of the wetland. Total metals results (from unfiltered samples) exceeded the GQS for manganese in one well, phenols in one well, and TOC in two wells. Hydrogen-3 was not detected above the detection limits in any of the shallow wells around the 800 Area Landfill during 2024.

TABLE 6.11

Annual Average Concentrations of 800 Area Landfill Shallow Groundwater Constituents, 2024

Parameter	Limit[a]	800171	800181	800191	800201	800271[b]	800281	800291	800301
Field Parameters									
Conductivity (µS/cm)	703	**734**[d]	**1,698**	**1,563**	**1,179**	568	**1,007**	**1,133**	**1,060**
pH	6.57–7.88	6.81 – 6.95	7.41 - 7.46	6.58 - 6.76	6.82 - 7.04	7.13 - 7.37	6.77 – 7.94	6.98 - 7.21	6.92 – 6.98
Filtered Samples (mg/L)[c]									
Ammonia Nitrogen	0.90	<0.18	<0.20	<0.18	**2.34**	<0.18	<0.18	<0.18	<0.18
Chloride	20	5	19	**127**	**25**	3	**36**	15	8
Sulfate	58	31	**280**	**209**	**102**	9	**93**	**191**	**178**
TDS	428	361	**1,100**	**917**	**760**	215	**519**	**708**	**645**
Arsenic	0.010	<0.001	0.0031	<0.001	0.0031	<0.001	<0.001	<0.001	0.001
Iron	0.099	<0.021	<0.021	0.048	**1.808**	<0.021	**0.311**	0.062	**0.430**
Manganese	0.097	<0.01	0.012	0.370	**0.202**	<0.01	**0.195**	**0.118**	**0.113**
Unfiltered Samples (mg/L)[c]									
Phenols (total)	0.033	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
TOCs	2.71	1.98	1.70	**4.63**	**27.0**	1.53	2.50	1.50	1.00
TOXs	0.086	0.033	0.034	0.064	<0.040	0.030	<0.040	0.031	<0.040
Chloride	200	4	18	89	26	4	32	15	8
Fluoride	4.0	0.13	0.39	0.37	0.38	0.15	0.24	0.43	0.27
Sulfate	400	24	355	148	117	12	91	201	151
Nitrate	10	<0.10	<0.10	<0.10	0.40	0.20	<0.10	<0.10	<0.10
Arsenic	0.05	<0.001	0.012	<0.001	0.0027	<0.001	<0.001	<0.001	0.0028
Barium	2.0	0.053	0.044	0.029	0.290	0.020	0.046	0.021	0.020
Boron	2.0	<0.10	<0.10	<0.10	0.100	<0.10	0.200	<0.10	<0.10
Copper	0.65	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Iron	5.0	0.740	<0.021	0.460	3.200	0.078	<0.021	<0.021	0.940
Lead	0.0075	0.0012	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Manganese	0.15	0.080	0.010	0.120	**0.210**	<0.010	0.010	<0.010	0.050
Hydrogen-3 (pCi/L)	20,000	<100	<100	<100	<100	<100	<100	<100	<100

TABLE 6.11 (Cont.)

Annual Average Concentrations of 800 Area Landfill Shallow Groundwater Constituents, 2024

Parameter	Limit[a]	800321	800331	800341	800351	800361	800371	800381
Field Parameters								
Conductivity (µS/cm)	703	**1,993**[d]	**818**	**859**	**938**	**930**	**903**	**1,200**
pH	6.57–7.88	6.65 - 6.81	6.93 - 7.47	7.07 – 7.33	7.09 - 7.14	6.99 - 7.04	6.96 – 7.08	6.72 - 6.78
Filtered Samples (mg/L)[c]								
Ammonia Nitrogen	0.90	<0.18	0.33	<0.18	0.23	<0.18	<0.18	<0.18
Chloride	20	9	7	7	4	15	3	6
Sulfate	58	**373**	**87**	**63**	**77**	**141**	**126**	**184**
TDS	428	**1,013**	**450**	415	**498**	**476**	**462**	**739**
Arsenic	0.010	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001
Iron	0.099	0.062	**0.733**	<0.021	**1.062**	<0.021	<0.021	<0.21
Manganese	0.097	**0.120**	**0.235**	0.044	0.020	0.013	0.018	0.074
Unfiltered Samples (mg/L)[c]								
Phenols (total)	0.033	0.013	<0.005	<0.005	0.006	<0.005	**0.044**	<0.005
TOC	2.71	1.15	1.13	1.24	1.34	1.60	1.00	1.72
TOXs	0.086	0.031	<0.032	<0.030	0.031	0.033	<0.032	<0.031
Chloride	200	7	6	7	4	16	3	5
Fluoride	4.0	0.31	0.41	0.23	0.29	0.32	0.44	0.22
Sulfate	400	243	89	60	74	146	138	162
Nitrate	10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	6.8
Arsenic	0.05	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001
Barium	2.0	0.014	0.041	0.026	0.085	0.034	0.058	0.030
Boron	2.0	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	<0.10
Copper	0.65	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Iron	5.0	<0.021	<0.021	<0.021	2.12	<0.021	<0.021	<0.021
Lead	0.0075	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Manganese	0.15	0.040	<0.01	<0.01	0.020	<0.01	0.030	0.020
Hydrogen-3 (pCi/L)	20,000	<100	<100	<100	<100	<100	<100	<100

[a] Refer to Table 6.10 for an explanation of groundwater quality limits for the 800 Area Landfill.

[b] Background well.

[c] In addition to the parameters shown, these samples were also analyzed for cadmium, chromium, cobalt, mercury, nickel, selenium, silver, and zinc but none of the samples contained these elements above their detection limits.

[d] Bold type indicates that the value exceeds the GRO.

6.5.3. Results of Analyses — Bedrock Monitoring Wells

The average 2024 results for the deep wells are shown in Table 6.12. Only results for constituents that were above detection limits in one or more samples during 2024 are shown. None of the VOCs, SVOCs, PCBs, and pesticides were detected. To simplify the data tables, results for these constituents are not shown.

The amount of dissolved salt in the deep wells was much lower than in the shallow wells. The lower dissolved salt concentrations may be a result of the greater depth of these wells, which reduces the impact of salt in road runoff. Background well 800273D had an exceedance for soluble arsenic. TOX's limit was exceeded in wells 800183D, 800193D, and 800203D. Soluble ammonia nitrogen's limit was exceeded in well 800203D, which also exceeded the soluble arsenic limit. Soluble manganese's limit was exceeded in well 800173D.

Groundwater monitoring results indicate that there is no evidence of the release of toxic chemicals or radioactive materials from the landfill. The parameters that are elevated are likely not related to releases from the landfill but are caused by natural or unrelated man-made factors such as road salt in roadway runoff.

6.6. CP-5 Reactor Area Monitoring

In addition to the required sampling of former waste sites, Argonne is voluntarily monitoring the condition of groundwater near the site of the former Chicago Pile-5 (CP-5) reactor. The CP-5 reactor was a five-megawatt research reactor that was used from 1954 until operations ceased in 1979. Decontamination of the interior of the structure, an investigation of the area surrounding the reactor, and corrective actions were completed by 2002. The IEPA issued a notice of NFA in 2003. In 2011, the final decontamination and demolition of the CP-5 structure was completed with the removal of all the remaining structures above and below the ground.

Groundwater adjacent to the reactor complex has been monitored since 1989. Figure 6.13 shows the current monitoring well network. All wells are screened in the glacial drift. The current network of wells is sampled quarterly and analyzed for soluble metals, chloride (filtered samples), and radioactive materials (cesium-137, hydrogen-3, and strontium-90). The results are presented in Table 6.13. The results are compared to Class I GQS and any results above these limits are shown in bold.

Elevated chloride levels were found in three wells. The two wells with the highest chloride results are located near the current road salt storage facility (a steel dome, designated as 330J on Figure 6.13, that had been part of the reactor complex but was converted to salt storage). Salt- laden runoff from this area is thought to be migrating to the wells, increasing chloride levels.

TABLE 6.12

Annual Average Concentrations of 800 Area Landfill Dolomite Bedrock Groundwater Constituents, 2024

Parameter	Limit[a]	800173D	800183D	800193D	800203D	800273D[b]	800383D
		G06D	G08D	G11D	G14D	G16D	G03D
Field Parameters							
Conductivity (µS/cm)	1,306	1,026	1,163	1,226	995	1,008	997
pH	6.48–7.74	7.07 - 7.28	7.04 - 7.22	6.96 – 7.07	7.04 – 7.14	7.06 – 7.17	7.12 - 7.16
Filtered Samples (mg/L)[c]							
Ammonia Nitrogen	1.0	0.55	0.76	0.64	**1.79**[d]	0.49	0.44
Chloride	140	47	101	113	32	13	64
Sulfate	150	129	145	138	53	116	93
TDS	880	572	688	668	608	444	571
Arsenic	0.0048	0.0023	0.0011	0.0011	**0.008**	**0.0071**	0.0029
Iron	1.60	1.048	0.476	0.848	1.31	1.06	0.620
Manganese	0.021	**0.028**	0.014	0.012	0.017	0.01	0.023
Unfiltered Samples (mg/L)[c]							
Phenols	0.033	0.010	<0.005	0.005	<0.005	<0.005	<0.005
TOC	5.3	1.25	1.36	1.28	2.78	<1	1.03
TOX	0.040	0.033	**0.138**	**0.043**	**0.048**	0.039	0.032
Chloride	200	46	104	110	41	13	77
Fluoride	4.0	0.44	0.50	0.42	0.42	0.39	0.44
Sulfate	400	134	146	139	64	118	88
Nitrate	10.0	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic	0.01	0.002	<0.001	0.001	0.010	0.009	0.004
Barium	2.0	0.057	0.033	0.045	0.150	0.047	0.067
Boron	2.0	0.20	0.20	0.20	0.20	0.145	0.20
Iron	5.0	1.53	0.62	1.11	3.30	1.43	1.43
Manganese	0.15	0.030	0.01	0.010	0.020	<0.01	0.020
Nickel	0.10	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Hydrogen-3 (pCi/L)	20,000	<100	<100	<100	<100	<100	<100

[a] Refer to Table 6.10 for an explanation of groundwater quality limits for the 800 Area Landfill.

[b] Background well.

[c] In addition to the parameters shown, these samples were also analyzed for cadmium, chromium, cobalt, copper, lead, mercury, selenium, silver, zinc, and cyanide, but none of the samples contained these compounds above their detection limits.

[d] Bold type indicates that the value exceeds the GRO.

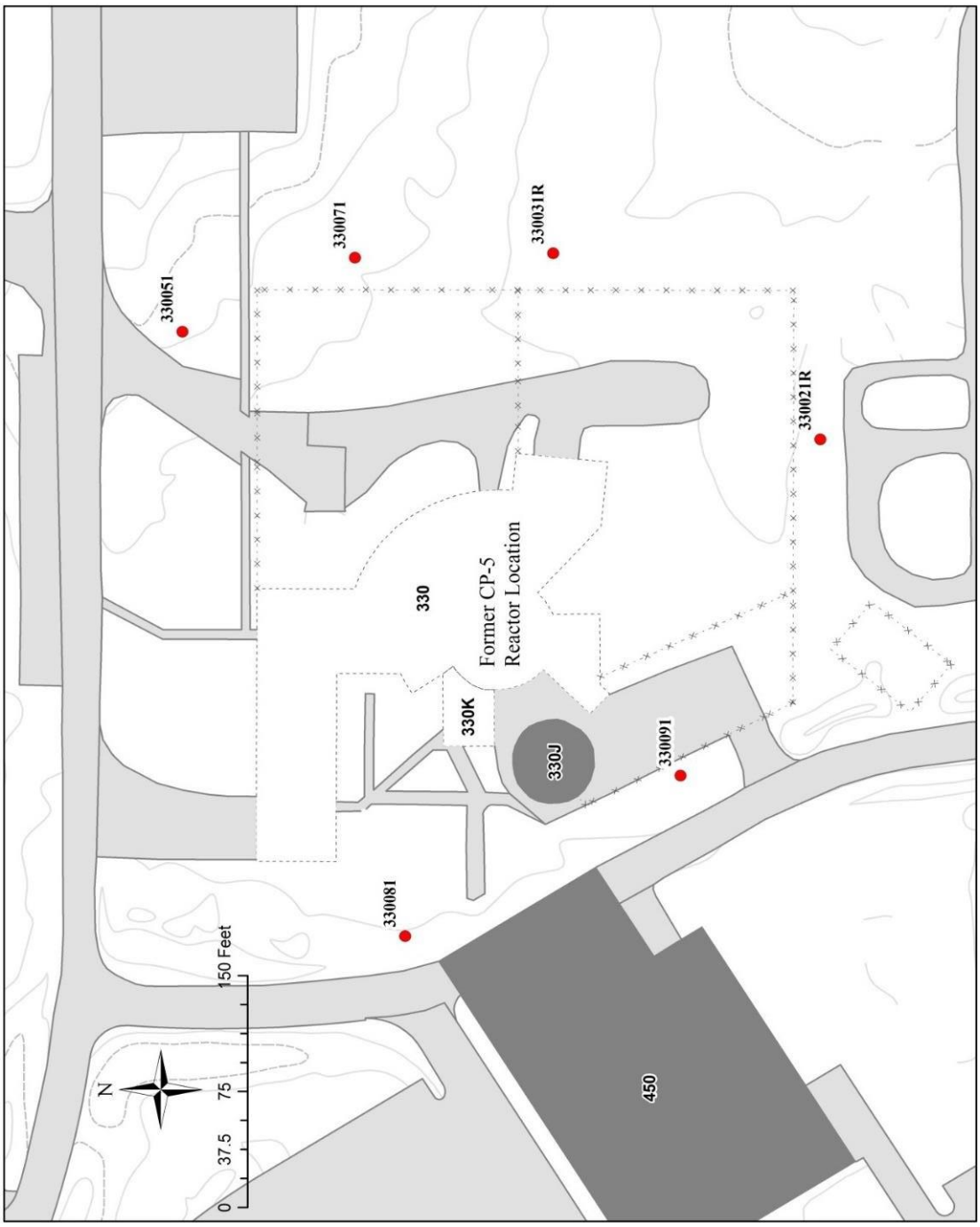


FIGURE 6.13 Locations of Monitoring Wells in the CP-5 Reactor Area

TABLE 6.13

Annual Average Concentrations of CP-5 Groundwater Constituents, 2024

Parameter	Class 1 GQS[a]	Well Number 330021R	330031R	330051	330071	330081	330091
Inorganics (mg/L)							
Chloride	200	70	110	**250**[b]	67	**742**	**12,980**
Filtered Metals (mg/L)							
Arsenic	0.01	<0.001	0.0016	<0.001	0.0014	<0.001	0.0081
Barium	2	<0.5	<0.5	<0.5	<0.5	<2.5	**5.47**
Beryllium	0.004	<0.0025	<0.0025	<0.0025	<0.0025	<0.012	**0.0093**
Cadmium	0.005	<0.0025	<0.0025	<0.0025	<0.0025	<0.012	<0.013
Chromium	0.1	<0.05	<0.05	<0.05	<0.05	<0.25	<0.25
Cobalt	1	<0.25	<0.25	<0.25	<0.25	<1.2	<1.25
Copper	0.65	<0.025	<0.025	<0.025	<0.025	<0.12	<0.12
Iron	5	<0.5	<0.5	<0.5	<0.5	<2.5	**65.13**
Lead	0.0075	<0.0005	<0.0005	<0.0005	0.0005	<0.0005	<0.0016
Manganese	0.15	<0.075	<0.075	<0.075	<0.075	0.038	**17.28**
Mercury	0.002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	0.1	<0.05	<0.05	0.052	<0.05	<0.25	<0.25
Silver	0.05	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.00078
Thallium	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.0065
Vanadium	0.049	<0.025	<0.025	<0.025	<0.025	<0.12	<0.13
Zinc	5	<0.5	<0.5	<0.5	<0.5	<2.5	<2.5
Radionuclides (pCi/L)							
Cesium-137	NA[c]	<2	<2	<2	<2	<2	<2
Hydrogen-3	20,000	<100	8,790	<100	<100	<100	211
Strontium-90	NA	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25

[a] Title 35 of the Illinois Administrative Code: Environmental Protection, Subtitle F, Chapter I, Part 620, Section 620.410 Groundwater Quality Standards for Class 1: Potable Resource Groundwater, 2012.

[b] Bold font indicates results above the Class I GQS limit.

[c] NA = Not applicable. Indicates that no GQS standard exists for this compound.

Well 330091 had annual average concentrations above GQS for soluble metals for barium, beryllium, manganese, and iron. It is thought that the metals are of natural origin. There are no known man-made sources of these metals near the CP-5 reactor.

Hydrogen-3 was detected during at least one quarter in two wells, but only one result was close to the GQS of 20,000 pCi/L. Well 330031R had an average hydrogen-3 concentration of 8,790 pCi/L. This well is located near the former reactor's sewer line. It is thought that contaminated wastewater released into the sewer system during its operational lifetime leaked out into the soil surrounding the sewer. Well 330031R (a replacement well) happened to encounter a region of soil containing some of this contaminated wastewater. An investigation performed in 2006 confirmed that the groundwater with elevated hydrogen-3 is isolated in a small porous zone and there is little migration of groundwater away from the reactor. Cesium-137 and Strontium-90 were not found above analytical detection limits in any of the wells.

6.7. Artesian Well Monitoring

An artesian well is located about 2,000 m (6,000 ft) southwest of the 317 Area in the Waterfall Glen Forest Preserve (grid location 3E in Figure 1.1). The water from this well was sampled four times during 2024 and analyzed for hydrogen-3. All hydrogen-3 concentrations in 2024 were below the detection limit of 100 pCi/L.

6.8. Groundwater Monitoring Program Summary

Argonne groundwater sampling activities during 2024 are summarized in Table 6.14. The monitoring program is a critical element of Argonne's groundwater protection program. The groundwater monitoring strategy focuses resources on those areas that have the potential to impact groundwater. The analytical results generated by the monitoring program demonstrate the degree of compliance with applicable groundwater standards and limits and they identify the need for continued groundwater remediation in the 317/319 Area.

Overall, groundwater quality at Argonne is good, with significant contamination present at only one location, the 317/319 Area, where concentrations of VOCs in groundwater are above applicable standards. Some of this groundwater comes to the surface in several small groundwater seeps in an isolated part of the Waterfall Glen Forest Preserve. Several remedial actions are underway in this area to reduce contaminant levels, including two groundwater extraction systems, an impermeable cap over the 319 Landfill, and continued sampling and analysis of groundwater samples.

TABLE 6.14

Summary of Groundwater Monitoring by Area, 2024

Groundwater Monitoring Element	Purpose	Number of Wells in Network	Number of Wells Sampled	Number of Sampling Events	Number of Analyses Performed	Percent of Results Nondetectable
317/319 Area wells and manholes	Environmental Surveillance	15	11	56	5,094	95%
317/319/ENE and GMZ wells and seeps	Permit Compliance/ LTS Program	71	46	144	7,217	93%
800 Area Landfill wells	Permit Compliance	24	21	92	8,911	92%
CP-5 wells	Environmental Surveillance	6	5	29	555	88%

Groundwater under the 800 Area Landfill exhibits elevated levels of a number of naturally-occurring metals and inorganic constituents; however, they are probably not related to landfill operations. Elevated levels of hydrogen-3 have been found in one well adjacent to the CP-5 reactor; however, hydrogeological studies have determined that this water is not migrating away from the reactor, the concentration is below the GQS, and it does not represent a hazard. There is little evidence of contamination in the dolomite aquifer, which is the uppermost usable aquifer under the site. One bedrock well in the 317 Area contains man-made contamination above applicable limits.

As shown in Table 6.14, the vast majority of the analytical results in 2024 were below analytical detection limits. Of the results that were above detection limits, only a small fraction were above applicable standards for chemicals or radioactive materials. Argonne has submitted reports containing these analytical data to IEPA.

7. QUALITY ASSURANCE

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Quality assurance is a fundamental component of all operations at Argonne National Laboratory A robust Quality Assurance Plan, complemented by stringent quality control measures, ensuring that environmental samples are representative and that all related data are accurate and defensible. Argonne personnel collect these samples, with approximately 95% analyzed by Argonne scientists within an in-house analytical laboratory. The remaining samples are processed by various contracted laboratories. Quality control is rigorously upheld through the calibration and verification of laboratory and field-portable instruments, as well as the use of numerous quality control samples, and intercomparison samples. All results undergo thorough verification and validation before being reported or utilized in decision-making processes.

The laboratory's commitment to quality assurance is further reinforced through the establishment of data quality objectives, regular internal and external audits, management reviews, and assessments. Comprehensive quality assurance and control plans, standard operating procedures, sampling plans, and procurement contracts are maintained. Specific quality assurance plans and documentation are developed for both radiological and chemical analyses, adhering to DOE Order 414.1D.[41] The *Uniform Federal Policy (UFP) for Implementing Environmental Quality Systems* (March 2005) and its accompanying *Uniform Federal Policy for Quality Assurance Project Plans* (March 2005) serve as guiding frameworks for these quality assurance programs, ensuring compliance and excellence in environmental monitoring.

7.1. Sample Collection and Handling

7.1.1 Field Sample Collection

Environmental monitoring samples, including soil, sediment, groundwater, surface water, stormwater, wastewater, air filters, and Optically Stimulated Luminescence (OSL) dosimeters are collected in accordance with documents such as standard operating procedures (SOPs), Quality Control plans, and Argonne permits. These SOPs specify requirements for the sample collection process, equipment usage and calibration, sample preservation techniques, and sample handling and shipment procedures.

Sampling activities are conducted by trained and qualified personnel, or personnel in training under the supervision of trained and qualified personnel. Samples are collected from designated sampling locations to ensure representativeness, and field measurements are conducted using calibrated instruments, with calibration documented.

Samples are collected and stored in a manner that is designed to maintain the integrity of the analytical constituents. For example, samples for trace radionuclide analyses are acidified immediately after collection to prevent hydrolytic loss of metal ions and are filtered to reduce leaching from suspended solids. Additionally, samples requiring refrigeration at 4° C for preservation are placed in coolers containing ice or frozen gel packs as soon as possible after collection and during transport, then transferred to a refrigerator upon arrival at the laboratory.

7.1.2 Field Quality Control Samples

Quality Control (QC) samples, including control samples, trip blanks, equipment blanks, and replicates, are designated by the sampling schedule and collected in the field. Argonne's EM Quality Control Plan contains the schedule for the collection of these QC samples.

7.1.3 Custody and Documentation

The Chain-of-Custody (COC) forms are signed and dated by both the sampler and the receiver, which include the Argonne in-house Analytical Services laboratory or subcontract laboratories. COC seals are signed and dated and placed on shipping containers as appropriate.

7.2. Data Management

A weekly sample collection schedule is managed using Argonne's in-house database system. This system tracks all pertinent information regarding sampling planning, sample collection, field data collection, requested analyses, and the analytical results. Sample log-in information is transferred to the in-house Analytical Services laboratory or subcontract laboratories, along with chain-of-custody transfer documents. After the samples have been analyzed, resultant data is electronically transferred to Argonne's QC Coordinator and the Database Manager for review. Once results are determined to be complete and valid, the data are entered into the computer database system. Multi-level reviews are performed to validate sampling schedules, sample collection information, and analytical data.

7.3 Analytical Laboratory QA/QC

Environmental samples collected under the Environmental Monitoring Plan are analyzed by one of four contracted commercial laboratories or by the Argonne Analytical Services (AS) laboratory. Each contract with commercial laboratories includes a detailed statement of work that outlines the scope, data deliverables, turnaround times, valid methods, and associated detection/reporting limits. These laboratories must adhere to Argonne's procurement technical specifications and are subject to regular reviews by our staff to ensure compliance with standards and achievement of data quality objectives.

The AS laboratory operates in full compliance with methods required by state and federal requirements and the Argonne National Laboratory Quality Assurance Program Plan. The program is dedicated to upholding the highest standards of quality assurance. This commitment begins with the development, implementation and validation of analytical methods to meet regulatory requirements and project objectives. By establishing clear detection and reporting limits, Argonne ensures its methods are sensitive and accurate, capable of identifying even trace levels of analytes. This foundational work supports Argonne's goal of delivering reliable and precise data, which is critical for informed decision-making and maintaining data integrity.

The AS laboratory maintains rigorous quality control measures, including calibrations, the use of standards traceable to the National Institute of Standards and Technology (NIST), Certified Reference Materials, and the implementation of Matrix Spikes and Matrix Spike Duplicates. These practices validate the accuracy and precision of our analytical methods. Strong performance in proficiency testing studies further demonstrates our capability to consistently produce reliable results that meet industry standards. Through these systematic efforts, Argonne upholds its commitment to data integrity, regulatory compliance, and informed decision-making.

Additionally, AS personnel conduct audits and reviews of procedures to identify areas for improvement, fostering a culture of continuous improvement and adaptation to new scientific advancements and regulatory changes. In 2024, three internal management assessments focused on lab notebooks, standard operating procedures, and compliance with NPDES permit requirements were conducted. No issues were identified that required reanalysis or affected data quality.

Analytical Services also emphasizes the importance of training and development for staff, recognizing that skilled personnel are essential to maintaining quality assurance and control. By fostering a knowledgeable and proficient workforce, they ensure that quality assurance and control practices are executed with expertise, ultimately delivering the highest quality results to clients and stakeholders.

7.4 Contract Laboratories and Disposal Facilities

Argonne used the following contract analytical laboratories for analysis of environmental samples in 2024:

- EnviroScience in Stow, OH for acute toxicity testing.
- Eurofins in University Park, IL for select chemical analytes.
- Eurofins in Barberton, OH for low level mercury analysis.
- Sterling Labs in Des Plaines, IL for per- and polyfluoroalkyl substances (PFAS) analysis.
- Suburban Laboratories in Geneva, IL for select chemical analytes.
- GEL in Charleston, SC for chemical and radiological waste samples

The process of selecting contract analytical laboratories involves the following factors:

- Accredited by the Illinois Environmental Laboratory Accreditation Program (IL ELAP) or U.S. Department of Energy Consolidated Audit Program (DOECAP) for the specific analyses to be performed.
- Their record on proficiency testing.
- Pre-selection bidding when applicable.

- Adherence to their own QA/QC programs, which must be documented and provided to Argonne. QC procedures that laboratories must follow include, but are not limited to, instrument calibrations, continuing calibration verifications, and analysis of duplicates, matrix spikes, certified reference standards and control samples validate measurement accuracy and precision.

Argonne used the following approved contract waste vendor facilities for Treatment, Storage, and Disposal Facilities (TSDF) in 2024:

- EnergySolutions in Clive UT
- EnergySolutions in Bear Creek, TN
- Tradebe Environmental Services in East Chicago, IN
- Clean Harbor Environmental (various locations)
- Waste Isolation Pilot Plant in Carlsbad, NM

The process for selecting contract waste vendor facilities for TSDF considers the following criteria:

- Possession of radiological materials license or RCRA permit (if a commercial facility).
- Performance with treating radiological/hazardous waste within mandated regulatory timeframes.
- Proper storage of incompatible wastes.
- Complete recordkeeping of DOE waste containers.
- Adhering to internal worker safety standard operating procedures and regulatory requirements.

7.5 Demonstration of Proficiency

In 2024 Argonne participated in two environmental proficiency testing programs: the Mixed Analyte Performance Evaluation Program (MAPEP) administered by the Radiological and Environmental Sciences Laboratory, which is operated by the U.S. Department of Energy Idaho Operations Office, and the Discharge Monitoring Report-Quality Assurance Program (DMR-QA), administered by the US EPA. Proficiency testing programs involve an accredited proficiency test provider sending a series of intercomparison samples to Argonne and its contracted laboratories. The laboratories analyze the samples and submit the analytical results to the provider. The test provider determines the acceptability of submitted results by conducting a statistical analysis and comparing them to established reference values. Argonne and its contracted laboratories have consistently performed very well on these tests and demonstrated strong proficiency.

The MAPEP program consists of a biannual distribution of sample matrices containing combinations of radionuclides. The results are provided in Tables 7.1 and 7.2. The 2024 Argonne performance resulted in 100% (50 out of 50) of the analyses being within the MAPEP acceptable range.

The DMR-QA program consists of an annual distribution of proficiency testing samples containing combinations of chemical components. The results are provided in Table 7.3. Argonne and its contracted laboratories' performance resulted in 100% (39 out of 39) of the analyses being within the DMR-QA acceptable range.

TABLE 7.1

Summary of MAPEP Series 50 Intercomparison Sample Results, 2024

Analyte	Matrix	Units	Reported Value	Reference Value	Acceptance Range	Performance Evaluation
Am-241	Air filter	Bq/sample	0.0712	0.0897	0.0628 - 0.1166	Acceptable
Cs-134	Air filter	Bq/sample	0.017	-[a]	False Positive Test	Acceptable
Cs-137	Air filter	Bq/sample	1.524	1.48	1.04 - 1.92	Acceptable
Co-57	Air filter	Bq/sample	0.706	0.819	0.573 - 1.065	Acceptable
Co-60	Air filter	Bq/sample	1.619	1.64	1.15 - 2.13	Acceptable
Mn-54	Air filter	Bq/sample	0.582	0.555	0.389 - 0.722	Acceptable
Pu-238	Air filter	Bq/sample	0.112	0.114	0.080 - 0.148	Acceptable
Pu-239/240	Air filter	Bq/sample	0.09	0.0936	0.0655 - 0.1217	Acceptable
Sr-90	Air filter	Bq/sample	1.467	1.56	1.09 - 2.03	Acceptable
U-234	Air filter	Bq/sample	0.121	0.125	0.088 - 0.163	Acceptable
U-238	Air filter	Bq/sample	0.121	0.13	0.091 - 0.169	Acceptable
Zn-65	Air filter	Bq/sample	0.361	0.332	Sensitivity Evaluation	Acceptable
Am-241	Water	Bq/L	0.002	-[a]	False Positive Test	Acceptable
Cs-134	Water	Bq/L	0.22	-[a]	False Positive Test	Acceptable
Cs-137	Water	Bq/L	10.94	9.7	6.8 - 12.6	Acceptable
Co-57	Water	Bq/L	24.65	25.4	17.8 - 33.0	Acceptable
Co-60	Water	Bq/L	10.71	10.27	7.19 - 13.35	Acceptable
H-3	Water	Bq/L	660.91	637	446 - 828	Acceptable
Mn-54	Water	Bq/L	7.8	7.36	5.15 - 9.57	Acceptable
Pu-238	Water	Bq/L	0.674	0.745	0.522 - 0.969	Acceptable
Pu-239/240	Water	Bq/L	0.696	0.769	0.538 - 1.000	Acceptable
Sr-90	Water	Bq/L	3.59	3.68	2.58 - 4.78	Acceptable
U-234	Water	Bq/L	0.965	0.99	0.693 - 1.287	Acceptable
U-238	Water	Bq/L	0.983	1.028	0.720 - 1.336	Acceptable
Zn-65	Water	Bq/L	0.42	-[a]	False Positive Test	Acceptable

[a] A dash indicates no reference value is needed.

TABLE 7.2

Summary of MAPEP Series 51 Intercomparison Sample Results, 2024

Analyte	Matrix	Units	Reported Value	Reference Value	Acceptance Range	Performance Evaluation
				-[a]		
Am-241	Air filter	Bq/filter	0.0206	0.0211	0.0148 - 0.0274	Acceptable
Cs-134	Air filter	Bq/filter	0.351	0.334	0.234 - 0.434	Acceptable
Cs-137	Air filter	Bq/filter	0.295	0.269	0.188 - 0.350	Acceptable
Co-57	Air filter	Bq/filter	0.005	-[a]	False Positive Test	Acceptable
Co-60	Air filter	Bq/filter	0.376	0.361	0.253 - 0.469	Acceptable
Mn-54	Air filter	Bq/filter	0.014	-[a]	False Positive Test	Acceptable
Pu-238	Air filter	Bq/filter	0.018	0.0157	0.0110 - 0.0204	Acceptable
Pu-239/240	Air filter	Bq/filter	0.018	0.0215	0.0151 - 0.0280	Acceptable
Sr-90	Air filter	Bq/filter	0.858	0.91	0.64 - 1.18	Acceptable
U-234	Air filter	Bq/filter	0.083	0.093	0.065 - 0.121	Acceptable
U-238	Air filter	Bq/filter	0.083	0.096	0.067 - 0.125	Acceptable
Zn-65	Air filter	Bq/filter	0.017	-[a]	False Positive Test	Acceptable
Am-241	Water	Bq/L	0.347	0.363	0.254 - 0.472	Acceptable
Cs-134	Water	Bq/L	22.31	22.3	15.6 - 29.0	Acceptable
Cs-137	Water	Bq/L	0.23	-[a]	False Positive Test	Acceptable
Co-57	Water	Bq/L	24.33	26.4	18.5 - 34.3	Acceptable
Co-60	Water	Bq/L	15.17	15	10.5 - 19.5	Acceptable
H-3	Water	Bq/L	395.44	374	262 - 486	Acceptable
Mn-54	Water	Bq/L	0.38	-[a]	False Positive Test	Acceptable
Pu-238	Water	Bq/L	0.389	0.439	0.307 - 0.571	Acceptable
Pu-239/240	Water	Bq/L	0.381	0.437	0.306 - 0.568	Acceptable
Sr-90	Water	Bq/L	10.62	11.2	7.8 - 14.6	Acceptable
U-234	Water	Bq/L	0.337	0.38	0.266 - 0.494	Acceptable
U-238	Water	Bq/L	0.329	0.385	0.270 - 0.501	Acceptable
Zn-65	Water	Bq/L	23.77	22.8	16.0 - 29.6	Acceptable

[a] A dash indicates no reference value is needed.

TABLE 7.3

Summary of DMR-QA Study 44 Intercomparison Sample Results, 2024

Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation
Antimony[a,b]	ug/L	490	482	395 - 570	Acceptable
Arsenic[a,b]	ug/L	316	308	259 - 370	Acceptable
Barium	ug/L	2260	2380	2020 - 2740	Acceptable
Beryllium	ug/L	348	338	287 - 389	Acceptable
Boron	ug/L	882	876	745 - 1010	Acceptable
Cadmium	ug/L	290	312	265 - 359	Acceptable
Chromium	ug/L	684	698	593 - 803	Acceptable
Cobalt	ug/L	342	356	303 - 409	Acceptable
Copper	ug/L	356	361	307 - 415	Acceptable
Iron	ug/L	3460	3580	3040 - 4120	Acceptable
Lead	ug/L	211	214	182 - 246	Acceptable
Manganese	ug/L	310	321	273 - 369	Acceptable
Nickel	ug/L	1050	1060	934 - 1190	Acceptable
Selenium[a,b]	ug/L	696	729	591 - 800	Acceptable
Silver	ug/L	276	267	227 - 307	Acceptable
Thallium[a,b]	ug/L	155	154	118 - 188	Acceptable
Vanadium	ug/L	1100	1140	969 - 1310	Acceptable
Zinc	ug/L	963	957	813 - 1100	Acceptable
Mercury	ug/L	23.7	22.5	15.8 - 29.2	Acceptable
Hexavalent Chromium	ug/L	826	818	689 - 936	Acceptable
Chloride	mg/L	48.6	45.7	39.5 - 52.0	Acceptable
Fluoride	mg/L	3.23	3.12	2.52 - 3.60	Acceptable
Sulfate	mg/L	10.2	12.4	9.29 - 14.8	Acceptable
Total Dissolved Solids (TDS) @180°C	mg/L	248	239	194 - 284	Acceptable
Total Suspended Solids (TSS)	mg/L	44.9	48.2	37.2 - 55.3	Acceptable
pH	S.U.	6.52	6.49	6.29 - 6.69	Acceptable
Ortho-Phosphate as Phosphorus	mg/L	0.657	0.65	0.552 - 0.748	Acceptable
Chemical Oxygen Demand (COD)	mg/L	50.3	51.5	34.6 - 66.1	Acceptable
Oil & Grease (O&G)	mg/L	133	149	109 - 170	Acceptable
Fathead Minnow (Pimephales promelas) Acute Toxicity[a]	LC_{50}	32.99	41	25.5 - 56.5	Acceptable
Ceriodaphnia dubia (Water Flea) Acute Toxicity[a]	LC_{50}	59.46	45.7	16.8 - 74.5	Acceptable
Nitrate as Nitrogen[a,b]	mg/L	21.2	18.8	15.7 - 21.8	Acceptable
Nitrite as Nitrogen[a,b]	mg/L	3.5	3.44	3.03 - 3.97	Acceptable
Total Cyanide[a,b]	mg/L	0.793	0.744	0.516 - 1.07	Acceptable
Total Phenolics[a,b]	mg/L	2.5	1.58	0.824 - 2.75	Acceptable
Total Kjeldahl Nitrogen[a,b]	mg/L	24.3	23.6	18.3 - 29.4	Acceptable
Ammonia as Nitrogen[a,c]	mg/L	11.3	11	9.02 - 13.5	Acceptable
Biochemical Oxygen Demand (BOD)[a,c]	mg/L	33.9	40.2	16.4 - 56.5	Acceptable
Mercury (Low-Level) [a,c]	ng/L	42	42.4	28.6 - 55.0	Acceptable

[a] Analysis performed by contract laboratory.

[b] Results from Water Pollution Study WP0124 used for DMRQA44.

[c] Results from Water Pollution Study WP0424 used for DMRQA44.

8. APPENDIX

8. APPENDIX

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Environment, Safety, and Health
Argonne National Laboratory
9700 South Cass Avenue, Bldg. 201
Lemont, IL 60439
Phone: 630-252-6048
Email: mmesarch@anl.gov
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